CERTIFICATION

I certify that the information contained in or accompanying this submittal is true, accurate, and complete As to those portions of this submittal for which I cannot personally verify the accuracy, I certify that this submittal and all attachments were prepared at my direction in accordance with procedures designed to assure that qualified personnel properly gathered and evaluated the information submitted I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations

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Document Title: Removal Action Plan
IR Site 10 Shoreline Slag Area
Naval Air Station North Island
San Diego, California

Date: 7/8/2002

REMOVAL ACTION PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Prepared for:

U. S. Department of the Navy
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Acronyms and Abbreviations

μR/hr	microroentgens per hour
AASHTO	American Association of State Highway and Transportation Officials
AC	asphaltic concrete
AIMTech	Advanced Infrastructure Management Technologies
ASTM	American Society for Testing and Materials
ATG	Applied Technology Group, Inc.
bgs	below ground surface
BMP	best management practice
Bechtel	Bechtel National, Inc.
CA-HSC	California Health and Safety Code
Caltrans	California Department of Transportation
CCR	California Code of Regulations
CERC	US Army Engineer Waterways Experiment Station, Coastal Engineering Research Center
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COPCs	contaminants of potential concern
CRZ	contaminant reduction zone
CTO	contract task order
DON	U.S. Department of Navy
DOT	U.S. Department of Transportation
DRMO	Defense Reutilization and Marketing Office
DTSC	Department of Toxic Substances Control
ECR	Environmental Conditions Report
EE/CA	Engineering Evaluation/Cost Analysis
EPA	U.S. Environmental Protection Agency
ERA	emergency removal action
ERI/RFI	extended remedial investigation/RCRA field investigation
ET	evapotranspiration
FPXRF	field portable x-ray fluorescence
ft^2	square feet
ft^3	cubic feet
H:V	horizontal to vertical
HWF	hazardous waste facility
IR	installation restoration
IT	IT Corporation
lbs	pounds
LLRM	low-level radioactive material
MHHW	mean higher high water
MLLW	mean lower low water
msl	mean sea level

Acronyms and Abbreviations (continued)

NaI	sodium iodide
NAS	Naval Air Station
NTCRA	non-time-critical removal action
OHM	OHM Remediation Services Corp.
PQCP	Project Quality Control Plan
Pier E	Pier Echo
PRG	EPA Region 9 Preliminary Remediation Goal
QA/QC	quality assurance/quality control
RAO	removal action objective
RAP	Removal Action Plan
RCRA	Resource Conservation and Recovery Act
RCT	Radiological Controls Technician
SAM	County of San Diego Department of Environmental Health Site Assessment and Mitigation
SAP	Sampling and Analysis Plan
SDCDEH	County of San Diego Department of Environmental Health
SHSP	Site Health And Safety Plan
SOP	standard operating procedure
STLC	soluble threshold limit concentration
SWDIV	Southwest Division
swl	still water level
SWMU	solid waste management unit
SWPPP	Storm Water Pollution Prevention Plan
TCLP	toxicity characteristic leaching procedure
TCP	Traffic Control Plan
USC	U.S. Code
USDA	United States Department of Agriculture
WCA	waste consolidation area
WMP	Waste Management Plan
yd^3	cubic yards

1.0 Introduction

This Removal Action Plan describes removal action activities to be performed by IT Corporation (IT) at the Naval Air Station (NAS) North Island, San Diego County, California. IT was contracted to perform this work by Southwest Division (SWDIV) under Contract Task Order (CTO) 0028 of Environmental Remedial Action Contract N62474-98-D-2076. The work includes a non-time-critical removal action (NTCRA) for Installation Restoration (IR) Site 10 Shoreline Slag Area under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and Chapter 6.8 of the California Health and Safety Code (CA-HSC).

1.1 Site Location and Background

The Shoreline Slag Area adjoins the shipping channel of San Diego Bay on the northwest portion of NAS North Island (Figure 1, "Site Vicinity Map"). The 4.1-acre site includes the coastal portion of IR Site 10 between Pier Echo (Pier "E") and Moffett Road, across from the Defense Reutilization Marketing Office (DRMO) (Figure 2, "Site Map"). IR Site 10 is entirely within the city of San Diego. The part of the Shoreline Slag Area that extends southwest of Pier E has been designated as Resource Conservation and Recovery Act (RCRA) Solid Waste Management Unit (SWMU) 134 (Bechtel National, Inc. [Bechtel], 1999). SWMU 135 encompasses the portion of the site located northeast of Pier E (Bechtel, 1999).

Reviews of historical engineering plans and aerial photography archived at the NAS North Island Public Works Office indicate that the Shoreline Slag Area was formerly occupied by tidelands. Dredge-and-fill operations performed from 1924 to 1936 extended the northwestern shoreline of NAS North Island to its present configuration and raised the tideland elevation by approximately 25 feet. The fill material was composed of sediments periodically dredged from the floor of San Diego Bay.

Military salvage operations began at a 10-acre site on the northwest shoreline of NAS North Island in the early 1930s (Bechtel, 1997) and subsequently expanded into the present-day DRMO. As indicated in Figure 2, the smelter that produced the slag wastes, designated as SWMU 75, was used from 1943 to 1967 for salvage operations to recover aluminum from scrap aircraft parts. Aircraft instrumentation painted with radium-226 for illumination purposes was apparently conveyed to the smelter with other metallic debris. Slag, a waste product of the smelting operation, was transported approximately 500 yards from the smelter (Figure 2) and disposed of at the intertidal zone and bluff adjoining the shoreline of San Diego Bay. The slag

has been identified as posing a potential human health risk (Advanced Infrastructure Management Technologies [AIMTech], 2001).

Field observations (OHM Remediation Services Corp. [OHM], 1999) indicate that slag disposal occurred subsequent to dredge-and-fill operations that extended and raised the northwestern shoreline of NAS North Island. A more detailed description of the site location and background can be found in the Engineering Evaluation/Cost Analysis (EE/CA) (OHM, 2001).

1.2 Previous Removal Action Activities

Removal action activities commenced in June 1995 with a walkover survey that indicated slag wastes disposed of at the Shoreline Slag Area emitted low levels of radioactivity that exceeded background levels (Bechtel, 1995; NAS North Island Staff Civil Engineer, 1995). As an interim action to mitigate potential human health and ecological risks associated with slag deposits located in the intertidal zone behind Building 380 and San Diego Bay (Figure 2), an Emergency Removal Action (ERA) was performed at SWMU 134 from July through December 1995 (Applied Technology Group, Inc. [ATG], 1996). The removal action addressed two 20- by 40-foot slag deposits in the ERA area (Figure 2). The slag deposits overlying the beach had a hard, resistant surface and varied in thickness from 1 to 4 feet; slag extended into the face of the shoreline bluff, which was 5 to 10 feet high and covered with broken concrete riprap.

The first phase of the ERA was performed between July 27 and August 18, 1995 and included removal of approximately 12,000 cubic feet (ft^3) of slag along with 8,000 ft^3 of adjoining beach sands. The excavated slag and beach sand were temporarily stored on NAS North Island to facilitate waste profiling prior to off-site disposal. The second phase of the ERA commenced in November 1995 and was completed December 5,1995. The excavated slag wastes were placed in U.S. Department of Transportation (DOT) shipping containers and transported to a licensed and permitted facility (Envirocare) in Clive, Utah, for land treatment and disposal.

To complete the removal action, OHM installed a containment system that mainly consisted of an inner geotextile layer to serve as a sediment barrier and an outer riprap layer to serve as the primary shoreline protection (by absorbing and deflecting wave energy) (OHM, 1996). The containment system was installed over a 200-foot stretch of shoreline embankment (Figure 2) and completely encompassed the portion of exposed embankment previously excavated by ATG. Work was performed during low tide (late afternoon to midnight) each day. At all other times, the work zone was submerged under water. After completion of construction, a security fence was installed to restrict access to the site.

The containment system put in place as part of the 1996 ERA has been compromised during the past six years due to the fact that the stone used in the construction of the rock revetment was undersized. The revetment stone has been removed by wave and/or tidal action and the geotextile liner is presently exposed in a few areas. Appropriate design changes with respect to stone sizing have been made for this removal action (see Section 3.2 of this report).

Results of waste profiling indicated that concentrations of lead and copper in the excavated slag material and in slag sample extracts exceeded the respective Title 22 California Code of Regulations (CCR) hazardous waste criteria (ATG, 1996). The lead, chromium, and cadmium concentrations in the slag sample extracts also exceeded RCRA hazardous waste criteria. As a result, the excavated slag material was deemed both a RCRA and a California hazardous waste. Because the material contained radium-226, it was designated a California combined waste (ATG, 1996).

Slag remaining in the area after the ERA was characterized during the subsequent extended remedial investigation (ERI)/RCRA field investigation (RFI) (AIMTech, 2001) and a supplemental field investigation (OHM, 1999).

1.3 Nature and Extent of Contamination

The physical appearance of the slag wastes currently present at the shoreline bluff varies as a function of metal types, the degree of incineration/melting to which the metals were subjected, the relative percentages of metals or ash present, and the extent of alteration due to weathering (OHM, 1999).

Metal debris associated with the slag wastes ranges from identifiable undeformed mechanical parts (e.g., gear chains) to fragments encompassed by completely melted material. Figure 3, "Slag/Slag Ash Extent," shows the distribution of slag waste types identified at the shoreline bluff as delineated during the supplemental field investigation (OHM, 1999). The slag wastes include the following materials:

- Friable, unconsolidated ash with metal debris
- Unconsolidated ash mixed with artificial fill material
- Well-indurated welded material with metal, glass, and/or ceramic inclusions
- Unconsolidated metal debris

The areal extent of slag wastes disposed at the shoreline bluff has been conservatively approximated at 17,343 square feet (ft^2) (AIMTech, 2001). The volume of slag waste material is estimated to range from 1,290 to 2,580 cubic yards yd^3, calculated using the average waste

thickness of 2 to 4 feet obtained from field measurements (AIMTech, 2001). The maximum observed overburden thickness is approximately 4 feet (OHM, 1999).

During previous sampling events, concentrations of antimony, copper, and nickel detected in one or more of the samples exceeded their respective CCR Title 22 soluble threshold limit concentration (STLC) (OHM, 1999). Results for cadmium, chromium, and lead in one or more of the previous samples exceeded RCRA toxicity characteristic leaching procedure (TCLP) criteria (OHM, 1999). Concentrations of cadmium, chromium, and lead exceeded both the TCLP criteria and STLCs for the metals (OHM, 1999). Contaminants of potential concern (COPCs) include arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver, zinc and radium-226 (AIMTech, 2001).

Due to the smelting of aircraft instruments painted with radium-226 along with the metallic scrap, small, randomly located fragments of low-level radioactive material are present at the IR Site 10 Shoreline Slag Area. A reconnaissance survey was performed in September 1996 and included the collection of gamma radiation and global positioning data with Ultrasonic Ranging and Data Acquisition System equipment. The survey covered the entire Shoreline Slag Area. Of the measurements collected during the survey, the majority indicated gamma exposure rates within background levels (i.e., 6.5 to 13.1 microroentgens per hour [μR/hr]) (AIMTech, 2001). Elevated gamma measurements obtained during the reconnaissance survey were associated with point sources identified as fragments of slag or metallic debris (AIMTech, 2001). Gamma exposure rates calculated from the measurements of point sources ranged from background levels to a maximum of 442 μR/hr (AIMTech, 2001).

1.4 Removal Action Objectives

The removal action objectives (RAOs) of this project are to reduce both the potential human health risks associated with metals in the slag wastes and the potential for the metals to have adverse effects on groundwater and the San Diego Bay. The RAOs will be accomplished with the construction of an on-site containment system. The planned NTCRA is proposed as an interim measure to mitigate the potential effects on human health of slag wastes disposed of at the shoreline bluff of the site but may be selected as the final remedy at a later date following completion of the feasibility study. Additionally, the planned NTCRA is part of the Navy's closure strategy for IR Site 10.

1.5 Scope of Work

The scope of work for this project includes the following:

- Site preparation including marking and temporary relocation of utilities, establishing dust and erosion control measures, clearing and grubbing, and removal of existing riprap
- Construction of a waste consolidation area (WCA)
- Excavation of slag wastes and placement of them in the WCA
- Confirmation sampling of excavated areas
- Backfilling waste excavation areas with clean soil
- Construction of a soil cover, with a minimum thickness of 5 feet, over the WCA
- Installation, development, and surface completion of groundwater monitoring wells
- Construction of a rock revetment along the shoreline bluff
- Site restoration, including construction of an asphaltic concrete (AC) access ramp for Building 380 and an AC access ramp for Pier E

A detailed description of each feature of work outlined above can be found in Sections 3, 4, and 5.

1.6 Removal Action Plan Organization

This Removal Action Plan (RAP) contains written procedures for executing the planned NTCRA at IR Site 10, and is organized to support efficient field execution of the NTCRA. Detailed field procedures and engineering analyses were developed and are presented in the appendices as supporting documents. The appendices include the following:

- **Appendix A, Site Health and Safety Plan (SHSP) –** The SHSP contains health and safety procedures required by 29 Code of Federal Regulations (CFR) 1910.120. The SHSP addresses health and safety issues pertaining to the protection against exposure of worker to contamination, air monitoring, accident reporting, emergency procedures, and physical hazards.
- **Appendix B, Sampling and Analysis Plan (SAP) –** The SAP was prepared to describe the groundwater, soil, and gamma radiation sampling rationale, sample collection procedures and analytical methods. The SAP also describes the sampling and analytical quality assurance/quality control (QA/QC) protocols and quality assurance methods, which will be implemented to evaluate the integrity of the sampling procedures and analytical data.

- **Appendix C, Environmental Conditions Report (ECR)** – The purpose of the ECR was to document existing buildings, plant and animal life and waste materials. The ECR includes results of a survey performed to document the existing conditions particularly those areas containing trees, shrubbery, grass, or wildlife that may be affected by the activities included in the scope.

- **Appendix D, Project Quality Control Plan (PQCP)** – The overall quality objectives of the PQCP are to outline procedures to ensure that the contractor performs within acceptable ranges of precision, accuracy, representativeness, completeness, and comparability.

- **Appendix E, Storm Water Pollution Prevention Plan (SWPPP)** – The SWPPP details the site-specific best management practices (BMPs) that will be implemented in accordance with the City of San Diego and California Department of Transportation (Caltrans) guidelines.

- **Appendix F, Traffic Control Plan (TCP)** – The TCP describes the procedures for controlling traffic along Moffett Road during transportation of equipment and materials. This TCP has been developed to assure that there is adequate consideration for the safety and convenience of motorists, pedestrians, and workers during construction.

- **Appendix G, Waste Management Plan (WMP)** – The WMP describes the procedures used and documents required for the identification of wastes, evaluation of disposal alternatives, preparation of waste profiles and manifests, transportation of wastes, and preparation of the final documentation.

In addition to the appendices that comprise the primary plan, this document also provides data and materials that support the implementation and design of the RAP in Appendices H, I, J, K, and L.

1.7 Project Organization and Points of Contact

The purpose of establishing the project organization structure and points of contact is to clearly define the lines of authority and communication as well as the responsibilities of key personnel to allow for the efficient, proper, and successful implementation of the NTRCA.

Key personnel and associated contact information are listed below and an organizational chart is presented in the SAP (Appendix B).

SWDIV	
Remedial Project Manager: Mark Bonsavage	(619) 556-7315
Resident Officer in Charge of Construction: Don Hough	(619) 545-4904
Naval Technical Representative: Don Hough	(619) 545-4904

SWDIV	
Navy Remedial Technical Manager: William Collins, R.G.	(619) 556-9901
Navy QA/QC Manager: Nars Ancog	(619) 532-2540
Region Environmental Installation Restoration Coordinator: John Locke	(619) 524-6405

IT Corporation	
Project Manager: Richard Wong, C.E.G.	(619) 437-6326, ext. 314
Technical Lead: Holly Buschman	(619) 437-6326, ext. 320
Manager of Heath and Safety: Fred Mlakar, C.I.H	(949) 660-5413
Quality Control Program Manager: Steve Massey	(619) 446-4522
Quality Control Site Manager: To be determined	
Site Superintendent: John Krowitz	(619) 437-6326, ext. 319
Field Analytical Services and Data Management Manager: Dwayne Ishida	(949) 660-7561

1.8 Statutory Authority and Other Requirements

This RAP has been prepared in accordance with the U.S. Department of Navy (DON) decision to undertake an NTCRA at IR Site 10, NAS North Island. The Department of Defense has the authority to undertake CERCLA response actions under 42 U.S. Code (USC) §9604, 10 USC §2708, and Federal Executive Order 12580. The Navy Public Works Center at NAS North Island was issued a federal and a state RCRA Hazardous Waste Facility (HWF) permit (U.S. Environmental Protection Agency [EPA] ID No. 7170090016) for a hazardous waste treatment and storage facility. The California EPA , Department of Toxic Substances Control (DTSC) is responsible for enforcing both the federal and state hazardous waste regulations. IR Site 10 is identified as a SWMU under the corrective provisions of the NAS North Island HWF Permit No. 97-SC-002 (DTSC, 1997). The Federal Facility Site Remediation Agreement (SWDIV, 1999) for NAS North Island is the administrative tool for regulating cleanup of this site.

1.9 Community/Public Involvement

The public has been involved throughout the RAP development process. To continue this public involvement process, the RAP will be made part of the Administrative Record available for public review at the following information repository established for NAS North Island:

City of Coronado Public Library
640 Orange Avenue
Coronado, CA 92118-2926
(619) 522-7390

Southwest Division Naval Facilities Engineering Command
Environmental Technical Library
1220 Pacific Highway, Building 129
San Diego, CA 92132-5190
(Contains the Administrative Record)

Responses to significant comments from the Public and Regulatory agencies are included in Appendix L.

1.10 Project Schedule

The anticipated schedule for the NTCRA is summarized below:

Submit Final Action memorandum, EE/CA and Removal Action Plan to DTSC	September 15, 2002
Completion of 60-day public review of Action Memorandum, EE/CA, and Removal Action Plan	December 15, 2002
Mobilization of personnel and equipment	December 31, 2002
Complete site preparation	January 31, 2003
Complete site remediation (excavation of slag wastes, construction of WCA, construction of rock revetment)	July 15,2003
Complete site restoration	July 31, 2003

2.0 Basis of Removal Action Design

An EE/CA was prepared to evaluate possible removal action alternatives for IR Site 10 Shoreline Slag Area (OHM, 2001). The alternatives were designed to mitigate potential adverse effects on human health, the groundwater, and the San Diego Bay from smelter slag wastes disposed in the area of the shoreline bluff at the site. Alternative 4 – Containment of Wastes with Rock Revetment and Cap was selected as the most cost-effective removal action for IR Site 10 (OHM, 2001; IT, 2002).

Details of the removal action activities and associated designs are provided in Sections 3, 4, and 5 of this RAP.

2.1 Removal Action Design Goals

The goal of the removal action design is to provide a cost-effective solution for achieving the RAOs for the site. The RAOs are as follows:

- Reduce potential human health risks associated with metals in the slag wastes
- Minimize erosion of slag wastes exposed in and underlying the shoreline bluff
- Minimize infiltration to reduce potential leaching of slag wastes
- Minimize migration of metals in slag wastes to San Diego Bay, groundwater, and the atmosphere

The design is also developed to meet the applicable or relevant and appropriate requirements identified in the EE/CA (OHM, 2001).

3.0 Removal Action Design

The removal action for the Shoreline Slag Area involves the excavation of the slag wastes, placement of slag wastes within the WCA and installation of an evapotranspiration (ET) cover (Figures 4 through 7). In order to further contain the slag material and protect it from being transported into the bay via tidal currents and wave action, a rock revetment will be constructed along the shoreline bluff (Figure 4, "Site Reconstruction"). Design details are outlined in the following sections.

3.1 Design of WCA

The design for the WCA provides for consolidating the excavated Site 10 slag wastes in an area located southwest of Pier E (Figure 4).

The WCA will consist of the following components:

- Compacted soil base
- Approximately 2,600 yd^3 of waste
- An ET cover

The compacted soil base of the WCA, to be constructed during initial site grading (see Section 5), will be situated at least 5 feet above mean higher high water (MHHW) to limit groundwater infiltration to the waste cell. The WCA will be approximately 120 feet long and 80 feet wide. The average thickness of the waste layer in the WCA will be 8 feet. A soil cover will be placed over the WCA to control the exposure pathway for humans and the surrounding environment and also to reduce the potential for infiltration of surface water into the underlying waste. The cover will be designed to utilize plant ET in preventing moisture infiltration to the underlying waste layer.

3.1.1 Evapotranspiration Cover

ET is a natural process by which water is transferred from the ground to the atmosphere by evaporation from the soil and transpiration through plants. ET covers are designed to maximize this process, thereby removing water from the cover before it can infiltrate through to the buried wastes. Additionally, ET covers are constructed of soils that effectively utilize capillary tension to retard or minimize unsaturated flow. Thus, the soil cover is designed to store rainfall that infiltrates through the surface until the ET process removes it. ET covers require less maintenance than traditional soil covers and are generally more easily constructed since only general earthwork is required and strict compaction control is not required.

3.1.1.1 ET Cover Components

The ET cover will consist of one continuous layer of soil (monofill) seeded with appropriate vegetation to optimize the ET process. If deemed necessary for plant growth, the top 12 inches of the cover will be topsoil. The monofill layer will be constructed to support the root system for the vegetation that will be planted on the cover. The rooting depth of the vegetation, should not exceed the total thickness of the soil cover.

Select Fill

The monofill ET cover will be composed of select fill, at least 60 inches thick. It will be placed directly on the waste in the WCA and will provide for infiltrated precipitation to be held until the ET process removes it. The resulting monofill is sometimes referred to as a "sponge" layer. Relatively fine-grained soils provide higher water storage capacities than coarse-grained soils. Soils with a textural classification of silty loam or sandy loam, as defined by the United States Department of Agriculture (USDA) Soil Textural Triangle, will be used. Approximately 4,000 yd^3 of select fill will be required.

The material used for the select fill shall have significant moisture retention potential in the pore spaces of the soil and be nonexpansive. The materials classified by the USDA as silty loam or sandy loam tend to possess this ability and are thus suitable for use as a select fill material. To achieve the desired soil textural classification, select fill should conform to the gradation shown in the Table 1, "Grain Size Distribution Requirements for Select Fill." However, acceptance of select fill is conditional upon demonstration that the fill material does, in fact possess the required properties. Each of these materials will be tested to determine the relationship between volumetric water content and hydraulic conductivity, and the results will be used to check the cover design. If necessary, either better fill materials will be obtained or the design of the cover will be modified. Refer to the SAP (Appendix B) for further details on sampling and analysis of select fill.

If a topsoil layer is determined necessary to support vegetation growth, the material used for the topsoil layer will consist of silty loam or sandy loam per the USDA Soil Textural Triangle. The maximum particle size will be less than or equal to 4 inches. The topsoil layer will have a pH value between 6.0 and 8.0, and an organic matter content between 5 and 10 percent. Soils will be amended to fall within these ranges for both pH and organic matter content. Other fertilizer or mineral amendments may also be added to foster an adequate growth of vegetation on the cover.

Vegetation

The primary purpose of the vegetation is to control wind and water erosion of the uppermost soil layer and to remove water from the soil via ET. Native grass mixtures tend to have long, fibrous root systems which make them capable of effectively removing water stored in the plant root zone of the soil. The vegetation will consist of the indigenous varieties, which contain a wide mixture of native grass species so that a high level of transpiration is maintained even under adverse growing conditions and during seasonal weather changes. Additionally, vegetation species will be selected that are relatively maintenance free, that readily grow in the climactic environment of the area, are noninvasive, and will not be easily eroded. The vegetation will have rooting depths of less than 60 inches to minimize root penetration into the waste.

3.1.1.2 Estimation of Appropriate ET Cover Thickness

To determine the depth of soil required in a monofill ET cover, estimates of the water storage capacity of the soil and of the maximum amount of water to be stored are needed.

The effective water storage capacity of a soil is the difference between the "drained upper limit" (i.e., the amount of water a soil will hold against the force of gravity) and the "lower limit of extraction" (i.e., the minimum soil moisture content to which a particular plant species can deplete soil moisture) (Anderson, 1994). Precipitation and ET are typically expressed as depths of water, whereas the amount of water in a soil is expressed as a percentage of the total soil volume. The effective water storage capacity of medium-to-fine textured, loamy soils will typically fall between 13 and 20 percent (Anderson, 1994). For the select fill with characteristics specified in Table 1, it was assumed that the effective water storage capacity would be 15 percent (or 1.8 inches per foot of soil).

The amount of water to be stored in the monofill ET cover depends upon the climactic characteristics of the site. For most sites located in arid regions, rainfall received during the middle and latter parts of the growing season will be quickly evaporated or transpired, assuming a good cover of perennial plants is present (Anderson, 1994). Therefore, the maximum precipitation received historically in the time period from October to May was used to estimate the minimum fill soil requirement. The maximum annual precipitation received during that period for the past 87 years of record (1914 to 2002) is 9.26 inches, recorded in December 1921 (National Oceanic and Atmospheric Administration, 2002).

Comparison of the effective water storage capacity of the soil specified for use in the monofill ET cover to the maximum precipitation value returns a minimum cover depth of 5.1 feet (see Appendix K for calculation).

3.1.2 WCA Design – Contingency Plan

In the event that a greater volume of waste than expected is encountered, a contingency design has been developed. The Contingency Plan provides for a WCA with a capacity for 4,000 yd^3 of waste (50 percent additional capacity). Contingency Plan design drawings are contained in Appendix I.

3.2 Design of Rock Revetment

A revetment is a facing of erosion-resistant material, such as stone or concrete, built to protect a shoreline feature against erosion. The major components of a revetment are the armor layer, filter layer, and toe. The armor layer provides the basic protection against wave action, while the filter layer supports the armor, provides for the passage of water through the structure, and prevents the underlying soil from being washed from under the armor stone. Toe protection prevents displacement of the seaward edge of the revetment.

The rock revetment was designed in accordance with guidance set forth in the following publications: *Shore Protection Manual, Volumes I and II* (US Army Engineer Waterways Experiment Station, Coastal Engineering Research Center [CERC], 1984); and *Design of Coastal Revetments, Seawalls, and Bulkheads (Manual No. EM 1110-2-1614)* (U.S. Army Corps of Engineers, 1995); and *Coastal Engineering Technical Note – Riprap Revetment Design* (CERC, 1985). Revetment design calculations are included as Appendix J.

3.2.1 Design Criteria

The Shoreline Slag Area rock revetment has been designed to resist overtopping by the design wave at the highest tide and to withstand wave attack anticipated to occur in San Diego Bay as a result of tidal influence and wakes from naval and various other large ships.

3.2.1.1 Design Wave Estimation

The design wave height was chosen to produce the most critical combination of forces on the revetment structure with due consideration of the economic life, structural integrity, and hazard for events that may exceed the design conditions. Wave characteristics were based on guidance received from an experienced coastal engineer who has completed various coastal engineering projects for the DON in San Diego Bay (Alcorn, 2001).

The design wave height selected was 3 feet (Alcorn, 2001). This wave height was selected because the Shoreline Slag Area is located in a protected embayment (San Diego Bay) and thus not subject to larger open-water waves. It was assumed that a design wave height of 3 feet would adequately represent the wave scenario in the Bay where waves are largely due to tidal

influence and boat wakes. The design wave period selected was 5 seconds based upon visual observation.

3.2.1.2 Wave Runup

Runup is the vertical height above the still-water level (swl) to which the uprush from a wave will rise on a structure (not the distance measured along the inclined surface). To complete the rough slope runup calculations (Appendix J), it was assumed that swl was equivalent to MHHW (2.73 feet mean sea level [msl]). This conservative assumption was made to accommodate the impact of the design wave on the structure at high tide conditions.

Using the design wave estimations described in Section 3.2.1.1, the revetment must be constructed so that the top of the structure extends to at least 4 feet above MHHW, vertically (see calculations in Appendix J).

3.2.1.3 Armor Unit Stability

Revetment armoring may range from rigid to flexible, however for this removal action, flexible armoring (i.e. riprap) was chosen. Riprap was chosen because it can tolerate varying amounts of displacement and shifting and is generally less expensive and easier to construct than more rigid types of armoring (e.g., seawalls, bulkheads). A riprap revetment provides excellent bank protection and can tolerate minor consolidation or settlement without structural failure.

Armor layer and underlayer stone was sized according to design wave height assumptions mentioned in Section 3.2.1.1. Using that information, the median size of the armor stone (graded riprap) should be 277 pounds (lbs) and the range of gradation should be 35 to 1,108 lbs (see calculations, Appendix J). These weights were converted to dimensions using guidance set forth in ASTM D 6092 resulting in a median dimension of 15.5 inches with a total range in stone gradation of 7.5 to 24.5 inches (see calculations, Appendix J).

The filter layer, or underlayer stone, was also sized according to design wave height assumptions mentioned above. Using that information, the required individual underlayer stone (graded riprap) unit weight is 14 lbs. The thickness of the graded riprap underlayer should be at least 2.5 feet to accommodate the full range of armor stone gradation with adequate thickness to support the maximum armor stone weight (see calculations, Appendix J).

3.2.1.4 Filter Layer

Wave action against a rubble structure creates turbulence within the structure and the underlying soil that may draw soil into the structure, allowing the rubble to sink. A filter layer (i.e., granular filter such as sand or a geotextile) placed on the slope prior to placement of underlayer and armor

stone helps the structure to withstand groundwater pressure which tends to wash underlying soil through the structure. Filter layers also help prevent undermining of the structure due to erosion of underlying soils by wave action.

The filter layer to be used in this removal action will consist of a non-woven polypropylene geotextile (filter fabric). The filter fabric will conform to Class 1 for stabilization requirements according to American Association of State Highway and Transportation Officials (AASHTO) geotextile specification M288-96. Based upon the grain size of existing soils at IR Site 10, as determined during previous investigations, it was determined that filter fabric with an apparent opening size of 70 (equivalent US standard sieve size) would be suitable for use as a filter blanket (see calculations, Appendix J).

3.2.1.5 Toe Protection

Toe protection is a supplemental armoring of the bottom surface of the revetment, which prevents waves and tidal currents from scouring and undercutting the revetment. The severity of toe scour is affected by wave breaking (when near the toe), wave runup and backwash, wave reflection, and the grain-size distribution of the beach material.

For the design of the IR Site 10 revetment toe, the following design parameters were assumed: a design wave height of 3 feet, a specific weight of armor stone of at least 162 pounds per cubic feet^3 (per ASTM C 127), gradation of armor stone used for revetment toe same as that of armor stone layer above grade on bluff, low-to-moderate scour potential at the site, and a revetment wall slope of 2:1 horizontal to vertical (H:V). The revetment must be configured such that the toe is between 3 and 4.5 feet vertically below ground surface (bgs) (see calculations, Appendix J).

4.0 Pre-Removal Action Activities

This section discusses the activities necessary to prepare for removal action activities at IR Site 10 Shoreline Slag Area. Planned pre-removal action activities include conducting a pre-mobilization conference and site preparation. Additionally, borrow soils to be used for the soil cover have been characterized and a seismic hazards investigation has been prepared. Each of these activities is described in the following sections.

The site has been surveyed for current site elevations and conditions and a biological study has been conducted. The ECR and the biological study are included as Appendix C.

4.1 Pre-Mobilization Conference

Before work begins a pre-mobilization conference will be conducted with the parties involved in the removal action project, including representatives from the state agencies, the DON, the contractor, and subcontractors. A list of topics to be covered at this meeting is as follows:

- Introducing team members
- Reviewing the general project scope
- Reviewing roles and responsibilities
- Reviewing the project schedule
- Reviewing the SHSP
- Reviewing the PQCP and the SAP
- Discussing key issues, concerns, and project goals
- Establishing scheduled meetings and briefings

Other topics may be covered as suggested by the attendees.

4.2 Site Preparation

Site preparation activities include obtaining any necessary permits or ensuring that substantive permitting requirements are met for on-site activities, obtaining utility clearance, establishing site security, mobilizing equipment and operations to the site, site clearing and grubbing, establishing erosion and dust control measures, and preparing the decontamination and spill containment area.

4.2.1 Permits and Utility Clearances

Applicable permitting requirements will be met and utility clearances will be conducted prior to executing work at the Shoreline Slag Area.

While CERCLA provides an exemption from obtaining permits for actions conducted entirely on site, substantive requirements of these permits will be met. Appropriate governing authorities will be notified of applicable work elements and required approvals will be obtained before work begins.

The permits that would be required if the site were not a CERCLA site and the issuing agencies are included in the following table:

Permit	Agency
Storm Water Discharge permit	California Regional Water Quality Control Board – Region 9 San Diego
Air emissions permit	San Diego County Air Pollution Control District
Coastal Impact Determination	California Coastal Commission
Construction/grading permit	City of San Diego
Dredge and Fill permit	US Army Corps of Engineers

The locations of existing utilities within the work area, both aboveground and below ground, will be identified and marked prior to beginning work at the site. Any available existing plans and as-built drawings of the site will be reviewed as part of this effort. A surface geophysical survey will be performed to confirm the location of the underground utilities and identify any unknown locations. Appropriate geophysical techniques such as electromagnetics or ground penetrating radar will be used. Utilities identified in the field will be marked on the ground surface in surveyor paint using the following codes:

- E –Electrical lines
- G – Gas
- T – Telephone
- W – Water lines
- S – Sewer lines
- SD – Storm drains

Utility companies will be notified of the planned activities and associated schedule. If necessary, site preparation activities may include the temporary rerouting of selected underground utilities.

4.2.2 Site Security

Existing fencing (Figure 2) will be removed prior to the installation of a site security fence. A temporary chain-link fence will be installed around the perimeter of the site to prevent unauthorized personnel from access to the site. A secondary purpose is to prevent theft of or

damage to equipment and facilities. The fence will be a minimum of 6 feet high. A double vehicular gate will be installed for vehicle access, and will be locked during non-working hours.

Environmental hazard signs will be posted on the perimeter fence at appropriate intervals. The printing on the signs will read, "Hazardous Waste Area, Unauthorized Personnel Keep Out." The signs will be printed in English and Spanish.

4.2.3 Field Mobilization

Upon completion of site security activities, personnel, equipment, and temporary field facilities necessary to implement the removal action will be mobilized to the site. Mobilization and setup of field support facilities will include mobilizing personnel and equipment to the site; establishing temporary facilities; and implementing health and safety procedures, dust control measures, traffic control measures, and storm water management procedures.

The site supervisor will be responsible for directing the site engineer, field technicians, equipment operators, and truck drivers in the construction and placement of temporary facilities, erosion control barriers, soil storage, and personnel and equipment decontamination areas. A portable toilet will be setup for construction personnel.

4.2.3.1 Mobilization of Personnel

The personnel listed below will be mobilized to the sites to implement the scope of work. Some individuals may perform multiple functions as is practical.

- Site Superintendent
- Site Safety and Health Supervisor/Radiological Controls Supervisor
- Radiological Controls Technician (RCT)
- Contractor Quality Control Officer
- Foreman
- Equipment Operator
- Laborers

The following personnel could also be mobilized to the sites, but may not be present throughout the duration of site activities:

- Project Manager
- Technical Lead
- Division Health Physicist
- Radiological Engineer
- Division Industrial Hygienist

- Project Chemist
- Transportation and Disposal Coordinator.

4.2.3.2 Radiation Worker Training

Site personnel will receive Radiation Worker Training prior to initiating any site work. The training requirements for this project are included in the SHSP in Appendix A. The Site Safety Officer will maintain personnel training records on site.

4.2.3.3 Mobilization of Equipment

Equipment will be selected and sized based on the designated tasks associated with the scope of work. Equipment likely to be mobilized to the sites includes the following:

- Excavator and backhoe
- Earthmoving equipment
- Pickup and dump trucks
- Soil compaction equipment
- Office trailer
- Trailer for analytical equipment
- Sodium-iodide (NaI) scintillation meter(s)
- Industrial hygiene monitoring equipment
- Generator (if power is not available)
- Polyethylene sheeting
- Miscellaneous hand tools

Earthmoving equipment expected to be used for the project include excavators , soil compactor, dump trucks, front-end loaders, a grader, track-mounted bulldozer, backhoe, and water truck (4,000 gallon capacity).

4.2.4 Decontamination and Spill Containment

Work and support areas will be clearly specified prior to beginning operations as discussed in the SHSP, Appendix A. Each work area will be divided into three zones, an exclusion zone (hot zone), a contamination reduction zone (CRZ), and a support zone. Decontamination stations will be set up in the CRZ at the site for personnel and equipment decontamination. Each station will consist of a sloped pad encircled by a berm. The area inside the berm will be lined with 10-mil polyethylene or equivalent material and will be equipped with a small sump and pump to collect cleaning liquids.

Personnel will undergo a sequential decontamination process upon leaving the exclusion zone and prior to entering the support zone. Personnel decontamination will include removal of

personal protective equipment and hand washing. Detailed procedures are provided in the SHSP (Appendix A).

Equipment and vehicles that come into contact with contaminated soil or liquid will be decontaminated prior to entering the support zone. The undercarriage of equipment and vehicles will be spray-washed with a pressure washer or dry brushed as appropriate. These decontamination processes will continue until visible soil is removed from the exterior of the vehicles and equipment. A standard operating procedure (SOP) for heavy equipment decontamination is referenced in the PQCP (Appendix D).

Water generated from the decontamination processes will be stored, tested, and disposed as described in the WMP (Appendix G).

4.2.5 Erosion Control Measures

Erosion control measures will be implemented in accordance with the SWPPP, Appendix E. BMPs will be enforced. Sandbags and silt fence will be placed to prevent runoff from leaving the site during operations. Protection will be placed around any downgradient storm drains.

4.2.6 Clearing and Grubbing

Following mobilization of heavy equipment to the site, existing vegetation on the shoreline bluff will be removed. Areas for material and equipment staging will be cleared and located within the area to be capped. Areas designated for the temporary stockpiling of excavated material will be lined and covered with plastic sheeting having a minimum thickness of 20 mil. Unsuitable material such as vegetation, decayed vegetable matter, sods, mulches, and compressible debris will be removed from the site and recycled if possible. BMPs will be implemented to protect the exposed site from erosion.

The existing riprap on the bluff along with the concrete pipeline foundation structures will be removed and placed on the off-site slope southwest of the IR Site 10 boundary (Figure 2). Additionally, the existing Building 380 asphalt access ramp will be demolished and replaced with a temporary soil access ramp graded on the northeast side of the concrete pad (Figure 4). to To the maximum extent possible, all riprap, concrete and asphalt removed from IR Site 10 will be recycled.

4.2.7 Dust Control

Upwind and downwind dust monitoring stations will be established to monitor particulate emissions during excavation and grading activities and transfer of excavated materials to

stockpiles. Particulate action levels and monitoring methods that will be used to protect worker and community health and safety are further specified in the SHSP (Appendix A).

Emission control actions will be implemented if necessary. Dust control measures will be implemented during mobilization to the project site and will continue during all phases of removal action activities. Dust control measures will include covering dust sources, spraying water on the source, applying dust-suppressing agents, and stopping work. If there is a possibility of spreading contaminants by applying water, or if it results in slippery or otherwise hazardous working conditions, work will be stopped until conditions are determined to be safe.

4.3 Borrow Site Soil Characterization

Eight local commercially-available borrow sources have been identified for potential use as cover material for IR Site 10. Typical soil samples were obtained from each of the local borrow sources for geotechnical laboratory testing. Laboratory tests were performed in general conformance to ASTM methods to classify the soil and estimate likely engineering behavior. Each soil sample was classified using the Unified Soil Classification System (USCS) (ASTM D 2488) followed by specific tests for particle-size analysis (ASTM D 422) and Atterberg limits (ASTM D 4318). Summary sheets for the tests are included in Appendix H.

At the time of construction, the decision will be made whether to use one of the eight previously identified sources or investigate for additional locally-available sources. In addition to analysis for engineering properties, soil chosen to be used as cover material will be analyzed for chemical constituents prior to use at IR Site 10 and topsoil characteristics will be verified to ensure plant growth. The sampling strategy, procedures, and required analytical methods are presented in the SAP (Appendix B).

4.4 Seismic Hazards Investigation

A seismic hazards investigation was conducted at the site to support the design and placement of the rock revetment. The investigation included borings and geologic logging in addition to research into local seismic conditions.

Data collected from the site was evaluated and the results are presented in the Seismic Hazards Investigation Report (OHM, 2001). The report includes information regarding the subsurface soil and groundwater conditions encountered during the investigation and local and regional seismic conditions. An evaluation of the potential for soil liquefaction, dynamic settlement, ground lurching, and other seismic effects and their effect on the containment system is included.

Other information provided in the report includes slope stability calculations for temporary excavation areas, rock revetment design recommendations, pavement recommendations, and surface water and erosion control recommendations.

5.0 Removal Action Activities

Removal action activities that will be conducted to complete the project include consolidation of the wastes present on Site 10, by construction of a WCA, rock revetment and ET cover. Construction details are outlined in the following sections.

5.1 Initial Site Grading

Upon completion of site preparation activities, outlined in Section 4.2, initial site grading will be conducted with construction of the WCA followed by excavation of all slag wastes and direct placement of wastes into the WCA.

5.1.1 Construction of WCA

To the southwest of Pier E, a waste consolidation area will be constructed with a footprint of a 9,600 ft^2 (Area A, Figure 8, "Excavation and Stockpile Areas"). Existing soil will be excavated to a mean elevation of approximately 8 feet msl or approximately 12 feet bgs. Excavation and on-site stockpiling of an estimated 4,300 ft^3 of clean overburden would proceed until excavation depth is achieved. If encountered, excavated slag wastes will be segregated and temporarily stockpiled (Area F, Figure 8). The stockpiled material will be placed upon and covered with plastic sheeting at the end of each day of excavation to protect the material from the wind and rain.

Excavation of the overburden and slag wastes (if encountered) would be performed using standard construction equipment (e.g., backhoes, excavators, bulldozers, and front-end loaders). A temporary slope no steeper than approximately 1.5:1 (H:V) will be maintained until the maximum excavation depth was achieved. The subgrade of the WCA will be scarified, moisture conditioned, and compacted using continuous passes of the equipment. The subgrade surface will be relatively smooth, free of obstructions, abrupt depressions or humps, and deposits of soft or loose soil. To segregate the waste from the underlying soil and provide support during construction activity, the bottom of the WCA will be covered by a minimum of 4 inches of gravel underlain by a non-woven geotextile. The geotextile will conform to Class 2 for separation requirements according to AASHTO M288-96. Figure 8 shows the approximate limits of WCA as well as existing topography, buildings, and foundations.

Upon completion of construction of the WCA excavation, the segregated material designated as waste (if any) will be moved from the temporary stockpile area and placed in 1 to 2-foot thick lifts and compacted with a track-mounted bulldozer.

5.1.2 Waste Excavation

The slag wastes on site will be excavated in a systematic manner will and placed in the WCA. In general, the excavation of the waste will begin in the eastern portion of the site and proceed to the west.

In the area northeast of Pier E (Area B, Figure 8), removal and on-site stockpiling of an estimated 970 yd^3 of clean overburden will proceed until visually-identifiable slag wastes are encountered in the excavation. Excavation of the overburden and slag wastes will be performed using standard construction equipment (e.g., backhoes, excavators, bulldozers, and front-end loaders). One or more excavators will work from the top of the shoreline bluff, excavating back from the face toward Moffett Road. A temporary slope no steeper than approximately 1.5:1 (H:V) will be maintained until the maximum excavation depth was achieved. Metal fragments, ash, and soil containing those materials will be placed directly into the WCA southwest of Pier E (Figure 8). Approximately 480 yd^3 of slag wastes are anticipated to be generated from this area.

In the area between the 36-inch storm drain and the WCA (Area C, Figure 8), excavation and on-site stockpiling of an estimated 1,350 yd^3 of clean overburden will proceed as described for Area B above. Approximately 1,520 yd^3 of slag wastes are anticipated to be generated from this area.

In the areas immediately surrounding the 36-inch storm drain and Pier E (Area D, Figure 8), removal and on-site stockpiling of an estimated 200 yd^3 of clean overburden will proceed until visually-identifiable slag wastes are encountered in the excavation. Removal of the overburden and slag wastes will be performed using hand-held excavation equipment. In this area to avoid damaging the respective structures, standard construction equipment will only be used to the extent practical. Metal fragments, ash, and soil containing those materials will be directly placed into the WCA southwest of Pier E (Figure 8). Approximately 600 yd^3 of slag wastes are anticipated to be generated from this area.

Each of the excavation areas extends only to the foot of the shoreline bluff. Since further action for the beach sediments in the Shoreline Slag Area was not recommended in the ERI/RFI (AIMTech, 2001), excavation of the beach is not planned as part of this removal action. However, in the ERI/RFI (AIMTech, 2001) it was recommended that discrete pieces of radioactive slag be removed to the maximum extent possible. As such, during the course of the removal action, large metal fragments that are readily accessible in the intertidal area will be removed and placed in the WCA. Additionally, if isolated "hot spots" are encountered on the beach during the ongoing radiological monitoring worker exposure, those materials will be excavated and placed in the WCA.

5.1.2.1 Waste Segregation

Segregation of slag wastes and nonimpacted soil will be based primarily on visual observation. The limits of excavation will be further delineated using a field-portable x-ray fluorescence (FPXRF) monitoring device per the procedures presented in the SAP (Appendix B). Metal fragments, ash, and soil containing those materials will be placed directly into the WCA. Accompanying soil that does not appear to contain slag wastes will be presumed to be nonimpacted soil and will be placed in temporary stockpiles (Area F, Figure 8) upon plastic sheeting pending confirmation analytical testing. The stockpiled material will be covered with plastic sheeting at the end of each day of excavation to protect the material from the wind and rain.

5.1.2.2 Criteria for Waste Excavation

The evaluation of appropriate criteria for delineation of the excavation areas in the Shoreline Slag Area was based upon reduction of potential human health risks associated with exposure to metals in the slag wastes and radium-226. The criteria used to determine cleanup goals for metals were the EPA Region 9 Preliminary Remediation Goals (PRGs) for Industrial Soil (Table 2, "Summary of Cleanup Criteria") (EPA, 2001). Industrial Soil PRGs were selected because IR Site 10 is situated in a portion of NAS North Island that is currently designated for utilization as part of base operations and will thus not be redeveloped as a residential or other non-industrial area in the foreseeable future. The site development plan for NAS North Island (EDAW, Inc., 2000) indicates that Pier E (located in the center of the site) will be upgraded as part of Military Construction Project P-760, and that Building 380 (located in the southwestern portion of the site) is scheduled for demolition. No other development is currently planned for the shoreline area of IR Site 10.

The appropriate radium-226 criteria delineation of the excavation areas in the Shoreline Slag Area were determined to be site background gamma exposure rates. During previous investigations, background gamma exposure rates for the Shoreline Slag Area were found to be in the range of 6.5 to 13.1 μR/hr (AIMTech, 2001).

Data from previous site assessments were compared to metals and radium-226 cleanup criteria and used to estimate excavation limits (Areas A-D, Figure 8).

5.1.2.3 Limits of Excavation

To determine the limits of the slag/slag ash waste excavation, preconfirmation soil samples would be collected and analyzed for selected indicator analytes (e.g., lead, copper, and zinc) using FPXRF devices. Procedures used would follow the guidance set forth in the draft EPA

Method 6200 (FPXRF Spectrometry for the Determination of Elemental Concentrations in Soil and Sediment). Analytical results for the progress soil samples will be compared against PRGs for the selected analytes (Table 2). The number and location of samples would be determined based on work progress and field conditions.

5.1.3 Postexcavation Activities

All excavated areas will be confirmation sampled and then backfilled with clean soil material, the source of which will be determined prior to field work.

A land surveyor registered in the State of California will survey the limits of the excavation and final confirmation sampling locations in the excavation area. Survey activities would be conducted in accordance with IT SOP 23.1, Land Surveying (IT, 2000). Horizontal control points would be based on North American Datum of 1983, California Zone 6 Coordinates. Vertical control points would be referenced to the NAS North Island datum, mean lower low water (MLLW).

5.1.3.1 Confirmation Sampling

Confirmation sampling will be performed to establish whether detected concentrations (if any) of metals and radium-226 in soil in the walls and at the base of the excavations are below cleanup criteria. Additionally, the presumed nonimpacted soil stockpiles will be sampled and analyzed for metals and radium-226 according to procedures in the SAP (Appendix B).

Metals

Confirmation that concentrations of metals left in place in the excavations (if any) are below cleanup criteria (Table 2) would be achieved using FPXRF devices. Sampling and analysis procedures for metals confirmation sampling are set forth in the SAP (Appendix B). If analytical results for confirmation samples of COPC metals are less than cleanup criteria (Table 2), the soil tested will be left in place and excavation activities will be stopped. In the event that analytical results for confirmation samples of COPC metals analytical results for confirmation samples of COPC metals are greater than the cleanup criteria (Table 2), then a 1-foot lift of soil will be removed and another FPXRF reading taken.

Radium-226

A radiological surface scan will be performed to locate all hot spots for each area of excavation. Hot spots are those areas that exceed the background exposure rates (6.5 to 13.1 μR/hr) to which the scanning instrument has been calibrated. The radiological surface scan will be performed by the RCT using an NaI gamma scintillation detector. The RCT will slowly walk the entire

excavation area while passing the detector slowly over the surface in a pendulum manner in front of the RCT's body. The radiological surveyor will carefully note any increase in count rate and will stop to investigate each increase. Locations that meet or exceed background exposure rates will be delineated with spray paint and surgically removed with hand tools to a maximum depth of 1 foot below grade. Soil will be removed from the location until the NaI gamma scintillator readings are equivalent to background levels to which the instrument has been calibrated. All wastes removed during confirmation sampling will be placed in the WCA. Additional details on the surface scan and instrument calibration are presented in the SAP (Appendix B).

5.1.3.2 Backfill of Waste Excavations

It is estimated that approximately 3,100 yd^3 of backfill material is required to achieve final site grading (Figure 4). However, the final volume will depend upon the actual amount of excavated soil. Backfill material will be placed in uniform loose lifts in the range of 6 to 12 inches in thickness and compacted. Prior to backfilling, a method specification will be developed using on-site equipment to achieve compaction equal to the preconstruction density of site soils.

5.2 Soil Cover over WCA

As described in Section 3, an ET cover will be placed over the waste layer in an effort to reduce the exposure pathway for humans and the surrounding environment and also to reduce the potential for infiltration of surface water into the underlying waste.

5.2.1 ET Cover Components

The ET cover will consist of one continuous layer at least 60 inches thick of soil (monofill) seeded with appropriate vegetation to optimize the ET process. If deemed necessary for plant growth, the top 12 inches of the cover will be topsoil. The cover should be able to support the root system for the vegetation, which will be planted on the cover. The rooting depth of the vegetation, which in this case is the total thickness of the soil cover should be less than 60 inches.

5.2.1.1 Select Fill Layer

The monofill ET cover will be composed of select fill, at least 60 inches thick, placed directly upon the compacted waste in the WCA. The select fill will be placed in 9-inch loose lifts, and compacted within the range of 85 to 88 percent maximum dry density using the modified Proctor method (ASTM D 1557). The upper 1 inch of each lift will be sufficiently roughened to provide good bonding between lifts and to maintain a loose compaction throughout the layer. Roughening the surface will be accomplished with disk, rotor tiller, sheeps-foot compactor or

other appropriate means. Scarification of at least the top 4-inches of this layer will also be required just prior to seeding the site. Approximately 3,500 yd^3 of select fill is required.

If necessary, the upper foot of the select fill layer will consist of an erosion-resistant, or topsoil, layer. This erosion-resistant layer will be a vegetative layer capable of sustaining native or other suitable plant growth. The topsoil layer will consist of a 12-inch layer of friable material, which can support heavy growths of grass and other vegetation. The topsoil will be uniformly distributed and evenly spread to its total thickness with minimal compaction requirements. This promotes the generation of the vegetative cover that will reduce the erosion of the topsoil. Topsoil is not readily available on NAS North Island, but is available in the greater San Diego area. If suitable topsoil is not available at the time of construction, either select fill soil or native topsoil (i.e. that present on site) will be used and amended with compost at a rate determined by soil testing. Typical rates of application are 6 tons of compost per 1,000 square ft^2. The topsoil layer will be placed in lifts, and compacted to a maximum relative density equal to or less than 85 percent maximum dry density using the modified Proctor method (ASTM D 1557).

5.2.1.2 Vegetation

Several suggestions of native species (shrubs and grasses) to be seeded on the ET cover have been made by the NAS North Island botanist (Pivorunas, 2001). To the best extent practical, the various plant species chosen to seed the cover will be well adapted to the area, noninvasive, and tolerant of periodic drought. Additionally, the plant cover selected will consist of cool season and warm season species to spread ET over as much of the growing season as possible.

Before seeding begins, the topsoil will be tilled to a minimum depth of 4 inches. Offset disks or similar tillage machines will be used where soil conditions and length of slope permit to achieve the minimum depth. The ET cover will be seeded and then periodically monitored to ensure that the plant community is thriving. Long term irrigation is not planned for the drought-tolerant plant community.

5.3 Rock Revetment Construction

Details of the construction of the rock revetment along the shoreline slag area are outlined in the following sections.

5.3.1 Subgrade Preparation

The existing slopes will be graded to a inclination of no steeper than 2:1 (H:V). The subgrade surface will be relatively smooth, free of obstructions, abrupt depressions or humps, and deposits of soft or loose soil.

5.3.2 Toe Excavation

Once the dewatering activity is successfully underway, the toe excavation will proceed. An excavator located on the beach will be used to dig the toe, with all contaminated material encountered to be placed in the WCA on top of the slope. The toe excavation will be approximately 4.5 feet in depth and 8 feet in width. The revetment will extend a length of 430 feet along the shoreline bluff (Figure 4).

5.3.3 Filter Fabric Placement

Nonwoven filter fabric will be laid smooth and free of tension, wrinkles and creases. The individual strips of plastic filter fabric will be placed to provide a minimum overlap of 3 feet at each joint; joints perpendicular to the shoreline will be made such that the upper strip of material will overlap the lower strip. Fabric will be secured in place with steel securing pins where foundation material will allow placing securing pins and with individual securing rocks where steel pins are not practical. All joints will be secured at regular intervals along the joint and elsewhere as necessary to properly secure the fabric in place. Additionally, the filter fabric will be properly anchored in the toe of the revetment and at the top of the revetment using an anchor trench. Work will be scheduled so that rock courses, to be placed over the fabric, follow along as soon as the plastic filter fabric assembly is completed and accepted.

5.3.4 Underlayer Placement

The underlayer and armor stone layers will be placed to grade in stages working from the toe of the revetment to the top of the bluff. Stone will be placed in a manner to ensure that the armor stone is uniformly distributed over the underlayer stone to form a well-keyed, densely placed, uniform layer of rock.

5.4 Land Surveying

A registered California land surveyor will perform land surveying activities throughout grading and rock revetment construction to monitor, guide, and document each element of construction. The surveying tasks will be conducted in accordance with SOP 23.1, Land Surveying (IT, 2000).

Grade stakes will be provided at the top of the slope on 25-foot centers. Grade stakes will also be placed at 25-foot centers on every 5-foot contour, where practical. Check and topographic shots will be taken at the top of the toe of slopes on 25-foot centers as well as every 5-foot contour on 25-foot centers, for each layer of soil or rock.

Prior to preparing the final surface, benchmarks will be located to establish new vertical and horizontal control. Temporary benchmarks will be established and utilized, as needed, through the duration of the field activities.

6.0 Post-Removal Action Activities

This section contains activities that will be conducted following the completion of removal action construction activities.

6.1 Groundwater Monitoring

Long-term monitoring of groundwater conditions at IR Site 10 will be conducted following completion of the removal action activity for further evaluation of groundwater quality and potential impacts from COPCs to marine organisms of San Diego Bay.

6.1.1 Installation of Groundwater Monitoring Wells

Four groundwater monitoring wells will be installed at the site (Figure 4). The wells will be installed in accordance with SOP 8.1, Monitoring Well Installation (IT, 2000). The locations were determined by analysis of groundwater conditions as presented in the ERI/RFI (AIMTech, 2001). The wells will be developed by bailing or pumping in accordance with SOP 8.2, Monitoring Well Development (IT, 2000).

6.1.2 Well Permits

No well permits are required for a NTCRA, in compliance with the County of San Diego Department of Environmental Health Site Assessment (SDCDEH) and Mitigation (SAM) Manual (SDCDEH, 2002) but substantive requirements will be met to provide the SAM Division of the SCDEH with appropriate information regarding well installation.

6.1.3 Well Design and Construction

The design of the groundwater monitoring wells is in accordance with the SAM Manual. As shown in Figure 9, "Groundwater Monitoring Well Design," the borehole for the groundwater monitoring wells will be 6 inches in diameter. In order to accommodate tidal influences and seasonal fluctuation upon the groundwater table, the groundwater monitoring wells will be constructed with a screened interval of 10 feet, 3 feet of which will extend above the existing groundwater table. Site groundwater is located approximately at an elevation of 4 feet above MLLW (Bechtel, 1997). The well casing will be constructed of 2-inch diameter, Schedule 40 polyvinyl chloride with a 0.010-inch slot screen.

6.1.4 Drilling Methods and Procedures

Well installation will be conducted in general conformance with the SAM Manual. A truck-mounted hollow-stem auger rig will be used to drill the boreholes and install the wells. Drilling

will be completed in accordance with SOP 14.1, Hollow Stem Auger Drilling (IT, 2000). The drill rig will be free from leaks of fuel, hyrdraulic fluid or oil. As an additional precaution during drilling and well development, plastic sheeting will be placed around the working area to contain potential spills and leaks.

6.1.4.1 Decontamination Procedures

All drilling equipment will be decontaminated prior to on-site use, between successive wells, and prior to removal from the site. These procedures will be enforced to prevent possible cross-contamination between boreholes. Grease and oil will not be permitted on any drilling rods or equipment. Decontamination procedures will be conducted in accordance with SOP 6.2, Drilling and Heavy Equipment Decontamination (IT, 2000) All rinsate water generated during decontamination procedures will be stored in labeled DOT-approved 55-gallon drums in the approved staging and equipment area.

6.1.4.2 Well Development

Following completion of each well, but no sooner than 24 hours after grouting is completed, each groundwater monitoring well will be developed. The purpose of well development is to restore the natural hydraulic properties of the aquifer, which may be altered during well installation. Well development will be completed in accordance with SOP 8.2, Monitoring Well Development (IT, 2000).

Upon completion of each monitoring well, depth to groundwater will be measured and the data entered on the final borehole log. Water level measurements will be taken in accordance with SOP 5.1, Water Level Measurements in Monitoring Wells (IT, 2000).

6.1.4.3 Collection of Soil Samples

Representative soil samples will be collected from the borehole during well installation. Soil samples will be collected in accordance with SOP 3.2, Subsurface Soil Sampling While Drilling (IT, 2000). Samples will be analyzed for metals and radium-226 as described in the SAP (Appendix B). The results of analytical testing will be used to document the concentrations of these contaminants outside the WCA.

6.2 Radiological Grid Survey

Following the completion of the construction activities, a radiological survey will be performed over the remediated area. The survey would be conducted in a grid-based fashion and performed in accordance with the methodologies in the *Multi-Agency Radiation Survey and Site Investigation Manual* (EPA, 1996).

The purpose of the survey is to document the radiological levels at the site and to compare these levels to the North Island background levels.

6.3 Site Restoration

The following activities will be conducted as part of site restoration: storm water erosion control measures will be removed, temporary on-site facilities will be demobilized, temporary fencing will be removed, utilities that were rerouted or removed (if any) will be replaced or repaired as necessary, decontamination systems will be removed and the decontaminated water will be properly disposed after sampling.

Additionally, site improvements will be constructed including an asphalt access ramp for Pier E, and asphalt access ramp for Building 380 and a permanent fence constructed around the WCA. The remaining unpaved areas of the site will be landscaped using xeriscape techniques to provide long-term erosion control.

6.3.1 Asphalt Access Roads

Asphalt access roads for Building 380 and Pier E will be constructed (Figure 4). Both roads will be at least 15 feet in width and be constructed of 3 inches of AC over a 4 inch aggregate base. The aggregate will conform to Type A, ¾-inch or ½-inch maximum size according to the Caltrans. The aggregate base will be compacted within the range of 90 to 95 percent maximum dry density using the modified Proctor method (ASTM D 1557). The AC material will be a steam-refined asphalt cement, viscosity grade AR4000, conforming to ASTM D 3381. Both roads will be constructed to direct water flows to the drainage outlet areas (Appendix E).

6.3.2 Final Site Grading

Final grade will be designed and maintained to reduce impacts to health and safety. It is also designed to minimize off-site borrow requirements, facilitate runoff control, and accommodate settlement. Final slopes will be graded and maintained to prevent ponding, and to prevent soil erosion due to high run-off velocities. Final site drainage features are presented and discussed in the SWPPP (Appendix E).

6.4 Long-Term Site Maintenance

The site will be maintained for as long as the consolidated waste remains at the Site. The Navy will develop a long-term site monitoring plan following the removal action. Annual inspections for evidence of burrowing animals and deep-rooting plants in the ET cover will be conducted. If encountered, deep-rooting plants will be removed and animal burrows will be filled. In the event of an earthquake, the site will be closely examined and any evidence that the integrity of the ET

cover has been weakened will be further investigated. Actions will be taken to remedy the situation.

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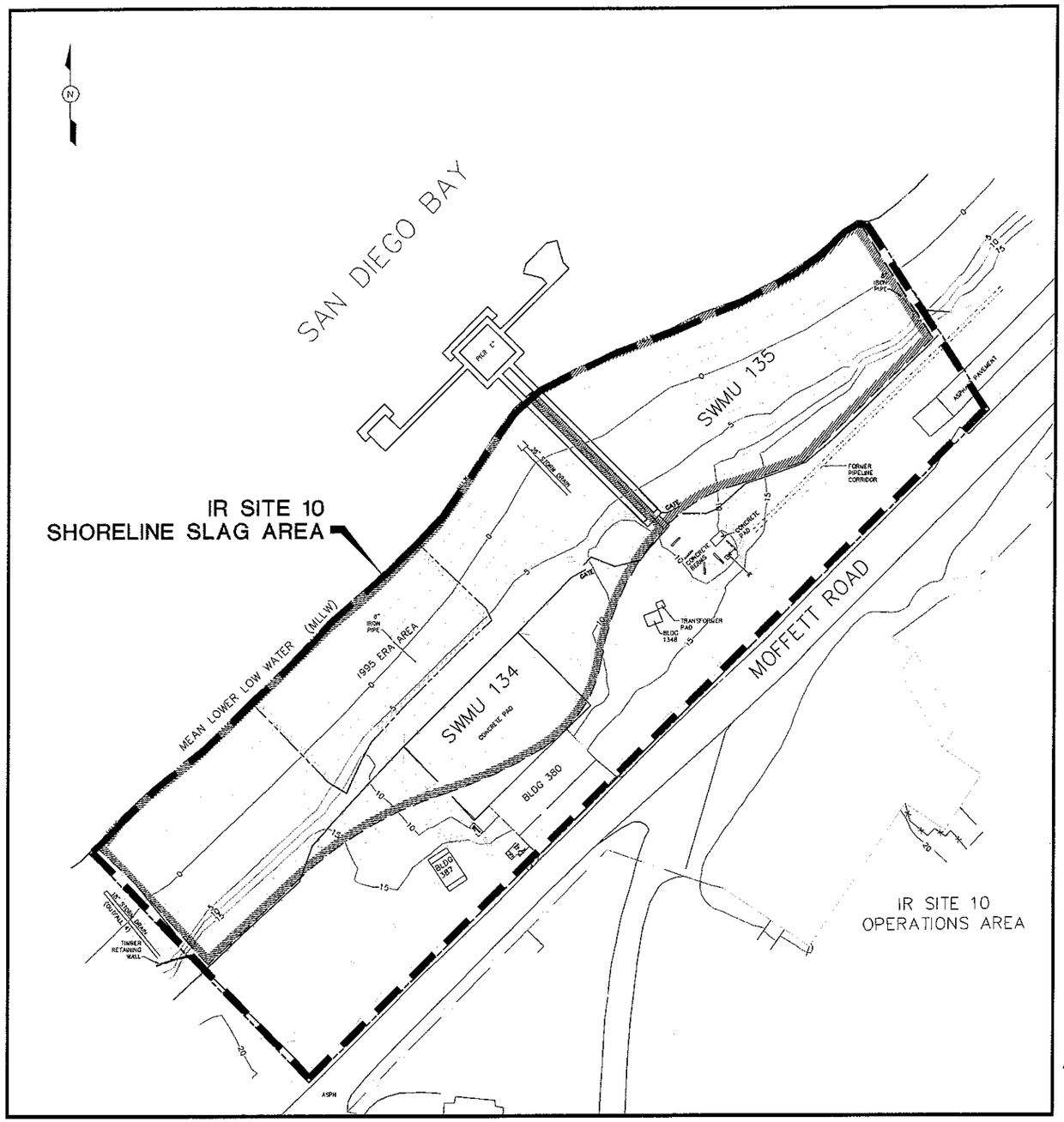
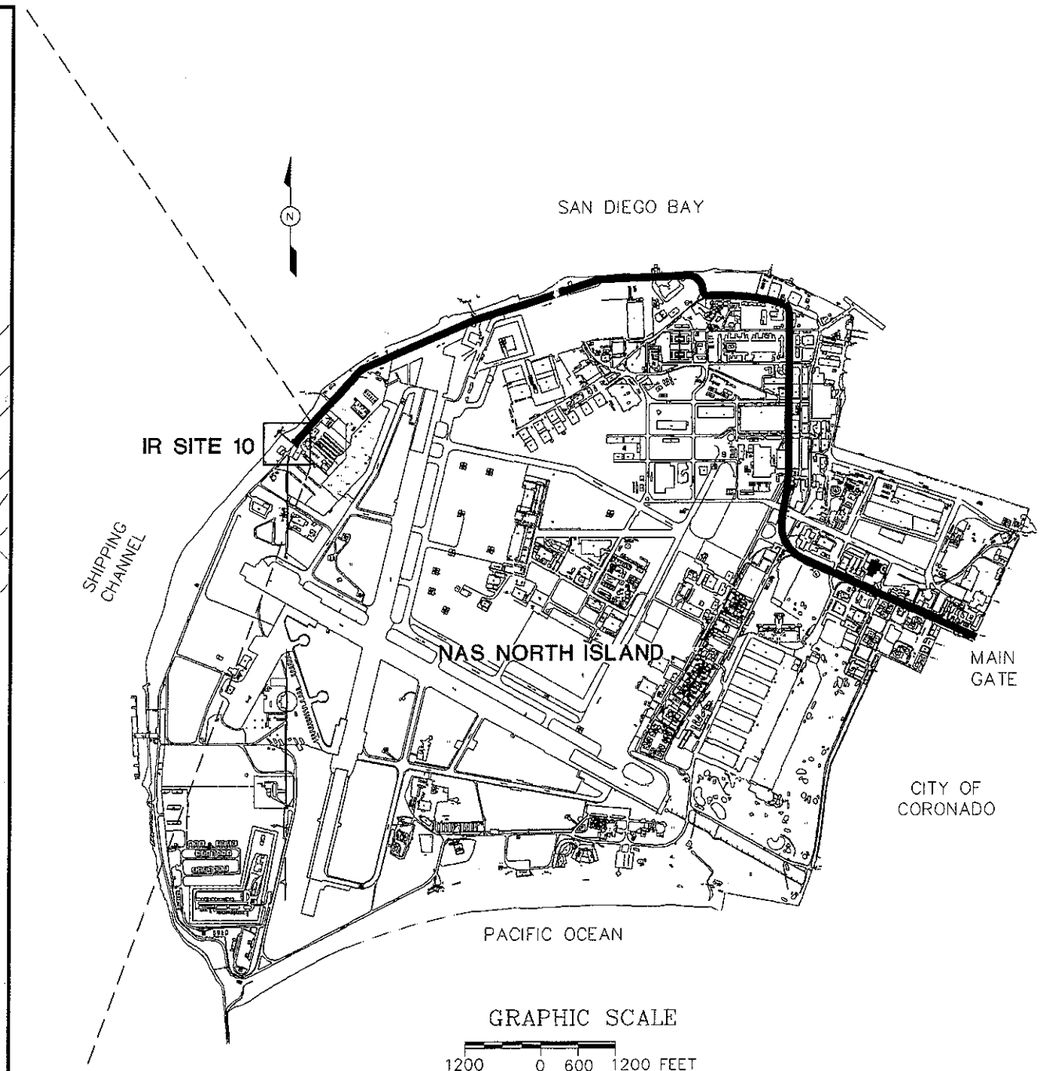
FIGURES





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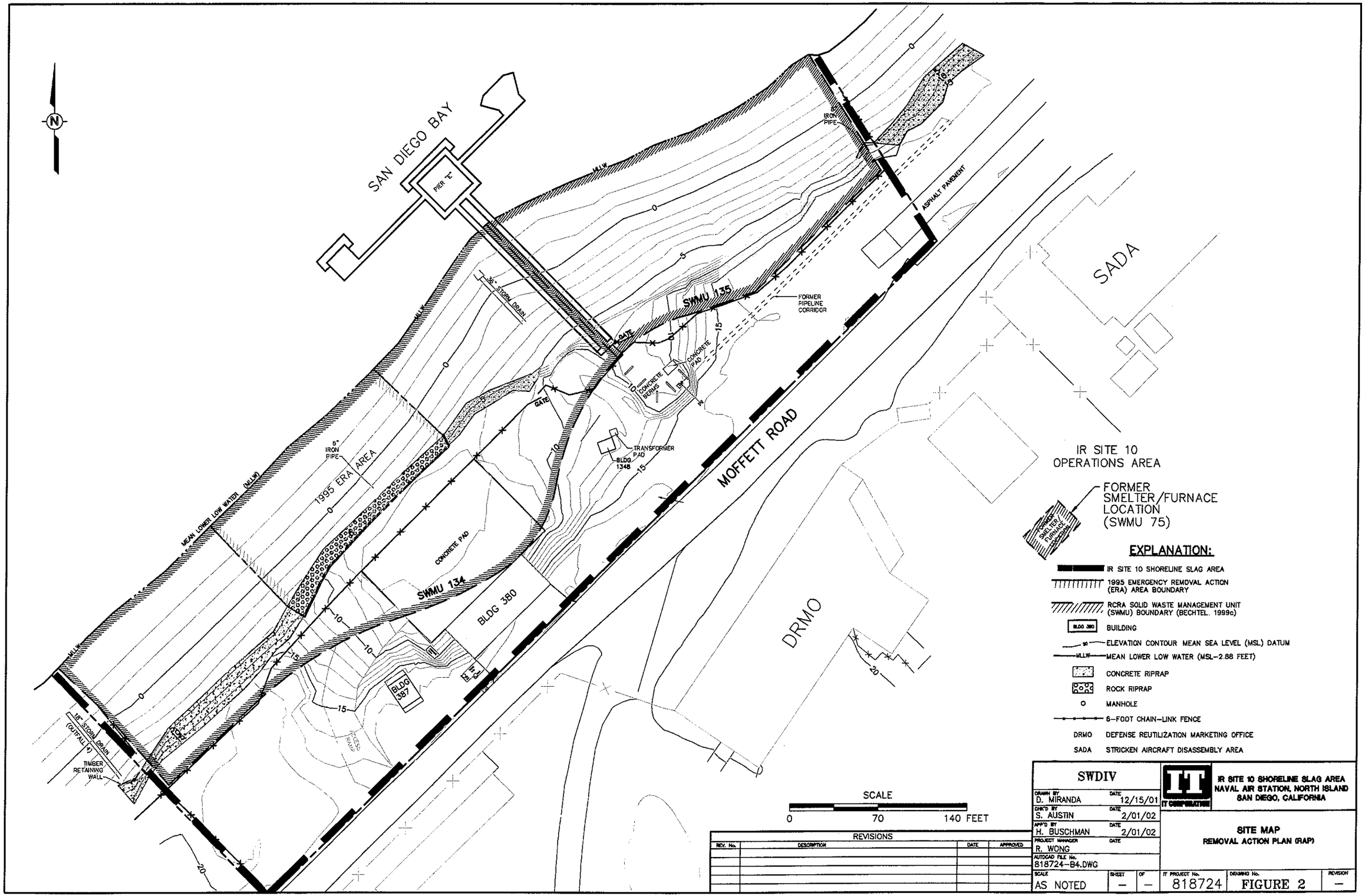
CHK'D BY S. AUSTIN	DATE 2/1/02		
APP'D BY H. BUSCHMAN	DATE 2/10/02		
PROJECT MANAGER RICH WONG			
AUTOCAD FILE No. 818724-B5			
SCALE AS NOTED	SHEET –	OF –	

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SITE VICINITY MAP
REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 1	–


N
SAN DIEGO BAY
PIER "E"
MLLW
MEAN LOWER LOW WATER (MLLW)
36" STORM DRAIN
GATE
SWMU 135
FORMER PIPELINE CORRIDOR
ASPHALT PAVEMENT
8" IRON PIPE
CONCRETE BERMS
CONCRETE PAD
TRANSFORMER PAD
BLDG 1348
MOFFETT ROAD
SADA
DRMO
1995 ERA AREA
CONCRETE PAD
SWMU 134
BLDG 380
BLDG 387
18" STORM DRAIN (OUTFALL 14)
TIMBER RETAINING WALL
IR SITE 10 OPERATIONS AREA
FORMER SMELTER/FURNACE LOCATION (SWMU 75)
EXPLANATION:
IR SITE 10 SHORELINE SLAG AREA
1995 EMERGENCY REMOVAL ACTION (ERA) AREA BOUNDARY
RCRA SOLID WASTE MANAGEMENT UNIT (SWMU) BOUNDARY (BECHTEL, 1999c)
BUILDING
ELEVATION CONTOUR MEAN SEA LEVEL (MSL) DATUM
MEAN LOWER LOW WATER (MSL-2.88 FEET)
CONCRETE RIPRAP
ROCK RIPRAP
MANHOLE
6-FOOT CHAIN-LINK FENCE
DRMO DEFENSE REUTILIZATION MARKETING OFFICE
SADA STRICKEN AIRCRAFT DISASSEMBLY AREA
SCALE
0 70 140 FEET
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IT CORPORATION
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA
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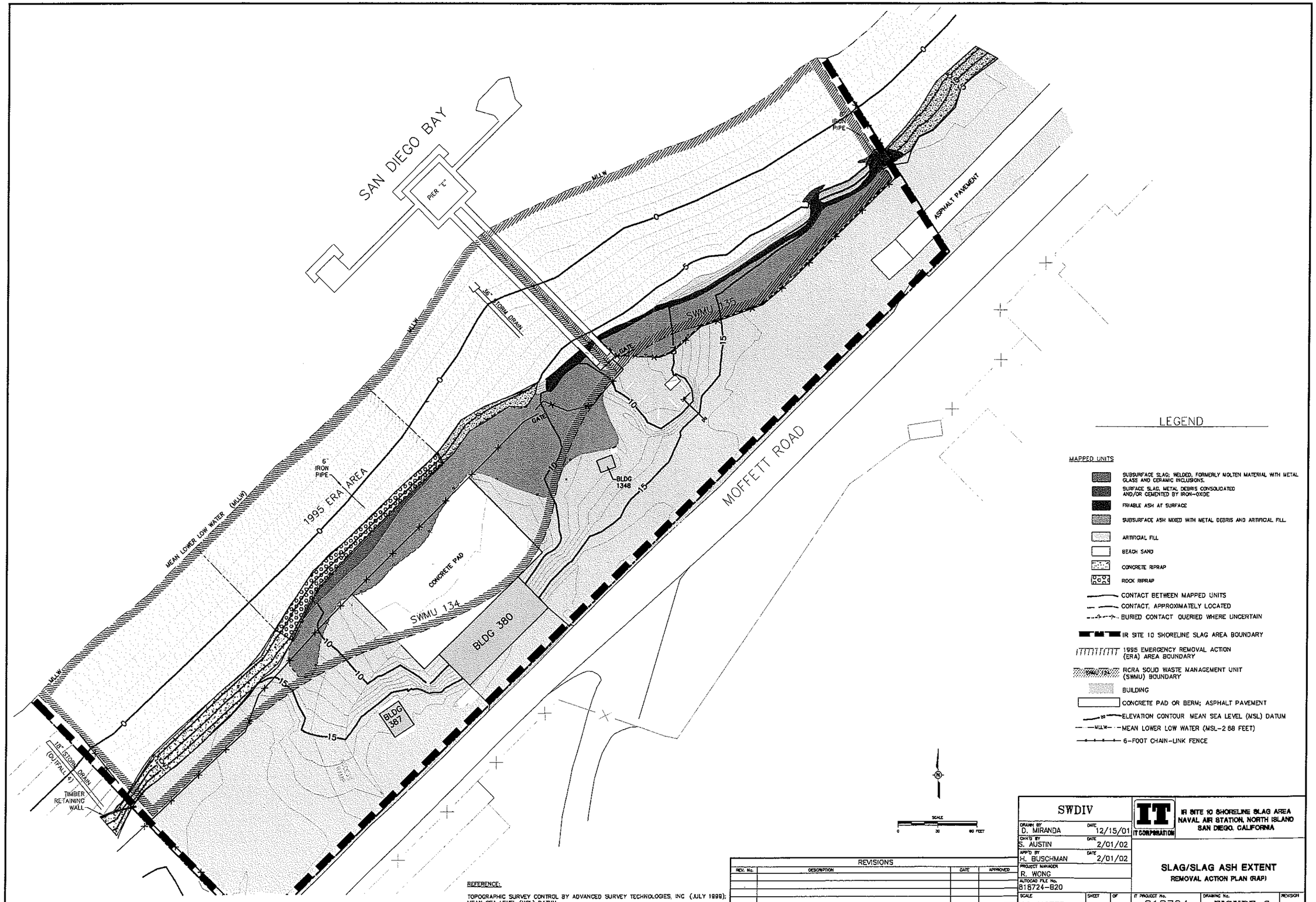
AUTOCAD FILE No. 818724-B4.DWG
SCALE AS NOTED SHEET – OF –
SITE MAP
REMOVAL ACTION PLAN (RAP)
IT PROJECT No. 818724
DRAWING No. FIGURE 2
REVISION –



REFERENCE:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

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NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

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SLAG/SLAG ASH EXTENT
REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 3	–

PIER "E"

18" STORM DRAIN

36" STORM DRAIN

CONCRETE AND PIPE WORK TO BE REMOVED

MW01

MW02

MW03

MW04

WASTE CONSOLIDATION AREA

BLDG 387

TRANSFORMER

BLDG 380

CANOPY

CONCRETE PARKING APRON

SEPTIC TANK (ABANDONED)

PUMP STATION

CONCRETE PAD

ELECTRICAL BOX

BUMPER POSTS

(2)4"PERFORATED

SEPTIC TANK (ABANDONED)

IR SITE 10 BOUNDARY

MOFFETT ROAD

RR TRACK

BUILDING 380 EXISTING ACCESS RAMP TO BE DEMOLISHED

BUILDING 380 TO REMAIN

BUILDING 387 TO REMAIN

BUILDING 1348 AND TRANSFORMER PAD TO REMAIN

SCALE

0 60 120 FEET

LEGEND:

- PIER "E" ACCESS RAMP
- BLDG. 380 NEW ACCESS RAMP
- E.T. COVER OVER CONSOLIDATED WASTE
- ROCK REVETMENT
- MW03 LOCATION OF GROUNDWATER MONITORING WELLS

NOTE:

UTILITIES TO REMAIN

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES INC (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

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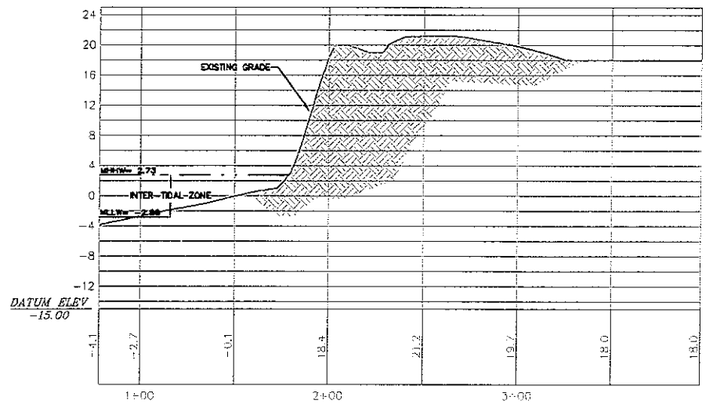
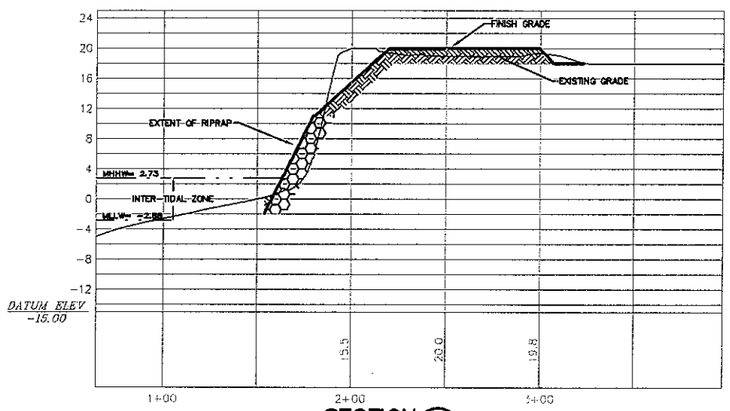
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO CALIFORNIA

SITE RECONSTRUCTION
REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 4	—



SECTION 1/4



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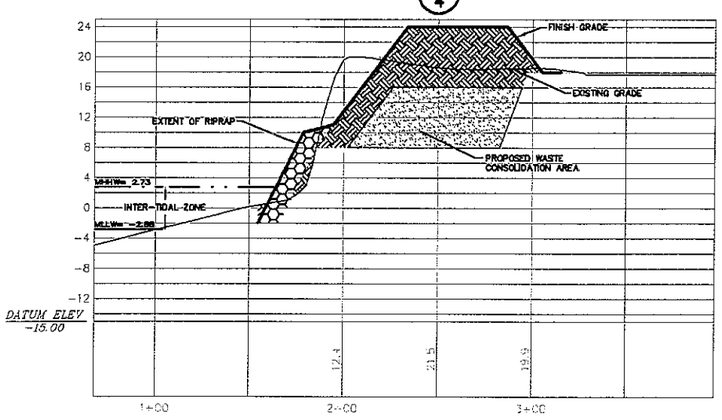

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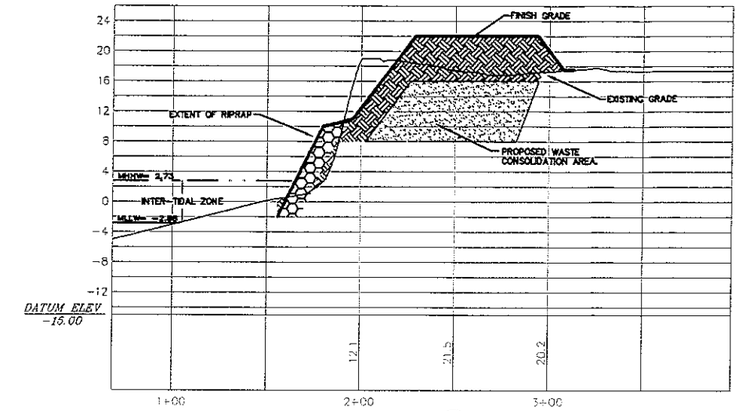

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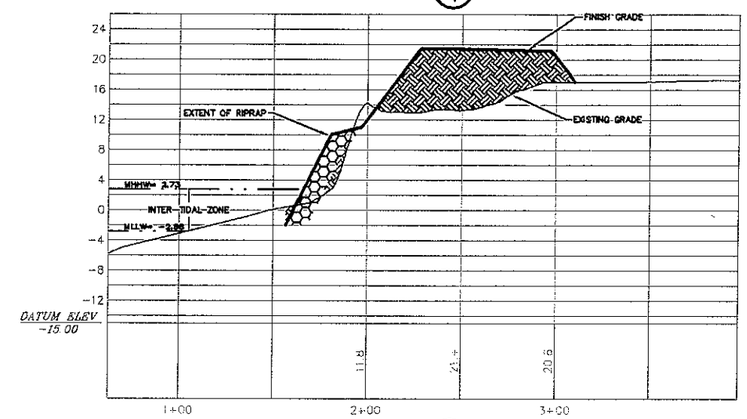
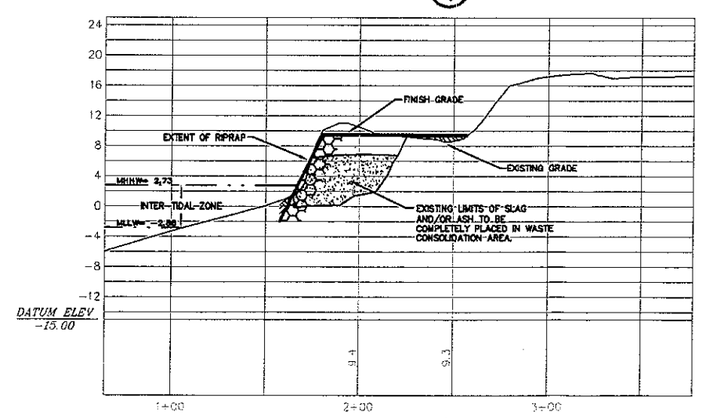


SECTION 5/4



SECTION 6/4

HORIZONTAL SCALE

0 80 160 FEET

VERTICAL SCALE

0 20 40 FEET

REFERENCES:

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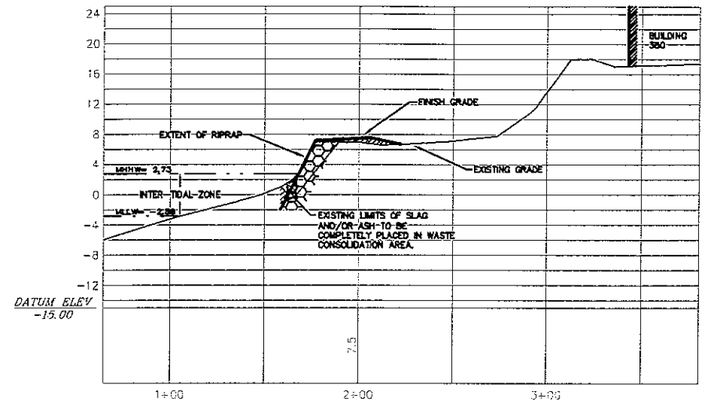
IT CORPORATION

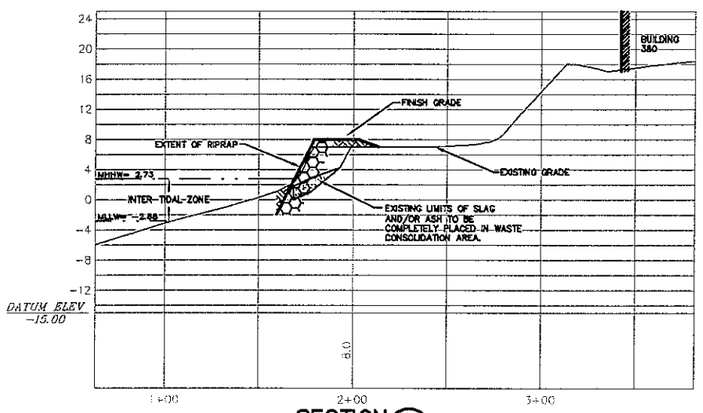
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SECTIONS 1 TO 6
SITE RECONSTRUCTION
REMOVAL ACTION PLAN (RAP)

SCALE	SHEET	OF	IT PROJECT No.	DRAWING No.	REVISION
AS NOTED	–	–	818724	FIGURE 5	–



SECTION 7/4



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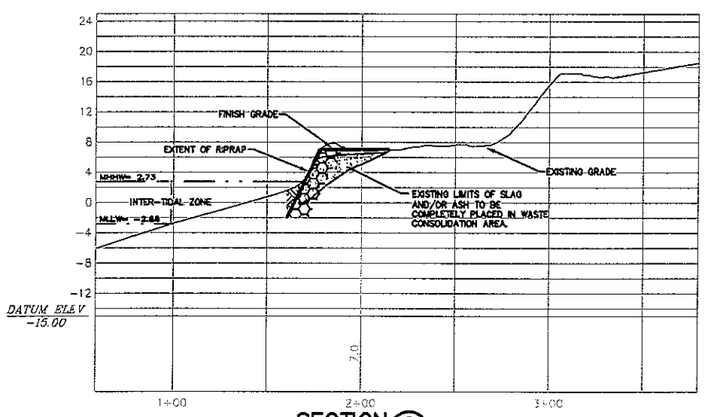

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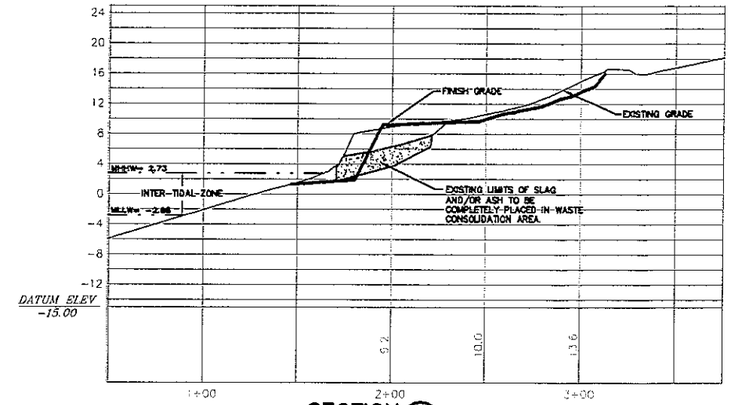

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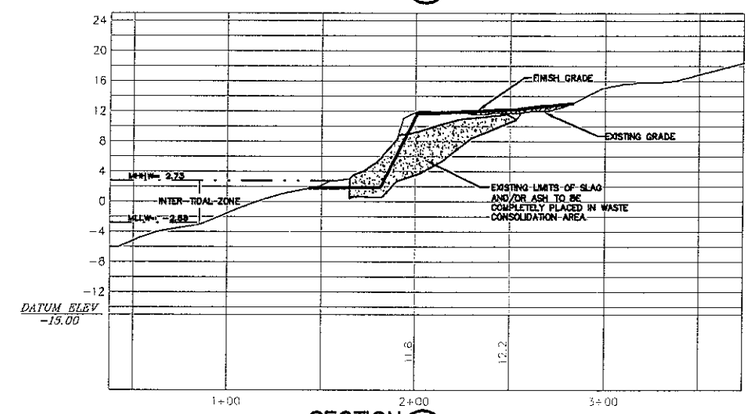
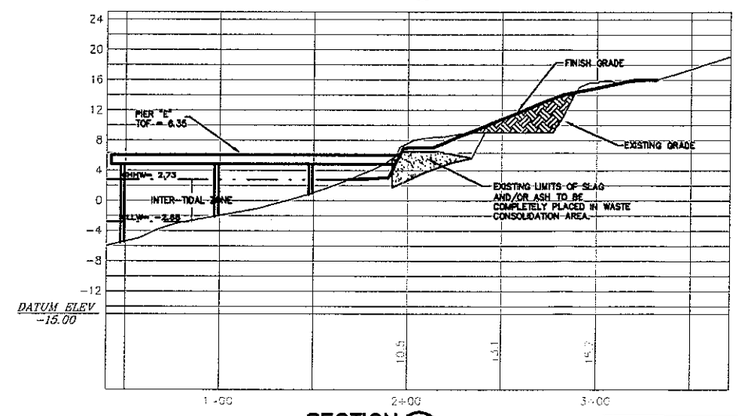


SECTION 11/4



SECTION 12/4

HORIZONTAL SCALE

0 80 160 FEET

VERTICAL SCALE

0 20 40 FEET

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC. (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

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APV'D BY H. BUSCHMAN	DATE 3/18/02	
PROJECT MANAGER R. WONG	DATE	
AUTOCAD FILE No. 818724-B21		
SCALE AS NOTED	SHEET –	OF –

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SECTIONS 7 TO 12
SITE RECONSTRUCTION
REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
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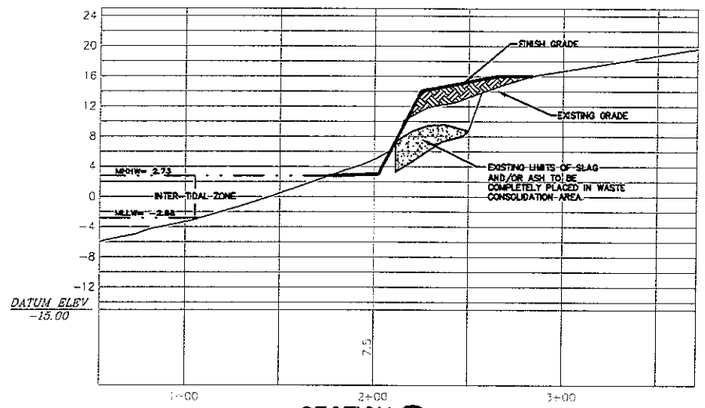
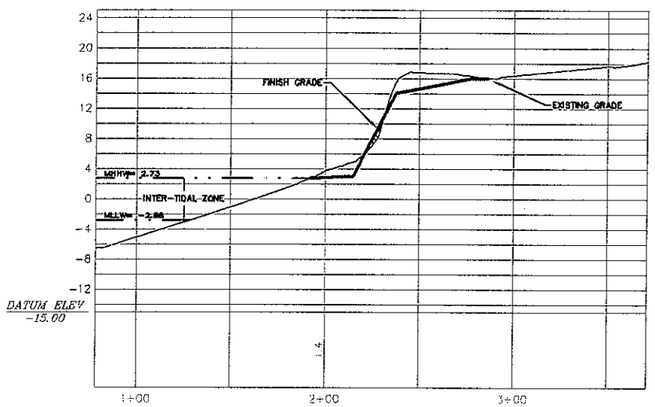
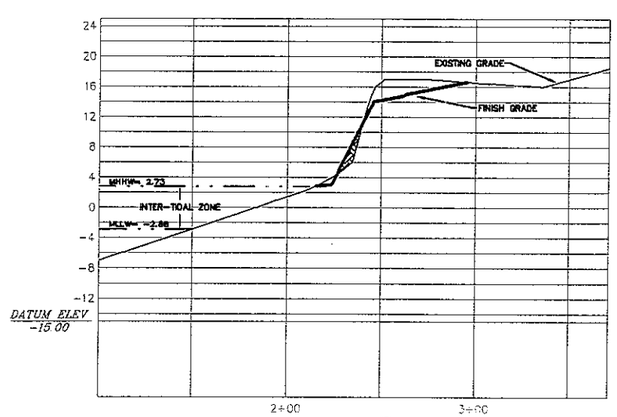


SECTION 13/4



SECTION 14/4



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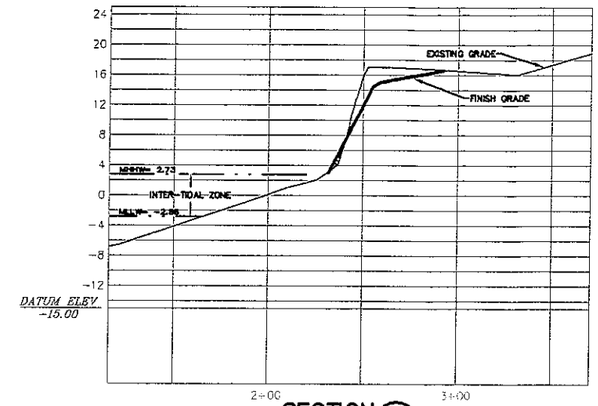

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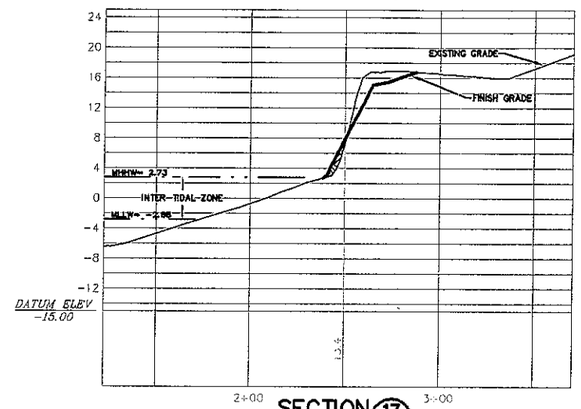

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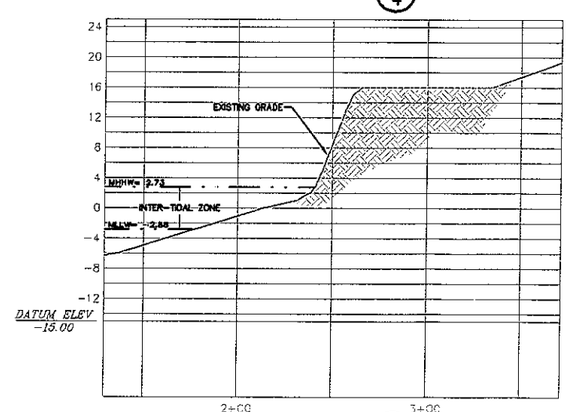

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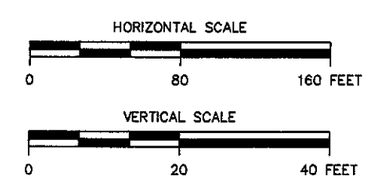

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC. (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

NAVY PUBLIC WORKS CENTER UNDERGROUND UTILITY INFORMATION (BECHTEL 1999a)

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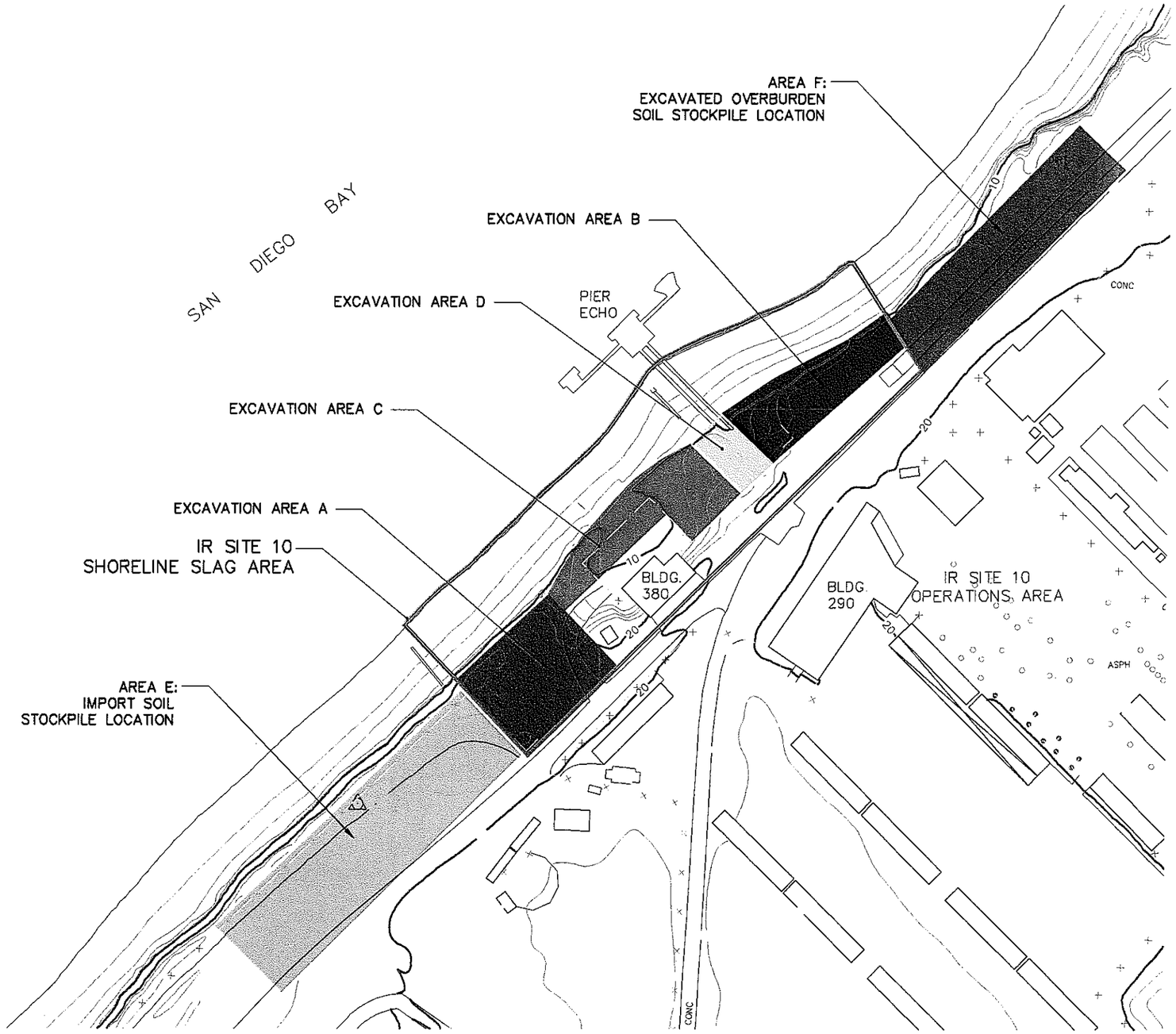
AUTOCAD FILE No. 818724-B21		
SCALE AS NOTED	SHEET –	OF –

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SECTIONS 13 TO 18
SITE RECONSTRUCTION
REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 7	–



GRAPHIC SCALE

0 80 160 FEET

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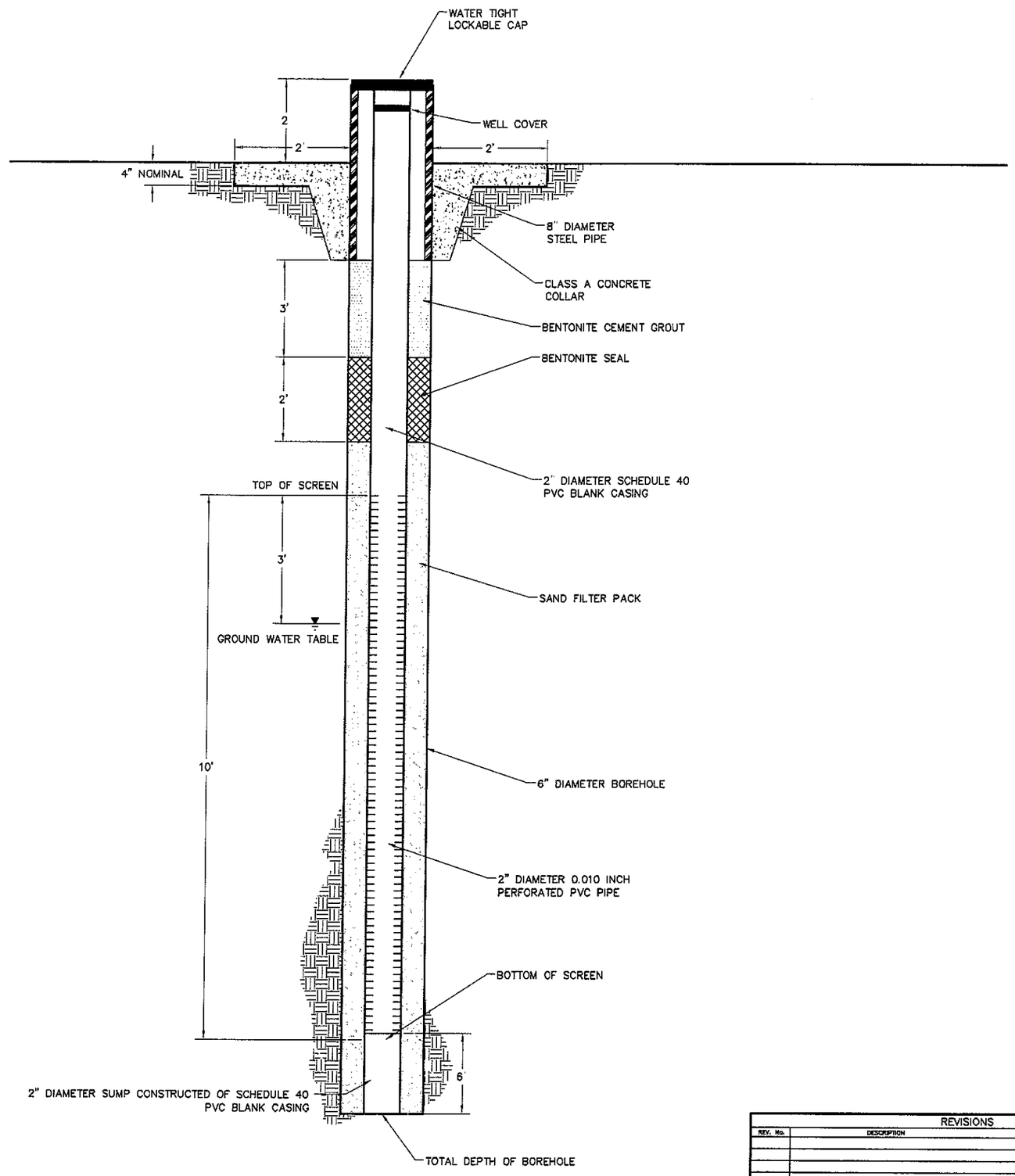
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

EXCAVATION AND STOCKPILE AREAS

REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 8	–



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NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

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GROUNDWATER MONITORING WELL DESIGN
REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 9	–

TABLES

Table 1
Grain Size Distribution Requirements for Select Fill

Classification	Particle Type	Percent of Particles by Weight
Gravel	Coarse Sand and Gravel (2.0 mm)	<10
Sand	Sand (0.05 to 2.0 mm)	10 to 60
Silt	Silt (0.002 to 0.05 mm)	15 to 70
Clay	Clay (less than 0.002 mm)	4 to 10

Note: Maximum particle size is 4 inches.
< denotes less than.
mm denotes millimeters.

Table 2
Summary of Cleanup Criteria

Contaminant	EPA Region 9 Industrial Soil PRG (mg/kg)	Previously-Established Site-Specific Background Gamma Exposure Rates[a] (µR/hr)
Antimony	820	N/A[a]
Arsenic	2.7	N/A
Barium	100,000	N/A
Beryllium	2,200	N/A
Cadmium	810	N/A
Chromium (total)	450	N/A
Cobalt	100,000	N/A
Copper	76,000	N/A
Lead	750	N/A
Molybdenum	10,000	N/A
Nickel	41,000	N/A
Selenium	10,000	N/A
Silver	10,000	N/A
Thallium	130	N/A
Vanadium	14,000	N/A
Zinc	100,000	N/A
Radium-226	N/A	6.5 to 13.1

Notes:

[a]As determined during the ERI/RFI (AIMTech, 2001).

µR/hr denotes microroentgens per hour.

mg/kg denotes milligrams per kilogram.

N/A denotes not applicable.

PRG denotes preliminary remediation goal.

APPENDIX A
SITE HEALTH AND SAFETY PLAN

SITE HEALTH AND SAFETY PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
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July 8, 2002

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U. S. Department of the Navy
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SITE HEALTH AND SAFETY PLAN
IR SITE 10 SHORELINE SLAG AREA
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SAN DIEGO, CALIFORNIA

Environmental Remedial Action
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July 8, 2002

Prepared by: _____ Date: July 8, 2002
Fred Mlakar, C.I.H.
Program Health and Safety Manager

Approved by: _____ Date: 7·8·02
Richard Wong, C.E.G., C.H.G.
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Attachment 5 Material Safety Data Sheets
Attachment 6 Radiation Protection Program, HS-700
Attachment 7 Radiation Protection Plan Standard Operating Procedures
Attachment 8 Air Sampling Procedure for Radioactive Materials

Acronyms and Abbreviations

µCi/mL	microcuries per milliliter
ALARA	as low as reasonably achievable
ANSI	American National Standards Institute
Cal/OSHA	California Occupational Safety and Health Administration
CCR	California Code of Regulations
CFR	Code of Federal Regulations
CHP	Certified Health Physicist
CIH	Certified Industrial Hygienist
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
dBA	decibels, A-scale
DAC	derived air concentration
DRMO	Defense Reutilization and Marketing Office
EM	Engineering Manual
EPA	U.S. Environmental Protection Agency
GFCI	ground fault circuit interrupter
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	high-efficiency particulate air
H&S	health and safety
HSM	Health and Safety Manager
HSO	Health and Safety Officer
IR	Installation Restoration
kV	kilovolt
mg/m^3	milligrams per cubic meter
MSDS	material safety data sheet
NAS	Naval Air Station
Navy	U.S. Department of the Navy
NIOSH	National Institute of Occupational Safety and Health
NRC	U.S. Nuclear Regulatory Commission
NTR	Naval Technical Representative
O_2	oxygen
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
ppm	parts per million
QA/QC	quality assurance/quality control
RCT	Radiological Controls Technician
RCS/HSO	Radiation Control Supervisor/Health and Safety Officer
ROICC	Resident Officer in Charge of Construction
RPP	Radiation Protection Plan
RWP	radiation work permit
SHSP	Site Health and Safety Plan
SOP	Standard Operating Procedures

USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard

1.0 Introduction

This Site Health and Safety Plan (SHSP) was prepared by IT Corporation (IT) to address the procedures for the on-site containment of slag wastes underlying the shoreline bluff at Installation Restoration (IR) Site 10, Naval Air Station (NAS) North Island, San Diego, California.

This SHSP establishes policies and procedures to protect workers and the public from potential hazards posed by work at IR Site 10. IT considers safety the highest priority during work at any site containing potentially hazardous materials and has established a policy of minimizing exposure. This policy is enforced on all projects. Although the SHSP focuses on the specific work activities planned for IR Site 10, it must remain flexible because of the nature of the work. Conditions could change and unforeseen situations could arise that require deviations from the original plan. This flexibility will allow IT superintendents and health and safety (H&S) officials to modify the SHSP to account for changing site conditions such as unexpected chemical hazards, weather conditions, or deviations to the scope of work.

Changes to the SHSP must be approved by the Health and Safety Officer (HSO), Health and Safety Manager (HSM), and Project Manager or Project Superintendent and must be recorded on the SHSP Change Approval Form (Attachment 1). The Navy Technical Representative (NTR) can acknowledge the change but is not required to sign the form. If a change is made to the SHSP, the project HSM will forward a copy of the SHSP Change Approval Form to the Contracting Officer.

This SHSP takes into account the information currently available from discussions with the project management team and materials provided by the U.S. Department of the Navy (Navy). All project activities will be conducted in a manner that minimizes the potential for injury, accident, or unforeseen incident. All IT employees, subcontractors, and visitors are required to read and sign the SHSP prior to site entry. The SHSP Acknowledgment Form is presented in Attachment 2.

This plan also provides for radiological protection of personnel working at the site and ensures compliance with applicable U.S. Nuclear Regulatory Commission (NRC) and equivalent State of California regulations. In addition, IT is committed to reducing personal radiation exposures to levels that are as low as reasonably achievable (ALARA). Strict adherence to established

radiation protection and ALARA rules, regulations, and concepts is required of each individual working in a radiologically controlled area.

1.1 Regulations and Guidelines

This SHSP and all site activities will be in compliance with the following regulations and guidelines:

- U.S. Department of Labor Occupational Safety and Health Administration (OSHA) Standards, specifically:
  - 29 Code of Federal Regulations (CFR) 1910.134: *Respiratory Protection*
  - 29 CFR 1910.120: *Hazardous Waste Operations and Emergency Response (HAZWOPER)*
  - 29 CFR 1910.1200: *Hazard Communication*
  - 29 CFR 1926: *Safety and Health Regulations for Construction*
- Title 8, California Code of Regulations (CCR)
- U.S. Environmental Protection Agency (EPA), *Standard Operating Safety Guides*, June 1992 (EPA, 1992)
- National Institute of Occupational Safety and Health (NIOSH)/OSHA/U.S. Coast Guard (USCG)/EPA, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, October 1985 (NIOSH/OSHA/USCG/EPA, 1985)
- U.S. Army Corps of Engineers (USACE), *Safety and Health Requirements Manual*, Engineering Manual (EM) 385-1-1, September 1996 (USACE, 1996)
- Navy/Marine Corps, *Installation Restoration Manual*, February 1997 (Navy/Marine Corps, 1997)
- American National Standards Institute (ANSI), *Practice for Respiratory Protection*, Z88.2 (ANSI, 1992)
- IT Corporation *Health and Safety Policies and Procedures Manual* (available on site)
- NRC, Title 10, CFR, Part 20, *Standards for Protection Against Radiation*
- U.S. Department of Transportation, Title 49, CFR, Part 173.400, *Radioactive Materials,* Subpart I
- EPA, Title 40, CFR, Part 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings*
- IT Corporation Policy No. HS700, Radiation Protection Program Plan

- ANSI, *Surface and Volume Radioactivity Standards for Clearance*, P/N13.12 (ANSI, 1999)
- ANSI, *Control of Radioactive Surface Contamination on Materials, Equipment and Facilities to be Released for Uncontrolled Use, ANSIN13.12* (ANSI, 1978)
- NRC, *Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities,* NUREG-1640 Vol. 1 (NRC, 1999).

In keeping with IT's policy of minimizing the radiation exposure of its employees, subcontractors, and the general public, the ALARA program will be implemented for this project. The program includes training employees and subcontractors, implementing safe work procedures, enforcing radiation work permit use, maintaining good housekeeping practices, and using personal protective equipment (PPE), as necessary. Controls described in this SHSP will act as the ALARA program.

1.2 Site Description and Contaminant Characteristics

NAS North Island is located in San Diego County, California, southwest of the city of San Diego, on the tip of the Silver Strand Peninsula.

Military salvage operations began at a 10-acre site on the northwest shoreline of NAS North Island in the early 1930s. The salvage yard has since expanded and is presently known as the Defense Reutilization and Marketing Office (DRMO). The DRMO and the adjoining Stricken Aircraft Disassembly Area constitute the 22-acre IR Site 10 Operations Area.

Salvage operations at the IR Site 10 Operations Area historically have involved the dismantling of aircraft and the disposition of military surplus materials. An open-hearth furnace (smelter) was used from 1943 to 1967 at the salvage yard to recover metals from scrap aircraft parts. Aircraft instrumentation painted with radium-226 to provide illumination was conveyed to the smelter along with other metallic scrap materials.

Slag, which was generated as a waste product of smelter operation at the salvage yard, was transported approximately 500 yards from the smelter and disposed of in the intertidal zone and bluff adjoining the shoreline of San Diego Bay. Field observations indicate that slag disposal occurred both during and subsequent to dredge and fill operations that extended and raised the northwestern shoreline of NAS North Island to its recent configuration and elevation.

The objectives of this project are as follows:

- Minimize erosion of slag wastes exposed in and underlying the shoreline bluff

- Minimize migration of metals in slag wastes to San Diego Bay, groundwater, and the atmosphere
- Minimize infiltration to reduce potential leaching of slag wastes
- Reduce potential human health risks associated with exposure to metals in the slag wastes

1.3 Scope of Work

The following tasks will be performed:

- Mobilization and site preparation including marking and temporary relocation of utilities, establishing dust and erosion control measures, clearing and grubbing of vegetation, and removal of existing riprap
- Construction of a waste containment area (WCA)
- Excavation of slag wastes and placement of them in the WCA
- Construction of a soil cover, with a minimum thickness of 5 feet, over the WCA
- Confirmation sampling of excavated areas
- Backfilling waste excavation areas with clean soil
- Installation, development, and surface completion of groundwater monitoring wells
- Construction of a rock revetment along the shoreline bluff
- Site restoration, including construction of an asphaltic concrete (AC) access ramp for Building 380 and an AC access ramp for Pier Echo (also known as Pier E)

These tasks, the anticipated hazards and control measures are detailed in the Hazard Analysis Forms in Attachment 3.

The field construction work for this project is expected to be completed within approximately one year.

2.0 Key Personnel and Management

IT maintains a policy of providing its employees, subcontractors, and authorized visitors with information and procedures to protect them and the adjacent community from any adverse effects that could result from work at a job site involving potentially hazardous substances. All personnel involved with this project will follow the H&S procedures set forth in this SHSP. Visitors will not be given entry to the site unless they read and agree to comply with this plan. The SHSP Acknowledgment Form (Attachment 2) will be signed by all who actively participate at the project site.

2.1 Project Manager

The Project Manager, Mr. Richard Wong, communicates directly with the NTR and will serve as the primary point of contact. The Project Manager's responsibilities include project scheduling, cost updating, overall project direction, and overseeing site safety. In addition, the Project Manager is responsible for determining the extent and level of input required for technical issues that arise during the tenure of the project. The Project Manager's direct subordinate will be the Project Superintendent for site activities.

The Project Manager's health and safety responsibilities are as follows:

- Being aware of the hazards associated with the job tasks for this project
- Ensuring that personnel are provided with proper training and equipment to perform their assignments safely
- Ensuring that personnel adhere to H&S rules, regulations, and procedures
- Frequently observing work in progress to ensure adherence to H&S rules, regulations, and procedures.

2.2 Project Health and Safety Manager

The project HSM for the site is Mr. Fred Mlakar. Mr. Mlakar is a Certified Industrial Hygienist (CIH) with more than 15 years of experience in the chemical and environmental remediation industries. He will be responsible for review and approval of the SHSP and will supervise and direct the activities of the project radiation control supervisor/health and safety officer (RCS/HSO). The HSM has the authority to stop unsafe operations, remove unqualified personnel from the work area, and approve changes to the SHSP.

The HSM is responsible for integrating all aspects of the SHSP, from development to implementation. HSM duties include assigning an RCS/HSO to implement the SHSP, advising the RCS/HSO on all related H&S aspects, reviewing any site-specific plans for compliance and completeness, and establishing and monitoring all related H&S procedures through site safety audits.

2.3 Radiation Control Supervisor/Health and Safety Officer

The RCS/HSO implements and enforces the project safety program and procedures at the project site.

The RCS/HSO will conduct daily safety meetings and will interface as required with other site representatives. The RCS/HSO performs duties such as confirming that personnel are fit for duty, coordinating emergency medical care, conducting a daily site safety inspection, and inspecting H&S equipment.

In addition, the RCS/HSO is responsible for maintaining safety equipment, posting daily air monitoring results, providing site orientation safety training for all personnel actively involved in site work, and other site safety documentation. The RCS/HSO takes the following actions, as appropriate:

- Orders the immediate shutdown of site activities in the case of a medical emergency or unsafe practice
- Ensures that protective clothing and equipment are properly stored, used, and maintained
- Ensures that ongoing environmental and personnel monitoring operations are in accordance with technical specifications and required procedures
- Restricts visitors from areas of potential exposure to harmful substances

A safety log will be maintained for all IT activities. This log will document daily safety meeting topics, training given, air monitoring information, first aid administered, visits of all outside personnel, and any incidents of a H&S nature. The RCS/HSO and/or Project Superintendent will investigate all accidents and prepare an accident investigation report and will forward the report to the IT Regional H&S Department and the NTR. Project safety inspections will be conducted weekly by the Project Superintendent and/or RCS/HSO. Attachment 4 presents a project safety checklist.

The RCS/HSO is responsible for on-site implementation and enforcement of the site safety program and procedures. The RCS/HSO will oversee personal monitoring and will decide when action levels have been reached that require more stringent personal protection.

The RCS/HSO has primary responsibility for the technical adequacy and correctness of the radiation protection and ALARA programs and for ensuring compliance with radiation protection rules, regulations, and procedures. The RCS/HSO coordinates and supervises all radiation protection activities for field personnel. The RCS/HSO is responsible for verifying that the radiation protection elements of the SHSP are implemented. The RCS/HSO is assigned to the project site on a full-time basis. The RCS/HSO coordinates activities with the Project Superintendent. Other duties of the RCS/HSO include the following:

- Implementing and maintaining the radiation protection program (including applicable procedures)
- Functioning in an advisory capacity to assist personnel in carrying out their radiation protection responsibilities
- Evaluating new tasks to incorporate radiation protection controls into the Removal Action Plan (RAP)
- Approving radiation work permits (RWPs) and selecting protective clothing for radiological work
- Stopping work if conditions indicate that a potential exists for an unexpected, excessive radiation exposure to personnel or the general public or if an individual violates the radiation protection rules, regulations, or procedures in a manner that could adversely affect personnel working at the site or the general public
- Ensuring that radiation exposures are ALARA
- Ensuring that adequate radiation safety training is provided to all project personnel and maintaining documentation of that training
- Performing periodic safety and quality reviews and monitoring activities of project operations to ensure compliance with the SHSP
- Reviewing planned site activities and implementing safety procedures to ensure safe performance and completion of the work
- Supporting operations personnel during an emergency event in order to minimize the spread of radioactive contamination
- Providing suggestions and advice to the superintendent in order to reduce personnel radiation exposures to ALARA
- Issuing dosimetry devices and maintaining personnel dosimetry records

- Reviewing radiation monitoring data to confirm that exposures or levels of contamination are acceptable
- Reviewing air sampling data and evaluating results against the limits specified for off-site emissions
- Assisting in providing required reports of personnel exposures to individuals and applicable regulatory agencies in cooperation with the IT Corporate office
- Implementing and maintaining records of radiological surveys and evaluations
- Making arrangements for all necessary services for bioassay analysis, if required
- Arranging maintenance and calibration services and maintaining associated records for radiation survey instruments used at the site
- Ensuring that all required monitoring is performed at the work site
- Ensuring that occupational monitoring is provided for workers who could come in contact with radiologically contaminated material
- Compiling survey data and calibration information for radiation monitoring equipment
- Periodically preparing a summary of exposures and verifying the effectiveness of the radiation protection program
- Confirming that calibration and instrument checks satisfy industry requirements
- Preparing, implementing, and maintaining a respiratory protection program (as necessary).

The RCS/HSO identifies and enforces the use of protective equipment for the various site activities. The RCS/HSO ensures that the protective equipment used meets the requirements of this SHSP. When conditions change, the RCS/HSO coordinates with the HSM to modify the protection to ensure that employee protection is appropriate for the new conditions.

The following logs, reports, and records will be developed and/or maintained on site by the RCS/HSO:

- Daily safety meetings
- Activity hazard analysis forms
- Training logs - site-specific and visitors
- Safety inspection logs
- Employee/visitor sign-in
- Ambient and personal air monitoring results
- Copy of OSHA 200 Log and all other H&S and radiological postings/notices

- SHSP
- SHSP Change Approval Form (Attachment 1).

2.4 Project Superintendent

The Project Superintendent is responsible for all field activities and enforces safe work practices by all crew members. The Project Superintendent watches for any effects on crew members, especially those symptoms possibly caused by heat stress or chemical exposure. The Project Superintendent oversees the safety of any visitors who enter the site. The Project Superintendent maintains communication with the IT Project Manager and the NTR.

2.5 Equipment Operators

Equipment operators are responsible for the maintenance, inspection, and safe operation of their assigned equipment. The equipment operators will report any equipment malfunctions or necessary repairs to the Project Superintendent.

2.6 Employee Safety Responsibility

Although the employer is responsible for providing a safe and healthful workplace, all employees are responsible for their own safety, as well as the safety of those around them. Employees shall use all equipment provided in a safe and responsible manner, as directed by the Project Superintendent. All IT personnel will follow the policies set forth in this SHSP and in the IT H&S Procedures Manual. Flagrant or willful disregard of H&S or radiological protection rules, regulations, or practices could result in disciplinary action. The basic responsibilities of site personnel are as follows:

- Site workers performing tasks in the restricted area will have a working knowledge of the H&S and radiological protection rules, regulations, and procedures. This will be accomplished by reviewing this SHSP and successfully completing training and instruction commensurate with each individual's work assignment.
- Workers will know the specifics of the task or job that they are to perform. This will be accomplished through the use of blueprints, technical manuals, standard operating procedures (SOPs), or instructions from supervisory personnel. Unfamiliarity with the job can result in an increased or unsuspected health or radiological safety hazard. The RWP is the one document with which the worker must be most familiar. It lists radiological conditions and precautions in the worker's specific work area. All workers working in areas covered by an RWP must comply with all requirements of the RWP.
- Workers will understand and follow the H&S and radiological protection requirements. Workers will also acquaint themselves with the chemical, physical, and radiological status of the areas in which they are assigned to work.

- Workers will discontinue working on a job or task whenever problems arise that could adversely affect the overall chemical, physical, or radiation exposure received or the radiological status of the job. The RCS/HSO (or designee) will be notified to reassess the situation.

Each worker is responsible for reporting any injuries, incidents, near misses, and safety infractions to the Project Superintendent or the RCS/HSO so that treatment can be obtained and/or corrective action taken.

3.0 Job Hazard Analysis

This section discusses potential radiation, chemical, physical, and environmental hazards to workers on the site. Section 3.1 discusses radiation hazards expected at the sites. Section 3.2 discusses each contaminant and includes information such as exposure limits and signs and symptoms of exposure. Section 3.3 discusses physical hazards associated with these sites, including hazards associated with construction, use of heavy equipment, fire hazards, and electrical hazards. Environmental hazards are discussed in Section 3.4 and are associated with the physical location of the sites, weather conditions, noise conditions, and flora and fauna contact. Section 3.5 discusses the risks and precautions associated with each task identified in the RAP. Section 3.6 describes the IT accident prevention plan.

Daily "tailgate" safety meetings are held at the start of each shift. Before the start of field activities, the potential radiation, chemical, physical, and environmental hazards and preventative safety measures are discussed. Attendance is mandatory for all employees.

An activity hazard analysis has been developed for each planned activity and operation associated with each major phase of the work. The hazard analysis identifies the sequence of work, specific hazards expected, and the control measures to be implemented to minimize or eliminate each hazard. The hazard analysis is used to augment daily safety meetings intended to heighten safety and hazard awareness on the job. This briefing will be documented and can be combined with the daily tailgate safety meeting.

3.1 Radiation Hazards

The primary radio nuclide of concern at IR Site 10 is radium-226. Radium-226 and its associated daughters emit alpha particles, beta particles, and photons. The expected nature and concentrations of radium contamination at the site present minimal risk of a measurable uptake, and external exposure rates are expected to be near background levels. All appropriate radiological controls and monitoring will be implemented to ensure and document that any potential exposure to ionizing radiation is ALARA for both workers and the public.

It is IT's policy to maintain radiation exposures to employees, subcontractors, and the general public as far below the limits specified by Federal law as reasonably achievable. The ALARA program will be implemented through employee and subcontractor training and use of work procedures and RWPs, good housekeeping practices, and appropriate PPE. Each individual

working in a radiological controlled area must comply with established radiation protection and ALARA requirements.

Training is an important aspect of controlling exposures to radiation hazards; therefore, personnel working in controlled areas will receive training prior to assignment. Radiation surveys and personnel monitoring will be conducted to evaluate radiological hazards and control measures. Methods for controlling radiological hazards include administrative controls such as procedures, RWPs, and postings and use of engineering controls and PPE.

An RWP system will be implemented at the site to ensure that each controlled area is accessed only by personnel who have the appropriate training, personnel monitoring, instrumentation, and PPE. The RWP can also be used as a safety information document. Hazards other than radiological can be included on the RWP so that proper protection for all possible hazards can be determined from one controlling document. Implicit in any RWP is the need for a briefing on the hazardous conditions present in the work environment. The RWP will list tasks and specific levels of protection for each worker covered by the RWP. The RWP will also detail the dosimetry requirements, the protective clothing requirements, and the expected radiation and contaminant levels to be encountered during the job.

Only authorized and trained personnel will be allowed in controlled areas (exclusion zone and contamination reduction zone [CRZ]). Upon exiting the exclusion zone, personnel will strictly follow the decontamination procedures detailed in Section 6. A frisking station will be established in the CRZ and will be used to ensure that radioactive contamination is not carried out of the controlled areas by personnel or equipment.

Limits of radiation exposures are set by the NRC for both internal and external exposure. Personal monitoring and dosimetry are outlined in Section 7.

3.2 Chemical Hazards

Table 1 lists chemicals identified at IR Site 10 based on site sampling and analytical data. Material safety data sheets (MSDSs) (Attachment 5) for any additional chemicals found or brought onto the site will be reviewed with all personnel during daily safety meetings. Initial levels of protection and air monitoring requirements will be based on the data provided or obtained prior to remediation work. These requirements could change as site conditions are more fully evaluated when work is under way.

IT's protective equipment requirements, combined with the requirement to wash arms, face, and hands before eating or smoking, should prevent exposure during these activities. In addition, the

project RCS/HSO and Project Superintendent will observe and warn crew members to be aware of the initial symptoms of chemical exposure. The amount of exposure depends primarily on the specific activities undertaken and the care with which the activities are performed. Any crew member will be removed from the work site and medically evaluated if the following initial symptoms persist and are unexplained by other causes (such as allergy, common cold, heat stress etc.):

- Dizziness or stupor
- Nausea, headaches, or cramps
- Irritation of the eyes, nose, or throat
- Euphoria
- Chest pains and coughing
- Rashes or burns.

Hazard Communication Program–The purpose of a Hazard Communication or Employee Right-to-Know Program is to ensure that the hazards associated with all chemicals at the field project site are communicated to all IT personnel and subcontractors, in accordance with 29 CFR 1926.59. A written hazard communication program has been established for IT and includes the following elements:

- ***Container Labeling***–IT personnel will ensure that all drums and containers are labeled according to contents. These drums and containers will include those from manufacturers and those produced on site by operations. All incoming and outgoing labels shall be checked for identity, hazard warning, and name and address of responsible party.
- ***MSDSs***–An MSDS will be located on site for each hazardous chemical used or known to be on site. MSDSs are also presented in Attachment 5.
- ***Employee Information and Training***–Employees will be trained on chemical hazards through formal safety training conducted annually and informal safety meetings. Project-specific chemical hazards will be communicated to employees through an initial site orientation meeting and during daily safety meetings held at IT field projects.

When any new hazardous material is introduced or discovered on site, employees will be given information about the material at the daily safety meeting. The Project Superintendent will be responsible for seeing that the MSDS on the new chemical or material is made available on site.

3.3 Physical Hazards

Numerous physical hazards associated with this project could cause accidents, personal injury, or operational problems if not identified and addressed. To minimize physical hazards, IT has

developed standard safety protocols that will be followed at all times.
Failure to follow safety protocols or continued negligence with regard to these policies will result in disciplinary action.

IT personnel are familiar with the field activities that will be conducted at this site. They are trained to work safely under various field conditions. In addition, the Project Superintendent will observe the general work practices of each crew member and equipment operator and will enforce safe procedures to minimize physical hazards. Hard hats, safety glasses, and safety boots will be required in all areas of the site.

3.3.1 Tripping, Slipping, and Falling Hazards

IT personnel and subcontractors will be reminded daily to maintain sure footing on all surfaces. Safety belts or harnesses will be required by any personnel working 6 feet above any surface, including man-lifts. Use of handrails when climbing stairs will be enforced. Personnel will not work under any suspended loads or under any equipment such as buckets of loaders and excavators.

To minimize tripping hazards, debris, job supplies, equipment, and materials will be removed daily from the work areas and stockpiled in storage areas. This housekeeping effort will be enforced by the RCS/HSO throughout the day.

3.3.2 Head and Back Injuries

As a minimum requirement, hard hats and safety glasses will be worn to perform any site activities. This will prevent minor injuries caused by bumping one's head while working around and under piping and other process-related structures. Personnel are instructed in proper lifting techniques and will be reminded at the daily safety meeting to not lift heavy items without assistance.

3.3.3 Falling Objects

This project can be accomplished without any object, regardless of size, free falling to the ground. All items raised will be slowly lowered to the ground using a grapple and/or skip bucket or other similar pieces of equipment. No personnel will work under such equipment at any time. In addition, the RCS/HSO will ensure that an adequate area is clear of personnel while equipment is in operation.

3.3.4 Heavy Equipment and Traffic

The use of heavy equipment for brush and debris removal, excavation, and lifting presents the greatest potential for injury to personnel. To minimize these hazards, designated routes will be

established for mobilization through the facility and specific traffic patterns will be established. All trucks and heavy equipment will have "spotters" for backing maneuvers. All personnel will wear reflective orange safety vests for work near traffic and in traffic.

Only qualified personnel will operate heavy equipment. Those crew members directly involved with "spotting" for the operator will be the only personnel allowed in the vicinity of the heavy equipment. All others will remain a safe distance from these operations.

Personnel needing to approach heavy equipment while the equipment is operating will observe the following protocols:

1. Make eye contact with the operator (and "spotter").
2. Signal the operator to cease heavy equipment activity.
3. Approach the equipment and inform the operator of intentions.

IT will follow all traffic rules. Company vehicles will yield to all bicycles and pedestrians. Work will proceed in a manner that results in the least interference with other NAS North Island activities.

3.3.4.1 Site Preinspection of Equipment

IT will use only heavy equipment that is in safe working order. To maintain this policy, all equipment brought onto the project site will be inspected for structural integrity, smooth operational performance, and proper functioning of all critical safety devices in accordance with the manufacturer's specifications. This inspection will be performed by the IT Project Superintendent, RCS/HSO, and the equipment operator.

Any equipment not conforming to operational and safety requirements will not be put into service until all necessary repairs are made to the satisfaction of the inspection group.

3.3.4.2 Operator Qualifications

Only qualified operators familiar with the equipment will be permitted to operate heavy equipment. Subcontractors will supply proof of their operator's capability and experience to operate specified equipment in a safe manner. IT reserves the right to remove from the project site any operator if there is question or doubt concerning that operator's capabilities.

3.3.5 Electrical Hazards

To prevent accidents caused by electric shock, the RCS/HSO will inspect all electrical connections on a daily basis. The RCS/HSO will shut down and lock out any equipment found to have frayed or loose connections until a qualified electrician can be contacted. The equipment

will be deenergized and tested before any electrical work is done. All equipment will be properly grounded prior to and during all work. In addition, ground fault circuit interrupters (GFCIs) will be installed for each outdoor circuit between the power source and tool. If generators are used to supply power, they will contain GFCIs.

3.3.6 Confined Space Entry

Confined space entries are not expected for this project. However, if necessary, confined space entries will be performed in accordance with Procedure HS300 of the H&S Procedures Manual. The manual will be available on site. Confined space entry is not permitted under this plan unless modified by the SHSP Change Approval Form
(Attachment 1).

A confined space is any enclosed area with a limited means of egress and inadequate ventilation for removal of any toxic or flammable atmosphere or oxygen (O_2)-deficiency. Examples of confined spaces include, but are not limited to, tanks; boilers; vessels; bins; manholes; tunnels; pipelines; underground utilities vaults; or any open-top space more than 4 feet deep such as pits, tubes, trenches, or vessels.

3.3.7 Fire and Explosion Hazards

Although hot work is not expected to be required for this project, atmospheric testing with a combustible gas indicator must be performed to determine the potential for a flammable atmosphere. A hot work permit must be issued to control the presence of equipment or operations producing open flames or sparks. Hot work permits and procedures are described in IT H&S Procedure No. HS314. A hot work permit must also be obtained from the NAS North Island Fire Department.

3.3.8 Overhead Electrical Hazards

Overhead power lines could present a hazard to equipment and personnel. To prevent equipment contact with power lines and to prevent arcing, adequate clearance must be maintained.

For lines rated 50 kilovolts (kV) or less, the minimum clearance between the lines and any part of the crane or load shall be 10 feet. For lines rated over 50 kV, the minimum clearance between the lines and any part of the crane or load shall be 10 feet plus 0.4 inch for each kV over 50 kV.

3.3.9 Excavation

Any excavation that is 4 feet or more in depth will be performed in accordance with EM 385-1-1 and Procedure HS307 of the H&S Procedures Manual. An excavation permit must be completed by a competent person before excavation begins. A competent person is a person

who has been trained on soil classification procedures and the requirements for excavation in accordance with applicable regulations such as 29 CFR 1926, Subpart P, or 8 CCR 1540 and 1541. The permit will require daily inspection of the operation and adjacent areas. Specific situations addressed in these inspections are possible cave-ins, indications of failure of protective systems (i.e., benching, sloping, or shoring), hazardous atmosphere, and other hazardous conditions. If the competent person finds evidence of any of these situations, employees will be removed from the hazardous area until the necessary precautions have been taken to ensure their safety. In addition to the excavation permit, a California Occupational Safety and Health Administration (Cal/OSHA) Activity Notification Form for Holders of Annual Excavation Permits must be filed with Cal/OSHA for any excavation 5 feet or deeper. IT has an annual permit for excavations in the State of California. Underground Services Alert (Dig-Alert) must also be notified before any excavation or drilling work begins, regardless of depth.

3.4 Environmental Hazards

Environmental hazards associated with the site will be discussed at the orientation meeting prior to field activities. Personnel will be apprised of symptoms of exposure to certain biological hazards and heat stress.

3.4.1 Weather and Heat Stress

The possible combination of ambient factors such as high air temperature, high relative humidity, low air movement, high radiant heat, and protective clothing can result in heat stress, which can consist of any of the following:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke.

At 75 degrees Fahrenheit ambient temperature, the Project Superintendent will begin heat stress control measures.

During the "tailgate" safety meetings, workers will be encouraged to increase consumption of water and/or electrolyte-containing beverages, and eating regular nutritious meals. Water and electrolyte-containing beverages will be provided on site and will be available for consumption during work breaks.

At a minimum, 10- to 15-minute rest periods will be provided for workers every 2 hours. In addition, workers are encouraged to take rests whenever they feel any adverse effects, especially

effects that could be heat related. The frequency of breaks could be increased based on worker recommendation or the decision of the RCS/HSO and Project Superintendent.

IT personnel are experienced hazardous material workers and through their extensive field experience, have become acclimated to heat and protective equipment requirements and recognize when heat stress presents a health concern. They have been trained to recognize the symptoms of heat stress. Nonetheless, heat stress, its symptoms, and the factors that can affect a person's ability to handle heat will be discussed during the daily "tailgate" meetings. Procedure HS400 of the H&S Procedures Manual describes the symptoms and causes of heat stress, as well as prevention and treatment, in further detail.

3.4.2 Hearing Conservation Program

On projects where noise levels could exceed a time-weighted average of 85 decibels, A-scale (dBA), hearing protection will be made available to all exposed employees. Sound level monitoring may also be conducted on site. All IT personnel have annual audiograms and will be restricted from high noise exposure if a hearing loss is detected. IT's hearing conservation program complies with OSHA and Cal/OSHA regulations.

3.4.3 Biological Hazards

The following biological hazards could be encountered on site:

- Potential contact with raw sewage is associated with the abandonment of septic tanks and the rerouting of sewage lines. Skin contact can lead to dermatitis, while ingestion can cause hepatitis. These afflictions are easily avoided by avoiding sewage contact and wearing water-resistant gloves, boots, and coveralls, if necessary. Of primary importance is thorough washing of hands prior to touching anything that comes in contact with food or drink.

- Animal bites and insect stings can cause localized swelling, itching, and minor pain that can be handled by first-aid treatment. In sensitized individuals, however, effects can be more serious and can include anaphylactic shock, which can lead to severe reactions in the circulatory, respiratory, and central nervous systems and, in some cases, death. At the safety orientation meeting, the RCS/HSO will identify any personnel who have had known reactions to bites and stings. No attempts should be made to capture any wild or semiwild animals such as cats or rats due to the possibility of bites or parasitic infestations.

- Poison oak causes discomfort, irritation, and inflammation of the skin. Personnel will be warned to prevent contact with unknown plants. Protective clothing worn by site personnel should reduce the probability of such exposure. Cleaning the skin thoroughly with soap and water after contact will also reduce risk of severe symptoms.

- Animal and bird droppings often contain mold, fungus, or bacteria that represent a significant respiratory hazard, including lung diseases and allergies. Personnel will be instructed not to touch visible droppings and to wear gloves and Tyvek™ suits, at minimum, when entering and working in limited access areas.

- The Hanta virus is sometimes transmitted by deer mice found in the southwestern United States and causes respiratory distress, sometimes with fatal consequences. Transmission of the Hanta virus occurs via exposure to mouse droppings. Good hygiene practices such as washing hands and face prior to eating and drinking will help minimize the potential for exposure to the Hanta virus. While work is in progress, use of high-efficiency particulate air (HEPA) cartridges and work practices that minimize generation of dust will help protect employees. For example, exposure to the Hanta virus can be minimized by avoiding areas where there are concentrations of mouse droppings. The virus can be inhaled in the dust from areas where mice have nested or left their droppings. Minimizing dust inhalation or avoiding these areas will lessen the risks of exposure. Any work in such areas should be done only with full Level C protection, including, at minimum, a HEPA air-purifying respirator. Thorough washing of hands and face after removing the PPE will further minimize the potential for exposure.

- Snakes pose a hazard. Personnel must use extreme caution when walking through the site area. If a snake is encountered, slowly and quietly back away from it and inform all personnel of its location. Do not attempt to move or kill a snake because certain snakes are protected under State and Federal laws. In the event of a snakebite, do not try to move the affected individual. Wipe off the skin because the venom will attack intact skin. Do not suck out the venom. Do not cut open the wound. Do not apply ice or ice packs. Do not use a tourniquet. Do not administer alcohol or medications. Call for medical assistance.

3.5 Task-Specific Risk Assessment

Task-specific risk assessments for this project were completed in the form of activity hazard assessments (Attachment 3).

Analyses completed prior to the start of work are based on available information and are intended as a starting point. Analyses will be revised as needed, depending on work requirements and conditions encountered. Any changes to the hazard analysis forms will be completed and approved using the SHSP Change Approval Form (Attachment 1).

Detailed descriptions of PPE required for each task and an overview of the air monitoring program and rationale are presented in Sections 5 and 7, respectively.

3.6 Accident Prevention

Accident prevention is a primary goal of all H&S procedures. This section outlines the accident prevention plan for this project.

3.6.1 Administrative Responsibilities

The Project Manager is ultimately responsible for the safety and health of site personnel. The Project Manager will provide the materials and equipment necessary to enhance and maintain safe site and work conditions.

The Project Superintendent has the responsibility and the authority to control the day-to-day field activities. The Project Superintendent reports to the Project Manager. The Project Superintendent will observe employees for signs of heat stress, excessive fatigue, and obvious outward signs of chemical exposure. In addition, the Project Superintendent will check that equipment brought to the site is in proper working condition, inspected regularly, and operated in a safe manner.

The RCS/HSO reports to the project HSM and is responsible for pointing out unsafe conditions that could pose a hazard to personnel or the public. The RCS/HSO will conduct regular safety inspections. Accident investigation will be performed by the RCS/HSO, the Project Superintendent, or both.

3.6.2 Site-Specific Training

All field employees will have received at least 40 hours of OSHA HAZWOPER training and Radiation Worker Training as described in Section 9 of this SHSP. Prior to working on site, all site personnel will undergo an H&S orientation during which the SHSP and site conditions will be discussed. Prior to each shift, a daily safety meeting will be held to discuss the H&S issues from the previous day, as well as issues for the current day.

3.6.3 Subcontractors

All subcontractors will be subject to the same training requirements as other field personnel. Subcontractors will be required to sign in daily and to attend a daily meeting discussing operations and safety issues. Subcontractor will report to the Project Superintendent.

3.6.4 Local Requirements

IT will comply with any applicable local requirements such as noise control and traffic rules. Traffic control will be developed as needed and as described in the Traffic Control Plan (Appendix F of the RAP).

3.6.5 Layout of Job Site

Upon arrival, the job site will be prepared as specified by the Project Superintendent in coordination with the Resident Officer in Charge of Construction. All subcontractors will be subject to the same controls as IT personnel, as described in Section 4.

3.6.6 Temporary Site Amenities

Temporary structures will be anchored to withstand winds and meet applicable State or local standards for anchoring mobile homes as specified in USACE Manual EM 385-1-1(04.A.03). Portable toilets complying with Cal/OSHA and EM 385-1-1 requirements will be made available. Potable water for hand washing will be made available.

3.6.7 Housekeeping

The project site will be kept in a neat and orderly fashion to prevent common injuries due to slips, trips, and falls and to maintain a professional work site. Personnel will not leave a work area in a disorderly condition. Accumulated trash will be removed at least weekly to minimize hazards caused by insects, bacteria, and decomposition. The Project Superintendent is responsible for maintaining job cleanup standards and safe access and egress.

3.6.8 Emergency and Contingency Plan

Fire extinguishers (ABC type) in ready condition and with a current inspection record will be placed in every work area on the job site. The Emergency Contingency Plan is provided in Section 8. A minimum 20-pound dry chemical fire extinguisher will be located at the entrance to the contamination reduction corridor in the CRZ of each area. Each piece of heavy equipment will have a dry chemical fire extinguisher (either 2½- or 5-pound), mounted within easy reach.

3.6.9 Safety Inspections

The RCS/HSO, Project Superintendent, and/or designee will perform regular safety inspections. A report describing the results of the inspection and any corrective actions taken will be maintained in the project files, and a copy of the report will be submitted to the NTR and IT HSM. Identified safety and occupational health deficiencies and corrective measures will be recorded in the Project Quality Control Plan (Appendix D of the RAP).

3.6.10 Accident Investigation

All occupational injuries/illnesses, vehicle accidents, and near miss incidents must be promptly reported and investigated in accordance with H&S Procedure HS020. *Supervisor's Employee Injury Report* and *Incident Investigation Report* must be completed for any cases requiring first aid.

In an injured worker requires medical treatment, the following steps will be taken:

- RCS/HSO will arrange for medical treatment for employee, as described in Section 8, and will notify the HSM.
- RCS/HSO will notify the Project Manager, HSM, NTR, and the Deputy Program Manager as soon as possible.
- The HSM will obtain a report from the physician clearing the employee to resume regular duties, describing modified work acceptable, or removing the employee from work duty.

In the case of a fatal injury or where three or more persons are admitted to the hospital for an overnight stay, Cal/OSHA and other appropriate agencies will be notified and an in-depth accident investigation will be conducted in addition to the steps identified above.

4.0 Work and Support Areas

To prevent personnel or equipment from tracking contamination off site, work areas and PPE will be clearly specified before the start of field operations. IT has designated work areas or zones as suggested by the *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCG/EPA, 1985). The site setup will take into consideration the working space, the type of contamination, and the activities to be performed.

Upon entrance to the site, IT personnel will control access to site control work zones. The work area will be divided into three zones: an exclusion or "hot" zone, a CRZ, and a support zone. For the purposes of radiological work, the exclusion zone and CRZ will be considered radiologically controlled areas.

4.1 Exclusion Zone

The exclusion zone will consist of areas where inhalation, oral contact, or dermal contact with contaminants is possible. This zone will be established at least 10 feet beyond the limits of the excavation activities. The exclusion zone perimeter can be indicated with barricade tape, usually red in color (yellow and magenta or black for radiological areas), or the entire area can be fenced to restrict entry to the area except to those individuals with the proper training, medical certification, and PPE. As a controlled area, the exclusion zone perimeter will be posted with the following caution signs, as appropriate:

CAUTION
CONTROLLED AREA
(OR)
RADIOLOGICAL AREA
ENTER AT DESIGNATED AREA ONLY

4.2 Contamination Reduction Zone

The CRZ, or transition zone, will be established between the exclusion zone and support zone. The CRZ will extend 20 feet in all directions from the exclusion zone, as practicable.
In this area, personnel will begin the sequential decontamination process required to exit the exclusion zone. To prevent off-site migration of contamination and to provide for personnel accountability, all personnel will enter and exit the exclusion zone through a corridor in the CRZ. The corridor is called the access control point. These zones are delineated with yellow and magenta or black barricade tape or rope.

Both personnel and equipment decontamination will be performed at the access control point. Personnel decontamination will require removal of PPE, frisking for radioactive contamination, and hand washing. Tools and materials used in this area will be moved to a decontamination station established for that purpose. Disposable tools and materials will be placed in the container set up at the access control point. The access control point will be posted with a sign reading as follows:

CAUTION
CONTROL POINT AREA
RWP REQUIRED FOR ENTRY

An access log will be posted at the access control point. Personnel will sign in upon entry to the exclusion zone and sign out upon exit.

4.3 Support Zone

The support zone will consist of a clearly marked area in which support equipment and sanitation facilities (e.g., toilets and drinking and washing water) are staged. Smoking, drinking, and eating will be allowed only in designated areas in the support zone. An emergency eyewash station will be located in this area.

4.4 Access Controls

The RCS/HSO and Project Superintendent will establish the physical boundaries of each zone and will instruct all workers and visitors on the limits of the restricted areas. No one will be allowed to enter a restricted area without the required protective equipment for the area. The Project Superintendent will ensure compliance with all restricted area entry and exit procedures.

The Project Superintendent will also designate a decontamination point for personnel to exit from the contaminated area and enter into the clean area, where personnel can rest and drink.

4.5 Visitor Access

Visitors must check in immediately upon arrival at the IT site office. Only authorized visitors will be allowed access to the contaminated areas. All visitors and subcontractors with access to contaminated areas must submit proof of 40-hour OSHA HAZWOPER and Rad Worker training and current medical certification. Each visitor will be required to provide and wear the necessary protective equipment during the visit and will be escorted by IT personnel. All visitors, subcontractors, and personnel will be required to sign a SHSP Acknowledgment Form (Attachment 2) to certify that they have read, understand, and will comply with the SHSP.

Failure to comply with this site entry procedures will result in denied entry to the exclusion zone or the CRZ of the site. A visitor's log will be kept by the Project Superintendent or designee.

4.6 Buddy System

A "buddy system" will be implemented whenever conditions represent a physical or chemical risk to personnel. The "buddy system" requires that two or three people work as a team, each looking out for the other. "Buddies" must always be in one another's line of sight and maintain verbal or visual communication. No one is allowed into the exclusion zone alone because hazards could exist that could render the employee helpless and require rescue.

5.0 Protective Equipment

This section describes the PPE and respiratory protection required for each type of task for this project. All personnel must wear appropriate protective equipment when activities involve exposure to hazards that cannot be adequately or feasibly controlled by engineering or administrative controls. Respiratory protection and skin, hand, and foot protection will be required when activities are known or suspected to result in chemical hazards such as atmospheric contamination exceeding action levels. EPA PPE level categories are as follows:

- ***Level A***–Used when the greatest level of skin, eye, and respiratory protection is needed and consists of a totally encapsulated suit with supplied breathing air.
- ***Level B***–Used when the highest level of respiratory protection is needed but a lesser level (than Level A encapsulated suit) of skin protection is required.
- ***Level C***–Used when criteria for using air-purifying respirators are met and a lesser level of skin protection is required.
- ***Level D***–Used only as a work uniform and in an area without respiratory hazards.

5.1 Reassessment of Personal Protection Equipment

The level of protection listed in this section will be upgraded or downgraded based on action levels from direct-reading instruments, changes in site conditions, or investigation results. Changes in protection levels require the completion of the SHSP Change Approval Form (Attachment 1), which must be approved and signed by the following site personnel:

- RCS/HSO
- HSM
- Project Manager or Project Superintendent.

If the level of protection is to be downgraded, personnel will continue to work in the original level of protection until the RCS/HSO and the Project Manager or Project Superintendent have discussed air monitoring results and the rationale for the downgrade. After an agreement has been reached and the change has been recorded on the SHSP Change Approval Form, PPE can be modified with approval from the HSM. The level of protection for any task can be upgraded at any time and documented. Table 2 defines the required PPE for potential site conditions.

5.2 Air-Purifying Respirators

Respiratory protective equipment for this project will be full-face Survivair 20/20 air-purifying respirators or equivalent for which the wearer has been fit-tested.

5.3 Respirator Cartridges

Crew members working in Level C will wear respirators equipped with HEPA air-purifying cartridges. Other brands of respirators will be equipped with equivalent NIOSH-approved cartridges, approved for the following:

- Organic vapors less than (<) 1,000 parts per million (ppm)
- Chlorine gas <10 ppm
- Hydrogen chloride <50 ppm
- Sulfur dioxide <50 ppm
- Dust, fumes, and mists with a threshold limit value greater than (>) 0.05 milligrams per cubic meter (mg/m^3)
- Asbestos-containing dusts and mists
- Radon daughters
- Radio nuclides
- Pesticides

5.4 Cartridge Changes

All cartridges will be changed daily at a minimum. However, water saturation of the HEPA filter or dusty conditions can necessitate more frequent changes. Changes will occur when personnel begin to experience increased inhalation resistance or breakthrough of a chemical warning property.

5.5 Inspection and Cleaning

Respirators will be checked periodically by the RCS/HSO or the HSM and will be inspected by the wearer before each use. All respirators and associated equipment will be decontaminated, surveyed for radiological contamination, and hygienically cleaned after use.

5.6 IT Respiratory Protection Program

The IT respiratory protection program is presented in IT Procedure No. HS600, which will be made available on site.

6.0 Decontamination Procedures

This section describes the procedures necessary to ensure that both personnel and equipment are free from contamination upon exiting the work site. Section 6.1 presents step-by-step descriptions of decontamination procedures for EPA Levels D and C.

When practicable, equipment or materials can be wrapped prior to use in the exclusion zone to prevent contamination. If conditions are relatively clean, equipment/materials can be wiped down with a damp cloth in the transition zone.

6.1 Personnel Decontamination

The objective of the personnel decontamination procedures is to ensure that any material that personnel have contacted in the hot zone is removed in the CRZ. Decontamination of personnel exiting the exclusion zone will be performed via the following steps, as appropriate to the specific work area:

- Level D
  - Step 1: Brush off boots.
  - Step 2: Remove outer gloves and suit (if used).
  - Step 3: Remove hard hat and wipe clean.
  - Step 4: Perform whole body contamination monitoring if exiting a contamination area.
- Level C
  - Step 1: Remove and dispose of all duct tape interfaces in a 55-gallon lined drum.
  - Step 2: Remove and dispose of outer boot covers in a 55-gallon lined drum.
  - Step 3: Remove and dispose of outer gloves in a 55-gallon lined drum.
  - Step 4: Remove and dispose of hood in a 55-gallon lined drum.
  - Step 5: Remove and store respirator for decontamination. Respirators will be decontaminated by the decontamination assistant.
  - Step 6: Remove suit and inner boot covers in a roll-down fashion. Remove one clean boot from the suit, and step on the step-off pad with it. Remove the other

boot, and step on the step-off pad with it. Dispose of suit and inner boots in a 55-gallon lined drum.

- Step 7: Remove and dispose of inner gloves in a 55-gallon lined drum.
- Step 8: Proceed to frisking station. Use instrument at a rate of 2 inches per second, at approximately ¼ inch from the surface of clothing and skin.
- Step 9: Wash hands, face, and neck.

6.2 Suspected Contamination

Any employee suspected of sustaining skin contact with chemical contamination will wash the affected area with soap and water. The worker will proceed to a decontamination area, where the exposed skin will be washed further. The worker will then remove clothing, wash again, don clean clothing, and be taken to a medical facility as necessary. For this project, contaminants should require only washing of affected areas.

If a worker notes that radiological contamination is present when performing personal monitoring, the worker shall stand fast and immediately contact a Radiological Controls Technician (RCT). The RCT or RCS will oversee all personal contamination cases and direct decontamination, if required.

6.3 Personal Hygiene

Before eating, smoking, or drinking, personnel will wash their hands, arms, neck, and face. Washing facilities and soap will be available in the support zone.

6.4 Equipment Decontamination

Any equipment that has come into contact with contaminated soil will be scraped and wiped in a designated decontamination area prior to removal from the site or a defined exclusion zone. The area typically will consist of a "pad" or covered bermed area where debris and tools are collected after equipment cleaning. Tools and other small equipment will be wiped prior to removal from the exclusion zone. After a thorough radiological survey, the equipment can be washed with water and detergent. Cleaning liquids will be collected into drums or a tank if there is a potential for chemical or radiological contamination.

6.5 Waste Handling

All liquids and disposable clothing will be treated as contaminated waste and disposed of properly. All contaminated waste or material will be in the custody of the Navy at all times. Contaminated clothing will be placed in a drum lined with a polyethylene bag. All waste

containers will be properly labeled and stored in accordance with regulatory requirements and the requirements of NAS North Island. NAS North Island will arrange for the proper disposal of all radioactive waste. Disposal of nonradioactive waste, including decontamination fluids, chemically contaminated debris, and PPE, will be arranged by IT.

7.0 Work Place Monitoring and Controls

This section addresses air and radiological monitoring and summarizes radiological exposure and engineering controls.

7.1 Air Monitoring

Ambient air monitoring will be conducted as necessary to determine airborne contaminant concentrations, ensure that respiratory protection is adequate to protect personnel against chemicals encountered, and ensure that harmful levels of airborne contaminants are not migrating off site. Personal sampling is not expected to be required given the low concentrations and types of contaminants.

7.1.1 Direct-Reading Instruments

Direct-reading instrumentation provides immediate data on specified contaminants and/or site conditions. These instruments are useful for screening and evaluating the proper level of personal protection and assisting in the determination of response actions in emergency situations. Direct-reading instruments and action levels to be used on this project are described in the following sections.

7.1.2 Miniram Aerosol Monitor

A Miniram Aerosol PDM-3 will be used to measure airborne particulates ranging from 0.1 to 10 micrometers in size. The Miniram PDM-3 will be used as an indicator of breathable dust in the work area and will serve to determine when additional dust control is required.

- ***Instrument*** — Miniram Aerosol Monitor Model PDM-3
  - ***Action Level***–1.0 mg/m^3 in workers' breathing zones and general site areas; 0.5 mg/m^3 for site perimeter (level chosen to minimize overall permissible dust release from site).
  - ***Action***–Implement dust control procedures.
  - ***Stop Work Level***–5.0 mg/m^3 in workers' breathing zones and general site areas; 1.0 mg/m^3 for site perimeter.

7.1.3 Monitoring Strategy

The direct-reading Miniram dust monitor will be used to measure dust concentrations. If concentrations exceed the 8-hour time-weighted average of 1.5 mg/m^3, dust suppression efforts will be increased. If dust suppression efforts fail to keep the dust concentration below

1.5 mg/m^3, Level C protective equipment will be used and the HSM will be notified. Integrated personal exposure monitoring may be conducted, at the discretion of the HSM. Exceeding 1.0 mg/m^3 at the perimeter will also require additional dust control.

Air surveillance will be conducted using air monitoring (direct-reading) instruments to screen for the presence of airborne contaminants. If unknown contaminants are identified through air sampling and laboratory analysis, comparisons of applicable exposure standards and air sampling results will be made to determine suitable exposure control measures.

Measurements will be taken in various locations to assess the impact of work operations on personnel and the environment. Measurements will be taken in personal (breathing zone) work areas, downwind perimeters, and upwind background locations. Data obtained from these locations will be used to establish worker protection levels, to assess the effectiveness of engineering and administrative controls, and to evaluate the impact of work operations on the environment.

Biased air surveillance techniques will be conducted based on worst-case exposure situations as determined by direct-reading instruments. Where appropriate, full shift time-weighted average measurements will be obtained and compared with applicable exposure standards (such as permissible exposure limits, threshold limit values , etc.).

Monitoring will be performed at the perimeter of the exclusion zone to measure fugitive emissions and confirm that concentrations are acceptable.

7.1.4 Quality Assurance/Quality Control

Adherence to proper quality assurance/quality control (QA/QC) procedures is essential for a meaningful air sampling effort. Calibration of equipment and document control are major QA/QC concerns.

7.1.4.1 Calibration and Maintenance Procedures

All direct-reading instruments will be calibrated daily or before each use. The date, time, span gas or other standard, and the name of the person performing the calibration will be documented. An exception is the Miniram PDM-3, which does not require calibration. The RCS/HSO will charge batteries each night and verify that instruments are fully charged before use each day. The RCS/HSO will clean the exterior of the instrument, clean the filters, and ensure that the sample train is clear each day.

Radiological field survey equipment and laboratory analysis equipment will be calibrated using standards traceable to the National Institute of Standards and Technology. All check sources will be kept in a locked container. Only the RCS/HSO or designee will have a key to this container. Personnel needing check sources will sign them out from the RCS/HSO or designee, indicating the date and time of receipt of each source. When the sources are returned to the RCS/HSO or designee, the time and date will be recorded next to the original entry.

Certificates of calibration will be obtained from an approved vendor and will contain the transfer standard number. Calibrations will be performed by qualified personnel on a semiannual basis or when repairs or performance indicate a need and as designated by the RCS/HSO. Certain types of equipment can be calibrated in the field, depending on the operating characteristics of the equipment. An instrument check will be performed at the beginning of each shift using a check source and control chart.

7.1.4.2 Documentation

Strict adherence to document and data control procedures is essential for good QA/QC. Data and calibration records must be accounted for and retrievable at all times. Essential types of documents include the following:

- Notes
- Maps
- Logbooks
- Data sheets
- Reports

7.2 Radiological Monitoring

The IT *Radiation Protection Plan* (RPP) is presented in Attachment 6 and RPP SOPs are presented in Attachment 7.

In accordance with corporate policies and procedures, worker health and safety will be maintained through appropriate training, monitoring, and controls. The rigor of these programs will be consistent with site conditions. Therefore, the protocols described in this section are consistent with current information on site conditions. If radiological conditions change, the rigor of exposure monitoring and work controls will be consistently tailored to ensure a safe working atmosphere consistent with company policies and procedures. The procedures outlined in this plan are based on information presented in *Technical Memorandum – Supplemental Field Investigation, IR Site 10 Shoreline Slag Area, Naval Air Station North Island San Diego, California (OHM Remediation Services Corp., 1999)*. Particular areas taken into consideration

are radium-226 concentrations in environmental media, documented exposure rates, the physical form of the medium, the physical makeup of the area, and the nature of the work tasks.

7.2.1 Airborne Radioactivity

Air sampling for radioactive contaminants is carried out on a task-specific basis and is based on the potential presence of radioactive materials. Priority is given to situations in which aerosols can be generated (e.g., excavation, sampling of dry soils, or decontamination activities). Air sample filters will be analyzed for alpha- and beta-gamma gross activity and compared against the derived air concentration (DAC) and action levels for radium-226.

Airborne radioactivity will be measured and documented in accordance with sampling procedures in Attachment 8. Work area air samples will be collected such that the sample accurately reflects concentrations in the atmosphere personnel are breathing.

7.2.1.1 Exposure Standards

DACs for control of internal exposures to radioactive materials are set forth in 10 CFR 20, Appendix B, Table 1, Column 3. The DAC for radium-226 is $3x10^{-10}$ microcuries per milliliter (µCi/mL).

Although very unlikely, an airborne radioactivity area warning sign will be posted if airborne radioactivity concentrations exceed 25 percent of the DAC (7.5E-11 µCi/mL). Posting requirements are specified in 10 CFR 20. Given the radium-226 concentrations present and the appropriate dust mitigation measures that will be implemented during intrusive tasks, detectable concentrations of airborne radioactive contamination is unlikely.

The administrative limit for occupational exposure to airborne radioactivity and actions taken when the levels are reached are summarized in Table 3. Air samples will be collected using calibrated sampling pumps. The flow rate and sample duration will be such that calculated minimum detectable concentrations are adequate to quantify the desired airborne concentration (< 9E-13 µCi/mL for perimeter samples and < $3x10^{-11}$ µCi/mL for work area samples). Samples will be analyzed for gross alpha and beta activity after the majority of the short-lived progeny decay (> 72 hours). The samples will be analyzed on site using a dual channel scaler/counter. This instrument is capable of measuring alpha- and beta-gamma radiation simultaneously.

7.2.1.2 Perimeter Air Samples

Samples will be collected at the boundary of radiological areas during operations that could create airborne radioactivity. Samples will be collected to ascertain compliance status with 10

CFR 20, which specifies maximum allowable airborne radioactivity in unrestricted areas. At least one sample will be collected upwind of the work area for comparison.

Samples for airborne particulate radioactivity will be obtained whenever any radiological operations are being performed. These samples will be collected on a glass fiber filter paper and will be used to determine/evaluate the need for engineering controls. In addition, samples for airborne particulate radioactivity will be collected at the downwind boundary of the restricted area. These samples will also be collected on a glass fiber filter paper, using a low-volume air sampler, and will be used to verify compliance with release criteria for airborne radio nuclides to unrestricted areas, as specified in 10 CFR 20 (9E-13 μCi/mL).

7.2.2 Evaluation of Surface Contamination

This section presents the procedures for evaluating surface contamination.

7.2.2.1 Exiting Radiological Areas

All personnel leaving contamination areas at the site will be monitored for contamination using appropriate instruments.

When personnel exit a contamination area, they will perform the following:

- Doff anticontamination clothing in accordance with the SHSP. Place the clothing in disposable clothing containers.
- Perform an exit survey (RWP will specify appropriate type of survey) using the step-off pad as necessary.
- Exit the area in accordance with decontamination procedures established in this SHSP.

Monitoring instruments must be capable of reliably detecting low-level contamination on personnel. Trained personnel designated by the RCS/HSO may monitor themselves. Any personnel contamination incidents shall be handled in accordance with RPP-003 – *Contamination Control* (Attachment 7).

7.2.2.2 Periodic Surveys

All work areas and equipment will be monitored for contamination in accordance with RPP-003 – *Contamination Control*. Contamination surveys will be conducted on a routine basis in order to prevent the spread of contamination, maintain personnel exposure ALARA, and minimize waste generation.

Periodic surveys of personnel working in areas of higher contamination will be conducted as directed by the RCS/HSO. Particular attention will be paid to items of PPE that frequently come in contact with contaminated items. PPE exhibiting high contaminant concentrations should be changed to reduce cross-contamination.

7.2.3 Exposure Monitoring

Gamma dose rate surveys of areas, equipment, or materials will be performed in accordance with RPP-004 – *Instrumentation and Surveillance* (Attachment 7) and as directed by the RCS/HSO. Baseline surveys will be performed to determine average exposure rates in the work area and at the perimeter of the work area. Exposure rate surveys will be performed using survey meters equipped with sodium iodide detectors or Geiger-Mueller detectors sensitive to gamma emissions.

After the baseline surveys, radiation exposure rate surveys will be conducted at the perimeter and in the work areas on a weekly basis to assess the levels of radiation to which workers are exposed. The administration and break trailers and surrounding areas will be included. Survey results will be maintained on file by the RCS/HSO.

7.2.4 Radiological Monitoring Instrumentation

The RCS will ensure that the appropriate quantity and types of instrumentation are available on site and that all radiological technicians are trained in the use of all required instrumentation. Types of instrumentation that are required for appropriate coverage are listed in Table 4. The RCS will ensure that instrumentation is operated and maintained in accordance with RPP-004 – *Instrumentation and Surveillance* (Attachment 7). In addition, the RCS will be responsible for the security and controls associated with radioactive check sources (e.g., keeping sources locked and marked and performing leak checks as appropriate).

7.2.5 Radiation Dose Monitoring

Administrative control limits are established at levels below regulatory limits specified in 10 CFR 20 to prevent inadvertent overexposure and to serve as an action level and control point to establish a radiation exposure that should be investigated. All IT employees are responsible for controlling their exposure to radiation hazards such that their annual dose remains below the administrative goal of 10 percent (0.5 rem) of the annual allowed regulatory limits.

Female employees should report a suspected or confirmed pregnancy to their supervisor at the earliest possible time. Pregnant workers will also inform the their supervisor of any special restrictions or instructions received from their personal physician. Total radiation dose to the unborn child shall not exceed 0.5 rem.

The basic methods used to control radiation exposure include implementation of training and personnel monitoring, evaluation of radiological conditions, use of work instructions and RWPs, implementation of engineering controls, and specification/use of PPE.

7.2.5.1 External Radiation Monitoring

External exposure shall be controlled and monitored in accordance with RPP-002 – *External Exposure Control* (Attachment 7). In addition, the following guidance shall be implemented on this field project. Based on current information on site radiation levels, external exposure monitoring is not expected to be necessary. If conditions warrant the administration of dosimetry for compliance purposes, the guidelines outlined in this section will be followed.

The RCS/HSO is responsible for ensuring that all personnel (i.e., employees, contractors, and visitors) are appropriately monitored for exposure to ionizing radiation. If required, measurement of personal radiation doses from penetrating external radiation will be performed using dosimeters. Requirements for the use of dosimeters are as follows:

- Personnel dosimetry will be required for individuals who are expected to receive an annual external whole-body dose greater than 100 millirems or an annual dose to the extremities, lens of the eye, or skin greater than 10 percent of the limit specified in 10 CFR 20.
- Dosimeters will be exchanged quarterly (every 3 months) at minimum.
- Dosimeters will be issued only to personnel formally instructed in their use and will be worn only by those to whom they are issued.
- To minimize the number of personnel in the dosimetry program, the issuance of dosimeters will generally be limited to anyone entering radiation areas, high radiation areas, or radiological buffer areas where there is a potential for external exposure.
- Personnel will return dosimeters for processing as scheduled or upon request and be restricted from continued radiological work until dosimeters are returned.
- Dosimeters will not be removed from the site without specific direction by the RCS/HSO.
- Personnel will not expose their dosimeters to x-ray devices, excessive heat, or medical sources of radiation.
- Unless otherwise directed by the RCS/HSO, personnel-monitoring dosimeters will be worn on the front of the body, between the neck and the waist

7.2.5.2 Exposure Determination

If required, dosimeters will be provided by a vendor accredited under the National Voluntary Laboratory Accreditation Program (NVLAP). IT will have the responsibility for distributing and collecting the devices. The official and permanent record of accumulated external doses received by personnel will be obtained from interpretation of the personnel monitoring devices. Upon written request, personnel will be informed of their exposure. If a dosimeter is lost or damaged, the RCS/HSO will investigate the exposure conditions and assign an external dose for the individual, with concurrence of the HSM.

Workers who are assigned an exposure monitor must provide a previous dose history within 5 days of badge assignment. Copies of past radiation exposures may be requested and kept on file. These records should be provided as soon as practical.

7.2.5.3 Lost or Damaged Dosimeters

Workers will leave the work place in a safe condition, immediately exit the area, and notify the RCS/HSO (or designee) if they lose or damage their dosimeter. A thorough search will be made for any dosimeter reported lost. Any worker whose exposure is being investigated will be excluded from work in radiologically controlled areas until the investigation is completed and documented and a dosimetry device is reissued.

7.2.5.4 Personnel Exposure Investigations

Personnel contamination incidents will be reported immediately to the HSM. In addition, significant personnel contamination incidents are reportable occurrences to the NRC or the equivalent State of California agency.

Any situations involving the suspected or known exposure of personnel in excess of IT's administrative limits will be promptly reported to the HSM and investigated and personnel exposures will be evaluated. This could require special bioassays, radiation surveys, air samples, and dosimeter processing.

7.2.5.5 Internal Dose Monitoring

Internal radiation exposure will be controlled in accordance with RPP-001 – *Internal Exposure Control* (Attachment 7). This procedure requires routine monitoring if work area airborne concentrations exceed 10 percent of a DAC. Therefore, based on information presented in the supplemental field investigation report and considering the expected project duration, a routine bioassay program is not expected to be required for this project. The following paragraphs provide project-specific guidance to ensure adherence to the corporate program in the event that special or nonroutine monitoring is required.

Nonroutine bioassay sampling for radiological substances will be initiated by the RCS/HSO for personnel affected by any of the following instances:

- Detectable (anything exceeding background) nasal contamination by alpha-emitting radio nuclides with half-lives greater than 24 hours
- Any indication of possible accidental intake of radiological materials, as determined by the RCS/HSO, with the concurrence of the HSM
- Failure of respiratory protection worn for radiological reasons
- Receipt of an internal dose that potentially exceeds 1 percent of the 10 CFR 20 dose limit, or as deemed necessary or prudent by the RCS or CHP.

The RCS/HSO will notify the HSM at the start of nonroutine sampling. Samples will be shipped to the analytical laboratory by 1-day courier or equivalent. The RCS/HSO will notify the receiving laboratory manager and the HSM of sample shipment information. On receipt, the laboratory manager, RCS/HSO, Certified Health Physicist (CHP), and HSM will determine the method of analysis, cost, and required minimum detection levels.

Urine samples representing a 24-hour void will be collected from the designated employees. Each sample will be documented by a chain-of-custody form and will be acidified (pH<1) in the field before transportation to the analytical laboratory.

If nonroutine internal exposure monitoring is necessary, a CHP will be notified and RPP-001 – *Internal Exposure Control* (Attachment 7) will be followed to ensure that the potential exposure is properly calculated and documented.

7.2.6 Quality Assurance Related to Radiological Controls

The RCS/HSO is responsible for ensuring that all applicable Corporate and site-specific procedures are implemented. Accuracy and completeness of all required documentation are vital to the radiological protection program. As such, depending on project duration, the CHP/HSM could perform a quality audit at any time to verify the quality of and compliance with the program.

7.3 Radiological Exposure Controls

Radiological exposure controls include both administrative and engineering controls.

7.3.1 Administrative Controls

Administrative exposure controls include radiological training, radiological surveys/ monitoring, and use of procedures and work practices to ensure that occupational exposures are ALARA.

The procedures set forth in RPP-015 – *Control of Radiological Work* (Attachment 7) will be followed at all times. The following sections address other controls not covered elsewhere in this SHSP.

7.3.1.1 Administrative Control Limits

Consistent with IT's commitment to the ALARA concept, administrative control limits are established to prevent inadvertent overexposure and to serve as action levels for the implementation of engineering and administrative controls and personal protective measures. Administrative control limits for airborne concentrations of radioactive materials will be set at 10 percent of the applicable value listed in 10 CFR Part 20. Engineering and/or administrative controls will be implemented, as practical, to reduce airborne concentrations of radioactive materials below the control limits. When such controls are not feasible or ineffective in reducing concentrations below the control limits, use of respiratory protection equipment will be considered.

7.3.1.2 Radiation Work Permits

An RWP system will be implemented at the site to ensure that access is limited to personnel who have the appropriate training, PPE, knowledge of procedures, and radiological oversight.

The RWP can also be used as an information document for industrial safety. Hazards other than radiological hazards can be included in the RWP so that proper protection for all possible hazards is documented in one controlling document. Implicit in any RWP is the need for a briefing on the radiological conditions present in the work environment.

The RWP will list tasks and specific levels of protection for each worker covered by the RWP. The RWP will also detail the dosimetry requirements, protective clothing requirements, and radiation and contamination levels expected to be encountered during the field activities.

7.3.1.3 Radiological Areas and Posting

All radiological areas will be appropriately classified and posted in accordance with RPP-005 – *Radiological Areas and Postings* (Attachment 7).

7.3.2 Engineering Controls

The primary radiological exposure issue associated with this project is the potential for airborne contamination due to intrusive activities. Adequate dust control measures taken when handling this material will mitigate the potential for occupational exposure. Only a drastic change in site conditions or other unforeseen scenario would require the implementation of respiratory

protection or HEPA ventilation: however, a brief discussion of those controls is presented in this section as a contingency.

Respiratory Protection–Respiratory protection will be used only if all other feasible controls fail to mitigate the internal deposition of radioactive materials. If needed, air sampling and required respiratory protection will be specified in the RWP. Full-face negative-pressure respirators with HEPA filters will be the first choice for personnel protection in areas with high airborne radioactivity.

If required, HEPA filter-equipped ventilators and vacuum cleaners will be used as necessary to help minimize airborne radioactivity.

7.3.3 Contingency Plan

An additional contingency plan is not needed because all reasonably foreseeable radiological incidents have been anticipated and are addressed in Sections 7.2 and 7.3 of this SHSP. The radio nuclide of concern at IR Site 10 is radium 226 from aircraft instrumentation painted with radium-226 to provide illumination. The strongest radiation source that can be expected to be encountered would be a radium painted instrument that was designed for human use, or remnants thereof. The anticipated nature and concentrations of radium contamination at the site present minimal risk of a measurable uptake, and external exposure rates are anticipated to be near background levels. With the radium-226 concentrations present and the prescribed dust control measures in place during intrusive tasks, detectable concentrations of airborne radioactive contamination are unlikely. Only a drastic change in site conditions or other unforeseen scenario would require the implementation of respiratory protection or HEPA ventilation, both of which are addressed in Section 7.3.2

8.0 Emergency Response

Primary and secondary emergency assembly areas are presented on Figure 1. Before the start of field activities, the Project Superintendent will discuss them with all personnel who will be conducting fieldwork. As work progresses, the RCS/HSO could alter these assembly areas depending on site and weather conditions. The RCS/HSO will fax the location of the new assembly areas to the HSM. The site-specific emergency contingency plan will be discussed in detail at the site safety orientation meeting.

8.1 Emergency Services

Upon arrival at the site, the Project Superintendent will ensure that all personnel know the system for communication of emergency situations. This section provides concise and clear directions for local emergency services. A phone or cellular phone (if phone lines are not installed) will be used to summon emergency assistance. All personnel on this project will know how to use a portable fire extinguisher.

The following emergency equipment will be maintained on site:

- Fire extinguisher (20-pound ABC-type dry chemical in CRZ and support trailer; 2½- or 5-pound dry chemical on each piece of heavy equipment)
- Industrial first-aid kit (located in the support trailer)
- Portable eyewashes, capable of supplying 15 minutes of water (located in CRZ)
- Two self-contained breathing apparatus, with at least one spare full air cylinder
- Air horn (in CRZ).

A spill station will be equipped with all necessary and applicable spill containment materials and appropriate PPE for each task.

8.2 Site Communications

Successful communication between field teams and contact between personnel in the various work zones is essential. The following communications systems will be available during site activities:

- Intrinsically safe two-way radios - at least one for each work crew for communication with other crews and with the support trailer, which will be equipped with a telephone

- Check-ins to the main IT office on site
- Compressed air horn (signals emergency evacuation only)
- Hand signals - as agreed upon prior to start of work activities
- Telephones - at least one in the support trailer or a cellular phone.

All IT site personnel will become familiar with both task-specific and sitewide standard and emergency communication signals at the orientation/training session held prior to the start of site work.

8.3 Medical Emergency Procedures

The procedures listed in the following sections outline the steps to be taken if an accident occurs.

8.3.1 Minor Injury

In the event of a minor injury, the following procedures will be implemented:

- Have qualified first-aid personnel treat injury.
- Contact task foreman or "buddy."
- Complete required incident report forms and notify HSM.
- Record injury and include name of injured person, nature of injury, and treatment given.

8.3.2 Serious Injury

In the event of a medical emergency when actual or suspected serious injury occurs, the following procedures will be implemented:

- Survey scene and evaluate whether the area is safe for entry.
- Remove the exposed or injured person from immediate danger.
- Render first aid if necessary. Decontaminate affected personnel after critical first aid is given. If monitoring or decontamination is not performed due to the urgency for care, an RCT should accompany the victim and care givers in order to preclude the spread of contamination.
- Obtain paramedic services or ambulance transport to local hospital. The following procedure will be followed even if no injury is visible:
  - Call 911.
  - Identify location, request medical assistance, and provide name and telephone number.

- Request assistance from emergency medical service and/or additional assistance.

- Evacuate other personnel in the work area to a safe distance until the Project Superintendent determines that it is safe to resume work. If there is any doubt regarding the condition of the area, work will not resume until all hazard control issues have been resolved.
- Complete required incident report forms and notify HSM.
- Notify the Project Manager, HSM, NTR, and Deputy Program Manager of incident and complete accident reporting forms and associated documents per HS020.

8.3.3 Fatal Injury

If a fatal injury occurs, the following additional steps will be taken:

- Notify immediate supervisor.
- Notify project HSM. IT Region or Corporate H&S will initiate contact with Cal/OSHA and other appropriate agencies.
- Immediately notify the NTR and deputy Program Manager.
- Stop all project work activities for 24 hours.
- Assist Cal/OSHA as directed.

Any personnel requiring emergency medical attention will be evacuated immediately from the exclusion zone and CRZ. Personnel will not enter the area to attempt a rescue if their own lives would be threatened. The decision to decontaminate a victim prior to evacuation will be based on the type and severity of the illness or injury and the nature of the contaminant. For some emergency victims, immediate decontamination could be an essential part of life-saving first aid. For others, decontamination could aggravate the injury or delay life-saving treatment. If decontamination does not interfere with essential treatment, it should be performed. If monitoring or decontamination is not performed due to the need for urgent care, an RCT should accompany the victim and care givers in order to preclude the spread of contamination.

If decontamination can be performed, the following steps will be taken:

- Wash external clothing and cut it away.
- Wrap victim in clean blanket or towel, if necessary.

If decontamination cannot be performed, the following steps will be taken:

- Wrap the victim in blankets or plastic to reduce contamination of other personnel.

- Alert emergency and off-site medical personnel to potential contamination; instruct them about specific decontamination procedures.
- Send site personnel familiar with the incident to escort the injured.

8.3.4 First Aid

Only qualified personnel will give first aid and stabilize an individual needing assistance. Life support techniques such as cardiopulmonary resuscitation (CPR) and treatment of life threatening problems such as airway obstruction and shock will be given top priority. At least two persons certified in first-aid techniques and CPR will be on site at all times. The RCS/HSO will be current in first aid and CPR and will maintain a list of the other personnel certified in first aid and CPR. Professional medical assistance will be obtained at the earliest possible opportunity.

To provide first-line assistance to field personnel in case of sickness or injury, the following items will be immediately available on site:

- First-aid kit
- Portable emergency eyewash
- Supply of clean water
- Blanket

The location of the above items will be established before the start of work and will be discussed in detail at the site safety orientation meeting.

8.4 Spill Response Procedures

The project is expected to involve low potential risk due to leaks of hazardous materials. If a spill occurs, it is believed, based on site investigations and analytical data, that only small amounts of hazardous materials would be released. However, as a cautionary measure, the appropriate spill response materials will be available on site.

In case of a spill of contaminated or hazardous materials, the following procedures will be followed:

- Determine that a spill has occurred.
- Notify the Project Superintendent.
- Identify protective clothing or equipment required to respond.
- Contain the spill.
- Notify the NTR and the Deputy Program Manager.
- Notify the NAS North Island Environmental Office.
- Neutralize and/or solidify any product.

- Transfer material into 55-gallon drums for appropriate disposal.
- Document the incident.

8.4.1 Release Prevention and Minimization Measures

The following procedures will be implemented to prevent and minimize releases of hazardous materials:

- Hazardous materials operations will not be conducted when the weather could cause significant risk to surrounding area if a spill should occur.
- All materials will be transferred in or over a bermed or "protected" area. A protected area is one that is covered with an impermeable material, such as polyethylene.
- Temporary storage tanks containing hazardous wastes or potentially hazardous wastes will be diked to contain potential releases.
- A supply of the following basic spill response materials and protective equipment will be maintained on site:
  - Absorbent sheets, pillows, booms, or absorbent material
  - Open-top 55-gallon drums or other containers with lids
  - Brooms, shovels, and other tools such as squeegees.

8.4.2 Emergency Coordinator

The Project Superintendent will serve as the primary emergency coordinator for all spills on this project.

8.5 Earthquake Response

If an earthquake occurs during site activities, the following steps are to be taken:

- Remain calm and do not panic.
- Stop working.
- If indoors, stay indoors away from windows and take cover under heavy furniture or interior walls if possible.
- If outdoors, stay away from power lines, power poles, and windows.
- If in a vehicle, stay in the vehicle until the earthquake is over.
- Do not use or do anything that might provide a source of ignition (e.g., smoking, cutting, or welding).

After the earthquake is over, the following steps are to be taken:

- Meet for a head count at a location designated by the project supervisor.
- Check for injuries. Do not move seriously injured personnel unless remaining where they are would create danger of further injury.
- Check vehicles, equipment, and project sites for any obvious damage.
- Check utility lines for damage. Switch off power, water, and gas until a utility official has inspected the site and determined that it is safe.
- If driving, watch carefully for hazards created by the earthquake (e.g., undermined roads, weak bridges, or overpasses).
- Prepare for aftershocks. Stay out of severely damaged sites.

8.6 Fire or Explosion Response

If a fire or explosion occurs, the fire department must be summoned immediately. A head count and evacuation procedures will be performed concurrently. Upon the arrival of the fire department, the Project Superintendent, Project Manager, or designee will advise the fire commander of the location and nature of the fire and the identity of any hazardous materials on site.

Upon the approval of the Project Superintendent or RCS/HSO, and only if it can be done safely, site personnel may do the following:

- Use fire extinguishers available on site to control or extinguish small localized fires.
- Remove or isolate flammable or other hazardous materials that could contribute to the fire.
- Begin containment and recovery of spilled materials.

ABC-type dry chemical portable fire extinguishers will be provided at the work location and in the immediate location of any flammable materials.

8.7 Site Evacuation Plan

Portable air horns will be used to alert personnel of site evacuation. Primary and secondary assembly areas are presented on Figure 1. The Project Superintendent will conduct a head count at the meeting area, and further directions or response discussions will be coordinated at that time.

If a facility-wide evacuation is necessary, sirens will be sounded to cue evacuation of the site. Normal traffic flow patterns will be in effect unless a local detour is required. Site control will be the responsibility of the Project Superintendent, who will establish new work area boundaries, as necessary.

If a large fire, explosion, or toxic vapor release occurs, a site evacuation will be ordered and the following steps will be taken:

- The applicable alarm (three long horn blasts) will be sounded and the NTR will be advised.
- The immediate situation will be evaluated, and personnel will evacuate in the upwind direction.
- Personnel will exit through the CRZ and take off or scrub outer boots (as a minimum) and remove their outer suit prior to leaving the CRZ.
- All personnel will assemble in an upwind area and, when the situation permits, a head count will be taken.
- The extent of the problem will be determined. A response team in protective clothing and self-contained breathing apparatus will be dispatched to the site to evacuate any missing personnel or to correct the problem if this can be done safely and with no risk to the health or safety of the response team members.

These above procedures will apply to all IT subcontractors and will be discussed with them prior to the start of work.

8.8 Emergency and Hospital Information

A map to the hospital and emergency telephone numbers will be posted on site. Directions to the hospital are listed in Table 5 and are shown in Figure 2. Emergency information is included in Table 6.

9.0 Training Requirements

This section presents specific training requirements for the project consistent with 8 CCR 5192(e), and EM 385-1-1, Section 28. Site-specific training will include information on the following:

- Names of personnel and alternates responsible for site safety and health
- Safety, health, and other hazards present on site
- Use of PPE, specific for the site
- Work practices by which the employee can minimize risks from hazards
- Safe use of engineering controls and equipment on site
- Medical surveillance requirements, including recognition of symptoms and signs that might indicate overexposure to hazards
- Decontamination procedures
- Emergency response plan
- Spill containment program.

All personnel will receive site-specific training prior to working on the site.

9.1 Training Prerequisites

Personnel who enter an area covered under the regulations set forth in 8 CCR 5192 must have a minimum of 40 hours of training and 3 days of supervised field experience. All personnel who enter the exclusion zone or CRZ are required to have this training. Personnel will have received 8-hour annual refresher training to maintain currency in hazardous waste operations as prescribed by this regulation. Furthermore, all supervisors will have received 8-hour supervisor training. Either the RCS/HSO or the Project Superintendent will provide copies of personnel training certifications to the Navy upon request. The RCS/HSO will ensure that all training, fit test, and medical certification records for IT and subcontractor employees are available on site at all times.

9.1.1 Radiation Safety Training

Training is one of the most important elements of an effective radiation and ALARA program. The amount and type of training depend on the individual's work assignment. Training

requirements for radiation workers are specified in 10 CFR 19.12. These requirements will be followed throughout this project.

9.1.1.1 Training Requirements

In order to implement the requirements set forth in 10 CFR 19.12 and 8 CCR 5192, all site workers will receive site-specific training. Radiation worker training for this project will require a number of hours in the classroom to review the following topics:

- Fundamentals of Health Protection
  - Radiological and toxic hazards of exposure to radioactive materials
  - Radioactivity and radioactive decay
  - Characteristics of ionizing radiation
  - How radioactive materials enter the body (e.g., inhalation, ingestion, and/or skin penetration)
  - Mode of exposure—internal and external
  - Man-made radiation sources
  - Why exposures to radioactive materials should be kept ALARA
  - Specific procedures for keeping exposure ALARA
  - Responsibilities of employees and management
  - Interaction with radiation protection staff
  - Operational procedures associated with specific job assignments
- Personal Hygiene at the Site
  - Wearing protective clothing
  - Using respirators and breathing air systems correctly
  - Eating, drinking, smoking, and chewing only in designated "clean" areas
  - Using proper methods for decontamination
  - Acute effects of exposure to radiation
  - Risks associated with occupational radiation exposures, including a summary of the information provided in the NRC (and equivalent State of California) regulatory guides

- Site-Specific Control Systems
  - SOPs
  - RWP system
  - Basic protective measures — time, distance, and shielding, as summarized in 10 CFR 20
  - Security and access control to designated areas
  - Hazards specific to the project site
  - Contamination control, including protective clothing/equipment and workplace design
- Health Physics Protection Measurements
  - Measurement of airborne radioactive materials
  - Bioassays to detect radioactive materials (urinalysis and/or in-vivo counting)
  - Radiation monitoring programs and procedures
  - Surveys to detect contamination of personnel and equipment
  - Radiation survey instrumentation—calibration and limitations
  - Personnel dosimetry, dose-equivalent limits, and dose-equivalent determinations
- Radiation Protection Regulations
  - Employee rights under 10 CFR Part 19
  - Radiation protection requirements in 10 CFR Part 20
  - Fertile female and fetal protection; special considerations as summarized in NRC Regulatory Guide 8.13
- Emergency Procedures
  - Personnel injury
  - Fire
  - Site evacuation and emergency procedures
  - Warning signs and alarms.

9.1.1.2 Documentation of Training

All workers will be tested on their comprehension of the training instruction, sign a statement acknowledging that they have received the training, and comply with the radiation protection rules and requirements before being allowed to enter a radiation or airborne area. All workers will sign a statement indicating that they have reviewed the incorrect answers to the test and understand them. These tests and statements will be maintained in the individual's personnel files.

9.2 Daily Safety Meetings

Daily "tailgate" safety meetings will be held at the start of each shift, prior to the day's remediation activities, and will include a discussion of potential chemical, physical, and environmental hazards and preventive safety measures. Hazard analysis briefings will be held prior to the start of a new task and will include a discussion of task-specific risks and precautions. Attendance is mandatory and will be documented.

10.0 Medical Surveillance

This section describes the specific medical surveillance required for this project. Additional details are presented in the *H&S Procedures HS100*, which will be made available on site.

No unique medical surveillance is expected to be required during this project. All employees will have received physical examinations in accordance with 8 CCR 5192. If employees experience symptoms consistent with exposure to chemicals, they will immediately report to the Project Superintendent or RCS/HSO. The Project Superintendent or RCS/HSO will immediately arrange for an examination with a local medical provider. Emergency phone numbers and contacts are listed in Section 8.

11.0 References

American National Standards Institute, 1978, *Control of Radioactive Surface Contamination on Materials, Equipment and Facilities to be Released for Uncontrolled Use, ANSI N13.12,* Draft.

American National Standards Institute, 1992, *Practice for Respiratory Protection, Z88.2.*

American National Standards Institute, 1999, *Surface and Volume Radioactivity Standards for Clearance, Standard P/N13.12.*

IT Corporation, 2001, *Health and Safety Policies and Procedures Manual.*

National Institute of Occupational Safety and Health/Occupational Safety and Health Administration/U.S. Coast Guard/U.S. Environmental Protection Agency, 1985, *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*, October.

Navy/Marine Corps, 1997, *Installation Restoration Manual*, February.

OHM Remediation Services Corp., 1999, *Technical Memorandum: Supplemental Field Investigation, IR Site 10 Shoreline Slag Area, Naval Air Station North Island, San Diego, California*, July 23.

Title 8, California Code of Regulations.

U.S. Army Corps of Engineers, 1996, *Safety and Health Requirements Manual, Engineer Manual* (EM) 385-1-1, September.

U.S. Department of Labor Occupational Safety and Health Standards:

- 29 CFR 1910.134: Respiratory Protection
- 29 CFR 1910.120: Hazardous Waste Operations and Emergency Response
- 29 CFR 1910.1200: Hazard Communication
- 29 CFR 1926: Safety and Health Regulations for Construction

U.S. Department of Transportation, Title 49, Code of Federal Regulations, Part 173.400, Radioactive Materials, Subpart I.

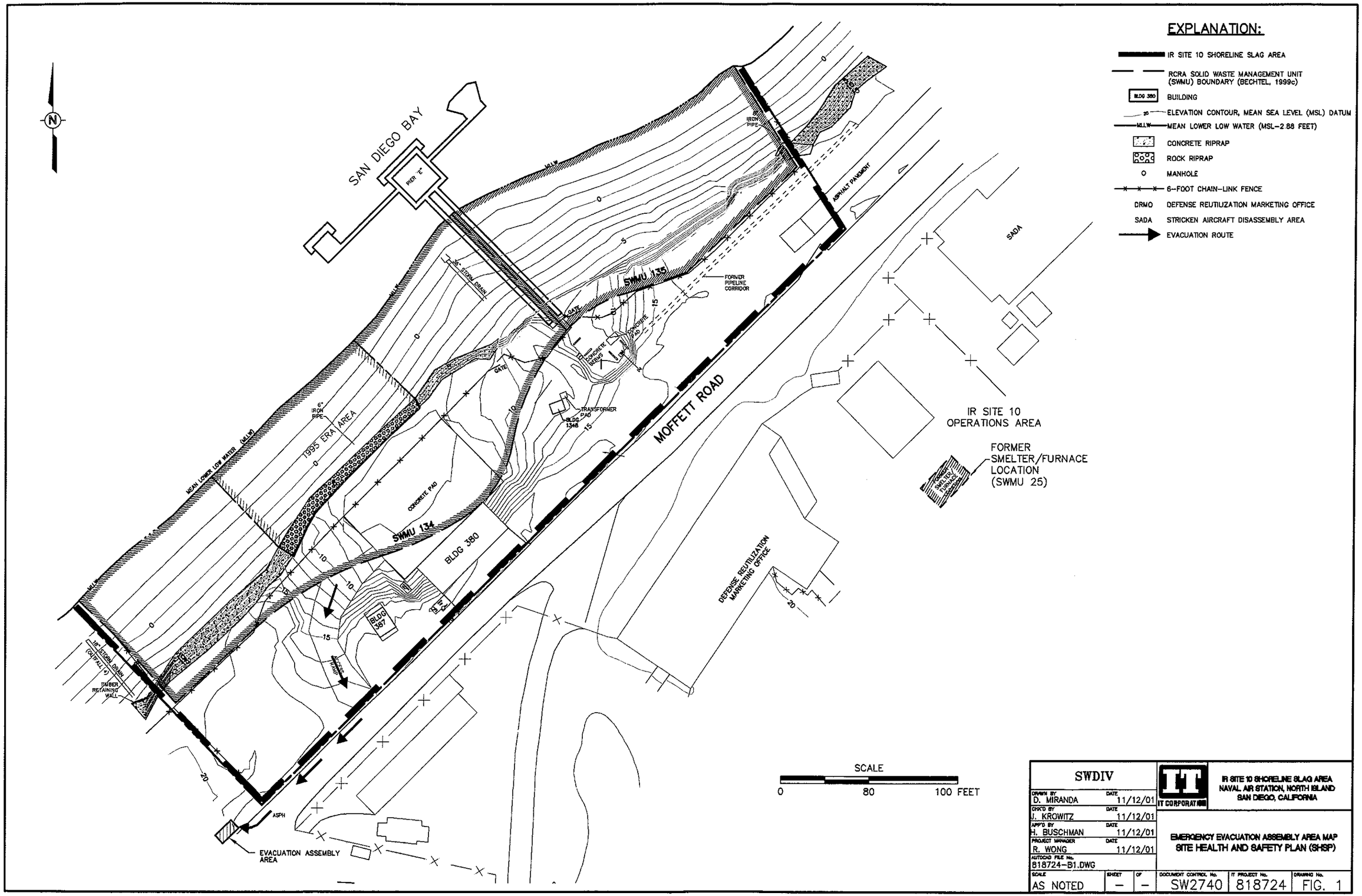
U.S. Environmental Protection Agency, 1992, *Standard Operating Safety Guides*, June.

U.S. Environmental Protection Agency, Title 40, Code of Federal Regulations, Part 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings.*

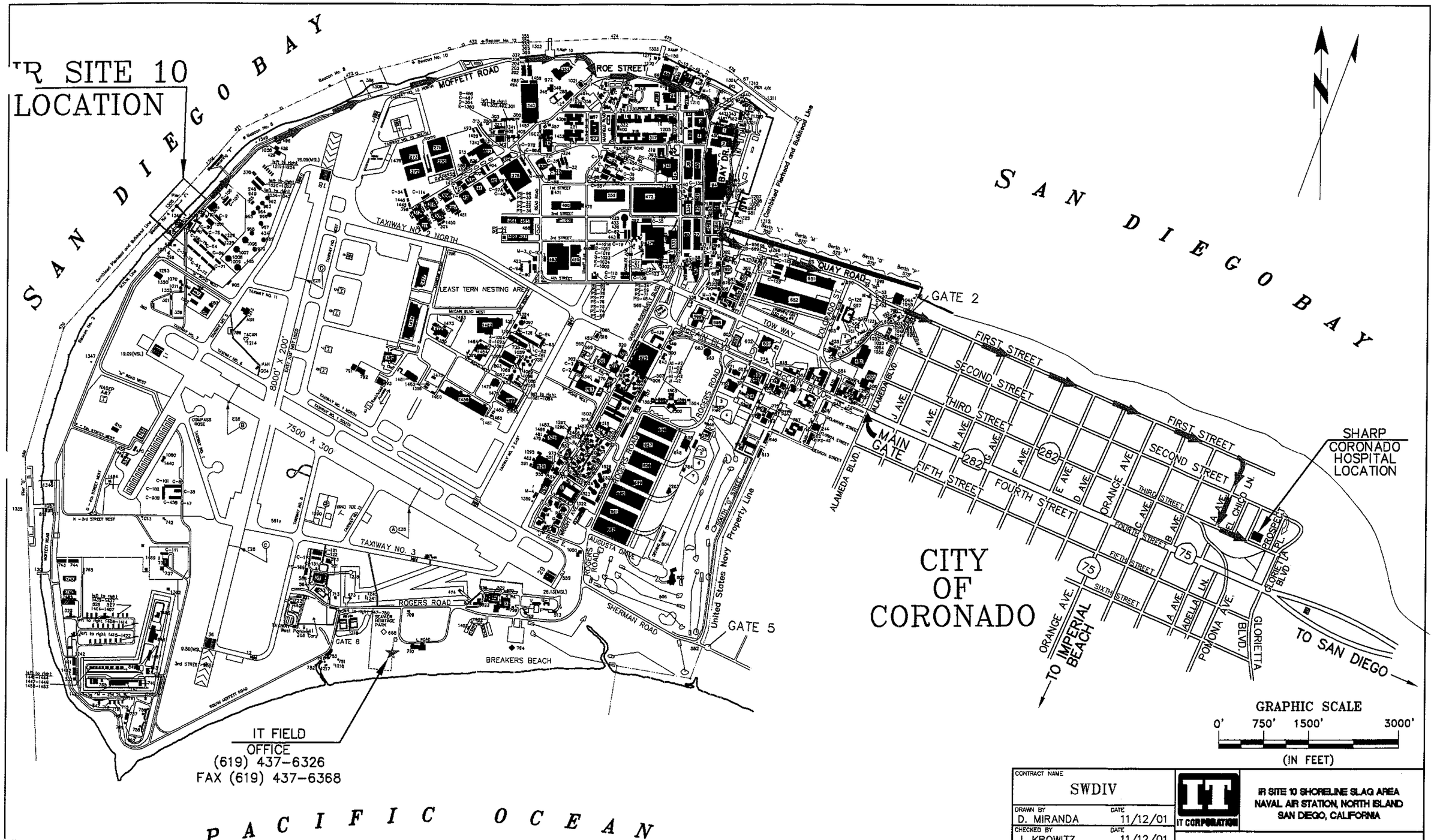
U.S. Nuclear Regulatory Commission, 1999, *Radiological Assessments for Clearance of Equipment and Materials from Nuclear Facilities*, NUREG-1640 Vols. 1 and 2, prepared by M.A. McKenzie-Carter, M.D. Otis, M.E. Anderson, J.A. Roberts, R.L. Gotchy, and R.A. Meck, Science Applications International Corporation, for Division of Regulatory Applications, Office of Nuclear Regulatory Research, Washington, DC, March.

U.S. Nuclear Regulatory Commission, Title 10, Code of Federal Regulations, Part 20, Standards for Protection Against Radiation.

FIGURES



SWDIV			IT CORPORATION	IR SITE 10 SHORELINE SLAG AREA NAVAL AIR STATION, NORTH ISLAND SAN DIEGO, CALIFORNIA		
DRAWN BY D. MIRANDA	DATE 11/12/01					
CHK'D BY J. KROWITZ	DATE 11/12/01			EMERGENCY EVACUATION ASSEMBLY AREA MAP SITE HEALTH AND SAFETY PLAN (SHSP)		
APP'D BY H. BUSCHMAN	DATE 11/12/01					
PROJECT MANAGER R. WONG	DATE 11/12/01					
AUTOCAD FILE No. 818724-B1.DWG						
SCALE AS NOTED	SHEET –	OF –	DOCUMENT CONTROL No. SW2740	IT PROJECT No. 818724	DRAWING No. FIG. 1	



NAS NORTH ISLAND SAN DIEGO, CALIFORNIA

HOSPITAL ADDRESS:
SHARP CORONADO HOSPITAL
250 PROSPECT PLACE
CORONADO, CALIFORNIA 92118
(PHONE) (619) 435-6251
(FAX) (619) 522-3782

CONTRACT NAME: SWDIV			IT CORPORATION	IR SITE 10 SHORELINE SLAG AREA NAVAL AIR STATION, NORTH ISLAND SAN DIEGO, CALIFORNIA	
DRAWN BY: D. MIRANDA	DATE: 11/12/01				
CHECKED BY: J. KROWITZ	DATE: 11/12/01			HOSPITAL ROUTE MAP SITE HEALTH AND SAFETY PLAN (SHSP)	
APPROVED BY: H. BUSCHMAN	DATE: 11/12/01				
PROJECT MANAGER: R. WONG	DATE: 11/12/01				
AUTOCAD FILE No.: 818724-e1					
SCALE: AS NOTED	SHEET: 1	OF: 1	DOCUMENT CONTROL No.: SW2740	IT PROJECT No.: 818724	DRAWING No.: FIG. 2

TABLES

Table 1
Chemical Hazards

Chemical Name	PEL (mg/m^3)	Route of Exposure	Signs and Symptoms of Overexposure
Antimony	0 5	Inhalation, Ingestion, Contact	Eye, skin, and nose irritation; cough; dizziness; headache; nausea; vomiting; diarrhea; insomnia
Arsenic	0 01	Inhalation, Ingestion, Contact, Absorption	Ulceration of nasal septum, dermatitis, intestinal disturbances, respiratory irritation
Barium	0 5	Inhalation, Ingestion, Contact, Absorption	Irritation of eyes, nose, throat, and skin
Beryllium	0 002	Inhalation, Ingestion, Contact	Anorexia, chest pain, cough, shortness of breath, eye irritation, dermatitis, cancer
Cadmium	0 005	Inhalation, Ingestion	Pulmonary edema, dyspnea, cough, chest tightness, substernal pain; headache; chills, muscular aches; nausea, vomiting, diarrhea; insomnia, emphysema, proteinuria, mild anemia; potential human carcinogen
Chromium	0 5	Inhalation, Ingestion, Contact, Absorption	Eye and skin irritation, lung fibrosis
Cobalt	0.05	Inhalation, Ingestion	Cough, decrease in lung function, asthma
Copper	0 2	Inhalation, Ingestion, Contact	Eye, nose, and throat irritation; dermatitis; perforation of nasal septum
Lead	0 05	Inhalation, Ingestion, Contact	Weakness, insomnia, malnutrition, constipation, abdominal pain, anemia, tremors, kidney disease, eye irritation
Molybdenum	5 0	Inhalation, Ingestion	Irritation of eyes, nose, and throat; anorexia; loss of coordination; dyspnea; anemia
Nickel	1 0	Inhalation, Ingestion	Skin sensitization, allergic asthma, lung irritation (lung and nasal cancer)
Selenium	0 2	Inhalation, Ingestion	Irritation of eyes, skin, nose, and throat; visual disturbances; fever; chills; intestinal disturbances
Silver	0 1	Inhalation, Ingestion, Contact	Throat, skin, and eye irritation; intestinal disturbances
Thallium	0 1	Inhalation, Ingestion, Contact, Absorption	Nausea, diarrhea, abdominal pain; perineuritis; tremors; pulmonary edema; liver, kidney damage; psychosis
Vanadium	0 05	Inhalation, Ingestion, Contact	Eye irritation of eyes, throat; green tongue; eczema; cough, wheezing, dyspnea

CNS denotes central nervous system
mg/m^3 denotes milligram per cubic meter
PEL denotes permissible exposure limit
TLV denotes threshold limit value

Table 2
Personal Protection Equipment

Measurement (mg/m^3)	Action and Protective Equipment
>1 0 sustained reading with the Miniram aerosol monitor (Section 7 1.1)	Upgrade to Level C. Air-purifying respirator should be equipped with HEPA filters. Apply dust control techniques such as wetting to reduce concentrations.
>3 0 sustained reading with the Miniram aerosol monitor (Section 7.1.1)	Stop work Evaluate options for dust control.

HEPA denotes high-efficiency particulate air.

mg/m^3 denotes milligrams per cubic meter.

Table 3
Radioactive Airborne Particulate Action Levels

Measurement (µCi/mL)	Action and Protective Actions
> $3x10^{-11}$ gross alpha (0.1 DAC) work area	Increase dust control such as wetting.
> 7 $5x10^{-11}$ gross alpha (0 25 DAC) work area ≥ 9E-13 µCi/mL for perimeter samples	Stop work. Evaluate additional engineering controls

µCi/mL denotes microcuries per milliliter.
DAC denotes derived air concentration.

Table 4
Radiological Exposure Pathways and Associated Monitoring

Tasks	Exposure Route	Monitoring Instruments	Prevention/Monitoring Techniques
Conducting radiological surveys; excavating and containerizing waste	External exposure	ESP-2 Kit-w/HP-270, Ludlum Model 19 or equivalent	Surveys with Geiger-Mueller detectors, Micro-R meters, ionization chambers, and/or solid state detectors Workers will wear dosimeters, if required.
Conducting radiological surveys; excavating and containerizing waste	Inhalation	Eberline RAS or equivalent	Engineering controls will be implemented to reduce particulate airborne levels PPE will be used based on the results of sample analysis.
Conducting radiological surveys; excavating and containerizing waste	Ingestion of surface contamination	Ludlum 2929, ESP-2 Kit-w/ HP-210, HP-260, or equivalent	Engineering controls, PPE, contamination monitoring, and procedures will minimize worker exposure.

PPE denotes personal protective equipment.

Table 5
Directions to the Hospital

Hospital	Directions
Primary Hospital Coronado Hospital 250 Prospect Place Coronado, CA 92118 (619) 435-6251	**From Site 10:** Take Moffet Road east and follow the perimeter to Roe Street Turn left on Roe Street until it ends at Quentin Roosevelt Blvd Turn right and continue on Quentin Roosevelt Blvd. At McCaine Blvd., turn left. Exit the base on McCain Blvd , which becomes 4th Street in Coronado. Turn left on Orange Ave Continue Two blocks and turn right on 2nd Street Turn right onto Prospect Place and continue to 3rd Street. **The Hospital is at the corner of Prospect Place and 3rd Street.**

Table 6
Emergency Information

Emergency Contact	Location/Contact Phone Numbers
Hospital	Coronado Hospital (619) 435-6251
Fire Department	9-911 on base, 911 using non-base phones
Military Police	9-911 on base, 911 using non-base phones
Local Ambulance Service	9-911 on base, 911 using non-base phones
Poison Control Center	(800) 876-4766
National Response Center	(800) 424-8802
Chemical Transportation Emergency Center (CHEMTREC)	(800) 424-9300
IT Occupational Physician: Health Resources	(800) 350-4511
IT Medical Incident Reporting: Virginia Gutierrez Health Resources	 (508) 647-0923 (508) 651-8939
IT Contact	IT Project Manager, Richard Wong (619) 437-6326 extension 314 IT Health and Safety Manager, Fred Mlakar (949) 660-5413, pager 949-451-7658
Navy Contact	Mark Bonsavage, Navy RPM (619) 556-7315 Michael Corry, ROICC Representative (619) 545-4889

IT denotes IT Corporation.

ROICC denotes Resident Officer in Charge of Construction.

RPM denotes Remedial Project Manager.

ATTACHMENT 1
SHSP CHANGE APPROVAL FORM

Site Health and Safety Plan Change Approval Form

Date of Change: _____ Amendment No. _____

Project Name: _____ Project Number: _____

Section of SHSP: _____ Page Number: _____

Change to Read:

_____

_____

_____

_____

Reason for Change:

_____

_____

_____

Approvals: _____
Project Manager/Project Superintendent

_____
Site Health and Safety Officer

_____
Project Health and Safety Manager

Acknowledgment (nonmandatory):

_____
Navy Technical Representative

ATTACHMENT 2
SHSP ACKNOWLEDGMENT FORM

Site Health and Safety Plan Acknowledgment

I understand and agree to abide by the provisions detailed in the Program Health and Safety Plan (HSP) and this Site Health and Safety Plan (SHSP) for the activities described in the Removal Action Plan. I understand that failure to comply with these provisions may lead to disciplinary action, which may include dismissal from the work site, termination of employment, or, for subcontractors, termination of the work contract.

Printed Name	Company	Signature	Date

ATTACHMENT 3
HAZARD ANALYSIS FORMS

ACTIVITY HAZARD ANALYSIS FOR BOREHOLE DRILLING AND WELL INSTALLATION AND ASSOCIATED OPERATIONS ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
Set up of equipment	Faulty or damaged equipment being utilized to perform work.	• All machinery or mechanized equipment will be inspected by the HSO and QC dept. and be in safe operating condition.	Level D (Hard hat, safety glasses or goggles, steel toed safety boots, reflective vests, ear protection).	None
Drill rig and support equipment staging	Uneven terrain, poor ground support, inadequate clearances, and contact with utilities.	• Earth drilling equipment will not be transported with the mast up. The only exceptions are: Movement over level, smooth terrain only after the path of travel has been inspected for stability and the absence of holes, other ground hazards and the travel distance is limited to very short safe distances. Whenever the equipment is parked, the parking brake will be set. Equipment parked on in clines will have wheel chokes. In all cases the out riggers should be set.	Level D (Hard hat, safety glasses or goggles, steel toed safety boots, reflective vests, ear protection, leather gloves).	None
Drilling and well installation Operations	Improper Work Practices/ Procedures	• Driller and helper must be present during all operations and TEST EACH KILL SWITCH DURING STARTUP. • All drillers performing work must possess required state or local licenses to perform such work. • Driller helper and other site personnel must know location of emergency shutoff switch. • Ensure jewelry is removed, loose clothing is buttoned and loose PPE is secured close to the body to avoid getting caught in moving parts. • Unauthorized personnel must be kept clear of drilling rig. • Area of drilling operation must be cordoned off and or barricaded. • When hazardous conditions are deemed present, operations must be shut down. • Do not allow drillers to climb on mast while it is erected. • Work areas, platforms, and walkways should be kept free of materials, debris, and obstructions such as, grease or oil that could cause a surface to become slick or otherwise hazardous. • Shut down drill rig to make repairs or adjustments to drill rig or to lubricate fittings. • Release all pressure on the hydraulic systems, the drilling fluid system, and the air pressure systems of the drill rig prior to performing maintenance.	Level D (Hard hat, safety glasses or goggles, steel toed safety boots, ear protection, leather gloves).	

ACTIVITY HAZARD ANALYSIS FOR BOREHOLE DRILLING AND WELL INSTALLATION AND ASSOCIATED OPERATIONS ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
		• Before raising the mast, check for overhead obstructions. • HS315 Control of hazardous energy sources will be followed if work is to be performed on rig.		
	Radium 226	• Compliance with Section 7.0 of the SHSP		Radiation detection instrumentation
	Sharp Objects	• Wear cut resistant work gloves when sharp edges or objects may cause the possibility of lacerations or other injury. • Maintain all hand and power tools in a safe condition. • Keep guards in place during use at all times. • All sharp objects should be identified during the pre-job inspection. • All knifes that are used will have locking blades to prevent them from folding on the users fingers.	Leather gloves	
	Struck by/ Against Heavy Equipment, Flying Debris, Protruding Objects	• Wear reflective warning vests when exposed to vehicular traffic. • Isolate equipment swing areas. • Make eye contact with operators before approaching equipment • Barricade or enclose the drilling area. • Restrict entry to the work area to authorized personnel during drilling activities. • Understand and review hand signals.		
	High Noise Levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period). • Assess noise level with sound level meter if possibility exists that level may exceed 85dBA TWA	Ear plugs	Sound Level Meter
	High/Low Ambient Temperature	• Monitor for Heat/Cold stress in accordance with IT • Health and Safety Procedures # HS400, HS401 • Provide fluids to prevent worker dehydration	Insulated Clothing (subject to ambient temperature)	Visual for heat stress

ACTIVITY HAZARD ANALYSIS FOR BOREHOLE DRILLING AND WELL INSTALLATION AND ASSOCIATED OPERATIONS ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
	Caught In/ Between Moving Parts	• Identify and understand parts of equipment which may cause crushing, pinching, rotating or similar injuries. These areas will be identified during the initial inspection. • Assure guards are in place to protect from these parts of equipment during operation. • Wear proper work gloves when the possibility of pinching, or other injury may be caused by moving/ handling large or heavy objects. • Maintain all equipment in a safe condition. • Keep all guards in place during use. • De-energize and lock-out machinery before maintenance or service. • Turning augers, belts, and chains can catch loose clothing or body parts and crush or sever hands and feet.	Level D (Hard hat, safety glasses or goggles, steel toed safety boots, leather gloves, and tyvek).	
	Slips, Trips, Falls	• Clear walkways, work areas of equipment, drilling overburden, debris and other materials • Mark, identify, or barricade other obstructions • Evaluate fall hazards above 4 ft.; use fall protection equipment (harness/lanyard), standard guardrails or other fall protection systems when working on elevated platforms above 6 ft • Use heavy duty industrial ladder. • Only one person on the ladder at any one time. • Only trained operators are permitted to use aerial lifts • Tie-off all straight/extension ladders or manually hold by co-worker at base • Anchorage points for fall arrest systems must support at least 5,400 pounds for each worker • Halt exterior work in high winds, severe weather		

ACTIVITY HAZARD ANALYSIS FOR BOREHOLE DRILLING AND WELL INSTALLATION AND ASSOCIATED OPERATIONS ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
	Underground/ Overhead Utilities	• Identify all utilities around the site before work commences • Cease work immediately if unknown utility markers are uncovered • Use manual excavation within 3 feet of known utilities • Utility clearance shall conform with 29 CFR 1926.955 (high voltage >700 kv) 15 feet phase to ground clearance; 31 feet phase to phase clearance.	Level D (Hard hat, safety glasses or goggles, steel toed safety boots, reflective vests, ear protection	Sub dynamic locating services.
	Fire/ Explosion	• Test well-head atmosphere with combustible gas meter. If the readings exceed 10% LEL then shut down the job. • Eliminate sources of ignition from the work area. • Do not refuel equipment while it is in operation. • Prohibit smoking. • Provide ABC (or equivalent) 20 lb fire extinguishers in all work areas, flammable storage areas, generator and compressor locations. • Store flammable liquids in well ventilated areas • Prohibit storage, transfer of flammable liquids in plastic containers • Post "NO SMOKING" signs • Store combustible materials away from flammables • Store all compressed gas cylinders upright, caps in place when not in use • Separate Flammables and Oxidizers by 20 feet minimum.	Portable eyewash and first aid kits.	
	Pressurized Lines Pressurized systems: -Hydraulic Systems -Grout -Mud Pumps -Compressed Air	• All discharge hoses and connections will be routinely inspected. • Discharge hose will be secured in place while pumping grout mixture. • Isolate equipment swing areas. • Make eye contact with operators before approaching equipment.	Level D	

ACTIVITY HAZARD ANALYSIS FOR SITE RESTORATION ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
Site Restoration	Struck by/ Against Heavy Equipment, Protruding Objects	• Wear reflective warning vests when exposed to vehicular traffic • Isolate equipment swing areas • Make eye contact with operators before approaching equipment • Wear hard hats, safety glasses with side shields, or splash/face shields and goggles, and steel-toe safety boots at all times • Understand and review hand signals	Warning vests, Hard hat, Safety glasses, Steel toe work boots	
	Slips, Trips, Falls	• Clear, walkways of equipment, tools, debris, other materials • Mark, identify, or barricade other obstructions		
	High Noise Levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) • Assess noise level with sound level meter if possibility exists that level may exceed 85dBA TWA	Ear plugs	Sound Level Meter
	Handling Heavy Objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb per person for manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads		
	High/Low Ambient Temperature	• Monitor for Heat/Cold stress in accordance with IT Health and Safety Procedures #HS400, HS401 • Provide fluids to prevent worker dehydration	Insulated Clothing (subject to ambient temperature)	Meteorological Equipment

ACTIVITY HAZARD ANALYSIS FOR SITE PREPARATION ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
Equipment/ Facility Set-up	Slips, Trips, Falls	• Clear walkways work areas of equipment, tools, vegetation, excavated material and debris • Mark, identify, or barricade other obstructions	Level D - hard hat, safety glasses, steel toe work boots	
	Radium 226	• Compliance with Section 7.0 of the SHSP		Radiation detection instrumentation
	Clearing vegetation	• Utilize heavy equipment as much as practicable for removing brush and vegetation. • If hand tools are to be used, inspect to ensure good working order.		
	Struck By/ Against Heavy Equipment	• Wear reflective warning vests when exposed to vehicular traffic • Isolate equipment swing areas • Make eye contact with operators before approaching equipment • Understand and review hand signals		
	Drowning	• Wear floatation jacket when working near water greater than 2 ft deep	Floatation device. Life jackets	
	Sharp Objects	• Wear cut resistant work gloves when lacerations or other injury may be caused by sharp edges or objects • Maintain all hand and power tools in a safe condition • Keep guards in place during use	Leather gloves	
	Uneven terrain	• Ensure stable footing when walking or working in embankments		

ACTIVITY HAZARD ANALYSIS FOR SITE PREPARATION ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
	Electrical Shock	• De-energize or shut off utility lines at their source before work begins • Use double insulated or properly grounded electric power-operated tools • Maintain tools in a safe condition • Provide an equipment-grounding conductor program or employ ground-fault circuit interrupters • Use qualified electricians to hook up electrical circuits • Inspect all extension cords daily for structural integrity, ground continuity, and damaged insulation • Cover or elevate electric wire or flexible cord passing through work areas to protect from damage • Keep all plugs and receptacles out of water • Use approved water-proof, weather-proof type if exposure to moisture is likely • Inspect all electrical power circuits prior to commencing work • Label all electrical boxes > 200 volts with circuit voltage • Follow Lockout-Tagout procedures in accordance with IT Health and Safety Procedures # HS315	Lockout/Tagout Devices	Voltage Meter or Tic Tracer
	High Noise Levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) • Assess noise level with sound level meter if possibility exists to exceed 85 dbA TWA	Ear plugs	Sound Level Meter
	Handling Heavy Objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb. maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads • Avoid carrying heavy objects above shoulder level • Avoid actions/activities that contribute to overexertion • Warm up muscles before engaging in manual lifting activities • Review lifting posture/techniques regularly at safety meeting		

ACTIVITY HAZARD ANALYSIS FOR SITE PREPARATION ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
	High/Low Ambient Temperature	• Monitor for Heat/Cold stress in accordance with IT Health and Safety Procedures # HS400, HS401 • Provide fluids to prevent worker dehydration	Insulated Clothing (subject to ambient temperature)	Meteorological Equipment

ACTIVITY HAZARD ANALYSIS FOR CONSTRUCTION, FILLING, AND CAPPING OF WASTE CONSOLIDATION AREA (WCA) ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
Preparation	Slips, Trips, Falls	• Clear walkways, work areas of equipment, tools, construction debris and other materials • Mark, identify, or barricade other obstructions	Level D - hard hat, safety glasses, steel toe work boots	
	Radium 226	• Compliance with Section 7.0 of the SHSP		Radiation detection instrumentation
All excavation activities	Struck by/ Against Heavy Equipment, Flying Debris, Protruding Objects	• Wear reflective warning vests when exposed to vehicular traffic • Isolate equipment swing areas • Make eye contact with operators before approaching equipment • Barricade or enclose the work area • Restrict work area entry to authorized personnel only during construction activities • Wear hard hats, safety glasses with side shields, and steel-toe safety boots • Understand and review hand signals • Slope sides of excavation per HS 307		
	High/Low Ambient Temperature	• Monitor for Heat/Cold stress in accordance with IT Health and Safety Procedures # HS400, HS401 • Provide fluids to prevent worker dehydration • Follow work/rest schedule in Section 3.3.1/3.3.2 of the HASP	Insulated Clothing (subject to ambient temperature)	Meteorological Equipment
	Vibration	• Rotate compaction tasks to minimize worker exposure to equipment vibration • Use compactors with vibration dampening devices	Anti-vibration gloves	
	High Noise Levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) • Assess noise level with sound level meter if possibility exists that level may exceed 85dBA TWA	Ear plugs	Sound Level Meter

ACTIVITY HAZARD ANALYSIS FOR CONSTRUCTION, FILLING, AND CAPPING OF WASTE CONSOLIDATION AREA (WCA) ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
Installing geotextile liner in WCA	Handling Heavy Objects	• Observe proper lifting techniques • Obey sensible lifting limits (60 lb. maximum per person manual lifting) • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads		
Placement of slag wastes in the WCA	Slag dust	• Control airborne dust by wetting and careful handling	Modified level or Level C with dust/mist cartridges	Mini-ram dust monitor
	Radium 226	• Compliance with Section 7.0 of the SHSP		Radiation detection instrumentation
Capping WCA with soil cover	See excavation, above			
	Radium 226	• Compliance with Section 7.0 of the SHSP		Radiation detection instrumentation

ACTIVITY HAZARD ANALYSIS FOR INSTALLATION ROCK REVETMENT ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
Install rock revetment	Slips, Trips & Falls	• Clear walkways, work areas of vegetation, equipment, tools, debris, excavated material • Mark, identify, or barricade other obstructions • Wear rubber boots in areas of standing water, mud, marsh • Use 3 point contact when ascending/descending heavy equipment • Park heavy equipment on level ground to avoid potential sprains/strains when ascending/descending	Hard-hat, goggles and face shield or safety glasses, steel toe work boots	Radiological monitoring equipment if deemed necessary the RCS/HSO
	Struck by/ Against Heavy Equipment, Flying Debris, Protruding Objects	• Use reflective warning vests, caution flags when exposed to vehicular traffic • Place barricades to isolate equipment swing areas • Isolate areas under suspended loads • Make eye contact with operators before approaching equipment • Barricade or enclose the work area • Restrict entry to the work area to authorized personnel during work activities • Wear hard hats, safety glasses with side shields, face shields and goggles and steel-toe safety boots at all times • Understand and review hand signals	Hard-hat, goggles and face shield or safety glasses, steel toe work boots	
	Drowning	• Wear floatation jacket when working near water greater than 2 feet deep	Floatation devices.	
	Sharp Objects	• Wear cut resistant work gloves when the possibility of lacerations or other injury may be caused by sharp edges or objects • Maintain all hand and power tools in a safe condition • Keep guards in place during use	Leather gloves	
	Contact Dermatitis	• Wear PPE to avoid skin contact with contaminated soil, plants, or other skin irritants • Identify and review poisonous plants with workers	Tyvek coveralls, duct tape bottom of coveralls to boots	

ACTIVITY HAZARD ANALYSIS FOR INSTALLATION ROCK REVETMENT ALWAYS EXPECT THE UNEXPECTED! ANTICIPATE AND ADJUST!				
Task Breakdown	**Potential Hazards**	**Critical Safety Practices**	**Personal Protective Clothing and Equipment**	**Monitoring Devices**
	Handling Heavy Objects	• Observe proper lifting techniques • Avoid sudden movements, jerking motions • Obey sensible lifting limits (60 lb. maximum per person manual lifting) • Prohibit running, jumping during geotextile deployment • Use mechanical lifting equipment (hand carts, trucks) to move large, awkward loads		
	Caught In/ Between Moving Parts	• Identify equipment operations which may cause crushing, pinching, rotating or similar motions • Provide and use proper work gloves when the possibility of pinching or similar injury may be caused by moving/handling heavy objects • Maintain communication between equipment operators and ground personnel • Maintain all equipment in a safe condition • Keep all guards in place during use • Review positioning plan with workers before weir, riprap placement begins	Leather gloves	
	High Noise Levels	• Use hearing protection when exposed to excessive noise levels (greater than 85 dBA over an 8-hour work period) • Assess noise level with sound level meter if possibility exists that level may exceed 85dBA TWA	Ear plugs	Sound Level Meter
	High/Low Ambient Temperature	• Monitor for Heat/Cold stress in accordance with IT Health and Safety Procedures # HS400, HS401 • Provide fluids to prevent worker dehydration	Insulated Clothing (subject to ambient temperature)	Meteorological Equipment

ATTACHMENT 4
PROJECT SAFETY CHECKLIST

PROJECT SAFETY CHECKLIST

Project: _____ Job No.: _____ Date: _____

The following safety checklist must be filled out on a weekly basis by the project supervisor or designee. Records of this weekly site safety inspection must be kept in the project files and be made available for review.

N/A	Yes	No	
☐	☐	☐	OSHA Posters, Site Safety Plan, Hazard Communication Program, OSHA Log 200, Health and Safety Procedures Manual, Weekly Safety Checklist
☐	☐	☐	Site Health and Safety Plan signed by all site personnel
☐	☐	☐	First-aid kit, eyewash, safety shower
☐	☐	☐	Fresh water available for drinking and washing
☐	☐	☐	MSDS for chemicals brought onto site
☐	☐	☐	All chemical containers properly stored and labeled
☐	☐	☐	Good housekeeping with a tidy, orderly appearance
☐	☐	☐	Work zones clearly defined and established
☐	☐	☐	Decontamination line set up in transition zone
☐	☐	☐	PPE appropriate for task
☐	☐	☐	Hard hat, safety glasses, steel-toed shoes for all personnel
☐	☐	☐	Fire extinguishers present with up-to-date inspection record
☐	☐	☐	Generators/fuel tanks grounded
☐	☐	☐	Appropriate air monitoring equipment on site properly used and maintained
☐	☐	☐	Compressed gas cylinders stored upright and secured
☐	☐	☐	Defective equipment tagged and taken out of service

Explanation of "No" answers or other comments:

_____

_____

ATTACHMENT 5
MATERIAL SAFETY DATA SHEETS

CONOCO -- DIESEL FUEL NO. 2 - DIESEL FUEL
MATERIAL SAFETY DATA SHEET
NSN: 9140002865296
Manufacturer's CAGE: 15445
Part No. Indicator: A
Part Number/Trade Name: DIESEL FUEL NO. 2

General Information

Item Name: DIESEL FUEL
Company's Name: CONOCO INC
Company's Street: 600 N DAIRY ASHFORD RD RM 3012
Company's P. O. Box: 4784
Company's City: HOUSTON
Company's State: TX
Company's Country: US
Company's Zip Code: 77210-4784
Company's Emerg Ph #: 713-293-5550/800-424-9300
Company's Info Ph #: 713-293-5550
Record No. For Safety Entry: 029
Tot Safety Entries This Stk#: 093
Status: SMU
Date MSDS Prepared: 14AUG91
Safety Data Review Date: 24JUN92
Supply Item Manager: KY
MSDS Serial Number: BMZTT
Specification Number: VV-F-800
Spec Type, Grade, Class: GRADE DF-2
Hazard Characteristic Code: F4

Ingredients/Identity Information

Proprietary: NO
Ingredient: PETROLEUM MID-DISTILLATE (DIESEL MARINE FUEL)
Ingredient Sequence Number: 01
Percent: 100 %
NIOSH (RTECS) Number: 1004302PE
CAS Number: 68476-34-6
OSHA PEL: 5 MG/M3 AS OIL MIST
ACGIH TLV: 5 MG/M3 AS OIL MIST
Other Recommended Limit: NONE SPECIFIED

Physical/Chemical Characteristics

Appearance And Odor: CLEAR OR LIGHT YELLOW LIQUID, AROMATIC ODOR
Boiling Point: 350 - 680F
Melting Point: NOT GIVEN
Vapor Pressure (MM Hg/70 F): 1 MMHG
Vapor Density (Air=1): > 1
Specific Gravity: 0.85 - 0.93
Decomposition Temperature: NOT GIVEN
Evaporation Rate And Ref: NIL
Solubility In Water: INSOLUBLE
Percent Volatiles By Volume: NIL

Corrosion Rate (IPY): UNKNOWN

Fire and Explosion Hazard Data

Flash Point: 130F,54C
Flash Point Method: TCC
Lower Explosive Limit: 0.4 %
Upper Explosive Limit: 6 %
Extinguishing Media: WATER SPRAY, FOAM, DRY CHEMICAL CAARBON DIOXIDE
Special Fire Fighting Proc: USE WATER TO KEEP FIRE-EXPOSED CONTAINERS COOL. IF LEAK OR SPILL HAS NOT IGNITIED, USE WATER SPRAY TO DISPERSE THE VAPORS AND TO PROVIDE PROTECTION.
Unusual Fire And Expl Hazrds: PRODUCTS OF COMBUSTION MAY CONTAIN CARBON MONOXIDE, CARBON DIOXIDE AND OTHER TOXIC MATERILS. DO NOT ENTER ENCLOSED OR CONFINED SPACE WITHOUT PROPER PPE.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): AVOID HEAT AND FLAME
Materials To Avoid: INCOMATIBLE WITH OXIDIZING MATERIALS

Health Hazard Data

Precautions for Safe Handling and Use

Control Measures

Transportation Data

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 24JUN92
MFR Label Number: NONE
Label Status: G
Common Name: DIESEL FUEL NO. 2
Chronic Hazard: NO
Signal Word: CAUTION!
Acute Health Hazard-Slight: X
Contact Hazard-Slight: X
Fire Hazard-Slight: X
Reactivity Hazard-None: X
Special Hazard Precautions: STORE IN WELL VENTILATED AREEA. KEEP CONTAINER TIGHTLY CLOSED. STORE IN ACCORDANCE WITH NATIONAL FIRE PROTECTION ASSN REGULATIONS. FIRST AID: INHALATION: REMOVE TO FRESH AIR. IF NOT BREATHING,

GIVE ARTIFICIAL RESPIRATION. IF BREATHING IS DIFFICULT, GIVE OXYGEN. CALL A PHYSICIAN. SKIN: FLUSH SKIN WITH WATER AFTER CONTACT. REMOVE CONTAMINATED CLOTHING. EYES: IMMEDIATELY FLUSH WITH WATER FOR 15 MINUTES. CALL A PHYSICIAN. INGESTION: DO NOT INDUCE VOMITING. IMMEDIATELY GIVE TWO GLASSES OF WATER. NEVER GIVE ANYTHING TO IF UNCONCIOUS CALL MD
Protect Eye: Y
Protect Skin: Y
Label Name: CONOCO INC
Label Street: 600 N DAIRY ASHFORD RD RM 3012
Label P.O. Box: 4784
Label City: HOUSTON
Label State: TX
Label Zip Code: 77210-4784
Label Country: US
Label Emergency Number: 713-293-5550/800-424-9300

BELL FUELS -- LEAD-FREE GASOLINE; NO-LEAD GASOLINE - GASOLINE,UNLEADED
MATERIAL SAFETY DATA SHEET
NSN: 9130012084172
Manufacturer's CAGE: 8P539
Part No. Indicator: A
Part Number/Trade Name: LEAD-FREE GASOLINE; NO-LEAD GASOLINE

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General Information

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Item Name: GASOLINE,UNLEADED
Company's Name: BELL FUELS, INC
Company's Street: 4116 WEST PATERSON AVE
Company's City: CHICAGO
Company's State: IL
Company's Country: US
Company's Zip Code: 60646
Company's Emerg Ph #: 312-286-0200
Company's Info Ph #: 312-286-0200
Record No. For Safety Entry: 060
Tot Safety Entries This Stk#: 064
Status: SP
Date MSDS Prepared: 23FEB90
Safety Data Review Date: 21OCT94
Supply Item Manager: KY
MSDS Serial Number: BVHJT
Specification Number: VV-G-1690
Spec Type, Grade, Class: CIVGAS
Hazard Characteristic Code: F2
Unit Of Issue: DR
Unit Of Issue Container Qty: 55 GALLONS
Type Of Container: DRUM, 18 GAGE
Net Unit Weight: 325.2 LBS

==========

Ingredients/Identity Information

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Proprietary: NO
Ingredient: HYDROCARBONS, AROMATIC
Ingredient Sequence Number: 01
Percent: 15-35
NIOSH (RTECS) Number: 1008732HA
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: SATURATED HYDROCARBONS
Ingredient Sequence Number: 02
Percent: 60-75
NIOSH (RTECS) Number: 1006886SH
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO

Ingredient: UNSATURATED HYDROCARBONS
Ingredient Sequence Number: 03
Percent: 1-15
NIOSH (RTECS) Number: 1006887UH
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

Proprietary: NO
Ingredient: DYE AND OTHER ADDITIVES
Ingredient Sequence Number: 04
Percent: 0.02
NIOSH (RTECS) Number: 1003746AD
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE RECOMMENDED

Physical/Chemical Characteristics

Appearance And Odor: BLUE OR CLEAR, TYPICAL HYDROCARBON ODOR.
Boiling Point: 90.0F,32.2C
Vapor Pressure (MM Hg/70 F): 414 @100C
Vapor Density (Air=1): 3-4
Specific Gravity: 0.71-0.77
Solubility In Water: NEGLIGIBLE.

Fire and Explosion Hazard Data

Flash Point: -50F,-46C
Flash Point Method: TCC
Lower Explosive Limit: 1.3
Upper Explosive Limit: 6
Extinguishing Media: ANY UL APPROVED CLASS B MEDIA SUCH AS FOAM, CARBON DIOXIDE, DRY CHEMICAL.
Special Fire Fighting Proc: NONE SPECIFIED BY MFG; HOWEVER USE APPROPRIATE PROTECTIVE EQPMT INCLUDING SELF-CONTAINED BREATHING APPARATUS.
Unusual Fire And Expl Hazrds: NONE SPECIFIED BY MFG; HOWEVER MATL IS HEAVIER THAN AIR AND WILL TRAVEL LONG DISTANCES & FLASHBACK. EXPLOSIVE MIXTURE FORMS W/GASOLINE & AIR.

Reactivity Data

Stability: YES
Cond To Avoid (Stability): NONE SPECIFIED BY MFG; HOWEVER AVOID OPEN FLAMES/HEAT/SPARKS/OTHER IGNITION SOURCES.
Materials To Avoid: OXIDIZERS.
Hazardous Decomp Products: NONE SPECIFIED BY MFG.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NOT RELEVANT.

Health Hazard Data

LD50-LC50 Mixture: UNKNOWN
Route Of Entry - Inhalation: YES
Route Of Entry - Skin: YES
Route Of Entry - Ingestion: YES
Health Haz Acute And Chronic: ACUTE:EYE:IRRIT @ HIGH VAP LEVELS OR DIRECT CONTACT W/FLUID. SKIN:IRRIT ON PROLONG CONTACT W/LIQ, DERM RESULTING FROM DEFATTING NATURE OF LIQ. SYSTEMATIC:CNS EFFECTS (NARCOSIS) @ HIGH VAP LEVELS; MUC MEMBRANE IRRIT, PNEUMONIA. INGEST:GASTROINTESTINAL DISTRUBANCES. CHRONIC:PERIPERAL NERVOUS SY EFFECTS, BLOOD ALTERATIONS
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: YES
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: PER MSDS:NONE STATED; HOWEVER CONTAINS GASOLINE WHICH IS CONSIDERED BY IARC TO BE POTENTIAL CARCINOGEN
Signs/Symptoms Of Overexp: EYE & SKIN IRRITATION. DERMATITIS NARCOSIS. GI DISTURBANCES:NAUSEA, DIARRHEA, STOMACH PAINS.
Med Cond Aggravated By Exp: NONE SPECIFIED BY MFG.
THOROUGHLY WASH AREA W/SOAP & WATER INHAL:REMOVE FROM CONTAMINATED AREA ADMINISTER ARTIFICIAL RESP IF NECESSARY. CALL PHYSICIAN INGEST:GIVE A VEGETABLE OIL TO RETARD ABSORPTION DO NOT INDUCE VOMITING. CALL PHYSICIAN. FATAL DOSE ADULT HUMAN APPROX 350G, CHILD APPROX 10-13G.

Precautions for Safe Handling and Use

Steps If Matl Released/Spill: KEEP PUBLIC AWAY. SHUT OFF SOURCE W/O RISK. ADVISE POLICE & NAT RESP CENTER 800-424-8802 IF SUBSTANCE HAS ENTERED A WATER COURSE OR SEWER. CONTAIN LIQ W/EARTH, SAND. RECOVER FREE LIQ BY PPUMPING OR W/SUITABLE ABSORBENT.
Neutralizing Agent: NONE SPECIFIED BY MFG.
Waste Disposal Method: UNDER MANY SPILL SITUATIONS LIQ CAN BE RECOVERED & RECLAIMED. WHERE SOLID ABSORBENTS ARE USED THEY SHOULD BE INCINERATED PER APPLICABLE STATE & LOCAL REGULATIONS.
Precautions-Handling/Storing: USE APPROPRIATE GROUNDING-DISPENSING PROCEDURES. STORE IN RELATIVELY COOL PLACE. DO NOT EXPOSE TO HEAT, OPEN FLAME OR OXIDANTS.
Other Precautions: NONE SPECIFIED BY MFG.

Control Measures

Respiratory Protection: FOR EXPOSURES IN EXCESS OF EXPOSURE LIMITS CHEMICAL CARTRIDGE RESPIRATOR OR AIR SUPPLIED EQUIPMENT.
Ventilation: LOCAL EXHAUST REQUIRED & EXPLOSION PROOF EQUIPMENT.
Protective Gloves: IMPERMEABLE GLOVES.
Eye Protection: NONE SPECIFIED HOWEVER SAF GLASSES/GOGG
Other Protective Equipment: NONE SPEICFIED BY MFG.
Work Hygienic Practices: WASH HANDS AFTER HANDLING & PRIOR TO EAT/DRINK/ SMOKE/USE OF TOILET FACILITIES. FOLLOW GOOD WORK HYGIENE PRACTICES

Transportation Data

Trans Data Review Date: 94294
DOT PSN Code: GTN
DOT Proper Shipping Name: GASOLINE
DOT Class: 3
DOT ID Number: UN1203
DOT Pack Group: II
DOT Label: FLAMMABLE LIQUID
IMO PSN Code: HRV
IMO Proper Shipping Name: GASOLINE
IMO Regulations Page Number: 3141
IMO UN Number: 1203
IMO UN Class: 3.1
IMO Subsidiary Risk Label: -
IATA PSN Code: MUC
IATA UN ID Number: 1203
IATA Proper Shipping Name: GASOLINE
IATA UN Class: 3
IATA Label: FLAMMABLE LIQUID
AFI PSN Code: MUC
AFI Prop Shipping Name: GASOLINE
AFI Class: 3
AFI ID Number: UN1203
AFI Pack Group: II
AFI Basic Pac Ref: 7-7

Disposal Data

Label Data

Label Required: YES
Technical Review Date: 21OCT94
Label Status: F
Common Name: LEAD-FREE GASOLINE; NO-LEAD GASOLINE
Signal Word: DANGER!
Acute Health Hazard-Moderate: X
Contact Hazard-Moderate: X
Fire Hazard-Severe: X
Reactivity Hazard-None: X
Special Hazard Precautions: ACUTE:EYE:IRRIT @ HIGH VAP LEVELS OR DIRECT CONTACT W/FLUID SKIN:IRRIT ON PROLONG CONTACT W/LIQ, DERM RESULTING FROM DEFATTING NATURE OF LIQ. SYSTEMATIC:CNS EFFECTS (NARCOSIS) @ HIGH VAP LEVELS; MUC MEMBRANE IRRIT, PNEUMONIA. INGEST:GASTROINTESTINAL DISTRUBANCES. CHRONIC:PERIPERAL NERVOUS SYS EFFECTS, BLOOD ALTERATIONS 1STAID:EYE:FLUSH FOR @ LEAST 15MINS W/WATER. SKIN:THOROUGHLY WASH AREA W/ SOAP & WATER. INHAL:REMOVE FROM CONTAMINATED AREA. ADMINISTER ARTIFICIAL RESP IF NECESSARY. CALL PHYSICIAN. INGEST:GIVE A VEGETABLE OIL TO RETARD ABSORPTION DO NOT INDUCE VOMITING CALL PHYSICIAN. FATAL DOSE ADULT HUMAN APPROX 350G, CHILD APPROX 10-13G.
Protect Eye: Y
Protect Skin: Y
Protect Respiratory: Y

Label Name: BELL FUELS, INC
Label Street: 4116 WEST PATERSON AVE
Label City: CHICAGO
Label State: IL
Label Zip Code: 60646
Label Country: US
Label Emergency Number: 312-286-0200

ATTACHMENT 6
RADIATION PROTECTION PROGRAM, HS-700

PROCEDURE

Subject: RADIATION PROTECTION PROGRAM

1.0 PURPOSE AND SUMMARY

The purpose of this procedure is to minimize the total risk of harm or injury to employees, contractors, visitors, and the public as a result of exposure to ionizing radiation and radioactive material resulting from IT managed projects. However, this goal is only achievable if each employee, visitor, and contractor assumes personal responsibility for their radiological safety by integrating the following three principles into all aspects of company operations. These principles are designed to govern all work activities with the potential for exposure to radiation or radioactive materials:

- No activity or operation involving exposure to radiation shall be conducted unless its performance is necessary for the completion of the assigned task.
- All radiation exposure shall be kept as low as reasonably achievable (ALARA) based on economic and societal considerations.
- No individual shall receive radiation doses in excess of federal or administrative limits.

Safety requirements proposed by a client will be respected and followed. If client requirements are equal to or more stringent than IT employee safety requirements the client program will be used in lieu of the IT program. If those requirements are not equal to or more stringent than company requirements and their implementation does not increase the hazards, the company will follow client procedures and overlay those procedures with company requirements, where applicable to ensure minimum company requirements are met.

To aid in achieving this goal, this Radiation Protection Program (RPP) Plan has been developed to guide the generation and implementation of Standard Operating Procedures for Radiation Protection. The following sections contain a description of the company program elements.

2.0 APPLICABILITY

This procedure applies to operations of the company where employees may be exposed to ionizing radiation in excess of local background levels

This procedure does not apply where project operations are conducted under the scope of an existing radiological control program, e.g., a DOE-approved radiation protection program. Additionally this procedure does not apply to ionizing radiation exposure received as part of company-specified medical procedures.

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- 8.3 Others

8.0 Attachments

4.0 RESPONSIBILITIES

4.1 Vice President, Health and Safety

- Formulate and guide management implementation of a RPP that, as a minimum, provides a framework for compliance with regulatory requirements and standard industry practice.

- Maintain sufficient organizational independence to review and evaluate company activities involving the use of radioactive materials, radiation-producing machines, and project sites where radioactive materials are present.

- Maintain copies of all company licenses/permits (plus attachments and amendments) for radioactive materials and radiation-producing machines. Note: License maintenance is the responsibility of the Corporate Radiation Safety Officer (CRSO), including updates to the corporate files.

4.2 Corporate Radiation Safety Officer

- Formulate and implement a RPP that, as a minimum, provides compliance with regulatory requirements, this RPP, and standard industry practice.

- Advise Radiation Safety Officers (RSOs) regarding nuclear-related issues as part of proposal and work efforts.

- Maintain direct access to the Vice President for radiation protection purposes.

- Maintain all decontamination and decommissioning licenses within the company acting as the RSO of record on the license.

- Maintain and review this RPP and implementing procedures including Health Physics Field Guides

4.3 Health Physics Professionals (HPPs)

- Provide support to the CRSO as needed to ensure fixed facilities and field projects are implementing radiation protection programs commensurate with hazards and regulatory or contractual requirements and compliant with this RPP.

- Provide company wide support during all phases of project work involving radioactive materials and/or radiation from preparation of bids, development of project specific RPPs, project oversight, evaluation of site closure data, and writing of final reports.

- Provide support and consultation to RSOs on an as needed basis to ensure worker protection is compliant with this RPP and with current regulatory guidance.

4.4 Radiation Safety Officers (RSO)

4.4.1 Fixed Facility Radiation Safety Officers

- Under the direction of the individual fixed facility (i.e.; Laboratories) managers, formulate and implement a specific RPP that, as a minimum, provides compliance with pertinent regulatory requirements, license provisions, and this RPP. The requirements of this RPP may be incorporated as part of the Chemical Hygiene Plan for Laboratories or as part of a site specific health and safety plan.

- Maintain direct access to the facility manager on matters relating to radiological protection.

- Maintain sufficient organizational independence to review and evaluate activities involving the use of radioactive materials and radiation-producing machines.

- Provide Authorized Users and radiation workers with the instruments, protective devices, dosimetry, training, and other items needed to perform their work in accordance with the RPP elements.

- Solicit assistance, as needed, from the CRSO or HPPs.

- Maintain direct access to the CRSO or HPPs for radiation protection purposes.

4.4.2 Project Radiation Safety Officers

- Under the direction of the CRSO or an HPP, formulate and implement a specific RPP that, as a minimum, provides compliance with pertinent regulatory requirements and this RPP.

- Maintain direct access to Project/Program Managers on matters relating to radiological protection.

- Provide Authorized Users with the instruments, protective devices, dosimetry, training, and other items needed to perform their work in accordance with the radiological protection program elements.

- Maintain direct access to the CRSO or a HPP for radiation protection purposes.

4.4.3 Gauge Radiation Safety Officers

- Maintain control of all nuclear gauges for which they are the RSO of record.

- Assist project personnel in applying for reciprocity for the use of nuclear gauges outside of the state of record on the license.

- Ensure all users of a nuclear gauge meet the training requirements per the license and manufacturer's recommendations and that their training is documented in project files before such persons use the nuclear gauge.

- Ensure all required leak tests are conducted as required by the license and manufacturer.

4.5 Authorized Users (AU)

- Under the direction of the RSO, maintain familiarity with and adhere to the requirements specified in licensing documents, facility/site/project radiation protection plans, and this RPP.

- Report to the RSO for radiation protection purposes.

4.6 Health and Safety Professionals

- Review project proposals so that appropriate health and safety issues have all been addressed.

- Consult with the CRSO or other HPP about the appropriate radiation safety steps to take for project proposals.

5.0 DEFINITIONS

Airborne Radioactivity Area. A room, enclosure, or area in which airborne radioactive materials in concentrations in excess of 10% of the derived air concentrations (DACs) specified in Appendix B, 10 CFR 20.1001-2401.

Authorized Users (AU). Individuals who, by virtue of training and/or experience, have been authorized by the RSO and/or licensing agency to use or directly supervise the use of radioactive materials under the requirements of a specific radioactive materials license or company work plan.

Company. All wholly-owned subsidiaries of the IT Group, Inc.

Contamination Area. Any area which contains removable activity that is greater than 200 disintegrations per minute (dpm) beta and/or gamma per 100 square centimeters (cm^2) above background, and/or greater than 20 dpm alpha per 100 cm^2 above background; any area which

contains fixed activity that is greater than 1000 dpm per 100 cm^2 beta and/or gamma above background, or greater than 100 dpm per 100 cm^2 alpha above background; or as specified in U.S. Nuclear Regulatory Commission (USNRC) Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors".

Health Physics Professionals (HPP). Individuals who, by virtue of their education and experience, are qualified to approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be certified by the American Board of Health Physics (Comprehensive).

Planned Special Exposures. An infrequent exposure to radiation separate from and in addition to the annual dose limit.

Radiation Area. Any area accessible to personnel, where radiation levels exist such that a major portion of the body could receive a dose equivalent in excess of five (5) millirem in any one hour at 30 cm from the radiation source or from any surface that the radiations penetrate.

Radiation Safety Officers (RSO). Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs are specified by federal or state license requirements, and shall not be changed without notification of the appropriate licensing authority. Fixed facility RSOs include RSOs for sealed sources that require licensing by the USNRC or agreement state. Fixed facility RSOs are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall have a college degree in Health Physics and/or extensive work experience and knowledge in health physics. Project RSOs shall be designated by an HPP or the CRSO.

Radiation Worker. An individual with the potential to receive in excess of 100 millirem, total effective dose equivalent, within one calendar year.

6.0 TEXT

6.1 Control of Work with Radioactive Materials or Radiation Producing Machines

Prior to initiating any work involving radioactive materials or radiation producing machines, a task or location-specific hazard control plan shall be in place with appropriate approvals. These materials include licensable sources and contaminated materials. Such plan shall be prepared in accordance with one of the sets of requirements listed below, as appropriate.

- **HS052 Health and Safety Plans (HASP)**
  The HASP shall address all hazards associated with the work, including exposure to radiation. Radiation protection aspects of the HASP shall comply with the RPP (HS700) and its associated Standard Operating Procedures, as applicable.

- **HS012 Chemical Hygiene Plan**
  Laboratories may incorporate radiation protection requirements with their Chemical Hygiene Plan. Compliance with applicable provisions of HS 700 is required.

- **Location-Specific Radiation Protection Program**
  Company locations where potential exposure to radiation is the only hazard to employees, other than normal office hazards, may prepare a stand-alone Location-Specific RPP which complies with the requirements of this procedure

6.2 Training in Radiation Program

Unless documented training in radiation protection has been provided elsewhere, all personnel with unescorted access to radiologically-restricted areas shall be trained in radiation protection in accordance with procedure HS050. This training may consist of General Employee Training in Radiation Protection (GET), Radiation Worker Training, Authorized User Training, and/or special briefings. Other site-specific (e.g., DOE) or license-specific (e.g., USNRC or individual state) training delivered on a project-specific basis may be substituted for training pursuant to HS-050 and this RPP.

General Employee Training in Radiation Protection: GET is designed to provide an awareness of company radiation protection practices to all employees who may encounter radiological hazards as a result of their job description or work location, but who are not considered to be radiation workers. GET consists of 1-2 hours of classroom training in the following topics:

- Basic radiation protection concepts;
- Applicable Federal, State, and company radiation protection policies and procedures;
- Employees and management responsibilities for radiation safety;
- Identification of radiological postings, barriers, labels, boundary control stations, and monitors;
- The risk of low-level occupational radiation exposure;
- The risk of pre-natal radiation exposure; and
- Emergency procedures.

Radiation Worker Training: Radiation Worker Training provides comprehensive knowledge of radiation protection activities at company or at client sites where such training is not provided. Radiation Worker Training is provided to all employees, visitors, or contractors permitted unescorted access to radiation areas, contamination areas,

airborne radioactivity areas, or to personnel with the potential to receive in excess of 100 millirem in one calendar year. Radiation Worker Training will consist of approximately eight hours of formal classroom training in the following topics:

- Radioactivity and radioactive decay;
- Characteristics of ionizing radiation;
- Man-made radiation sources;
- Acute effects of exposure to radiation;
- Risks associated with occupational radiation exposures;
- Special considerations in the exposure of declared pregnant women;
- Dose equivalent limits;
- Modes of exposure (internal and external);
- Dose equivalent determinations;
- Basic protection measures (time, distance, shielding);
- Specific company procedures for maintaining exposures as low as is reasonably achievable;
- Orientation regarding the Radiation Work Permit form (Attachment 3);
- Radiation survey instrumentation, calibration, and limitations;
- Contamination control, including the use of protective clothing and equipment, and workplace design;
- Personnel decontamination;
- Emergency procedures;
- Warning signs, labels, barriers, and alarms;
- Responsibilities of employees and management;
- Interactions with the Vice President, Health and Safety and other radiation protection personnel; and

- Operational procedures associated with specific job assignments.

Authorized User Training: In addition to Radiation Worker Training, advanced training in radiation protection shall be provided to AUs who are not otherwise qualified by previous training and experience. Authorized User training consists of 40 hours of formal classroom, site-specific and on-the-job training, as well as a detailed briefing on the contents of location-specific hazard control plans and Standard Operating Procedures for Radiation Protection.

Special Briefings: Special briefings and job mock-ups shall be required for those personnel involved in work activities associated with a significant radiological hazard. The need for special briefings shall be specified on the Radiation Work Permit (Attachment 3) or as determined by the RSO for fixed facilities and by the Health and Safety Manager for project-related activities.

Activity-Specific/Client-Specific Training: Where specific client requirements exist, and/or the HPP or RSO determines that additional training is required to ensure safety, the requirement shall be established in the Health and Safety Plan or Radiation Protection Program or Chemical Hygiene Plan covering that activity.

All forms of training shall be updated annually. Training records shall be maintained by the RSO, with copies forwarded to the Training Department. These records shall include attendance sheets, results of proficiency examinations, copies of proficiency examinations, and course lesson plans.

6.3 Radiation Exposure Control

External Exposure Limits: External exposure limits for employees, visitors, and contractors shall be consistent with those established by the USNRC in 10 CFR 20.1201. In developing the radiation protection requirements for a facility or project, the RSO or HPP shall specify the appropriate requirements. Administrative goals for exposure of employees, visitors, and contractors shall be 10% or less of the regulatory limits.

Employees under 18 years of age are not permitted access to radiologically-restricted areas at company fixed facilities or client locations. Therefore, annual external exposure limits for minors shall not exceed the limits shown in 10 CFR 20.1207.

Exposure of the Unborn: Exposure limits for the unborn child shall not exceed those established by the USNRC in 10 CFR 20.1208 for the entire gestation period. Employees working with radioactive material shall be informed of the potential effects that may result to an embryo-fetus at low exposure levels. Employees shall be encouraged to notify the RSO regarding suspected or confirmed pregnancies. When pregnancy is declared, evaluation shall be performed by the RSO to determine the potential for the employee to exceed the regulatory exposure limit during the nine month gestation period. If the

potential exists or if an employee's request for transfer is approved, the employee will be transferred to a different job assignment during the pregnancy pursuant to the guidelines found in company procedure HS041.

External Exposure Monitoring: All employees, visitors, and contractors permitted unescorted access to posted Radiation Areas of company or client sites shall be assigned a personnel dosimeter to wear while on site. The personnel dosimetry program shall be accredited by the National Voluntary Laboratory Accreditation Program (NVLAP). All personnel dosimeters used for the external dose of record for each employee, visitor, or contractor shall consist of thermoluminescent dosimeters (TLDs) or equivalent. A formal investigation shall be performed by the RSO in the event that a whole body or area dosimeter shows an exposure in excess of 10 percent of the limits specified in 10 CFR 20.1201 or if a dosimeter is lost.

Internal Exposure Limits: Internal exposure limits for employees, visitors, and contractors shall be consistent with those established by the U. S. Nuclear Regulatory Commission in 10 CFR 20.1201. Administrative goals for intakes by employees, visitors, and contractors are not to exceed 10% of the regulatory limits, however the basic policy of the company is that all internal exposures are preventable.

Internal Exposure Monitoring: Employees, visitors, and contractors shall participate in a program of internal exposure monitoring whenever required by radiological conditions, by the provisions of 10 CFR 20.1502, by pertinent license requirements, or as recommended by the RSO. Monitoring shall be performed whenever an administrative limit may have been exceeded or a nasal smear reveals the presence of detectable radioactivity. Monitoring methodologies and frequencies shall be appropriate for detecting the types and quantities of radioactive materials in use by the employee, and shall be determined by the regional HPP.

Internal Dose Assessment: Internal radiation doses shall be assessed for each employee, visitor or contractor involved in the bioassay program at least once per year. Internal radiation doses shall be reported as committed effective dose equivalent, assigned in the year in which the dose was received. The RSO shall ensure internal dose assessments are performed when required by this procedure. Internal dose assessments shall be performed by personnel trained in the assessment of internal dose.

6.4 ALARA Program

While the majority of occupational radiation exposures incurred by employees, visitors, or contractors of the company are historically low, all exposures are assumed to entail some risk. Therefore, the following three principles to govern work activities with the potential for exposure to radiation or radioactive materials shall be adopted:

- No activity or operation shall be conducted unless its performance will produce a net positive benefit.

- All radiation exposures shall be kept as low as reasonably achievable (ALARA) considering economic and societal costs.

- No individual shall receive radiation doses in excess of federal or administrative limits.

The ALARA principle is the basis for much of the company's radiation protection program. The following basic elements shall be addressed in the ALARA program:

- Policy and management commitment;

- Organization and responsibilities;

- Administrative exposure control levels;

- ALARA training;

- Plans and procedures;

- Internal audits;

- Methodology for cost/benefit optimization;

- Radiological design review;

- Radiological work planning; and

- Records.

Each location performing work involving radioactive materials shall establish a radiation protection subcommittee in their safety council. This subcommittee shall review the ALARA program at their location to verify that it is effectively implemented. (NOTE: For project offices infrequently handling radioactive materials, this subcommittee should be active only when such work is being planned or executed.)

6.5 Contamination Control

The company has adopted specific concentration limits for radioactive materials which may exist on equipment and surfaces located in "unrestricted areas" and "contamination areas". Unrestricted areas may include, but are not limited to, laboratory floors, benches, equipment, and materials released from potentially contaminated areas for unrestricted use. Contamination surveys shall be performed in accordance with license or project requirements to confirm that concentrations of radioactive materials in unrestricted areas satisfy the contamination limits shown below. Materials or equipment being released from contaminated areas will be surveyed to ensure that residual surface contamination meets

the limits determined to be applicable for the project site. Materials exceeding the limits will be either decontaminated to within the limits or be treated as radioactive material.

Contamination areas shall be clearly defined and may include, but are not limited to, designated benches, equipment, hood areas, or glove boxes in a radiation area or a contaminated area. Temporary control zones may be established by the AU or RSO in order to minimize the spread of contamination.

Loose Contamination Limits: Loose radioactive contamination shall be maintained at concentrations that are as low as reasonably achievable (ALARA). Areas where loose contamination is detected shall be classified as follows:

- Unrestricted Areas: Less than Reg. Guide 1.86 Table 1 removable limits for the contaminants of concern above background.

- Contamination Areas: Greater than Reg. Guide 1.86 Table 1 removable limits for the contaminants of concern above background.

NOTE: When more than one contaminant exists within an area or facility the more restrictive removable contaminant limit shall be applied.

Loose contamination shall be measured with dry disc smears wiped over a suspect surface area of at least 100 cm^2 and counted in an appropriate counting device.

Fixed Contamination Limits: Fixed radioactive contamination shall be maintained at concentrations that are as low as reasonably achievable (ALARA). Areas where fixed contamination is detected shall be classified as follows:

- Unrestricted Areas: Less than Reg. Guide 1.86 Table 1 average limits for the contaminants of concern detected by direct survey.

- Contamination Areas: Greater than Reg. Guide 1.86 Table 1 limits for the contaminants of concern above background.

NOTE: When more than one contaminant exists within an area or facility the more restrictive removable contaminant limit shall be applied.

Fixed contamination shall be measured by direct survey with portable radiation survey instruments sensitive to beta/gamma radiation (e.g., thin wall G-M instrument or equivalent) or alpha radiation (e.g., alpha probe and rate meter).

Decontamination: Contamination found in excess of the stated limits for unrestricted areas shall be decontaminated to acceptable limits or the designation of the area shall be changed. The area shall be restricted until the decontamination can be completed. Decontamination methods and correct area postings shall be determined by the RSO.

Material and/or equipment that cannot be decontaminated below the limits specified shall be properly labeled and protected (i.e., bagged, stored, barricaded, etc.).

Control of Work in Contamination Zones: Work with radioactive materials shall be planned in advance to minimize the received dose and the potential for spread of contamination. Work personnel are responsible to ensure that all necessary materials and equipment are readily and easily available prior to the start of an operation. All work areas shall be surveyed and resurveyed following the operation. Absorbent, disposable materials shall be placed on working surfaces, and reagent containers and equipment may be wrapped in plastic prior to use, when applicable.

The engineering controls, administrative controls, and personal protective equipment requirements shall be established in the Health and Safety Plan, RPP, or Chemical Hygiene Plan applicable to the task.

Work involving concentrated liquid radioactive standards shall be performed in a fume hood.

6.6 Instrumentation and Surveillance

Instrumentation: Instrumentation used by employees to assess radiation exposure levels and/or contamination levels shall be of sufficient sensitivity and accuracy to assess radiation exposure levels at company or client facilities. Radiation protection instruments shall be calibrated at the frequency specified in the licensing documents and/or at least annually. RSOs are responsible for providing calibrated instruments for use. Calibration and repair records shall be maintained in the project files or fixed facility records, by the RSO.

Fixed laboratory instrumentation used for analysis of samples shall be checked for satisfactory performance pursuant to vendor instruction manuals. Acceptable performance shall be demonstrated by measurement of background counting rates and by the response of the instruments to appropriate calibration sources and/or check sources.

Surveillance: Radiation and swipe surveys of company premises or client locations where radioactive materials are handled shall be performed on a planned and periodic basis. Non-routine surveys shall be performed at the discretion of the RSO or any time there is reason to suspect that radiation levels may have changed or that contamination is present. Periodic leak tests of sealed radiation sources shall be performed as required in 10 CFR 30 or pertinent license requirements.

6.7 Radiological Areas and Posting

Radiological area definitions and posting/labeling requirements throughout company or client facilities shall be as described in 10 CFR 20, Subpart J. All personnel permitted unescorted access to the radiologically-restricted areas of company or client facilities shall be trained in recognition of posting/labeling.

A radiation area is defined as any area accessible to personnel, where radiation levels exist such that a major portion of the body could receive an external dose equivalent in excess of five (5) but less than 100 millirem in any one hour at 30 cm from the radiation source or from any surface that the radiations penetrate. A radiation area shall be posted with signs that are magenta (purple) and yellow in color, and bearing the words "CAUTION - RADIATION AREA" along with the three-blade radiation symbol. Personnel entering a radiation area shall wear a personnel radiation dosimeter.

A high radiation area is defined as an area, accessible to personnel, in which radiation exposure rates should result in an individual receiving a dose equivalent in excess of 100 millirem but less than 500 rad in any one hour at 30 cm from the radiation source or from any surface that the radiations penetrate. Such areas shall be posted with magenta and yellow signs bearing the words "CAUTION (or DANGER) -- HIGH RADIATION AREA" and the three-blade radiation symbol. Personnel entering a high radiation area shall wear a personnel dosimeter. Each entrance or access point to a high radiation area shall be locked and controlled in accordance with 10 CFR 20.1601.

Note: Black may be substituted for magenta in any posting, however magenta is preferred.

A contaminated area is defined as an area accessible to personnel, where there exists fixed and/or removable contamination in excess of the limits established for unrestricted access. Such areas may occur anywhere in the restricted areas, and shall be posted with magenta and yellow sign and/or tape bearing the words "CONTAMINATED" or "INTERNAL CONTAMINATION". The boundaries of these areas shall be clearly visible. The RSO shall approve all work in contaminated areas prior to its start. Contaminated areas can be designated either as "Contaminated Area" or "High Contamination Area," depending upon the level of contamination present.

Areas having the potential for having airborne contamination that exceeds 10% of a derived air concentration, found in 10 CFR 20 Appendix B, Table 1 shall be posted as an "Airborne Contamination Area."

Each area or room in which radioactive materials are stored in quantities that are greater than 10 times the quantity of such materials shown in 10 CFR Appendix C of 20.1001-2401 or Category II or III samples as defined below shall be posted with the magenta and yellow symbol and the words "CAUTION: RADIOACTIVE MATERIAL(S)" at each entrance point.

Samples containing radioactive materials shall be classified with respect to handling requirements in order to limit personnel exposure to radiation. Sample classifications are:

- Category I: Gross alpha less than 0.01

- Category II: Less than 0.1 mR/hr on contact; Less than 0.01 µCi/g total activity; Gross alpha, greater than 0.01 but less than 0.1 µCi; Gross beta, greater than 0.1 but less than 1 µCi.

- Category III: Greater than 0.1 mR/hr on contact; Greater than 0.01 µCi/g total activity; Gross alpha, greater than 0.1 µCi; Gross beta, greater than 1 µCi.

At sites or facilities which contain licensable radioactive materials, USNRC Form 3, "Notice to Employees" (see Attachment 4), or applicable state equivalent, shall be posted in prominent locations, including but not limited to the break room and employee bulletin boards. Radiation Work Permits shall be posted at the entrance to controlled zones or radiation areas.

Caution signs may not be necessary in areas/rooms where radioactive materials are present for a period of less than eight (8) hours, provided that the materials are attended throughout this period by an individual who has been trained in the precautions for radiation exposure of personnel. The RSO shall make this determination.

6.8 Control of Radiological Work

Control of work involving radioactive materials is accomplished by establishing radiological standards and responsibilities, using first-line supervisors and radiological protection personnel to monitor performance of radiological work, training workers in radiation hazards, and providing personnel with operating procedures and/or Radiation Work Permits (RWPs) that include the radiological protection measures and controls necessary for safe completion of the job.

For work at client facilities, RWPs shall be initiated by the Supervisor and approved (Attachment 3). For fixed facilities, RWPs shall be initiated for work with all Category III samples, or work conducted within a posted radiation or contamination area, and shall be approved by the RSO. Prior to performing work under a RWP, workers shall sign the RWP signifying they have read the RWP, fully understand all requirements and radiological conditions, and agree to comply with the requirements. RWP and associated records shall be maintained in a retrievable, legible form by the RSO for fixed facilities.

For projects, RWPs shall be required for all work in areas posted with any of the following: Contamination Area, High Contamination Area, Airborne Radioactivity Area, Radiation Area , High Radiation Area, or Very High Radiation Area. All RWP shall be maintained in the project file. Changes in the manner of work performance shall require a review of the RWP in accordance with Attachment 3.

6.9 Engineered Controls and Respiratory Protection

As required in 10 CFR 20, Subpart H, engineered controls shall be the primary means whereby intake of airborne radioactivity by workers and/or exposure to external radiation

is minimized. Workers shall not be subject to the increased physical stress and loss of work efficiency by wearing respirators unless engineered controls or administrative controls are determined to be ineffective. In the event that respirator usage is required, the following conditions shall apply:

- Users shall receive a medical examination within the prior twelve months which indicates that the user is medically fit to wear the assigned respirator.
- Users shall receive training on the topics of respiratory protection and respirators in accordance with II Procedure HS601.
- Users shall be clean-shaven each day on all sealing surface areas under the respirator.
- Users shall comply with the provisions of the Company Respiratory Protection Program as described in HS601.

6.10 Receipt, Handling, and Identification of Radioactive Materials

Incoming packages, known or suspected to contain radioactivity shall be monitored by a qualified person for exposure rate and removable external contamination, pursuant to 10 CFR 20.1906. Radioactive material shall be marked as such to ensure proper handling and storage. Markings may include tags or stickers (in yellow and magenta) indicating "Internal Contamination" or "Radioactive Materials".

Items identified as radioactive materials shall be maintained in a radioactive material storage area established for this purpose within a restricted area.

Radioactive materials received by the company in excess of the limits specified in 10 CFR 30.71, Schedule B, shall be entered in a radioactive material inventory log as required by Federal or State regulations or specific licensing requirements. If the log is required, it shall be maintained to track and demonstrate compliance with maximum possession limits established in the applicable license, and update radioactive material inventory as specified

6.11 Packaging and Transportation of Radioactive Materials

Radioactive material which is shipped from the company shall be packaged and shipped in a manner which minimizes radiation exposure to the shippers, the general public, and to the environment. Shipments shall be packaged, surveyed, and labeled in accordance with Department of Transportation (DOT) regulations, 49 CFR 173.400, Subpart I and 10 CFR 71. Prior to shipment of radioactive material from a company facility or project, the RSO shall determine that the receiver is licensed to receive the type, quantity and form of radioactive material present in the shipment. A copy of the receiving facility's license or a certification that the facility is licensed for possession of the material is required prior

to shipment. The person(s) assigned to perform this task will have current training status in accordance with 49 CFR 172-700.

6.12 Control of Radioactive Waste

Control of radioactive waste materials shall be accomplished by:

- Preventing materials from becoming unnecessarily and/or excessively contaminated;
- Decontaminating and reusing items such as tools and equipment;
- Identifying, controlling, and promptly repairing leaks from radioactive systems or from other sources of contamination;
- Monitoring materials for radioactivity and removing non-radioactive materials prior to disposal; and
- Using waste volume reduction techniques when practical.

Waste segregation practices shall be implemented in order to assure separation of radioactive materials from non-radioactive materials, exclusion of liquids from the waste stream, and minimization of the volume of mixed (hazardous/radioactive) wastes generated.

All radioactive waste shall be disposed of in containers deemed appropriate for solid or liquid waste. All radioactive waste containers shall comply with Department of Transportation (DOT) specifications. Plastic liners and absorbent material shall be routinely used. The isotope(s), activities, and volumes of all materials placed in the waste containers shall be recorded in the container inventory log at the time of the addition. Waste containers shall be labeled and maintained in an area established for that purpose.

Radioactive waste shall be disposed of by one of the following means:

- Transfer to a waste disposal service which is licensed to receive such waste in accordance with 10 CFR 20.2001.
- Transfer to the original supplier which is properly licensed to receive radioactive materials;
- Release into the sanitary sewer in conformance with 10 CFR 20.2003.
- Other means specifically approved in advance by the USNRC pursuant to 10 CFR 20.2002, or specific license requirements.

6.13 Radiation Protection Records

Records shall be maintained in order to document implementation of this RPP and to demonstrate compliance with the USNRC or state license requirements. Records relating to a fixed facility radiological control program shall be maintained for the duration of the USNRC or state license, or disposed of as authorized by the USNRC or applicable state agency. Records shall include:

- Training records on each worker indicating date of training, test results, and instructor name/company name;
- Radiation Work Permits and associated records;
- Radiation exposure records on each worker including both internal and external exposure results in accordance with 10 CFR 20, Subpart L;
- Calibration records for instrumentation;
- All documentation on dose estimates;
- Bioassay results for all samples submitted by employees, visitors, or contractors; and
- Site monitoring data (i.e., ambient surveys, contamination surveys, airborne radioactivity surveys, environmental monitoring surveys, etc.) collected by company personnel.

Employee exposure records shall be on file at the company's Corporate office through the Health and Safety department, and personnel exposure records shall be maintained for the duration of employment plus 30 years, per company Procedure HS102. These records shall include:

- Radiation exposure records on each worker including both internal and external exposure results in accordance with 10 CFR 20, Subpart L.
- All documentation on dose estimates and supporting information; and
- Bioassay results for all samples submitted by employees, visitors, or contractors.

Employees, visitors, and contractors have the right to review their personnel exposure records upon request. Exposure reports shall be prepared by the RSO/HPP annually, when requested, and at the time of employment termination. If the most recent monitoring results are not available at that time, a written estimate of the dose shall be provided, together with a clear indication that it is an estimate rather than a dose of record. Any letter containing dose estimates will be followed up within 90 working days with a letter listing dose of record.

6.14 Program Documentation

This procedure (HS700) shall control all work within the IT Group involving radiation or radiation producing machines. The following Standard Operating Procedures shall also be implemented to control this work unless location-specific written alternative guidelines are received and approved by the HPP.

RPP-001	Internal Exposure Control
RPP-002	External Exposure Control
RPP-003	Contamination Control
RPP-004	Instrumentation and Surveillance
RPP-005	Radiological Areas and Posting
RPP-006	Sample Screening and Shipping
RPP-007	Receipt, Handling and Identification of Radioactive Materials
RPP-008	Engineered Controls and Respiratory Protection
RPP-009	Packaging and Transportation of Radioactive Materials
RPP-010	Radiation Protection Records
RPP-011	Control of Standard Operating Procedures for Radiation Protection
RPP-012	Emergency Response and Notifications
RPP-013	Handling Sealed Radiation Sources
RPP-014	Quality Assurance in Radiological Protection
RPP-015	Control of Radiological Work
RPP-016	Radiological Area Surveys

6.15 Emergency Response Notifications

For emergencies where radioactive materials may be involved, consideration shall be given to exposure to radioactive materials and ionizing radiation, in addition to the other hazards present. Advance planning and preparation for potential emergencies shall be

stressed to personnel in order to ensure that the initial response to an emergency is proper and not hampered by lack of facilities or equipment.

The appropriate responses for the following incidents or emergencies as they pertain to the safe use of radioactive materials shall be as described in the project Health and Safety Plan, license requirements, or facility plan. Management review and follow-up shall be as described in Procedure HS020:

- Electrical power failures;
- Minor spills (liquid or dry);
- Major spills;
- Accidents involving radioactive dusts, mists, fumes, vapors or gases;
- Injuries to personnel involving radioactive contamination;
- Fires or other emergencies; and
- Fire prevention.

In addition, radiological incidents may include lost or damaged TLDs or accidental over-exposures. Employees shall promptly notify the RSO of lost or damaged TLDs. The RSO shall issue a new dosimeter for that monitoring period, evaluate/estimate the radiation exposure incurred from the beginning of the monitoring period until the time of loss damage, and record all pertinent information in the employee's dosimetry records. It may be necessary to limit the exposure of the individual involved until the investigation is completed.

If it is known or suspected that radioactive material has been taken into the body, the RSO shall be notified immediately. The RSO, the HPP and the Vice President, Health and Safety shall evaluate the amount of material ingested/inhaled and the resulting exposure. This investigation may include airborne activity sampling and analysis, bioassays, or whole body counting, as needed.

The RSO, with guidance from the regional HPP, shall notify the USNRC as required by 10 CFR 20.2201, 20.2202 and 20.2203 of any incident involving licensed material which has caused or threatens to cause certain conditions or effects as delineated in license requirements or applicable regulations. Planned Special Exposures, if authorized by the Vice President, Health and Safety, shall be reported pursuant to 10 CFR 20.2204. Reports of personnel overexposure and Planned Special Exposures shall be retained as permanent records, with copies forwarded to the employee. Additional exposure of an individual involved in an overexposure incident shall be restricted to ensure that the

individual does not exceed any applicable regulatory limits. The health aspects of the specific exposure received shall be presented by the RSO to the involved individual.

Injuries or illnesses occurring on the job will be responded to as for other injury or illness incidents, in that medical or hospital assistance will be enlisted from nearby facilities. Injuries or illnesses involving radioactive materials and warranting emergency professional medical care will be handled in a manner commensurate with their severity. The HPP will provide consultation for such emergencies by direct involvement.

6.16 Quality Assurance in Radiological Protection

All activities conducted as part of this Radiation Protection Program shall be subject to quality assurance requirements. The quality assurance provisions for radiological protection will provide consistency/accuracy of results and documentation/verification of the effectiveness of the Radiation Protection Program. These provisions shall include the following:

- Facility or project-specific procedures shall be developed to implement this Radiation Protection Program.
- Audits/assessments shall be conducted by the CRSO or a designee to determine compliance with USNRC regulations, applicable state regulations, applicable license requirement, and this Radiation Protection Program.
- The company radiation protection program shall be audited/assessed at least annually by the CRSO or designee.

Any employee or subcontractor employee may contact the Vice President of Health and Safety to report items, activities, or procedures which they deem inconsistent with regulatory and/or administrative requirements, and the provisions of this Radiation Protection Program. However, prior to contacting the Vice President of Health and Safety they should report their concerns to their immediate supervisor project manager. If the employee is not satisfied then they should contact the Vice President of Health and Safety. Company management shall ensure that there are no punitive consequences resulting from an employee's reporting of their valid concern.

7.0 EXCEPTION PROVISIONS

Variances and exceptions shall be permitted pursuant to the provisions of IT procedure HS013, "Health and Safety Procedure Variances"

8.0 CROSS REFERENCES

8.1 Requirements and Specifications

Title 10, Code of Federal Regulations, Part 19, "Notices, Instructions, and Reports to Workers; Inspections"

Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation"

U. S. Department of Energy N-5480.6, "Radiological Control Manual"

Title 10, Code of Federal Regulations, Part 835, "Occupational Radiation Protection"

USNRC and Agreement State Licenses

8.2 Related Company Procedures

HS-001, "Safety Policy"

HS-013, "Health and Safety Procedure Variances"

HS-020, "Accident Prevention Program: Reporting, Investigation and Review"

HS-022, "Accident Prevention Program: Review of New Proposals, Projects, Construction, and Jobs by Heath and Safety"

HS-040, "Stop Work Authority"

HS-041, "Embryo-Fetus Protection Program"

HS-050, "Company Employee and Subcontractor Training Requirements"

HS-051, "Tailgate Safety Meetings"

HS-052, "Health and Safety Plans"

HS-060, "Hazard Communication"

HS-310, "Hazardous Waste Operations at Uncontrolled Waste Sites"

Other applicable Company Health and Safety procedures.

8.3 Others

American National Standard, "Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments", ANSI N323A, 1997.

National Council on Radiation Protection and Measurement, Report No. 59, "Operational Radiation Safety Program"

National Council on Radiation Protection and Measurements, Report No. 71, "Operational Radiation Safety - Training"

International Commission on Radiological Protection, Publication No. 35, "General Principles of Monitoring for Radiation Protection of Workers"

USNRC Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors"

USNRC Regulatory Guide 1.144, "Auditing of Quality Assurance Programs for Nuclear Power Plants"

USNRC Regulatory Guide 8.2, "Administrative Practices in Radiation Monitoring"

9.0 ATTACHMENTS

1. Responsibility Matrix
2. Approval Authority
3. Radiation Work Permit (This form is mandatory unless an alternate form is specified in a location specific requirement.)
4. USNRC FORM 3

ATTACHMENT 1
RADIATION PROTECTION PROGRAM
Responsibility Matrix

Action	Procedure Section	Responsible Party					
		VP Health & Safety	HPP	RSO	AU	HS Manager	Supervisor
Formulate/guide management implementation of radiation protection procedures	3.1.1, 3.3.1.1, 3.3.2.1	X	X	X			
Review/evaluate activities involving radiation	3.1.2	X					
Maintain copies of company licenses and permits	3.1.3	X					
Advise management of nuclear-related issues during proposal preparation	3.2.2		X				
Provide Authorized Users with appropriate equipment	3.3.1.4			X			X
Ensure adherence to requirements of license and radiation protection plans/procedures	3.4.1				X		X
Review proposals to ensure Health & Safety compliance	3.5.1					X	
Ensure all employees are properly trained	5.2, 5.3						X
Ensure exposure monitoring is recorded as appropriate	5.3			X			
Establish contamination control zones	5.5			X	X		
Ensure proper calibration of instruments	5.6			X			
Determine radiological areas and postings	5.7			X			
Initiate/obtain approval of Radiation Work Permits	5.8						X
Ensure handling, packaging, and transportation of radiological materials/waste is appropriate per this procedure	5.10-5.12			X			X
Radiation protection records shall be retained for duration of USNRC or state license or disposed of as authorized by USNRC or applicable state agency	5.13			X		X	
Employee exposure monitoring records to be retained for duration of employment + 30 years	5.13, HS102			X		X	

ATTACHMENT 2
APPROVAL AUTHORITY

Action	Approval Required*
USEPA Level A PPE IDLH Corporate procedure variance Special Circumstances ***Potential for personnel radiation exposure to exceed 500 mrem (TEDE) within one calendar year*** ***Planned special exposures***	Project Manager Project/Location HS Staff HS Manager CIH ***RSO*** ***HPP*** ***Vice President***
USEPA Level B PPE ***Potential for personnel radiation exposure to exceed 100 mrem (TEDE) within calendar year*** ***Access to airborne radioactivity areas***	Project Manager Project/Location HS Staff HS Manager CIH ***RHO*** ***HPP***
USEPA Level C or D PPE ***Access to Radiation, Contamination, or Radioactive Materials areas (posted or unposted)*** ***Access to areas with ambient exposure rates***	Project Manager Project/Location HS Staff (other than the writer) ***RSO***

* Project/Location HS staff must be a degreed Health and Safety Professional to execute this approval level

HS Manager and corporate level professionals are authorized to designate an alternate professional reviewer to act in their place, and to permanently delegate this approval authority to individual Health and Safety Professionals

RSOs shall be IT Technical Associates in Health Physics, radiation protection professional designated by an HPP, or a Fixed Facility RSO.

ATTACHMENT 3
RADIATION WORK PERMIT

Location:	**Release Number:**
Job Description:	
Job Supervisor	**Phone #:**
Job Start Date:	**Job Finish Date:**

SITE CHARACTERIZATION					
	RADIATION LEVELS			CONTAMINATION	
Location	Type	Contact (mrem/hr)	Work Area (mrem/hr)	Type	Activity (dpm/100cm^2)

AIRBORNE	OTHER HAZARDS	
Activity (iCi/mi)	Type	Levels

PERSONAL PROTECTIVE EQUIPMENT					
BODY & HANDS	**X**	**FEET**	**X**	**HEAD**	**X**
Coveralls: 1pr; 2pr Lab Coat Plastic Suit Paper Coveralls Cloth Liners Rubber Gloves Surgical Gloves Tape Gloves to Coveralls		Shoe Covers (canvas) Plastic Booties Rubber Shoes Paper Shoe Covers Tape Booties to Coveralls No Personal Outer Clothing		Surgical Cap Canvas Hood Plastic Hood Face Shield Goggles Hard Had	
HS COVERAGE	**X**	**RESPIRATORY** / **PF**	**X**	**DOSIMETRY**	**X**
None Start of Job End of Job Continuous		Dust Mask N/A Half Face 10 Full Face 50 Air-Fed Hood 2K Airline Full Face 2K Self-Contained 10K Lapel Air Sampler Per Individual Per Group		TLD Dosimeter 0-200mR Dosimeter (high) range _____ Extremity TLD Neutron Badge Digital Alarming Dosimeter Per Individual Per Group	

Special Instructions:	**Waste Handling:**
Preparer:	
Approval ***(Project Radiation Safety Officer)***	
Expiration Date:	**Termination Date:**

ATTACHMENT 7
RADIATION PROTECTION PLAN STANDARD OPERATING PROCEDURES

This attachment presents the following Radiation Protection Plan (RPP) standard operating procedures:

- RPP-001 - Internal Exposure Control
- RPP-002 - External Exposure Control
- RPP-003 - Contamination Control
- RPP-004 - Instrumentation and Surveillance
- RPP-005 - Radiological Areas and Postings
- RPP-007 - Radiation Protection Program
- RPP-015 - Control of Radiological Work

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-001

TITLE: **Internal Exposure Control**

REVISION NO.	DATE
001	9/23/96

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1 PURPOSE AND OBJECTIVES

The purpose of this procedure is to describe the method for controlling internal radiation exposure. This procedure is applicable to all work activities that involve radioactive materials or the potential for internal exposure to radioactive materials. The objective of the procedure is to assure that the potential for internal radiation exposure of IT employees, visitors and contractors is minimized by establishing and enforcing good work practices, dose limits, and administrative dose control points.

2 RESPONSIBILITIES

2.1 Corporate Director of Health and Safety (Director) shall:

2.1.1 Assure that internal radiation exposures of all employees, visitors and contractors are maintained as low as is reasonably achievable (ALARA).

2.1.2 Approve all planned exposures in excess of regulatory or license limits.

2.2 Health Physics Professional (HPP) shall:

2.2.1 Approve all planned exposures in excess of administrative, regulatory or license limits.

2.2.2 Assist the RSO in performance of internal dose assessments, selection of appropriate bioassay methods, and determination of monitoring frequency.

2.2.3 Approve all internal dose assessments prior to entry into the dosimetry record.

2.2.4 Provide guidance to the Director and RSO on matters pertaining to internal dose assessment and internal exposure control.

2.2.5 Assist RSOs in designing and implementing a contamination control program.

2.3 Radiation Safety Officer (RSO) shall:

2.3.1 Develop and administer an industry-standard internal radiation monitoring program when applicable.

2.3.2 Approve all planned exposures in excess of administrative, regulatory, or license limits.

2.3.3 Design and implement a contamination control program that ensures that internal exposure to radioactive materials is minimized and that worker exposure to airborne and loose surface contamination is within allowed limits.

2.4 Project Managers and Fixed Facility Directors shall:

2.4.1 Disseminate this policy to all applicable personnel.

2.4.2 Enforce participation in the monitoring program as scheduled by the RSO.

2.4.3 Appropriate funds as necessary to implement a contamination control program as designed by the RSO and HPP.

2.5 **IT** Employees, Visitors, and Contractors shall:

2.5.1 Maintain an awareness of the internal radiation dose limits and follow radiological controls if pertinent to a job assignment.

2.5.2 Comply with **IT** policy in order to maintain their own internal radiation dose within prescribed limits.

2.5.3 Participate in the internal radiation monitoring program as directed by the RSO.

3 REFERENCES

3.1 Requirements and Specifications

3.1.1 IT Corporation Policy No. HS-700, "Radiation Protection Program Plan"

3.1.2 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation", 1991.

3.2 Related Procedures

3.2.1 IT Corporation Procedure No. RPP-010, "Radiation Protection Records"

3.2.2 RPP-008, "Engineered Controls and Respiratory Protection"

3.3 Others

3.3.1 International Commission on Radiological Protection, "ICRP Task Group on Reference Man", ICRP Publication 23, 1975.

3.3.2 International Commission on Radiological Protection, "Limits of Intakes of Radionuclides by Workers", ICRP Publication 30, 1980.

3.3.3 International Commission on Radiological Protection, "Individual Monitoring for Intakes of Radionuclides by Workers: Design and Interpretation", ICRP Publication 54, 1987.

3.3.4 American National Standards Institute, "Practice for Occupational Radiation Exposure Records System", Report No. ANSI N13.6 - 1966 (R1982).

4 DEFINITIONS

3.1 Activity - Disintegration rate of a radioactive material stated in dps, becquerels, Ci or other acceptable unit.

3.2 Annual Limit on Intake (ALI) - The activity of a radionuclide which, if taken into the body, would irradiate a person, represented by Reference Man, to the limit set by the regulatory agency for each year of occupational exposure.

3.3 Approval - An act of endorsing or adding positive authorization or both.

3.4 Bioassay - Measurement of amount or concentration of radioactivity in the body or in material excreted or removed from the body for purposes of estimating the quantity of radioactive material in the body.

3.5 Committed Dose Equivalent - The dose equivalent to an organ or a tissue that will be received from an intake of radioactive material by an individual during the 50-year period following the intake.

3.6 Committed Effective Dose Equivalent - The sum of the committed dose equivalents to individual tissues resulting from an intake of a radionuclide multiplied by the appropriate weighting factors

Install Equation Editor and double-
click here to view equation.

(w_T):
where w_T = the weighting factor representing the ratio of the stochastic risk resulting from irradiation of tissue (T) to the total risk when the whole body is irradiated uniformly; H_T is the dose equivalent received by tissue (T); and H_{wb} is the stochastic dose-equivalent limit for uniform irradiation of the whole body.

3.7 Direct bioassay - In-vivo measurements to estimate the quantity of radioactive material in the human body using instrumentation that detects radiation emitted from the radioactive material.

3.8 Half-life, biological (T_b) - The time in which half the quantity of a material in a compartment, in an organ, or in the whole body is eliminated by biological processes.

3.9 Half-life, physical (T_R) - The time taken for the activity of a radionuclide to lose half its value by radioactive decay.

3.10 Half-life, effective (T_e) - The time taken for the activity of a radioactive material in a

Install Equation Editor and double-click here to view equation.

compartment, in an organ or in the whole body to be reduced to half its value by a combination of biological elimination and radioactive decay:
where T_e = the effective half time; T_b = the biological half time; and T_R = the radiological or physical half time.

3.11 Health Physics Professionals (HPP) - Individuals who, by virtue of their education and experience, approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be Certified by the American Board of Health Physics (Comprehensive).

3.12 Indirect bioassay - Estimate of amount of radioactive material in the human body based on measurements of radioactive material in excreta or in other biological materials from the body, and on a biological model for movement of the material in body tissues and organs.

3.13 Intake - Amount of radioactive material entering the body through the nose, mouth, or skin.

3.14 Internal dosimetry - Specification, analysis, and interpretation of bioassay measurements that result in an estimate of internal dose equivalent or dose commitment.

3.15 May - The word **may** is used to denote permission.

3.16 Monitoring - The measurement of activity in the whole body, in a region of the body, in material eliminated from the body or in the air to help estimate the intake of radioactive material. The term monitoring also includes interpretation of the measurements.

- Routine monitoring is monitoring carried out at regular intervals during normal operations.
- Special monitoring is monitoring carried out in actual or suspected abnormal conditions.
- Confirmatory monitoring is monitoring carried out in situations where workers are unlikely to be exposed to significant intakes, in order to demonstrate satisfactory conditions.

3.17 Organ - A differentiated part of the body that performs a special function.

3.18 Radiation Safety Officers (RSO) - Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs shall be specified by federal or state license requirements, and are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall be selected by the HPP.

3.19 Reference Man - A person with the anatomical and physiological characteristics defined in the report of the ICRP Task Group on Reference Man (ICRP Report No. 23).

3.20 Retention Function - A mathematical expression for that fraction of the initial body content of radioactive material retained in the organ of reference at time t after intake. The retention function is represented by the expression R(t).

3.21 Shall - The word **shall** is to be understood as a requirement.

3.22 Should - The word **should** is to be understood as a recommendation.

4 EQUIPMENT/MATERIALS REQUIRED

4.1 Sample Collection Kits

4.2 Chain of Custody Forms

4.3 Request for Analysis Forms

5 METHODOLOGY

5.1 Administrative Dose Limits

5.1.1 Engineered controls shall be used and control shall be applied to contamination at the source to minimize internal exposures. This contamination control program will be implemented by the RSO and Project Manager and will rely on engineeered controls as much as practicable, with the use of respiratory protection being minimized to the extent that the job task/site allow.

5.1.2 Individual internal doses shall be administratively controlled to not exceed those associated with intake of radioactive materials at 10% of the Annual Limit of Intake (ALI) referenced in 10 CFR 20.

5.1.3 Approval by the RSO and HPP is required for any employee, visitor, or contractor to exceed this limit.

5.1.4 The RSO shall take the following steps if there occurs an intake of radioactive materials that exceeds the administrative dose limits:

A. Inform the HPP of the occurrence.

B. Investigate the incident immediately.

C. Determine the root cause(s) and identify corrective actions to prevent recurrence.

D. Inform the HPP of the results of the investigation and any corrective actions taken.

E. Deny the individual involved further access into radiologically controlled areas pending assessment of internal dose and investigation of the circumstances involved in this intake.

5.1.5 For cases in which administrative dose limits have been exceeded, the RSO shall estimate the internal radiation dose. The results of the dose estimate shall be approved by the HPP, and retained permanently in the individual's dosimetry record.

5.2 Direct Bioassay Program

5.2.1 In-vivo bioassay (whole body counting) equipment may be used to monitor personnel for radionuclides that emit gamma rays or x-rays.

5.2.2 The capability for in-vivo bioassay should be provided by an approved contractor as deemed necessary by the RSO.

5.2.3 Whole body counting equipment shall be sensitive enough to detect 10% of the ALI at the 95% confidence interval for those radionuclides expected to be encountered by personnel.

5.2.4 Abnormal results identified in any calibration or system check shall be reported to the HPP and RSO for review and corrective action.

5.2.5 When an outside contractor performs WBC services, the RSO shall ensure that the requirements listed herein are included in the purchase order with the contractor.

5.3 Indirect Bioassay Program

5.3.1 *In-vitro* bioassay may be used to monitor personnel for internal deposition of radionuclides that cannot be detected using whole body counting equipment, or when measurement of individual elimination rates is desired.

5.3.2 The capability for *in-vitro* bioassay analyses shall be provided by a contractor as deemed necessary by the RSO.

5.3.3 Analyses shall be performed when a potential intake of alpha- or beta-emitting radionuclides is suspected.

5.3.4 To assure the quality of the results of the *in-vitro* bioassay program, the RSO shall require that the radioanalytical laboratory used for processing of biological samples comply with the recommendations of USNRC Regulatory Guide 4.15.

5.4 Monitoring Frequency

5.4.1 Baseline bioassays shall be performed upon assignment with potential internal exposures or at the discretion of the RSO or when project requirements dictate this need.

5.4.2 The RSO shall obtain the results of termination bioassays from previous employers.

5.4.3 If a baseline bioassay is deemed necessary, the type of sample and analysis shall be determined by the RSO or HHP or client HP department.

5.4.4 Routine bioassays shall be performed as stipulated in each project's health and safety plan, or in license requirements for **IT** fixed facilities. Where no such plan exists, routine bioassays shall be performed in accordance with the following guidance:

A. Prior to, and upon termination of work within a radiologically controlled zone or area where airborne activity was >10 percent of a DAC.

B. Throughout the work period at a frequency determined by the RSO.

5.4.5 Special or non-routine bioassays shall be performed when it is suspected that an individual may have received an internal deposition that potentially exceeds 1 percent of the 10 CFR 20 dose limit, or as deemed necessary or prudent by the RSO or HPP.

5.5 Validation of Bioassay Results

5.5.1 The RSO shall determine the validity of bioassay results prior to their inclusion in the internal dose assessment process.

5.5.2 The RSO shall evaluate the following items to ascertain the validity of monitoring results:

- Sample collection errors;
- Radiation background interference during counting;
- Calibration errors;
- Computer software errors;
- Errors due to counting geometry; and/or
- Statistical errors.

5.5.3 Only valid bioassay results, as determined by the RSO shall be used for assessment of internal radiation dose. If the data are not valid, the RSO shall document the basis for that conclusion and include the documentation in the individual's dosimetry record. The RSO

shall also estimate the internal dose to the individual via other means and include the estimate in the individual's exposure history.

6.5.4 The HPP shall review and approve all internal dose estimates prior to their becoming a part of the workers' exposure history.

5.6 Interpretation of Bioassay Results

5.6.1 The RSO should complete the top of the form entitled "Interpretation of Bioassay" (See Attachment 1).

A. The RSO shall identify the route of entry (i.e., inhalation, ingestion, etc.), which should be the most likely route based upon current knowledge of exposure conditions. However, this selection can and should be modified as further information becomes available.

B. The ALI for the radionuclide in question should be obtained from 10 CFR 20, Appendix B, Table 1.

C. The solubility class is only applicable to intake by inhalation and should be based upon current knowledge of the chemical form and/or particle size.

5.6.2 Using available bioassay results, the RSO should complete the table on Attachment 1 per instructions provided with that attachment.

6.6.3 The HPP shall review all forms for correct input values and calculations. They shall also review all data that support the internal dose estimate.

5.7 Action Levels

5.7.1 Selection and conduct of follow-up actions by the RSO should include consideration of the following:

A. The dosimetric significance of all involved radionuclides;

B. The presence of indicator radionuclides;

C. The likely routes of entry of the radionuclide(s) into the body;
D. Suspected biokinetic processes at times shortly after intake;

E. The time required for absorption and elimination to occur;

F. The expected retention or excretion of the radionuclides;

G. The availability of analytical services;

H. The required sensitivity and measurement turnaround time; and/or

I. The required sample size.

5.7.2 The Investigation Level should be set at the following:

$$IL = 0.3 \times f \times ALI$$

Where IL = the Investigation Level, f = the fraction of the year to which a particular routine monitoring result applies, and ALI is the Annual Limit on Intake for the radionuclide in question.

5.7.3 Follow-up actions for deposited radionuclides detected at levels in excess of one IL may include the following, at the discretion of the RSO:

A. Additional measurements; and/or

B. Acquisition of other data necessary to describe the retention of the radionuclide(s) in the body.

6 RECORDS

6.1 All Records pertinent to this procedure shall be maintained pursuant to RPP-015.

6.2 Individual Monitoring Records:

6.2.1 Internal radiation exposure received during prior employment.

6.2.2 Internal exposure received at other installations during current employment by **IT**.

6.2.3 Results of individual whole body counts and bioassay results

6.3 Internal Radiation Monitoring Program Records

6.3.1 Procedures and methods for interpretation and evaluation of individual exposure data
6.3.2 Capabilities of bioassay services

6.3.3 Program review and audits

6.3.4 Investigation reports for instances in which significant internal depositions occur

6.3.5 Procedures and records associated with *in-vitro* and *in-vivo* bioassay techniques including set-up, testing, calibration, and daily and weekly response checks of whole body counting equipment

6.3.6 Internal dose assessments, including the bases for the dose assessment

7 ATTACHMENTS

7.1 Attachment 1 - "Interpretation of Bioassay"

ATTACHMENT 1
INTERPRETATION OF BIOASSAY

Subject:	Route of Intake:
Date of Intake	Annual Limit on Intake:
Radionuclide:	Dose Conversion Factor:
Solubility Class: ☐ D ☐ W ☐ Y	

t (days)	Volume (Mass)	Activity	O (corrected)	(a) IRF	(b) O x IRF (needed only for least squares fit)	(c) IRF^2 (needed only for least squares fit)	(d) Intake
					(e)	(f)	

(g)
Intake = Average of (d) =

or

(g)
Intake = (e)/(f) =

(h)
H_{50} = (g)/(ALI) x 5 =

or:

(i)
H_{50} = (g) x DCF =

Dosimetrist / Date
* Needed only if least-squares fit is required.

ATTACHMENT 1 (cont'd)

INSTRUCTIONS FOR THE COMPLETION OF INTERPRETATION OF BIOASSAY FORM

1. The value listed for "t" should be the number of days between the suspected date of intake and the date of sample collection for indirect bioassay, or the date of measurement for direct bioassay

2. Values for "Volume" or "Mass" are applicable to indirect bioassay measurements only.

3. The "Activity" should be the actual activity reported from the bioassay measurement.

4. The values for "O(corrected)" are "Activity" values corrected to reflect the appropriate units of activity in the applicable bioassay compartment. For example, a single 200 ml urine sample is analyzed and found to contain 25 pCi of "Activity". This value must be corrected to reflect the activity in a twenty-four-hour void. Therefore, "O(corrected)" is equal to (25 pCi × 1400 ml) ÷ 200 ml, or 175 pCi.

5. Values for "IRF" shall be selected from those contained in ICRP Publication 54

6. For a single bioassay result or to obtain the average intake from multiple bioassay results:

   6.1 Values entered in column (c), labeled "Intake", are obtained by solving the equation: "O(corrected)" × "IRF".

   6.2 It is not necessary to complete columns (a) and (b).

   6.3 For multiple bioassay results, the average of the column (c) values is computed and entered in slot (d) below, marked "Intake"

7. To obtain a least-squares fit for multiple bioassay data:

   7.1 Columns labeled (a) and (b) should be completed, with the totals for each column entered in slots (e) and (f), respectively

   7.2 The best estimate of intake should be obtained by solving for (e) ÷ (f), and entering the result in (g).

8. An estimate of Committed Dose Equivalent, or "H_{50}", in units of rem, should be obtained by one of the following means:

   8.1 Divide the value entered in either (d) or (g) by the ALI, multiply the result by 5, and enter the result in (h).

   8.2 Multiply the value entered in either (d) or (g) by an appropriate Dose Conversion Factor (Federal Guidance Report #11), and enter the result in (i)

9. Since the H_{50} is assigned in the year in which the dose is received, the value of (h) or (i) can be added to the external dose for that year and compared directly to administrative or legal dose limits in order to guide follow-up actions

INTERNATIONAL TECHNOLOGY CORPORATION

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-002

TITLE: **External Exposure Control**

REVISION NO.	DATE
001	9/19/96

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1 PURPOSE AND OBJECTIVES

The purpose of this procedure is to describe the external radiation exposure control system for **IT** and to ensure that external radiation exposure of **IT** personnel is minimized by establishing dose limits and administrative dose control points. This procedure is applicable to all **IT** work activities which involve the use of, or work activities in the vicinity of, radiation sources or radiation-producing machines.

2 RESPONSIBILITIES

2.1 Corporate Director of Health and Safety (Director):

2.1.1 Provides administrative review and control of personnel external radiation exposure levels; and

2.1.2 Approves all planned exposures in excess of regulatory or administrative limits, and for planned exposures as a result of emergency or recovery operations.

2.1.3 Approves all Health and Safety Plans (HASPs), Work Plans (WPs), and Proposals for work having potential to exceed 500 mrem to any person.

2.2 Health Physics Professional (HPP):

2.2.1 Provides guidance and information on external exposure considerations to the Director.

2.2.2 Assists the RSO in investigating unexpected results and recommending corrective actions.

2.2.3 Performs special dose assessments at the request of the RSO.

2.2.4 Approves all planned special exposures.

2.2.5 Approves all HASPs, WPs, and Proposals for work having the potential to exceed 100 mrem to any person.

2.3 Radiation Safety Officer (RSO):

2.3.1 In conjunction with project managers or fixed facility managers, assigns **IT** personnel and contractors to the appropriate external radiation monitoring program (e.g., monthly or quarterly TLD exchange frequency, beta/gamma or beta/gamma/neutron dosimeter usage);

2.3.2 Secures accredited (NVLAP) personnel dosimetry services from pre-qualified vendors;

2.3.3 Determine the occupational radiation dose received during the current year for all personnel working at a fixed facility or a job site who are issued dosimetry (NRC Form 5 or equivalent).

2.3.4 Attempt to obtain the records of cumulative occupational radiation dose (NRC Form 4 or equivalent).

2.3.5 Reviews and approves dosimetry results, investigates unexpected results, and recommends corrective actions;

2.3.6 Estimates doses to individuals when dosimeters have been lost.

2.3.7 Maintains dosimetry records pursuant to RPP-010. ITNS0405.

2.3.8 Provides reports to IT employees on their radiation exposure history upon request.

2.3.9 Approves all planned exposures in excess of administrative limits.

2.3.10 Approves all HASPs, WPs, and proposals involving potential radiation exposure to workers, does a project man-rem budget, and submits the budget to the HHP for concurrence/approval.

2.4 Project Managers and Fixed Facility Managers

2.4.1 In conjunction with the RSO, assigns project personnel and contractors to the appropriate monitoring program; and

2.4.2 Reviews personnel dosimeter processing summary reports, taking appropriate corrective actions when necessary (e.g., work restriction) to assure that external dose limits are not exceeded, and that radiation exposures are maintained as low as reasonably achievable.

2.4.3 Approves all HASPs, WPs, and Proposals involving potential radiation exposure to workers.

3 REFERENCES

3.1 Requirements and Specifications

3.1.1 IT Corporation Policy No. HS-700, "Radiation Protection Program Plan"

3.1.2 Title 10, Code of Federal Regulations, Part 19, "Notices, Instructions and Reports to Workers; Inspections".

3.1.3 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation".

3.2 Related Procedures

3.2.1 IT Corporation Procedure No. RPP-015, "Radiation Protection Records"

3.3 Others

3.3.1 Institute of Nuclear Power Operations, Report No. INPO 88-010, "Guidelines for Radiological Protection at Nuclear Power Stations".

3.3.2 National Bureau of Standards, "NVLAP Dosimetry LAP Handbook - Operational and Technical Requirements of the Laboratory Accreditation Program for Personnel Dosimetry Processors", NBS 85-3170, May, 1985.

3.3.3 American National Standards Institute, ANSI N322-1975, "Inspection and Test Specifications for Direct and Indirect Reading Quartz Fiber Pocket Dosimeters".

3.3.4 American National Standards Institute, "Personnel Dosimetry Performance - Criteria for Testing", ANSI N13.11, 1983.

3.3.5 American National Standards Institute, "Radiation Protection Instrumentation Test and Calibration", ANSI N323, 1978.

4 DEFINITIONS

4.1 Approval - An act of endorsing or adding positive authorization or both.

4.2 Dosimeter - Radiation-sensitive element(s) in a holder[1] used to provide a cumulative irradiation record of an individual.

4.3 Health Physics Professionals (HPP) - Individuals who, by virtue of their education, and experience, approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be Certified by the American Board of Health Physics (Comprehensive).

4.4 High Radiation Area - An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.1 rem in one hour at 30 cm. from the radiation source or from any surface through which the radiation penetrates.

4.5 May - The word **may** is used to denote permission.

4.6 Radiation Area - An area, accessible to individuals, in which radiation levels could result in an individual receiving a dose equivalent in excess of 0.005 rem, but less than 0.1 rem, in one hour at 30 cm. from the radiation source or from any surface which the radiation penetrates.

The holder is considered to be a part of the dosimeter.

4.7 Radiation Safety Officers (RSO) - Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs are specified by federal or state license requirements, and are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall be selected by the HPP.

4.8 Radiologically Controlled Area: Any area posted to control access to radioactive material or contaminated facilities.

4.9 Shall - The word **shall** is to be understood as a requirement.

4.10 Should - The word **should** is to be understood as a recommendation.

4.11 TLD - Required Area - Any area where an individual may receive:

- 500 mrem annual effective dose equivalent (external sources) to the whole body
- 5000 mrem annual dose equivalent (external sources) to the skin or extremity
- 1500 mrem annual dose equivalent (external sources) to the lens of the eye

4.12 Whole Body - The head, lens of the eye, trunk, gonads, arms above the elbow, and legs above the knees. The remaining parts of the body are considered to be individual extremities.

5 EQUIPMENT/MATERIALS REQUIRED

5.1 Personnel Dosimeters

5.2 Pocket Ionization Chambers

5.3 Personal Alarming Dosimeters

6 METHODOLOGY

6.1 External Radiation Exposure Control Methods:

6.1.1 Each Project Manager or Fixed Facility Manager, in conjunction with the RSO, shall be responsible for identifying and controlling sources of radiation.

6.1.2 Each Project Manager and each **IT** employee shall plan and perform work involving radioactive materials in order to minimize the external radiation exposures received.

6.1.3 The Director shall establish dose limits and administrative dose control levels.

6.1.4 The RSO shall monitor personnel in radiation areas or TLD required areas for external radiation exposure.

6.1.5 The RSO shall document and track exposures received.

6.2 Regulatory dose limits

6.2.1 Individual doses for monitored personnel shall not exceed the limits of 10 CFR 20 or 10 CFR 835 per calendar year, excluding medical radiation exposures.

6.2.2 Approval by the Director and the HPP is required for any individual, either employee or contractor, to exceed these limits.

6.2.3 The Director, the HPP or the RSO shall inform the appropriate regulatory agency of any instance in which an individual exceeds a regulatory limit in a calendar year.

6.2.4 Access to radiation areas shall be controlled such that individual doses for non-monitored personnel should not exceed 0.1 rem whole body per calendar year, excluding medical radiation exposures.

6.2.5 Total radiation dose to the unborn child shall not exceed 0.5 rem.

6.3 Administrative Dose Control for Radiation Workers:

6.3.1 Each **IT** employee shall be responsible for controlling their exposure to radiation hazards such that their annual dose remains below the administrative goals for **IT** which is 10 percent of the annual allowed regulatory limits.

6.3.2 Project managers shall not permit personnel to receive occupational radiation exposure in excess of the administrative limit unless the following are instituted:

A. Approval by the Director and HPP is granted.

B. The individual's Project Manager or Fixed Facility Manager shall verify that the need exists for the individual to exceed the administrative control point. Examples of a need to use workers over their administrative limit include:

- Other qualified individuals with lower accumulated exposures are not available.
- The unique ability or experience of the individual will minimize collective exposure.

6.3.3 The RSO shall investigate instances in which administrative dose control points are exceeded without authorization.

6.4 Monitoring Requirements

6.4.1 The RSO shall provide each radiation worker with a primary dosimetry device capable of measuring the individual's whole body exposure when work requirements cause the worker to enter a TLD Required Area.

6.4.2 Other **IT** employees with the potential for entering radiologically controlled areas or handling radioactive materials or devices may be issued a primary dosimetry device at the discretion of the RSO.

6.5 Previous Exposure History

6.5.1 Each **IT** employee who requires monitoring for radiation exposure shall have their previous exposure to radiation or radioactive materials determined or estimated.

6.5.2 Each individual shall complete a Nuclear Regulatory Commission Form-4, "Occupational External Radiation Exposure History" and/or NRC Form 5 (see Attachment 1).

6.5.3 The RSO shall obtain previous exposure histories from an individual's former employer(s) whenever possible. Requests for exposure histories shall be initiated by completing a "Request for Occupational Exposure History" form (See Attachment 2).

6.5.4 No **IT** employee or contractor shall be permitted to exceed 100 mrem of whole body occupational exposure without a known or estimated exposure history on file.

6.6 Secondary Dosimetry Devices

6.6.1 The RSO may provide each individual who may enter a "high radiation area" as part of their work with a self-indicating, dose integrating device such as a Pocket Ionization Chamber (PIC), which is considered to be a "secondary" dosimetry device.

6.6.2 The primary dosimetry device and the PIC within a hand's width of each other on the part of the whole body that is expected to receive the highest exposure.

6.6.3 **IT** personnel should read their PICs periodically to ensure doses received are consistent with expectations.

6.6.4 The RSO shall identify workers whose PIC totals indicate they are at or near administrative dose levels, process their primary dosimetry device.

6.6.5 At no time should an **IT** employee wear a PIC without a primary dosimetry device.

6.7 Placement of monitoring devices

6.7.1 The **IT** employee shall place the primary dosimetry device on the part of the whole body that is likely to receive the highest exposure, normally the front trunk of the body between the neck and waist.

6.7.2 The **IT** employee shall place extremity dosimetry as close as possible to the source without restricting the use of the extremity.

6.7.3 The employee shall place the skin dosimetry at a location representative of the dose to the skin of the whole body considering the shielding provided by any protective clothing or materials worn.

6.7.4 All dosimeters shall be stored on-site at a low background area designated by the RSO.

6.8 Monitoring Extremity Exposures

6.8.1 For work situations in which extremity exposures are expected to be significantly greater than whole body exposures, or if extremity exposures are expected to exceed 5000 mrem per calendar year, the RSO shall specify additional dosimetry devices to be placed on the extremities to measure and control extremity dose.

6.8.2 Each extremity of a worker shall be provided with a dosimetry device if the extremity is to be placed into a radiation field (including both penetrating and non-penetrating radiation) in which the extremity could receive 1000 mrem <u>or</u> more than twice the expected whole body dose.

6.9 Monitoring Skin Exposure

6.9.1 The Project Manager should control skin dose rates by shielding or decontamination.

6.9.2 Dose to the skin of the extremities is considered to be extremity dose and not dose to the skin of the whole body.

6.9.3 The RSO shall perform a calculation of skin dose if a worker may have received significant dose from skin contamination (e.g., 100 mrad) or if detectable skin contamination cannot be removed by decontamination.

6.11.4 The HPP should approve all skin dose calculations.

6.10 Equipment and Facilities Specifications

6.10.1 Primary dosimetry services for routine use by **IT** personnel, including dosimeters and processing equipment, shall be accredited by the National Voluntary Laboratory Accreditation Program (NVLAP) for the type of radiations monitored.

6.11 Deployment, Storage, and Retrieval of Primary Dosimeters

6.11.1 The RSO shall deploy, retrieve and process primary dosimetry devices issued to **IT** employees at least quarterly.

6.11.2 If an individual is known or suspected to have reached or exceeded an administrative exposure control level, the RSO shall process the primary dosimetry device prior to the individual being allowed to receive additional external radiation exposure.

6.15.6 Deployment may be by personal exchange between the individual and the RSO or by standard overnight mail service for off-site personnel.

6.15.7 Dosimeters awaiting deployment or shipment to the vendor for processing, including transit dosimeters, shall be stored in an appropriate storage room.

6.15.8 The background radiation exposure rate in the storage facility shall not exceed 20 millirem over a one month period.

6.15.8.1 If the monthly exposure limit in the storage facility is exceeded, an investigation into causes shall be initiated by the RSO.

6.15.8.2 The results of processing of dosimeters stored in the facility during this period of anomaly shall be evaluated with respect to background comparisons.

6.15.9 Dosimeters to be processed shall be placed in a vendor-supplied shipping box.

6.15.9.1 The appropriate transit dosimeters and control dosimeters shall also be packaged in the shipping box.

6.15.9.2 After packaging, the shipping box shall be returned to the storage facility until transferred to the carrier.

6.15.10 The packaged dosimeters shall be shipped to the vendor within twenty-four hours of packaging, using standard overnight mail service.

6.12 Assessment of External Dose

6.12.1 A dose assessment, to determine an accurate estimate of external radiation dose received by monitored individuals, should include the following:

A. Reading of the individual's undamaged dosimetry device(s);

B. Testing of damaged or possibly damaged dosimetry devices in order to ensure the device is operational prior to returning it to service or to determine why the device failed;

C. Confirming undamaged dosimetry results or exposure estimates by determining the exposure received by co-workers or workers doing similar work and by calculating an exposure based on the time spent and the dose rates in the work area;

D. If multiple whole body dosimetry is used, assigning the worker the highest dose measured over the monitoring period on the whole body.

6.12.2 The RSO shall perform an assessment of a worker's dose under the following conditions:

A. If a worker does not wear, or does not wear in the correct location, a primary dosimetry device,

B. If a worker loses or damages a dosimetry device,

C. If a secondary dosimetry device alarms, indicates an off-scale condition, or is damaged,

D. Any time multiple, whole-body dosimeters are worn,

E. If a comparison of primary and secondary devices for the same time period and body location shows a difference of greater than 25% in measured exposure and the exposure of either device exceeds 100 mrem.

6.12.3 Dose assessments shall be reviewed and approved by the RSO and the HPP prior to assignment of a dose of record other than that measured by the primary dosimetry device.

6.12.4 The worker shall sign the dose assessment to verify that the information provided by the worker is accurate and to indicate that the information on the assessment has been explained to them.

6.12.5 The results of a dose assessment shall be entered in the individual's radiation dose totals (USNRC Form 5), and a copy of the dose assessment shall be placed in the individual's dosimetry record file. (See Attachment 3 for Form 5.)

6.13 Trend Analysis of External Dosimetry Results

6.13.1 Trend analysis of personnel dosimetry and dose assessment results is an important ALARA tool.

6.13.2 The RSO should analyze the following parameters, recorded as part of the routine radiation protection program for trends on a monthly or quarterly basis:

A. Mean individual and collective external radiation exposure for IT personnel;

B. Mean individual and collective external radiation exposure by job classification;

C. Mean individual and collective external radiation exposure by a particular task; and

D. Frequency of personnel external exposure incidents.

7 RECORDS

7.1 All Records pertinent to this procedure shall be maintained pursuant to RPP-015.

7.2 The following Individual Exposure Records shall be maintained:

7.2.1 Name and Social Security number of the individual

7.2.2 Radiation exposure received during prior employment (See Attachment 2)

7.2.3 Exposure received by individuals at other work locations during current employment by IT Corporation (See Attachment 1)

7.2.4 Individually-worn dosimeter measurements

7.2.5 Radiation dose estimates from special studies

7.2.6 Records of unusual exposures

7.3 The following Monitoring Program Records shall be maintained:

7.3.1 Investigation reports for instances in which significant external radiation exposures occur

7.3.2 Reports that summarize trends in external radiation exposures in workers

7.3.3 Procedures and records associated with the vendor-supplied personnel dosimetry program, including set-up, testing, calibration, and quality control records

7.3.4 External dose assessments, including the bases for the dose assessment

8.0 ATTACHMENTS

8.1 Attachment 1 - USNRC Form 4

8.2 Attachment 2 - Request for Dosimetry Records

8.3 Attachment 3 - USNRC Form 5

ATTACHMENT 1

ATTACHMENT 2

REQUEST FOR DOSIMETRY RECORDS

06/04/02

[ADDRESS]

Re: Request for Occupational Exposure History

Gentlemen:

So that we may compile radiation exposure histories for new employees, we request your cooperation in providing us with the history of exposure to radioactive materials, including both internal and external exposures, for the following individuals, who was formerly employed at your facility.

Name:

Social Security No:

Dates of Employment:

Signature Authorizing Release: _____

Your assistance is appreciated. Should you have any questions, please telephone me at **[Telephone No.]**. Please mail response to the attention of the Radiation Safety Officer, **IT** Corporation.

Sincerely,

_____
Radiation Safety Officer
IT Corporation

ATTACHMENT 3

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-003

TITLE: **Contamination Control**

REVISION NO.	DATE
001	9/23/96
002	3/4/2000

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1 PURPOSE AND OBJECTIVES

This procedure provides requirements and guidelines for the control of radioactive contamination at project work sites. Note: The contamination limits cited in this procedure are for classification of contamination areas or release of equipment. If contamination surveys are performed for building or facility release, Draft Regulatory Guide DG-4006 "Demonstrating Compliance With the Radiological Criteria for License Termination" should be used to determine acceptable residual contamination limits in the absence of authorized release limits from the regulatory agency.

2 RESPONSIBILITIES

The Project Manager or Fixed Facility Director is responsible for assuring that the requirements of this procedure are met on projects or at fixed facilities where contamination may be present.

3 REFERENCES

3.1 Requirements and Specifications

3.1.1 IT Corporation Policy No. HS-700, "Radiation Protection Program Plan"

3.1.2 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation"

3.1.3 Reg. Guide 1.86 "Termination of Operation Licenses for Nuclear Reactors"

3.1.4 Draft Regulatory Guide DG-4006 "Demonstrating Compliance With the Radiological Criteria for License Termination," August, 1998

3.2 Related Procedures

3.2.1 IT Corporation Procedure No. RPP-010, "Radiation Protection Records"

3.2.2 IT Corporation Procedure No. RPP-005, "Radiological Areas and Posting"

3.2.3 IT Corporation Procedure No. RPP-004, "Instrumentation and Surveillance"

3.3 Others

None

4 DEFINITIONS

4.1 Approval - An act of endorsing or adding positive authorization or both.

4.2 Controlled Area - Any area to which access is controlled to protect individuals from exposure to radiation or radioactive materials.

4.3 Corporate Radiation Safety Officer (CRSO) – An individual who by virtue of their education and experience provides corporate oversight for all work involving or pertaining to radioactivity. Is responsible for maintenance of the IT Radiation Protection Program and all enabling procedures and field guides. The CRSO shall be responsible for the maintenance of the corporate decontamination and decommissioning license(s). The CRSO shall be Certified by the American Board of Health Physics (Comprehensive).

4.4 Fixed Contamination - Fixed contamination is non-removable by normal means. The contamination is imbedded within the pores or tightly adhered to the surface of the item.

4.5 Health Physics Professionals (HPP) - Individuals who, by virtue of their education, and experience, approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be Certified by the American Board of Health Physics (Comprehensive).

4.6 Large Area Wipe - Wipes used to provide qualitative indications of radioactive contamination rather than quantitative. The most widely accepted material for large area smears is masslin (an oil impregnated fiber material), or other materials such as soft absorbent paper towels may be used.

4.7 Loose Contamination - Contamination that is loosely adhered to a surface and can be easily removed.

4.8 May - The word **may** is used to denote permission.

4.9 Radiation Safety Officers (RSO) - Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs are specified by federal or state license requirements, and shall not be changed without notification of the appropriate licensing authority. Fixed facility RSOs are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall have a degree in health physics or at least five years experience in health physics, and shall be selected by the CRSO.

4.10 Radiological Area - Any area within a Controlled Area where an individual can receive a dose equivalent greater than 5 mrem in 1 hour from a radiation source or any surface through which the radiation penetrates, or in any 5 consecutive days a dose in excess of 100 mrem, or when airborne radioactivity concentrations greater than 25 percent of the derived air concentration (DAC) found in 10 CFR 20, Appendix B, Table 1 are present (or are likely to be), or where surface contamination in excess of the guides found in NRC Reg. Guide 1.86 Table 1, included as Attachment 1 in this procedure, is present (or is likely to be). For the purpose of contamination control, Radiological Areas include; Contamination Areas and Airborne Radioactivity Areas.

4.11 Shall - The word **shall** is to be understood as a requirement.

4.12 Should - The word **should** is to be understood as a recommendation.

4.13 Smears - The method most commonly used for evaluation of surface contamination levels. Normally, smears are a circular disk (approx. 1" - 1 3/4" diameter) of paper or cloth which is wiped over a known area (usually 100 cm^2 = 4" x 4") to pick up small particles of radioactive contamination.

5 EQUIPMENT/MATERIALS REQUIRED

5.1 Step-off pads

5.2 Personnel Protective Equipment (PPE)

5.3 Portable survey instruments

5.4 Beta-Gamma Frisker

5.5 Alpha Frisker

5.6 Alpha, Beta-Gamma Scaler

5.7 Portable Air Sampler

5.8 Smears

5.9 Masslin or soft paper towels

6 METHODOLOGY

6.1 Contamination Limits

6.1.1 Personnel, equipment, and facilities shall be considered contaminated if the amount of radioactive material exceeds the values shown in Attachment 1.

6.1.2 Contamination on personnel shall always be considered removable.

6.2 Tagging and Posting

6.2.1 Contamination and Airborne Radioactivity areas shall be posted in accordance with RPP-010, "Radiological Areas and Posting".

6.2.2 All contaminated items that are not in a posted radiologically controlled area shall be appropriately contained to prevent the spread of contamination and tagged. The tag shall

contain information on extent and type of contamination. Methods for containment include, but are not limited to bagging wrapping, securing openings, etc. Normally yellow bags are used to contain contaminated items so as to be readily visible at a distance. However, clear or other colored bags may be used as approved by the RSO

6.2.3 Equipment released from a posted contamination area shall have a Unconditional Release Tag attached. An example tag is shown as Attachment 2.

6.2.4 Only RSO personnel or designees shall post and tag or remove postings and tags.

6.3 Protection of Personnel, Equipment, and Areas

6.3.1 Protection of Personnel

A. Personnel shall wear PPE as required by a Radiation Work Permit (RWP) or the RSO whenever they are in contaminated areas.

B. General guidelines for donning and removal of PPE (e.g. full set) are contained in Attachment 3. Specific donning and removal requirements may differ from this general listing. If so the specific guidelines will be listed at the site.

C. Non-disposable PPE used by personnel may have residual, fixed contamination present. The limits on contamination for reuse of PPE are 1000 dpm/100 cm^2 alpha, and/or 15000 dpm/100 cm^2 beta-gamma

Note: Smearable contamination limits for PPE are shown in Attachment 1.

6.3.2 Protection of Equipment

A. Material that is to enter a contaminated area should be protected to the maximum extent possible. This may include bagging, taping, etc.

B. Material that cannot be protected from becoming contaminated should be treated in a manner to facilitate decontamination whenever possible. These measures may include painting, strip coating or polishing.

6.3.3 Protection of Areas

A. Any equipment outside of a contamination area that has removable contamination on it shall be bagged or wrapped in yellow plastic and taped or otherwise sealed to prevent contamination from spreading.

B. Contaminated equipment shall be stored in designated storage areas. These areas shall be approved by the RSO.

C. Storage areas shall be protected to prevent them from becoming contaminated. This may include the use of floor coverings, other physical barriers, etc.

D. Storage areas may also be treated to the maximum extent practicable to allow decontamination, including painting or sealing concrete.

6.4 Ingress/Egress of Contaminated Areas

6.4.1 Contamination areas shall be demarcated such that ingress/egress is through a single designated point.

6.4.2 Where possible at the designated entry point, one way traffic flow in and out of contamination areas should be encouraged.

6.4.3 Ingress/egress points should be located in low contamination areas.

6.4.4 Workers shall remove all PPE except inner gloves and shoe covers in the contamination area near the egress point when leaving. PPE shall be placed in the designated receptacles at the egress point.

6.4.5 Egress points should have a step-off pad or sticky pad between the clean area and the contaminated area. Inner gloves and shoe covers shall be removed at this point prior to entry into the clean area.

6.4.6 Personnel shall frisk themselves and personal items for contamination immediately upon leaving a contaminated area. The type of frisk (e.g. whole body or limited) will be designated by the RSO. If personnel are contaminated they shall remain where they are and call for assistance from the RSO or designee.

6.4.7 Friskers shall be located as close to egress points as background radiation levels allow.

6.4.8 Items, other than personal items, shall be surveyed by the RSO or designee when leaving the contaminated area.

6.5 Identification of Contaminated Areas and Equipment

In addition to the tagging and posting requirements, contaminated areas and equipment shall be identified through association with the colors yellow and magenta. Contaminated equipment should be bagged or wrapped in materials that are yellow.

6.6 Surveillance of Contaminated and Clean Areas

6.6.1 A surveillance program shall be prescribed by the RSO and initiated to routinely survey controlled areas for contamination.

6.6.2 Contaminated areas that are accessed weekly shall be surveyed weekly.

6.6.3 Clean areas and infrequently-accessed contaminated areas shall be surveyed monthly.

6.7 Contamination Surveys - Precautions

6.7.1 In the course of performing contamination surveys, particular attention should be given to the following:

1) Any leaks, spills, puddles, grease, or cracks and crevices where dust and dirt may collect, and

2) Areas where a contaminated person could inadvertently spread contamination.

6.7.2 The surveyor should initially look at the most obvious areas which might become contaminated (e.g., clothing, door knobs, telephones, stairways, floors, hand rails, etc.).

6.7.3 Since job preparation and material selection can be the most important steps an RPT may make to effectively perform his/her duties, sufficient planning time should be allotted prior to performing the work.

6.8 Taking a smear

NOTE: When taking a smear, the area covered should be as close to 100 cm^2 as possible.

6.8.1 Hold the smear with the thumb and first two fingers and while applying moderate pressure, move the smear in a "S" pattern approximately 16 inches in length, (100 cm^2 ~ 4" x 4" square).

6.8.2 It may be necessary to estimate the surface area of irregular surfaces and areas which are less than 100 cm^2.

6.8.3 Smears may be counted on a frisker for field analysis. When more accurate quantitative analysis is needed, smears shall be counted on a smear counter or sent to a low background lab for counting on a low background alpha and beta smear counter.

6.9 Taking a Large Area Wipe

NOTE: Wipes are used when a quick qualitative indication of contamination is needed.

6.9.1 For large flat surfaces such as floor areas, a masslin mop may be used. Areas greater than 10 ft^2 or extremely dirty areas require that multiple wipes be used to prevent build up and self absorption on the masslin.

6.9.2 Large area wipes may be counted on a frisker for field analysis. If quantitative values are required 100 cm^2 smears need to be taken of the area.

6.10 Direct Frisking

6.10.1 Perform direct frisking to assess fixed contamination. When surveying for fixed contamination the entire surface area should be frisked.

CAUTION: The surveyor should be aware of any protruding objects (e.g., wire mesh screens, sharp objects) which could penetrate the frisking probe and render it inoperable.

6.10.2 To frisk for beta-gamma emitters, hold the frisking probe approximately □ inch from the item while moving the probe 1-2 inch per second over the surface.

6.10.3 To frisk for alpha emitters, hold the probe □ inch from the item.

6.10.4 If an increase on the meter is noted, re-scan the affected area to obtain a more quantitative measurement.

6.11 Background Radiation

6.11.1 Determine the background radiation levels prior to performing a survey.

NOTE: The background levels should not exceed 250 cpm beta/gamma and 5 cpm alpha for frisking purposes or for reading smears. These levels will allow for reasonably reliable indications of contamination. If background levels exceed these values the RPT shall find a lower background area to frisk personnel or smears.

6.11.2 Background levels shall be subtracted from instrument readings to obtain actual contamination measurement.

6.12 Personnel Surveys

6.12.1 All personnel shall monitor themselves for contamination upon exiting a contamination area.

6.12.2 Alarm set-points and/or administrative action levels shall be set by the RSO based on regulatory requirements of the specific project.

6.13 Restrictions of Contamination Areas

6.13.1 All contaminated areas shall be posted for the following:

No eating, drinking, smoking or chewing.

6.13.2 No materials shall leave the contamination area unless surveyed and approved by the RSO or designee.

6.13.3 No protective clothing or radioactive materials shall be allowed to be taken into clean areas such as eating areas, offices, restrooms, or laboratories unless pre-authorized by the RSO.

6.13.4 The RSO shall strictly enforce all restrictions to control the spread of contamination and report to the Project Manager or Fixed Facility Director any repeat violations.

6.14 Postings

6.14.1 The RSO shall determine contamination areas and post such areas in accordance with RPP-010, "Radiological Areas and Posting".

6.14.2 Postings shall also include the approximate levels of surface contamination in the area and personnel protection requirements.

6.15 Access Control

Access control points shall have the following:

- step-off pads,
- contaminated-waste barrel (for disposal of gloves, shoe covers, tyvek coveralls, etc.),
- contamination monitoring instruments.

6.16 Initiation of a Personnel Contamination Incident

6.16.1 Individuals are considered contaminated when measurements of the skin reach or exceed 1000 dpm/15 cm^2 probe beta-gamma or 200 dpm/60 cm^2 probe alpha activity.

6.16.2 If an individual determines through friskings that they are contaminated, they shall:

A. Notify the RSO or designee immediately,

B. Remain at the location where the contamination was identified, and

C. Take measures to prevent further spread of contamination.

6.16.3 Upon notification, the RSO shall resurvey the individual and initiate a Personnel Contamination Report (PCR) (Attachment 4) if the person is contaminated.

6.17 Decontamination of Personnel

6.17.1 Decontamination procedures should involve removing the contamination with the least possible insult to the individual. Decontamination procedures (arranged in a progressive order) may include:

A. Wash contaminated area with hand soap and water

B. Wash contaminated area with laundry detergent and water

C. Wrap contaminated area with plastic to cause sweating

D. Other measures taken only under the direction of the Project RSO.

CAUTION: Decontamination procedures shall never result in reddening or abrasion of the skin nor involve cutting or shaving of hair unless specifically authorized by the Project RSO.

6.17.2 Decontamination of the eyes shall be restricted to flushing with water.

6.17.3 Decontamination of the nasal passages shall be restricted to nose blowing and nasal swabs.

6.17.4 Decontamination shall only be conducted under the supervision of the RSO or designee.

6.18 Documentation and Reporting of a Personnel Skin Contamination

6.18.1 The RSO shall document personnel skin contamination using the form and instructions shown in Attachment 4.

6.18.2 The RSO shall be notified of all skin contamination incidents.

6.18.3 Employees, contractors and visitors shall record skin contamination in the Field Activity Daily Log (FADL).

6.18.4 The Project Manager or Fixed Facility Director shall be notified prior to letting any individual leave the jobsite or facility with contaminated skin.

6.19 Assessment of Skin Dose

6.19.1 The RSO, in conjunction with the HPP, shall make a dose assessment for each skin contamination of beta-gamma emitters when it is anticipated that the dose would be >50 mrem under any of the following conditions:

A. When the area of contaminated skin is >100 cm^2 the maximum value of dose averaged over any area of >100 cm^2 is to be assessed, recorded, and included in

the annual skin (shallow) dose equivalent.

B. When the area of skin exposed is ≥ 10 cm^2 but <100 cm^2 the dose equivalent to that tissue is to be determined by:

$$H = fD$$

where:
f = Fraction of skin exposed compared to 100 cm^2.
(In no case shall an "f" of <0.1 be used.)
D = Maximum dose averaged over a 1 cm^2 of skin

The calculated dose is to be recorded and included in the annual skin (shallow) dose equivalent.

C. When the area of skin exposed is <10 cm^2 the maximum value of dose averaged over any 1 cm is to be assessed and recorded in the individual's occupational exposure history as a special entry but is not to be included in the annual skin (shallow) dose equivalent.

6.19.2 To calculate skin dose, the RSO may use the following techniques:

A. Thumb rules, which are simplified, conservative calculations used for low-level contamination.

1. Thumb rules may only be used for contamination below 50,000 dpm-hours.

2. The thumb rule is 5000 dpm-hours equals 1 mrem based on the limiting isotope SrY-90.

B. Dose conversion factors may be used whenever more accurate calculations are necessary or the levels exceed those allowable for thumb rules.

1. Dose conversion factors may be obtained from MIRD 11, ORNL 5000, Kocher, etc.

2. Isotopic ratios and information may be obtained from data on plant history, waste streams, air samples, smears, or from samples gathered during decontamination.

C. The VARSKIN computer program (includes revisions and updates) may be used whenever more accurate calculations are necessary or the levels exceed those allowable for thumb rules.

D. Other techniques specifically approved by the HPP.

6.19.3 Information used to calculate skin doses and the calculations should be shown on the Personnel Skin Contamination Report - Continuation Sheet (Attachment 4).

7 RECORDS

7.1 All Records pertinent to this procedure shall be maintained pursuant to RPP-015.

7.1 Activities described in this procedure shall be recorded on the standard IT Field Activity Daily Log for that date.

7.2 All contamination surveys shall be documented on a Radiological Survey Form.

7.3 All skin or personnel contamination incidents shall be documented as required in RPP-002.

8 ATTACHMENTS

8.1 Attachment 1 - Surface Radioactivity Guides

8.2 Attachment 2 - Sample Contamination Tag and Unconditional Release Tag

8.3 Attachment 3 - Guidelines for Donning and Removal of Personal Protective Equipment

8.4 Attachment 4 - Personnel Skin Contamination Report

ATTACHMENT 1

SURFACE RADIOACTIVITY GUIDES

NUCLIDE[1]	REMOVABLE[2,4]	TOTAL[2,3] (FIXED PLUS REMOVABLE)
U-nat,U-235,U-238 and associated decay products	1,000 dpm α/100 cm^2	5,000 dpm α/100 cm^2
Transuranics, Ra-226, Ra-228, Th-230, Th-228, Pa-231, Ac-227, I-125, I-129	20 dpm/100 cm^2	300 dpm/100 cm^2
Th-nat, Th-232, Sr-90, Ra-223, Ra-224, U-232, I-126, I-131, I-133	200 dpm/100 cm^2	1,000 dpm/100 cm^2
Beta-gamma emitters (nuclides with decay modes other than alpha emission or spontaneous fission) except Sr-90 and others noted above[5]	1,000 dpm β-gamma/100 cm^2	5,000 dpm β-gamma/100 cm^2

1 Where surface contamination by both α and β-gamma-emitting nuclides exists, the limits established for α and β-gamma-emitting nuclides should apply independently.

2 As used in this table, dpm (disintegrations per minute) means the rate of emission by radioactive material as determined by correcting the counts per minute observed by an appropriate detector for background, efficiency, and geometric factors associated with the instrumentation

3 The levels may be averaged over 1 m^2, provided the maximum surface activity in any area of 100 cm^2 is less than three times the guide values For purposes of averaging, any square meter of surface shall be considered to be above the activity guide G if: (1) from measurements of a representative number (n) of sections it is determined that $1/n \sum_n S_i \geq G$, where S_i is the dis/min-100 cm^2 determined from measurement of section i; or (2) it is determined that the sum of the activity of all isolated spots or particles in any 100 cm^2 area exceeds 3G.

4 The amount of removable radioactive material per 100 cm^2 of surface area should be determined by wiping that area with dry filter or soft absorbent paper, applying moderate pressure, and assessing the amount of radioactive material on the wipe with an appropriate instrument of known efficiency. (Note - The use of dry material may not be appropriate for tritium) When removable contamination on objects of surface area less than 100 cm^2 is determined, the activity per unit area should be based on the actual area and the entire surface should be wiped. Except for transuranics and Ra-226, Ra-228, Ac-227, Th-228, Th-230, and Pa-231 α emitters, it is not necessary to use wiping techniques to measure removable contamination levels if direct scan surveys indicate that the total residual surface contamination levels are within the limits for removable contamination

5 This category of radionuclides includes mixed fission products, including the Sr-90 which is present in them. It does not apply to Sr-90 which has been separated from the other fission products or mixtures where the Sr-90 has been enriched

ATTACHMENT 2

SAMPLE CONTAMINATION TAG

ATTACHMENT 2 CONT'D

Unconditional Release Tag

Unconditional Release Tag

Description of Material:

_____
_____
_____
_____
_____

Released From – (Name of Facility)

_____
_____

Date:_____

Time: _____

RPT Initials: _____
or
RSO Initials: _____

Date: _____

The items described above meet the contamination limits allowed for unconditional release from this facility.

ATTACHMENT 3

GUIDELINES FOR DONNING AND REMOVAL OF PERSONNEL PROTECTIVE EQUIPMENT

1. Donning of Protective Clothing

   A. Inspect gloves

   B. Inspect protective clothing, including hood when applicable.

   C. Don protective clothing:

      1)don plastic shoe covers over work shoes
      2)don coveralls
      3)don rubber overshoes
      4)place dosimetry in coveralls
      5)tape joints and seams (as required)
      6)don surgeon cap and hood
      7)don cotton liners
      8)don neoprene (surgeon's gloves)
      9)don rubber gloves
      10) tape outer gloves to sleeves

   D. Check for proper attire.

2. Removal of Protective Clothing

   A. Remove all tape

   B. Remove hood

   C. Remove all overshoes

   D. Remove rubber gloves

   E. Remove dosimetry

   F. Remove surgeon cap

   G. Remove coveralls

   H. Remove plastic booties

   I. Remove inner gloves

3. Proceed to nearest frisker.

ATTACHMENT 4

Personnel Skin Contamination Report

the IT group

Personnel Skin Contamination Report

Report No._____

Name:_____ Employee No.:_____ SSN: _____

Date/Time of Incident: Nuclides Involved:

Location of Incident:

Draw a sketch of the areas contaminated - mark and number locations and include estimate of surface area involved.

Location of Contamination	Initial Contamination Levels/Time	Levels After 1st Decontamination Levels/Time	Levels After 2nd Decontamination Levels/Time	Levels After 3rd Decontamination Levels/Time
1)				
2)				
3)				

Name of HPT performing decontamination:

Instrument Used: Cal. Due Date

Dose Assessment:			
Total dmp-hours at each location	(1)	(2)	(3)
Skin Dose at each location	(1)	(2)	(3)
Name of HP performing dose assessment:			

Reviewed by:

Approved by:

Skin Dose Assigned by: Date Assigned:

ATTACHMENT 4 (cont'd)

Instructions for Completing the Personnel Skin Contamination Report

1. Personnel Skin Contamination Report No. - Insert the next sequential number obtained from the Personnel Skin Contamination Log maintained by the Project RSO.

2. Name of Individual - Insert the first name/middle initial/last name of the contaminated individual.

3. Employee No./SSN - Insert the 5 digit Employee ID Number and the 9 digit Social Security Number of the individual.

4. Date/Time of Incident - Insert the date the incident occurred and the estimated time of contamination.

5. Location of Incident - Describe the location where the contamination occurred including site, building number, and room number, etc.

6. Mark and Number Locations of Contamination - On the figures shown mark where the contamination has been found and number the separate locations. The size of the area contaminated shall be estimated also and shown. Examples follow:

   (a) 100 cm^2 on elbow area (b) 50 cm^2 on thigh

7 Initial Contamination Levels/Time - Insert the highest contamination level (in dpm) found at each location and denote the time when the contamination may have occurred.

8. Levels after Decon 1, 2, 3, - Insert the highest contamination level found at each location after the appropriate decontamination effort. In addition, denote the time that the decontamination effort occurred.

9 Name of Radiation Protection Technician performing decontamination - The Radiation Protection Technician responsible for performing the decontamination shall insert their first name/middle initial/last name.

10. Instrument used - Insert the type of instrument used by the Technician to measure the contamination including manufacturer, model number, probe type, and probe number.

11. Cal. Due Date - Insert the date when the next calibration is due

12 Total dpm-hours at each location - Calculate dpm-hours by multiplying the contamination level (dpm) and the time (hours) it was present on the individual. This shall be completed for each location through each decontamination effort and then totalled and inserted here.

13 Skin dose at each location - Insert the skin dose (in mrem) for each location.

14. Name of Radiation Protection Technician performing skin dose assessment - The Radiation Protection Technician who performed the skin dose assessment shall insert their first name/middle initial/last name.

ATTACHMENT 4 (cont'd)

15. Reviewed by - The PCR shall be reviewed by an independent Radiation Protection staff member who shall place their signature in this space.

16. Approved by - The PCR shall be approved by the Project RSO, who shall place his signature in this space

17. Skin Dose Assigned by - The Project RSO shall assign the highest skin dose value (from a contamination area greater than 10 cm^2) to the individual. The individual who assigns the dose shall sign in this space.

18. Date Assigned - The Project RSO shall insert the date that the dose was assigned.

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-004

TITLE: **Instrumentation and Surveillance**

REVISION NO.	DATE
001	9/23/96
002	3/4/2000

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1 PURPOSE AND OBJECTIVES

This procedure contains the requirements for performing radiation surveys, documenting surveys, and the means by which proper functioning of survey instruments is assured. This procedure applies to all radiation surveys conducted for compliance purposes by IT Radiation Safety Officers, radiation protection technicians (RPTs) or contractor RPTs.

2 RESPONSIBILITIES

2.1 Director

Shall assure adequate funding and resources for purchase (or rental), repair, and calibration of radiation survey instrumentation.

2.2 Radiation Safety Officer (RSO)

2.2.1 Shall ensure that all radiation surveys performed for demonstration of compliance conform to the requirements of this procedure.

2.2.2 Shall maintain an adequate inventory of functional, calibrated radiation survey instrumentation. Normally these instruments should be acquired from IT's Rad Instrument Division.

2.2.3 Shall store and control the use of all radiation survey instrumentation.

2.3 Project Managers or Fixed Facility Mangers

2.3.1 Shall assure that the RSO obtains radiation instruments in accordance with this procedure.

2.3.2 Shall assure that only qualified personnel, trained in the proper use and care of instruments, are permitted to operate portable radiation detection instrumentation.

2.4 Authorized Users/Operators

Shall report non-functional equipment to the RSO as soon as identified.

3 REFERENCES

3.1 <u>Requirements and Specifications</u>

3.1.1 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation"

3.1.2 Title 10, Code of Federal Regulations, Part 31, "General Domestic Licenses for Byproduct Material"

3.1.3 IT Corporation Policy No. HS-700, "Radiation Protection Program Plan"

3.2 Related Procedures

3.2.1 IT Corporation Procedure No. RPP-001, "Internal Exposure Control"

3.2.2 IT Corporation Procedure No. RPP-002, "External Exposure Control"

3.2.3 IT Corporation Procedure No. RPP-010, "Radiation Protection Records"

3.2.4 IT Corporation Procedure No. RPP-011, "Control of Standard Operating Procedures for Radiation Protection"

3.2.5 IT Corporation Procedure No. RPP-013, "Handling Sealed and Unsealed Radiation Sources"

3.3 Others

3.3.1 American National Standard, "Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments", ANSI N323A, 1997.

3.3.2 U. S. Nuclear Regulatory Commission, Regulatory Guide 8.21, "Health Physics Surveys for Byproduct Material at NRC-Licensed Processing and Manufacturing Plants"

4 DEFINITIONS

4.1 Approval - An act of endorsing or adding positive authorization or both.

4.2 Authorized User (AU) - Individuals who, by virtue of training and/or experience, have been authorized by the RSO to use or directly supervise the use of radioactive materials under the requirements of a specific radioactive materials license or **IT** work plan.

4.3 Health Physics Professionals (HPP) - Individuals who, by virtue of their education, and experience, approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be Certified by the American Board of Health Physics (Comprehensive).

4.4 May - The word **may** is used to denote permission.

4.5 Procedure - A document that specifies or describes how an activity is to be performed. It may include methods to be employed, equipment or materials to be used and sequence of operations.

4.6 Radiation Safety Officers (RSO) - Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs are specified by federal or state license requirements, and shall not be changed without notification of the appropriate licensing authority. Fixed facility RSOs are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall be **IT** Technical Associates in Health Physics, or shall be selected by the HPP.

4.7 Shall - The word **shall** is to be understood as a requirement.

4.8 Should - The word **should** is to be understood as a recommendation.

5 EQUIPMENT/MATERIALS REQUIRED

Appropriate Check Sources

6 METHODOLOGY

6.1 Radiation Surveys

6.1.1 Radiation surveys shall be performed as necessary to evaluate:

6.1.1.1 External radiation exposure to personnel;

6.1.1.2 Surface contamination (see RPP-003 "Contamination Control"); or

6.1.1.3 Concentrations of airborne radioactive materials in ambient air or effluents;

6.1.2 Radiation surveys shall be performed by personnel who are qualified pursuant to HS-700, "Radiation Protection Program Plan".

6.1.3 Results of radiation surveys shall be documented, using the forms and instructions contained in Attachment 1. Each survey shall be recorded on a Radiological Survey Log (Attachment 2).

6.1.4 The results of radiation surveys shall be reviewed by the RSO for completeness and for trending of radiological conditions in specific buildings or facilities.

6.2 Radiation Survey Instrumentation

6.2.1 The Rad Instrument Division in conjunction with a Health Physics Professional (HPP) shall authorize and control all radiation survey instrument purchases, and shall issue procurement specifications for all instruments to be purchased.

6.2.2 Radiation survey instrumentation shall be of the appropriate type, and shall have sufficient accuracy and sensitivity to determine the type and magnitude of radiological hazards to which personnel may be exposed.

6.2.3 Prior to purchase of new instrument types the HPP shall evaluate them for the following characteristics:

NOTE: These items are normally performed by the manufacturer and credit may be taken for the manufacturer's evaluation and testing.

A. Physical construction;

B. Effect of shock, sound, vibration, electric transients, radiofrequency energy, magnetic fields and humidity;

C. Extent of switching transients, capacitance effects, geotropism and static charge effects;

D. Power supply, including stability and battery life;

E. Range, sensitivity, linearity, detection limit, and response to overload conditions;

F. Accuracy and reproducibility (precision);

G. Energy dependence;

H. Angular dependence;

I. Response to ionizing radiations other than those being measured; and

J. Temperature and pressure dependence on measurements.

6.2.4 The RSO shall obtain radiological instrumentation to support a field project or fixed facility from the Rad Instrument Division. When the necessary instruments are not available then they shall use other approved rental companies or instrument vendors.

6.2.5 Instrumentation shall be calibrated as described in "Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments", ANSI N323A, 1997.

6.2.6 Instrumentation shall be calibrated/re-calibrated on the following frequency:

6.2.6.1 Prior to initial use;

6.2.6.2 Every six months ± one month;

6.2.6.3 Whenever the instrument fails a required response check or radiation source check;

6.2.6.4 After any repair or preventative maintenance; or

6.2.6.5 Whenever damage or malfunction is known or suspected.

6.2.7 Instrumentation shall be selected and used based on ability to perform adequately in the presence of the ranges and types of radiation expected.

6.2.8 Prior to each use, or daily in the case of routine use, each instrument shall be tested in the following functions, as appropriate:

6.2.8.1 The instrument's background and response to a check source;

6.2.8.2 Battery status;

6.2.8.3 A test of the reset button;

6.2.8.4 A test of the audible response;

6.2.8.5 Examination for physical damage; and

6.2.8.6 Verification that a current calibration sticker is fixed to the instrument.

Note: The results of step 6.2.8.1 should be entered on an Instrument Daily Background and Source Check (Attachment 3).

6.2.9 Each instrument should be tested at least weekly against a reference standard source in a fixed geometry on at least one scale, and the response (dpm) shall be within ±20% of the true source emission.

6.2.10 Instruments failing any of the tests shall be taken out of service, segregated from other instruments, tagged as "out of service", and repaired/calibrated prior to further use.

6.3 Instrument Inventory

6.3.1 The fixed facility or field project inventory of instruments, supplies, forms, and support equipment shall be adequate to support IT's needs, including an allowance for those instruments undergoing calibration or maintenance.

6.3.2 The Rad Instrument Division shall maintain an adequate inventory of properly calibrated and maintained instruments to support IT projects and fixed facilities.

6.3.2 The inventory of radiation survey instrumentation at a fixed facility or field project shall be physically verified by the RSO or HPP on a quarterly basis.

6.4 Smear Counters

6.4.1 Each smear counter (i.e. gross alpha, gross beta, or combination) upon initial setup shall have the following performance checks made once all operational parameters are established:

A. A minimum of five ten minute background counts shall be made and an average background value and standard deviation (at 95% confidence level) shall be calculated.

B. A minimum of five source counts shall be made to determine the counting efficiency. Count time shall be determined such that a minimum of 10,000 counts will be collected.

C. Counter efficiency shall be calculated using the average source counts per minute value, subtracting the average background, and dividing the resultant value by the source disintegrations per minute.

D. Performance check charts will be initiated for both background and source counts. Each chart will have 95% confidence bands established for future equipment performance checks.

6.4.2 On a daily basis during routine use each smear counter will have a background and source check count performed, and the resultant values will be plotted on their respective performance check charts.

6.4.3 Any time a performance check count falls outside of the 95% confidence bands the count will be repeated. If the next count falls outside of the confidence band the RSO will be contacted.

6.4.4 The RSO shall evaluate possible equipment failure modes and review past performance data. The RSO may do either of the following:

A. Tag the equipment "out of service" and initiate efforts to get the equipment sent to the factory for repair.

B. Establish new background and efficiency performance charts, and allow the equipment to be used.

NOTE: If option (B) is selected the RSO shall personally review the daily performance check data to ensure that the equipment is functioning properly or is tagged "out of service" and returned to the factory.

7 RECORDS

7.1 All Records pertinent to this procedure shall be maintained pursuant to RPP-015.

7.2 A log (see Attachment 2) shall be maintained of all radiation surveys performed.

7.3 A file of inspection, calibration, and maintenance history shall be maintained for each instrument.

7.4 An vendor-supplied Certificate of Calibration shall be maintained for each instrument successfully calibrated.

7.5 Instruments shall have a label affixed to them with the following information:

7.6 Instruments that require response checks and reference checks shall have a label, tag, or card attached showing the initials of the individual performing the check and the date.

7.7 The following records shall be generated and maintained:

7.7.1 Radiological Survey Forms (Attachment 1)

7.7.2 Radiological Survey Log Sheets (Attachment 2)

7.7.3 Instrument Daily Background and Source Check Sheets (Attachment 3)

7.8 All records shall be maintained in accordance with RPP-010 "Radiation Protection Records".

8 ATTACHMENTS

8.1 Attachment 1: "Radiological Survey Form and Instructions for Use"

8.2 Attachment 2: "Radiological Survey Log Sheet"

8.3 Attachment 3: "Instrument Daily Background and Source Check"

ATTACHMENT 1

ATTACHMENT 2

ATTACHMENT 3

the igroup

Page _____ of _____

RADIOLOGICAL SURVEY FORM

Survey Number _____

Survey Description: _____
_____
_____
_____
_____
Drawing Attached: Yes___ No

Survey Date: _____

Survey by: _____/_____
Signature Date

Print Name: _____

Reviewed _____/_____
Signature Date

Instrument (1)
Instrument Model: _____
Instrument Ser. # : _____
Calibration Due: _____
Efficiency : _____
MDA: CF:

Instrument (2)
Instrument Model: _____
Instrument Ser. # : _____
Calibration Due: _____
Efficiency : _____
MDA: CF:

Instrument (3)
Instrument Model: _____
Instrument Ser. # : _____
Calibration Due: _____
Efficiency : _____
MDA: CF: BKG:

Instrument (4)
Instrument Model: _____
Instrument Ser. # : _____
Calibration Due: _____
Efficiency : _____
MDA: CF: BKG:

Survey Point	Smearable Contamination		Fixed Contamination		Radiation Level (μR/hr)	Instrument Used	Additional Comments
	Alpha dpm/100cm^2	Beta/gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/gamma dpm/100cm^2			

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Page _____ of _____

RADIOLOGICAL SURVEY FORM CONTINUATION SHEET

Survey Number _____

Survey Point	Smearable Contamination		Fixed Contamination		Radiation Level (μR/hr)	Instrument Used	Additional Comments
	Alpha dpm/100cm^2	Beta/gamma dpm/100cm^2	Alpha dpm/100cm^2	Beta/gamma dpm/100cm^2			

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RADIOLOGICAL SURVEY LOG

SURVEY NUMBER	SURVEY DATE	SURVEYED BY	DESCRIPTION

Instrument Daily Background and Source Check

Instrument No. : _____ Setup Date: _____

Cal Date: _____ Source ID: _____

Probe No. : _____ Project No.: _____

Range Background _____ cpm to _____cpm

Source_____ cpm to _____ cpm

Date	Source Reading	Background Reading	Acceptable Y or N	Technician Initials	Additional Comments

Completed By _____ Date _____

Reviewed By _____ Date _____

INTERNATIONAL TECHNOLOGY CORPORATION

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-005

TITLE: **Radiological Areas and Posting**

REVISION NO.	DATE
001	9/23/96
002	3/4/2000

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1 PURPOSE AND OBJECTIVES

This procedure describes the radiological areas and posting requirements for IT job sites and fixed facilities. This procedure applies to all job sites and fixed facilities.

2 RESPONSIBILITIES

2.1 The RSO or designee is responsible for placing and removing radiological postings.

NOTE: Postings shall not be placed or removed by others!

2.2 The Project Manager or Fixed Facility Director is responsible for assuring that personnel are trained and understand the meaning of each type of posting, and that they follow the requirements of each.

3 REFERENCES

3.1 Requirements and Specifications

3.1.1 IT Corporation Policy No. HS-700, "Radiation Protection Program Plan"

3.1.2 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation"

3.2 Related Procedures

3.2.1 IT Corporation Procedure No. RPP-010, "Radiation Protection Records"

3.3 Others

3.3.1 Title 10 Code of Federal Regulations, Part 835, "Radiation Protection for Occupational Workers"

3.3.2 Regulatory Guide 1.86, "Termination of Operating Licenses for Nuclear Reactors,"

4 DEFINITIONS

4.1 Airborne Radioactivity Area - Any area where airborne radioactive concentrations exceed 25% of the Derived Air Concentrations (DAC).

4.2 Approval - An act of endorsing or adding positive authorization or both.

4.3 Authorized User (AU) - Individuals who, by virtue of training and/or experience, have been authorized by the RSO to use or directly supervise the use of radioactive materials under the

requirements of a specific radioactive materials license or **IT** work plan.

4.4 Contamination Area - any area where radioactive materials exceed the limits shown in Regulatory Guide 1.86, Table I.

4.5 Controlled Area - see Radiologically Controlled Area.

4.6 Derived Air Concentration (DAC) - The values obtained by dividing the Annual Limit on Intake by the volume of air breathed by an average worker during a working year (i.e. $2.4X10^3$). These values are listed in 10 CFR 20 Appendix B Table 1.

4.7 Dosimetry - Required Area - Any area where an individual may receive:

- 500 mrem annual effective dose equivalent (external sources) to the whole body (i.e., 0.25 mrem/hr for 2000 hours)
- 5000 mrem annual dose equivalent (external sources) to the skin or extremity (i.e., 2.5 mrem/hr for 2000 hours)
- 1500 mrem annual dose equivalent (external sources) to the lens of the eye (i.e., 0.75 mrem/hr for 2000 hours)

4.8 Health Physics Professionals (HPP) - Individuals who, by virtue of their education, and experience, approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be Certified by the American Board of Health Physics (Comprehensive).

4.9 High Radiation Area - Any area where an individual may receive a dose equivalent of 100 mrem or greater but less than 500 Rad in one hour at a distance of 30 cm from the radiation source or from any surface through which the radiation penetrates.

4.10 May - The word **may** is used to denote permission.

4.11 Radiation Area - Any area where an individual may receive a dose equivalent greater than five mrem but less than 100 mrem in one hour at a distance of 30 cm from the radiation source or from any surface through which the radiation penetrates.

4.12 Radiation Safety Officers (RSO) - Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs are specified by federal or state license requirements, and are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall be **IT** Technical Associates in Health Physics, or shall be selected by the HPP.

4.13 Radioactive Material Area - An area where radioactive materials are stored or handled and where working conditions in the general area are normally such that radiation and contamination levels

are maintained below those for which posting is required.

4.14 Radiologically Controlled Area - Any area to which access is controlled in order to protect individuals from exposure to radiation and radioactive materials. Examples of these areas are: airborne radioactivity area, radiation area, high radiation area, very high radiation area, or contamination area.

4.15 Shall - The word **shall** is to be understood as a requirement.

4.16 Should - The word **should** is to be understood as a recommendation.

4.7 Very High Radiation Area - Any area where an individual may receive a dose equivalent of 500 rad or greater in one hour at a distance of 30 cm from the radiation source or from any surface through which the radiation penetrates.

5 EQUIPMENT/MATERIALS REQUIRED

5.1 Rad Rope/Tape

5.2 Stanchions

5.3 Postings

6 METHODOLOGY

6.1 Posted Areas

The following areas shall be posted:

- Radiologically Controlled Areas
- Radiation Areas
- High Radiation Areas
- Very High Radiation Areas
- Airborne Radioactivity Area
- Contamination Area
- Dosimetry Required Area
- Radioactive Materials Area

6.2 Posting Requirements

6.2.1 All areas that contain radiation hazards and require exposure control shall be clearly designated by appropriate signs, tags, or labels.

6.2.2 The radiation symbol and the color combination yellow and magenta shall be used to signify the actual or potential presence of ionizing radiation and to identify objects,

devices, materials, or combinations of materials which emit ionizing radiation.

6.2.3 The symbols and color combination of yellow and magenta are not to be used for purposes other than to warn of the actual or potential presence of a radiation or contamination hazard.

6.2.4 Each sign, tag, or label shall be displayed prominently and must be recognizable from a safe distance. The signs and symbols shall conform to ANSI N12.1-1971 and ANSI N2.1-1971.

6.2.5 Each posted area shall be defined and clearly marked with appropriate signs and may include a portion or all of a room, building, area, or vehicle. Areas without clearly defined existing boundaries should be defined by the use of radiation tape, ribbon, or rope.

6.2.6 Supplementary notices specifying the requirements for entry to and exit from areas and other special precautions that are to be exercised shall be posted in conjunction with radiation warning signs and tags to provide personnel with any required additional instructions or information not given by the signs and tags.

6.2.7 The information signs, tags, labels, and notices shall be kept current, reflecting any changes in radiological conditions.

6.2.8 Warning signs, tags, labels, notices and other radiation hazard identification markings will be removed when the conditions requiring their use no longer exist.

7 RECORDS

All Records pertinent to this procedure shall be maintained pursuant to RPP-010, "Radiation Protection Records."

8 ATTACHMENTS

None

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-007

TITLE: **Purchase, Receipt, Handling, and Identification of Radioactive Material**

REVISION NO.	DATE
001	9/23/96
002	3/4/2000

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1 PURPOSE AND OBJECTIVES

This procedure contains the administrative controls for acquisition, receipt, and collection of radioactive materials. This procedure applies to all functions pertaining to receipt and handling of sources, samples or other items known or suspected to be radioactive

2 RESPONSIBILITIES

2.1 **The Radiation Safety Officer shall**

2.1.1 Approve all requests for acquisition of radioactive standards and sources.

2.1.2 Provide training for performance of radiation surveys, evaluate survey results, provide guidance and direct any/all remediation of incidents involving radioactive materials and/or radiation

2.1.3 Approve PPE and methods for the collection of known or suspect radioactively contaminated samples or materials.

2.2 **The Project Manager or Fixed Facility Director shall** verify that a radiation survey is completed on all materials known or suspected to be radioactive before they are released for further use.

3 REFERENCES

3.1 Requirements and Specifications

3.1.1 IT Corporation Policy No. HS-700, "Radiation Protection Program Plan"

3.1.2 Title 10, Code of Federal Regulations, Part 33, "Specific Domestic Licenses of Broad Scope for Byproduct Material".

3.1.3 Nuclear Regulatory Commission, Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation".

3.1.4 Nuclear Regulatory Commission, Title 10, Code of Federal Regulations, Part 71, "Packaging and Transportation of Radioactive Material".

3.2 Related Procedures

3.2.1 IT Corporation Procedure No. RPP-003, "Contamination Control"

3.2.2 IT Corporation Procedure No. RPP-004, "Instrumentation and Surveillance"

3.2.3 IT Corporation Procedure No. RPP-006, "Sample Screening and Shipping"

3.2.4 IT Corporation Procedure No. RPP-009, "Packaging and Transportation of Radioactive Material"

3.2.5 IT Corporation Procedure No. RPP-010, "Radiation Protection Records"

3.2.6 IT Corporation Procedure No. RPP-013, "Handling Sealed Radiation Sources"

3.3 Others

3.3.1 "A Review of the Department of Transportation Regulations for Transportation of Radioactive Materials," U.S. Department of Transportation, 1983.

4 DEFINITIONS

4.1 Approval - An act of endorsing or adding positive authorization or both.

4.2 Authorized User (AU) - Individuals who, by virtue of training and/or experience, have been authorized by the RSO to use or directly supervise the use of radioactive materials under the requirements of a specific radioactive materials license or **IT** work plan. (Note: Check license requirements for inclusion of authorized users in the license.)

4.3 Counts Per Minute (CPM) - A relative unit used to measure the rate of radiation events detected by a sensitive radiation detector and survey rate meter, equivalent to a Ludlum Model 14C or Model 3.

4.4 Health Physics Professionals (HPP) - Individuals who, by virtue of their education, and experience, approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be Certified by the American Board of Health Physics (Comprehensive).

4.5 Limited Quantity - A maximum quantity of a hazardous material listed by the DOT, for which there are specific exceptions from marking, labeling and packaging. The quantity of radioactive material that is excepted from these requirements is listed in 49 CFR 173.421.

4.6 May - The word **may** is used to denote permission.

4.7 MicroRoentgen per hour (μR/hr) - A unit of gamma exposure rate measured by a survey meter equivalent to the Ludlum Model 19. 1000 μR/hr is equivalent to 1 millirad per hour (mR/hr).

4.8 Normal Background - The ambient radiation field to which we are exposed daily, originating from cosmic rays, naturally occurring radionuclides (^{40}K, etc.) and human endeavors (fallout, fuel cycle, etc.). This radiation field is variable, and causes a survey meter to respond in the absence of radioactive materials.

4.9 Radiation Safety Officers (RSO) - Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs are specified by federal or state license requirements, and are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall be **IT** Technical Associates in Health Physics, or shall be selected by the HPP.

4.10 Radiation Survey Instrument - A hand held radiation survey instrument capable of detecting ionizing radiation.

4.11 Radioactive Shipping Labels - A label bearing the radiation symbol and the isotope and quantity contained in the package which is applied to two sides of a shipping package. The label selected shall be indicative of the external radiation levels measured on the surface of the package. Specifically:

4.11.1 White I - radiation levels on the surface of the package are less than 0.5 mrem/hr and the radiation level at 1 meter is < 50 microrem/hr.

4.11.2 Yellow II - radiation levels on the surface of the package are less than 50 mrem/hr and at 1 meter < 1 mrem/hr.

4.11.3 Yellow III - radiation levels on the surface of the package are less than 200 mrem/hr and at 1 meter 10 mrem/hr. (Note: If shipped as exclusive use radiation levels can be higher as allowed by the US Department of Transportation (DOT) regulations.)

4.12 Type A Quantity (A_1 and A_2 Quantities) - The maximum quantity of radioactive material permitted in a Type A package. The A_2 quantity shall be used when the physical form has **NOT** been certified as a special form by the DOT. These quantities are listed by individual isotopes in the DOT regulations, 49 CFR 173.435.

4.13 Shall - The word **shall** is to be understood as a requirement.

4.14 Should - The word **should** is to be understood as a recommendation.

5 EQUIPMENT/MATERIALS REQUIRED

5.1 A radiation survey instrument calibrated within the last six months and source checked on the day that it is used.

5.2 Smears

5.3 Disposable bench-liner (When applicable to a fixed facility.)

5.4 Protective clothing

6 METHODOLOGY

6.1 Purchase of Radioactive Materials

6.1.1 The individual requesting acquisition of radioactive material shall inform the RSO of the quantity and form needed, and the intended use for the material.

6.1.2 The RSO shall review and approve the planned acquisition based upon safety considerations, existing inventory, and license limits.

6.1.3 Upon approval by the RSO, the requisition shall be submitted to the purchasing agent to complete the purchase order.

6.1.4 The RSO shall maintain a file of approved acquisitions pending their addition to the inventory.

6.1.5 When the inventory is updated following receipt of the materials, the approved forms shall be transferred to the inventory file.

6.1.6 When the materials are received, the materials are added to the inventory as required by standard operating procedures and/or license requirements.

6.2 Receipt of Radioactive Materials

6.2.1 All papers, forms, manifests, etc., accompanying the shipment shall be inspected.

6.2.2 If the information on these forms is unclear or incomplete:

A. Work shall be stopped.
B. Clarification shall be obtained from a supervisor.
C. The Project Manager and the RSO shall be consulted before proceeding.

6.2.3 Visually inspect the outer container checking for leaks or stains that may indicate damage to the contents.

CAUTION: If damage or stains are noted evaluate your protective clothing. You should be prepared for a worst-case scenario before proceeding if stains are noted (double gloves, spill tray and absorbent material at hand, etc.).

6.2.2 Perform a smear survey of the outer shipping container.

NOTE: When low energy beta (e.g., tritium) contamination is suspected, use appropriate smears for liquid scintillation counting.

6.2.3 If smear results are within the allowed limits proceed with unpacking the shipment.

CAUTION: If smear results are **NOT** within allowed limits isolate the package, perform a direct frisk of your hands, and notify the RSO.

6.3 Collection of Samples

6.3.1 Workers collecting samples at a job site covered by a job specific health and safety plan (HASP) will be required to adhere to the requirements of the plan.

6.3.2 If the sample collection work is not covered by a HASP these steps will be followed.

A. Sampling personnel will contact the job site RSO or the Regional HPP for task specific directions and proper PPE.

B. Sampling personnel will obtain all PPE and additional site control equipment required (e.g. postings, boundary tape/rope, radiation monitoring equipment, etc.).

C. At the site, postings and warnings for site identification, decontamination/monitoring areas, and support function areas will be set up as required.

D. Samples will be collected as required by a work plan or contract.

E. All personnel, samples, and equipment will be radiologically monitored prior to entering the support zone area to ensure that no detectable contamination is present (see RPP-003 "Contamination Control").

F. Any contamination found will be reported to the job site RSO and removed using the techniques described in RPP-003 "Contamination Control."

G. All skin contamination events that occur at sites where a job site RSO is not present will be decontaminated as described in RPP-003 and then reported to a RSO or Regional HPP as soon as possible following the incident. Items that need to be reported are:

- Person affected and SS number,
- Location and size of the affected area,
- Activity level of contaminant (net dpm per detector area above background),
- Estimated duration of exposure (how long was the contaminant possibly present),
- Potential radionuclide(s) involved,

- Methods used to decontaminate the individual, and
- Specific events leading up to the contamination, paying particular attention to those behaviors, outside influences, or PPE failure that may have lead up to the event.

6.4 Identification of Radioactive Materials

6.4.1 All samples containing known or suspect radioactive materials will be identified with a "Radioactive Material" sticker.

6.4.2 When required by DOT regulations, the sample container will be clearly marked with the contact dose rate or contact count rate (for the case of low level activity samples).

7 RECORDS

7.1 All Records pertinent to this procedure shall be maintained pursuant to RPP-010.

7.2 The RSO and the Director shall maintain the records pertaining to the inventory of licensable radioactive material.

7.3 The RSO shall submit a copy of the current NRC license as requested by the vendor supplying the radioactive material.

7.4 All personnel opening packages containing certified solutions or sources shall forward all pertinent sample information to administrative personnel, and all certificates to the RSO.

8 ATTACHMENTS

None

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-007

TITLE: **Purchase, Receipt, Handling, and Identification of Radioactive Material**

REVISION NO.	DATE
001	9/23/96
002	3/4/2000

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2.1 The Radiation Safety Officer shall

2.1.1 Approve all requests for acquisition of radioactive standards and sources.

2.1.2 Provide training for performance of radiation surveys, evaluate survey results, provide guidance and direct any/all remediation of incidents involving radioactive materials and/or radiation.

2.1.3 Approve PPE and methods for the collection of known or suspect radioactively contaminated samples or materials.

2.2 **The Project Manager or Fixed Facility Director shall** verify that a radiation survey is completed on all materials known or suspected to be radioactive before they are released for further use.

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4.13 Shall - The word **shall** is to be understood as a requirement.

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5 EQUIPMENT/MATERIALS REQUIRED

5.1 A radiation survey instrument calibrated within the last six months and source checked on the day that it is used.

5.2 Smears

5.3 Disposable bench-liner (When applicable to a fixed facility.)

5.4 Protective clothing

6 METHODOLOGY

6.1 Purchase of Radioactive Materials

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6.1.2 The RSO shall review and approve the planned acquisition based upon safety considerations, existing inventory, and license limits.

6.1.3 Upon approval by the RSO, the requisition shall be submitted to the purchasing agent to complete the purchase order.

6.1.4 The RSO shall maintain a file of approved acquisitions pending their addition to the inventory.

6.1.5 When the inventory is updated following receipt of the materials, the approved forms shall be transferred to the inventory file.

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6.2 Receipt of Radioactive Materials

6.2.1 All papers, forms, manifests, etc., accompanying the shipment shall be inspected.

6.2.2 If the information on these forms is unclear or incomplete:

A. Work shall be stopped.
B. Clarification shall be obtained from a supervisor.
C. The Project Manager and the RSO shall be consulted before proceeding.

6.2.3 Visually inspect the outer container checking for leaks or stains that may indicate damage to the contents.

CAUTION: If damage or stains are noted evaluate your protective clothing. You should be prepared for a worst-case scenario before proceeding if stains are noted (double gloves, spill tray and absorbent material at hand, etc.).

6.2.2 Perform a smear survey of the outer shipping container.

NOTE: When low energy beta (e.g., tritium) contamination is suspected, use appropriate smears for liquid scintillation counting.

6.2.3 If smear results are within the allowed limits proceed with unpacking the shipment.

CAUTION: If smear results are **NOT** within allowed limits isolate the package, perform a direct frisk of your hands, and notify the RSO.

6.3 Collection of Samples

6.3.1 Workers collecting samples at a job site covered by a job specific health and safety plan (HASP) will be required to adhere to the requirements of the plan.

6.3.2 If the sample collection work is not covered by a HASP these steps will be followed.

A. Sampling personnel will contact the job site RSO or the Regional HPP for task specific directions and proper PPE.

B. Sampling personnel will obtain all PPE and additional site control equipment required (e.g. postings, boundary tape/rope, radiation monitoring equipment, etc.).

C. At the site, postings and warnings for site identification, decontamination/monitoring areas, and support function areas will be set up as required.

D. Samples will be collected as required by a work plan or contract.

E. All personnel, samples, and equipment will be radiologically monitored prior to entering the support zone area to ensure that no detectable contamination is present (see RPP-003 "Contamination Control").

F. Any contamination found will be reported to the job site RSO and removed using the techniques described in RPP-003 "Contamination Control."

G. All skin contamination events that occur at sites where a job site RSO is not present will be decontaminated as described in RPP-003 and then reported to a RSO or Regional HPP as soon as possible following the incident. Items that need to be reported are:

- Person affected and SS number,
- Location and size of the affected area,
- Activity level of contaminant (net dpm per detector area above background),
- Estimated duration of exposure (how long was the contaminant possibly present),
- Potential radionuclide(s) involved,

- Methods used to decontaminate the individual, and
- Specific events leading up to the contamination, paying particular attention to those behaviors, outside influences, or PPE failure that may have lead up to the event.

6.4 Identification of Radioactive Materials

6.4.1 All samples containing known or suspect radioactive materials will be identified with a "Radioactive Material" sticker.

6.4.2 When required by DOT regulations, the sample container will be clearly marked with the contact dose rate or contact count rate (for the case of low level activity samples).

7 RECORDS

7.1 All Records pertinent to this procedure shall be maintained pursuant to RPP-010.

7.2 The RSO and the Director shall maintain the records pertaining to the inventory of licensable radioactive material.

7.3 The RSO shall submit a copy of the current NRC license as requested by the vendor supplying the radioactive material.

7.4 All personnel opening packages containing certified solutions or sources shall forward all pertinent sample information to administrative personnel, and all certificates to the RSO.

8 ATTACHMENTS

None

INTERNATIONAL TECHNOLOGY CORPORATION

IT CORPORATION

STANDARD OPERATING PROCEDURE

NUMBER: RPP-015

TITLE: **Control of Radiological Work**

REVISION NO.	DATE
001	9/23/96

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1 PURPOSE AND OBJECTIVES

This procedure establishes the method to be followed in obtaining a Radiation Work Permit (RWP). This procedure applies to all work within a radiologically controlled area at a fixed facility or field work site, or when working with Category III radioactive samples, or other non-radiologically controlled area work for which a RWP is deemed necessary by the Radiation Safety Officer (RSO).

2 RESPONSIBILITIES

2.1 RSO, or his designee shall:

2.1.1 Maintain a supply of Radiation Work Permit Forms (Attachment 1).

2.1.2 Insure that all work performed inside a radiologically controlled area is covered by a current RWP.

2.1.3 Perform periodic surveillance to determine compliance with this procedure by fixed facility or field personnel.

2.2 Authorized Users

2.2.1 Initiate RWP's for all work in a radiologically controlled area or when directed by the RSO. Complete Section 1 which includes job location, issue date, shift, expiration date, brief job description, and signature. (See Attachment 1).

2.2.2 Review completed RWP's with team members and obtain their signatures on the RWP.

2.2.3 Post completed RWP's at the work location or maintain at the work site.

2.2.4 Ensure that RWP requirements are followed by task team members.

2.3 RSO or Designee shall:

2.3.1 Complete Section II of the RWP.

2.3.2 Review completed RWP's with the Team Leaders. Provide additional instructions if required.

2.3.3 Monitor compliance of task team members to RWP requirements.

2.3.4 Maintain copies of completed RWP's in facility or project Health and Safety working files

2.4 Team Members Shall:

2.4.1 Read the RWP and sign the RWP to indicate knowledge and understanding of requirements and intent to comply with those requirements.

2.4.2 Perform the work in accordance with the requirements specified in the RWP.

3 REFERENCES

3.1 Requirements and Specifications

3.1.1 IT Corporation Policy No. HS-700, "Radiation Protection Program Plan"

3.1.2 Title 10, Code of Federal Regulations, Part 20, "Standards for Protection Against Radiation"

3.2 Related Procedures

3.2.1 IT Corporation Procedure No. RPP-010, "Radiation Protection Records"

3.2.2 IT Corporation Procedure No. RPP-001, "Internal Exposure Control"

3.2.3 IT Corporation Procedure No. RPP-002, "External Exposure Control"

3.2.4 IT Corporation Procedure No. RPP-003, "Contamination Control"

3.2.5 IT Corporation Procedure No. RPP-004, Instrumentation and Surveillance

3.2.6 IT Corporation Procedure No. RPP-005, Radiological Areas and Posting

3.2.7 IT Corporation Procedure No. RPP-006, "Sample Screening and Classification"

3.2.8 IT Corporation Procedure No. RPP-008, "Engineered Controls and Respiratory Protection"

3.3 Others

3.3.1 "Health Physics Manual of Good Practices for Reducing Radiation Exposure to Levels that are As Low As Reasonably Achievable (ALARA)," Department of Energy Manual, PNL-6577, June, 1988.

4 DEFINITIONS

4.1 Approval - An act of endorsing or adding positive authorization or both.

4.2 Health Physics Professionals (HPP) - Individuals who, by virtue of their education, and experience, approve and provide oversight for work involving or pertaining to radioactivity. The HPP shall be Certified by the American Board of Health Physics (Comprehensive).

4.3 May - The word **may** is used to denote permission.

4.4 Radiologically Controlled Area - An area where access is restricted in order to reduce the likelihood of exposure to radiation or radioactive contamination.

4.5 Radiation Safety Officers (RSO) - Individuals who, by virtue of training and/or experience, have been authorized to develop, administer and implement a radiation protection program. Fixed facility RSOs are specified by federal or state license requirements, and shall not be changed without notification of the appropriate licensing authority. Fixed facility RSOs are authorized to use or directly supervise the use of radioactive materials under the specifications of a specific radioactive materials license. Project RSOs shall be selected by the HPP.

4.6 Radiation Work Permit (RWP) - An authorizing document that establishes the radiological requirements for working with known or potential radiological hazards. Its purpose is to inform personnel on work scope to define controls to prevent the spread of contamination and to inform workers of existing radiological conditions. This document may also be specified as a "Radiation Work Permit" (RWP).

4.7 Screening - Gross measurement of radiations emitted from a sample likely to contain significant quantities of radioactive material.

4.8 Shall - The word **shall** is to be understood as a requirement.

4.9 Should - The word **should** is to be understood as a recommendation.

5 EQUIPMENT/MATERIALS REQUIRED

5.1 Portable radiation survey meter, capable of detecting the radiation likely to be emitted from the samples being analyzed or from the radiological materials at a field site.

5.2 Container suitable for collecting contaminated waste and trash.

5.3 Warning signs and banners capable of identifying the radiologically controlled zone and entry requirements.

6 METHODOLOGY

6.1 A RWP shall be used to establish the radiological requirements for working with known or potential radiological hazards.

6.2 At a fixed facility potentially radiologically contaminated samples shall be screened and classified before analysis.

6.3 The work supervisor shall request a RWP from the RSO before Category III samples are analyzed.

6.4 At a fixed facility or job site the RSO shall establish the requirements for the RWP after discussing the job with the work supervisor and having reviewed radiation surveys of the job site to evaluate radiological conditions.

6.5 Personnel working inside a radiologically controlled area without an escort shall:

6.5.1 Complete the radiation safety training courses required by the NRC license, and the IT procedure HS-050;

6.5.2 Meet the posted entry requirements; and

6.5.3 Participate in the routine bioassay program, if any.

6.6 Personnel who have not completed the requirements specified above, may enter a radiologically controlled area if approved by the RSO, and shall be escorted by a person designated by the RSO.

6.7 The RSO shall establish the following provisions:

6.7.1 RWP number. This number shall be the month and year that the RWP shall be issued, plus a sequential number at the end (ex., 0591-01). This information shall be entered into a log maintained by the RSO.

6.7.2 Protective requirements specified on the RWP form.

6.7.3 Special instructions specified on the RWP form.

6.7.4 Approval signature.

6.8 A RWP shall be valid for seven (7) consecutive days, unless otherwise noted.

6.9 If an activity covered by a RWP exceeds seven (7) days, an extension may be granted by the RSO.

6.10 The RWP shall be posted at the boundary of the radiological control area, near the entrance if practical.

6.10.1 All employees performing the job shall sign the RWP.

6.10.2 This signature demonstrates the employee's understanding of all requirements.

6.11 The radiologically controlled area shall be equipped with the following equipment as appropriate:

6.11.1 Portable, radiation survey instrument;

6.11.2 Warning signs as required by 10 CFR 20 or state license requirements and any additional signs required by RPP-005; and

6.11.3 A container designated for trash potentially contaminated with radioactive materials;

6.12 If job requirements on a RWP change or any unusual/unexpected events occur:

6.12.1 The RSO shall be notified as soon as possible

6.12.2 A new RWP shall be issued or changes shall be made to the existing one.

6.13 Persons exiting the control zone shall frisk their clothing and shoes before leaving as required on the RWP.

6.13.1 The survey instrument and count rate for "clean" shall be determined by the RSO for each type of frisker needs. For an associate to exit the control zone, instrument readings shall be at or below the established count rate.

6.13.2 The RSO shall investigate any suspected personnel contamination incidents.

6.14 The supervisor shall notify the RSO when the work with radioactive materials/samples is completed.

6.15 The RSO at a fixed facility or his designee shall:

6.15.1 Confirm that all samples requiring a RWP have been removed from the area and returned to Sample Control or transferred to a different control zone.

6.15.2 Confirm that all waste and contaminated trash has been removed from the zone and is properly stored in the Chemical Storage Room.

6.15.3 Perform a direct survey of the floors and surfaces likely to come in contact with the radioactive material.

6.15.4 Perform a wipe test survey to represent the floors and surfaces likely to come in contact with the radioactive material.

6.15.5 The RSO shall remove the RWP and other restrictions from the area after the results of the

surveys are complete and shall file the RWP in accordance with Section 7.0.

6.16 When at a work site the job covered by an RWP is complete:

6.16.1 The RSO or designee will make surveys of the area to determine radiological conditions in the work area and record survey results on a survey form.

6.16.2 The RSO or designee will remove the RWP from the area and file it in accordance with Section 7.0.

7 RECORDS

7.1 All Records pertinent to this procedure shall be maintained pursuant to RPP-010.

7.2 RWPs shall be maintained by the RSO as quality assurance records.

8 ATTACHMENTS

8.1 Attachment 1 - Radiation Work Permit Form

ATTACHMENT 1
RADIATION WORK PERMIT

INTERNATIONAL TECHNOLOGY CORPORATION

RADIATION WORK PERMIT

Release Number:

Location:

Job Description:

Job Supervisor: Phone #:

Job Start/Finish Dates:

SITE CHARACTERIZATION

LOCATION	RADIATION LEVELS			CONTAMINATION	
	Type	Contact (mrem/hr)	Work Area (mrem/hr)	Type	Activity (dpm/100 cm^2)

AIRBORNE	OTHER HAZARDS	
Activity (µCi/ml)	Type	Levels

PERSONAL PROTECTIVE EQUIPMENT

BODY & HANDS	X	FEET	X	HEAD	X
HS COVERAGE	X	RESPIRATORY PF		DOSIMETRY	

Special Instructions: All personnel have stop work authority. This RWP shall be updated to reflect site conditions with corresponding protective measures and apprpriate monitoring. All personnel will be radiation worker trained prior to entering radiolgocial areas or handling radioactive material. Daily safety meetings shall address all site conditons/hazards. Workers shall be briefed on this RWP prior to commencing work and any time the requirements of this RWP are changed

Waste Handling: Wastes will be handling as directed by Site Supervison with concurrence of the radiolgocial controls technician. If warranted, characteristics of waste may require modifications to this RWP prior to handling

Preparer:

Approval ***(Project Radiation Safety Officer)***

Expiration Date: **Termination Date:**

IT Form HS700B

ATTACHMENT 2

CLASSIFICATION OF SAMPLES

CATEGORY I
gross alpha <0 01 µCi/sample
gross beta <0.1 µCi/sample
total activity <0 002 µCi/gram

CATEGORY II

Category IIa Limits per Sample	Category IIb Limits per Sample	Category IIc Limits per Sample
<1 mR/hr Contact	≥ 1 but < 10 mR/hr Contact	≥ 10 mR/hr Contact
≤0.002 µCi/g Total Activity	>0.002 µCi/g Total Activity	≥.01 µCi/g Total Activity
Gross Alpha ≥.01 but <.1µCi Gross Beta ≥.1 but < 1 µCi	Gross Alpha ≥.1 but < 1 µCi Gross Beta ≥ 1 but < 10 µCi	Gross Alpha ≥ 1 µCi Gross Beta ≥ 10 µCi
Follow safe lab practices for handling radioactive materials.	RWP required. Work must be performed under HEPA protected hood if possible. Monitoring of equipment and area will be required at job completion Frisker station will be required.	RWP required HP coverage may be required. Work must be performed under HEPA protected hood if possible. Segregation of lab waste may be necessary. Monitoring of equipment & area required at job completion.

ATTACHMENT 3

POLICY STATEMENT

I understand that samples received at the ORL for mixed waste analysis shall be classified by Health Physics prior to their release to the laboratory for analysis. I further understand that sample classification is based on radiological screening performed at the facility or on an evaluation by Health Physics of radiological data provided by the client. Waiver of the requirements above can only be made in writing by the Radiation Safety Officer or his designee.

I understand that samples labeled as **"Safety Work Release", "Radiation Work Permit"** or **"Health Physics Coverage Required"** shall be analyzed under the direction of Health Physics. I understand that to perform analytical work on mixed waste samples or on samples labeled as described above without appropriate health physics classification or coverage is a violation of the facility Sample Screening and Classification Policy (sample radiological screening procedures are exempt from these requirements). I also understand that violation of this policy will result in disciplinary action which involves a written warning and may involve termination of employment for repeated offense.

I certify that I have read and that I understand the requirements stated above.

Printed Name Signature Date

ATTACHMENT 8
AIR SAMPLING PROCEDURE FOR RADIOACTIVE MATERIALS

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1.0 Scope

1.1 Purpose

This procedure describes two techniques for determining the concentration of airborne radioactive particulates. The techniques differ only in sample collection; the analytical technique for determining the concentration from the filter media is the same for either sample collection method. The procedure supports the following objectives:

- Demonstrate compliance with the intake limits for workers specified in applicable Federal or state regulations.
- Meet the posting requirements for airborne radioactivity areas specified in applicable Federal or state regulations.
- Determine whether precautionary ALARA measures such as process or engineered controls, increased surveillance, limitation on working times, provision of respiratory protection equipment, or other precautions should be considered.
- Determine whether exposures to radioactive materials are being maintained ALARA.

1.2 Applicability

This procedure applies to all IT Corporation (IT) personnel and subcontractors performing airborne particulate monitoring on the Naval Air Station North Island (NASNI) Site 10 Project site.

2.0 Responsibilities

2.1 Radiological Controls Supervisor

The Radiological Controls Supervisor (RCS) or designee is responsible for the performance of airborne radioactive particulate monitoring on the NASNI Site 10 project. Specific responsibilities include:

- Selecting proper equipment
- Ensuring properly calibrated and tested equipment is available
- Determining appropriate sampling frequencies and locations
- Evaluating monitoring data

2.2 Radiological Controls Technician

The Radiological Controls Technician (RCT) is responsible for performing airborne radioactive particulate monitoring on the NASNI Site 10 project. Specific responsibilities include:

- Using properly calibrated air samplers
- Performing operability checks
- Placing air samplers in proper locations
- Collecting airborne samples
- Documenting surveys

3.0 Equipment and Materials

Air Sampler: Low Volume or High Volume (as appropriate)

Particulate Filters, Envelopes for filter storage

Airborne Radioactivity Sample/Monitor Report (Appendix A)

Airborne Radioactivity Sampling Log (Appendix A)

4.0 Air Sample Collection Instructions

4.1 Determining Need for Airborne Radioactivity Sampling

Airborne particulate surveys should be performed as follows:

- At least every four hours and when airborne radioactivity is expected to at the highest levels;
  - In radiological areas when radiological work is performed,
  - During radiological work that has been known to cause or is expected to cause airborne radioactivity, and
  - In occupied areas where removable contamination exceeds 10,000 dpm/100 cm^2 beta-gamma or 500 dpm/100 cm^2 alpha.
- During initial opening of systems, tanks, or voids that potentially contain significant airborne radioactive contamination.
- To assist in determining the type and frequency of bioassay measurements needed.
- To assist in proper selection of respiratory protective equipment.

- During operations where respiratory protective equipment has been prescribed for protection from airborne radio nuclides.

4.2 Placement of Sampling Equipment

Air sampling equipment shall be located in the vicinity of the workers to provide an indication of airborne radioactivity levels to which workers are exposed.

The location of actual or potential release points, air flow patterns, operational experience and areas occupied should be taken into consideration for the placement of fixed air samplers.

4.3 Selection of Air Sampling Equipment

Low volume air samplers may be used for general area continuous sampling and /or job coverage where the sampler placement is representative of work location and job duration is sufficient to obtain a necessary air volume.

High volume air samplers may be used for short-duration job coverage applications, characterization of an area or when a grab sample is needed for a nonroutine event.

4.4 Air Sample Collection

Select an air-sampling unit and install the appropriate diameter filter in the filter head. The sampler shall be in calibration in accordance with Reference RPP-004.

Select a suitable location for sampling. Choose the location based upon an evaluation of the operation being performed. The ideal location shall approximate the breathing zone of a worker and shall be between the source of the potential airborne material and the location of the worker(s).

Determine the necessary sample volume to ensure that a Minimum Detectable Activity (MDA) of <10% of the applicable DAC is obtained.

Turn on the air-sampling unit, adjust the flow rate or set the required volume to be taken. Record the start date and time.

Record the exact location of the air sampling unit and the nature of the work being performed. Record any other pertinent comments.

Periodically check the air sampler unit for proper operation.

After sample collection, record the final flow rate and time, and turn off the air-sampling unit. Remove the air filter and place in sample envelope.

Record pertinent data and the initials of the RCT who performed the sampling on the airborne radioactivity sample/monitor report found in Appendix A.

5.0 Analysis and Data Review

Perform an initial count of the sample, as per Reference RPP-004, as soon as possible within 12 hrs of taking the sample.

Record the results on the airborne radioactivity sample/monitor report and in the airborne radioactivity sample log, Appendix A. If the results are greater than 10% of the most restrictive Derived Air Concentration (DAC), as listed in Appendix B of Reference 10 CFR Part 20 of the nuclide of concern notify the Radiological Controls Supervisor (RCS).

The RCS shall routinely review the airborne radioactivity sample log to note any trends of increasing airborne activity at various work locations. The RCS shall also review the airborne radioactivity sample/monitor reports for accuracy.

6.0 Records

All forms generated as a result of this procedure shall be maintained throughout the duration of the project and retained in accordance with Reference RPP-010.

7.0 References

10 CFR Part 20, "Standards for Protection Against Radiation"

RPP-004, "Instrumentation and Surveillance"

RPP-010, "Radiation Protection Records"

EXHIBIT A
AIRBORNE RADIOACTIVITY SAMPLE FORMS
(3 PAGES)

IT CORPORATION
AIRBORNE RADIOACTIVITY SAMPLE/MONITOR REPORT

Project Name:_____ Project number_____ Reviewed by: _____/
RCS(or Designee) / Date

Sample ID No/ Sample taken by:	Sample Description / Location	Air Sampler/ Serial No.	Start/Stop Date/Time	Initial Flow rate	Final Flow rate	Average Flow rate	Total Run Time(min)	Total Run Vol(ml)	FR	Instr. Type/ Serial No.	Bkg. (cpm)	Instr. Eff.	Sample (cpm)	Date/Time of Count	Activity (uCi/ml)	MDA (uCi/ml)	Counted/Calculated By Signature

IT CORPORATION
AIRBORNE RADIOACTIVITY SAMPLING LOG

PROJECT NAME: NUMBER :

DATE	SAMPLE ID	LOCATION	WORK ACTIVITY	RESPIRATORY REQUIREMENTS	AIRBORNE ACTIVITY (µCi/ml)	REVIEWED BY

APPENDIX B
SAMPLING AND ANALYSIS PLAN

SAMPLING AND ANALYSIS PLAN
(FIELD SAMPLING PLAN AND QUALITY ASSURANCE PROJECT PLAN)

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Submitted to:

U.S. Department of the Navy
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SAMPLING AND ANALYSIS PLAN
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July 8, 2002

Reviewed by: _____ Date: July 8, 2002
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Field Analytical Services Manager

Approved by: _____ Date: 7/9/02
Narciso Ancog
U.S. Navy Quality Assurance Officer

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Acronyms and Abbreviations

>	greater than
<	less than
µmho/cm	micromhos per centimeter
µR/hr	microRoentgens per hour
µS/cm	microSiemens per centimeter
%R	percent recovery
ASTM	American Society for Testing and Materials
bgs	below ground surface
CCR	California Code of Regulations
CCV	continuing calibration verification
COC	chain of custody
COPC	contaminant of potential concern
DQO	Data Quality Objective
DTSC	Department of Toxic Substances Control
EDD	Electronic Data Deliverable
ELAP	Environmental Laboratory Accreditation Program
EPA	U.S. Environmental Protection Agency
ERA	emergency removal action
ERI	Extended RI/RFI
GC/MS	gas chromatograph/mass spectrometer
HCl	hydrochloric acid
ICAL	initial calibration
ICAP	Inductively Coupled Argon Plasma
IR	Installation Restoration
IT	IT Corporation
LCS	laboratory control samples
MS/MSD	matrix spike/matrix spike duplicate
MSA	Method of Standard Addition
Navy	U.S. Department of the Navy
NFESC	Naval Facilities Engineering Service Center
NRaD	Naval Research and Development
PARCC	precision, accuracy, representativeness, completeness, and comparability
PCB	polychlorinated biphenyl
pCi/g	picoCuries per grams
pCi/L	picoCuries per liter
PE	performance evaluation
QA	quality assurance
QA/QC	quality assurance/quality control
QC	quality control
RAP	Removal Action Plan
RCRA	Resource Conservation and Recovery Act
RFI	RCRA Facility Investigation
RI	remedial investigation

Acronyms and Abbreviations (continued)

RPD	relative percent difference
SAP	Sampling and Analysis Plan
SOP	standard operating procedure
STLC	soluble threshold limit concentration
SVOC	semivolatile organic compound
SWDIV	Southwest Division
SWRCB	State of California Water Resources Control Board
TCLP	toxicity characteristic leaching procedure
TPH	total petroleum hydrocarbon
TRPH	total recoverable petroleum hydrocarbon
TTLC	total threshold limit concentrations
USCS	Unified Soil Classification System
USRADS	Ultrasonic Ranging and Data Acquisition System
VOC	volatile organic compound
WCA	waste consolidation area
XRF	x-ray fluorescence

1.0 Introduction

This Sampling and Analysis Plan (SAP) was prepared in support of the non-time critical removal action at Installation Restoration (IR) Site 10 Shoreline Slag Area at the Naval Air Station North Island located in San Diego, California. IT Corporation (IT) prepared this SAP under Contract Task Order 0028 of Southwest Division (SWDIV), Naval Facilities Engineering Command, Remedial Action Contract N62474-98-D-2076.

This SAP contains the necessary elements of a Field Sampling Plan and a Quality Assurance Project Plan. This document provides guidelines for field and analytical activities performed for this project.

This SAP meets U.S. Environmental Protection Agency (EPA) guidelines (EPA, 1999) stipulated for this project and complies with the Navy Technical Direction Letter of September 10, 2001. The document has been prepared in accordance with the Navy Installation Restoration Chemical Data Quality Manual (Naval Facilities Engineering Service Center [NFESC], 1999).

1.1 Site History and Background

This section provides a summary of site-specific background information relevant to sampling. A more detailed discussion of site location, history, and previous investigation information is presented in the Removal Action Plan (RAP).

1.1.1 Previous Investigations

Environmental investigation of the IR Site 10 area began in the early 1980s and primarily addressed soil and groundwater contamination in the portion of the site now designated as the Operations Area (Figure 1). Detailed accounts of the activities and findings of these investigations are described in the Remedial Investigation/Resource Conservation and Recovery Act (RCRA) facility investigation (RI/RFI) report (Bechtel, 1997).

The slag remaining at the site after the 1995 emergency removal action (ERA) was characterized during a subsequent extended RI/RFI (ERI) and a supplemental field investigation. The findings and recommendations of these investigations are summarized in the following sections.

1.1.2 Extended Remedial Investigation/RCRA Facility Investigation

An ERI was performed from 1996 to 1999 to characterize intertidal beach sands and marine sediments and groundwater beneath the Shoreline Slag Area, to assess the nature and extent of slag impacts, and to evaluate potential human health and ecological risks associated with

slag-impacted media (Advanced Infrastructure Management Technologies [AIMTech], 2001). The San Diego-based Space and Naval Warfare Systems Command formerly Naval Research and Development [NRaD]) performed ecological risk screening for marine biota to address the potential bioaccumulation and toxicity effects of slag-impacted sediments (NRaD, 1997).

- Intertidal Beach Sands and Marine Sediments. A total of 98 marine sediment and beach sand samples were collected in March 1998 from an area extending from the base of the shoreline bluff, along the length of the shoreline slag area, to approximately 200 feet off shore. The samples were collected from maximum depths of 1 to 2 feet below ground surface (bgs). X-ray fluorescence (XRF) techniques were used to analyze the samples for chromium, copper, lead, and zinc for screening purposes. Confirmation samples submitted for laboratory analysis were tested for these same metals, as well as for arsenic, cadmium, mercury, nickel, and silver. In November 1998, additional samples were collected along the shoreline, immediately northeast of the Shoreline Slag Area, to determine whether slag-impacted sediments had migrated off site via tidal and long-shore currents.

  Analytical results for the sediment samples were compared with results for samples collected at the IR Site 1 Point Loma reference station (NRaD, 1997). Samples from the reference station are deemed representative of background levels. Elevated metals concentrations were primarily associated with isolated samples collected in the intertidal zone near the base of the shoreline bluff (particularly in the 1995 ERA area) and were not observed northeast of the site boundary. Metals concentrations, radium-226 activities, and gamma exposure rates for shoreline sediments collected bayward of the intertidal zone were within background levels.

  Based on human health and ecological risk screening results, the ERI report recommended no further action for the slag-impacted beach sands and marine sediments at the site.

- **Groundwater.** In March 1998, 14 wells were installed to assess groundwater quality, velocity and direction, and tidal influence on the groundwater flow regime. Two wells were installed on top of the shoreline bluff to total depths of 20 and 15 feet bgs. The remaining wells were located in the intertidal zone at depths ranging from 10 to 18 feet bgs. The wells were screened over intervals ranging from less than 1 foot to 10 feet. Based on groundwater conductivity measurements, which ranged from 1.4 to 52 microSiemens per centimeter (µS/cm) or micromhos per centimeter (µmho/cm), where 52 µmho/cm is representative of water in San Diego Bay, six wells were selected for sampling to assess the seawater/freshwater interface or mixing zone.

  Two wells on the bluff and four intertidal zone wells were sampled during March, September, and November 1998. The groundwater samples were tested for metals and radium-226. The only metal that exceeded the *California Enclosed Bays and Estuaries Plan* criteria (State of California Water Resources Control Board [SWRCB], 1995) was lead in one sample collected during September 1998. The

maximum radium-226 activity detected in the samples was 3.7 picoCuries per liter (pCi/L), which is below the 5 pCi/L criterion set forth in the *California Enclosed Bays and Estuaries Plan*.

- The ERI report recommended no further action for groundwater underlying the Shoreline Slag Area (AIMTech, 2001).

- Nature of Slag Wastes. An ERI reconnaissance survey was performed in September 1996 and included the collection of gamma radiation and global positioning data with Ultrasonic Ranging and Data Acquisition System (USRADS) equipment. Electromagnetometers were coupled to the USRADS equipment to obtain subsurface geophysical data. The survey covered the entire Shoreline Slag Area, the area of the former smelter in the Operations Area, and the inferred route from the smelter to the area of slag disposal. Of the approximately 26,000 measurements collected during the survey, the majority indicated gamma exposure rates within background levels (i.e., 6.5 to 13.1 micro-Roentgens per hour [μR/hr]). The geophysical data suggested the presence of subsurface anomalies potentially associated with buried slag and associated metallic debris.

  Elevated gamma measurements obtained during the reconnaissance survey were associated with point sources identified as fragments of slag or metallic debris. Gamma exposure rates calculated from the measurements of point sources ranged from background levels to a maximum of 442 μR/hr. During a follow-up survey (AIMTech, 2001) in April 1997, 86 of the 104 elevated point sources were excised, primarily from the intertidal zone. Sediments surrounding the point sources were also removed until gamma measurements were obtained within the background range. Laboratory analysis of the point sources indicated activities ranging from background levels of 0.2 to 0.9 picoCuries per gram (pCi/g) to a maximum of 9,474 pCi/g. Excised point sources and impacted sediments were containerized for off-site disposal.

  The easily eroded slag source material exposed in and underlying the shoreline bluff was cited in the ERI report as a potential risk to human health and the environment.

1.1.3 Supplemental Field Investigation

During May and June 1999, a supplemental field investigation was performed at the Shoreline Slag Area to characterize the physical and chemical characteristics of the slag source material in greater detail and to confirm the extent and volume of material requiring remediation (OHM, 1999). During the investigation, slag waste types were mapped and representative samples were collected and submitted for laboratory analysis. Ten slag waste samples were collected at the IR Site 10 shoreline slag area and tested for California Code of Regulations (CCR) Title 22 metals and radium-226. Concentrations of antimony, copper, lead, and zinc detected in one or more of the samples exceeded total threshold limit concentrations (TTLC). Concentrations of antimony, copper, and nickel detected in one or more of the samples exceeded respective soluble threshold

limit concentrations (STLCs). Results for cadmium, chromium, and lead for one or more of the samples exceeded toxicity characteristic leaching procedure (TCLP) criteria. Concentrations of cadmium, chromium, and lead exceeded both the TCLP criteria and STLCs for the metals.

In addition, a geophysical survey and a limited gamma survey were performed.

1.2 Scope and Objectives

The objective of this removal action is to mitigate the potential risk to human health or to the environment. The removal action objectives are to be met by excavation of the slag wastes, placement of slag wastes within a waste consolidation area (WCA), installation of an evapotranspiration (ET) cover over the WCA, and construction of a rock revetment on the shoreline bluff to minimize erosion. Sampling will be performed to characterize the following:

- Wastes on site
- Wastes generated from this action
- Off-site borrow material

This SAP has been prepared to ensure the data collected during the removal activities are precise, accurate, representative, complete, and comparable to meet the intended use of the data. This document describes the sampling procedures that will be followed, and the quality assurance objectives and quality control requirements that will be used for this project. Quality control requirements associated with the sampling activities are presented in this document.

The lead regulatory agency performing oversight of this site is the California EPA, Department of Toxic Substance Control (DTSC).

1.3 Project Organization

The project organization for this removal action consists of representatives from the U.S. Department of the Navy (Navy) and the IT Team. The project organization is shown in Figure 2. The project team consists of the following members:

- Remedial Project Manager
- Quality Assurance Officer
- Project Manager
- Quality Assurance Program Manager
- Health and Safety Manager
- Site Superintendent
- Project Health and Safety Officer
- Project Contractor Quality Control Representative

- Project Chemist
  - Field Chemist/Technologist
- Database Manager
  - Technical Lead

The responsibilities of the team members associated with the sampling activities are presented in Table 1, "Personnel and Responsibilities."

2.0 Data Quality Objectives

The data quality objective (DQO) process is a series of planning steps, based on scientific methods, designed to ensure that the types, quantity, and quality of environmental data used for decision making are appropriate for the intended application. The DQO process, as defined by the EPA, consists of seven steps, which are designed to provide a systematic approach to resolving all the issues that pertain to the site investigation and remediation (EPA, 1994a). The DQO planning steps are summarized in Table 2.

3.0 Sampling and Analysis Strategy

This section introduces the sampling strategy for the removal action, which includes the types of samples that will be collected and analyzed and the purpose of sample collection and analysis in meeting the project objectives.

3.1 Excavation Confirmation Sampling for Metals

Soil from the bottom and sides of each excavation will be tested using XRF technology. The bottom of the excavation will be marked off in 20-foot grids. An XRF reading will be taken at each node and at the intersection of the grid and the base of the walls of the excavation. XRF readings will also be taken at 20-foot horizontal intervals at the vertical midpoint of the sidewalls. Any contaminants of potential concern (COPCs) detected above action criteria, as specified in Table 3 in samples from the floor of the excavation, will require the removal of an additional 1 foot of soil, over a 20- by 20-foot area, centered on the noncompliant sample point. Any COPCs detected in the sidewall samples will require the removal of a 20-foot segment of sidewall, 1 foot deep, centered on the noncompliant sidewall sample. Soil will be tested for the following COPC metals:

- Arsenic
- Cadmium
- Chromium
- Copper
- Lead
- Mercury
- Nickel
- Silver
- Zinc

3.2 Radiological Survey

Soil from the bottom and sides of the excavation will be screened for radioactivity using a sodium-iodide scintillation meter (or equivalent). If levels of radiological activity are noted above the established site background gamma radiation levels (see Table 2 of the RAP), flags will be placed at the locations to designate the material for removal. The removed material will be placed in the WCA. If, for some reason, previously-established site background gamma radiation levels are not appropriate cleanup criteria for this removal action, a new site-specific radiological background study will be conducted. If the source of the radioactivity is not readily

identifiable, samples may be collected and submitted to a licensed off-site laboratory for analysis by gamma spectroscopy.

3.3 Soil Sampling of Borrow Material for ET Cover

This remedial action will consolidate and cover slag wastes from IR Site 10 Shoreline Slag Area. The proposed cap is expected to cover approximately 0.15 acres. Borrow soil from an off-site source will be characterized for possible use in the ET cover. If the borrow material facility does not already have the appropriate data, the borrow soil will be sampled and tested for the following:

- Unified Soil Classification System by American Society for Testing and Materials (ASTM) D 2488 (2000)
- Water Content by ASTM D 2216
- Particle-Size Analysis by ASTM D 422
- Atterberg Limit Tests by ASTM D 4318

Four representative samples will be collected from the site. All samples must pass the ET cover geotechnical criteria. Criteria for the above tests are outlined in Section 3.1.1 and listed in Table1 of the RAP. In addition to the above-listed tests, Hydraulic Conductivity Tests by ASTM D 5084 and Capillary Moisture Relationship for Soil by ASTM D 3152 may be run to further evaluate the suitability of the material for use in construction of the ET cover.

Additionally, soil used for the ET cover will be tested for compliance with environmental criteria. A composite sample will be generated from each borrow soil source. Four discrete samples will be composited into one test sample. Unless generator knowledge or prior testing can limit the scope of testing, the borrow soil sample will be tested for the following:

- Semivolatile organic compounds (SVOCs) by EPA Method 8270C
- Title 22 Metals by EPA Methods 6010B/7000
- Purgeable total petroleum hydrocarbons (TPH) by Modified EPA Method 8015B
- Extractable TPH by Modified EPA Method 8015B
- Chlorinated pesticides by EPA Method 8081A
- Polychlorinated biphenyls (PCBs) by EPA Method 8082
- Volatile organic compounds (VOCs) by EPA Method 8260B

If VOC analysis is required, the VOC sample will not be composited. A discrete sample will be collected for analysis according to the procedures referenced in Section 4.3.6 of this SAP. Criteria for the above tests will be determined by the disposal facility.

3.4 Soil Sampling of Borrow Material for Fill Material

It is anticipated that most of the fill material for the WCA will come from clean overburden soil from the slag waste excavation. The overburden soil will be tested for the following:

- Title 22 Metals by EPA Methods 6010B/7000
- Radiological screening using a sodium-iodide scintillation meter (or equivalent)

If it is necessary to import soil for use as fill material for the site excavations, potential borrow sources will be tested for compliance with environmental criteria prior to import. A composite sample will be generated from each borrow soil source. Four discrete samples will be composited into one test sample. Unless generator knowledge or prior testing can limit the scope of testing, the borrow soil sample will be tested for the following:

- SVOCs by EPA Method 8270C
- Title 22 Metals by EPA Methods 6010B/7000
- Purgeable TPH by Modified EPA Method 8015B
- Extractable TPH by Modified EPA Method 8015B
- Chlorinated pesticides by EPA Method 8081A
- PCBs by EPA Method 8082
- VOCs by EPA Method 8260B (if necessary)

If VOC analysis is required, the VOC sample will not be composited. A discrete sample will be collected for analysis according to the procedures listed in Section 4.3.6. Criteria for the above tests are listed in Table 4.

Additionally, the borrow material will undergo Modified Proctor Compaction Testing per ASTM D 1557. Criteria for this test is set forth in Section 6.0 of the RAP.

3.5 Soil Samples from Drilling Activities

During the construction of the four groundwater water monitoring wells, soil samples will be collected every 5 feet and submitted to the laboratory for analysis. The results of analytical testing will be used to document the lithology and, additionally, concentrations of COPCs outside the WCA at the time of groundwater monitoring well installation. Borings will be advanced 15 to 25 feet bgs depending upon the location. Samples will be tested for the following:

- Title 22 Metals by EPA Method 6010B/7000
- Radiological screening using a sodium-iodide scintillation meter (or equivalent)

Additionally, soil from the borings will be tested for the following geotechnical parameters:

- USCS by ASTM D 2488
- Water Content by ASTM D 2216
- Particle-Size Analysis by ASTM D 422 or ASTM C 136
- Atterberg Limit Tests by ASTM D 4318

3.6 Investigation Derived and Decontamination Waste Testing

The removal activities are expected to produce decontamination water from the decontamination of field equipment. Liquid waste will be stored on site in 55-gallon drums. One liquid sample will be collected from the waste stream prior to disposal to characterize the decontamination water. Due to prior knowledge regarding the source, analytical testing will be limited to the following:

- Total recoverable petroleum hydrocarbon (TRPH) by EPA Method 418.1
- Title 22 metals by EPA Methods 6010B/7000

Soil cuttings from drilling activities will be characterized by analytical results from individual borings.

Upon review of the analytical data, the transportation and disposal options will be evaluated. Waste will be transported to a State of California-approved facility for disposal, will be disposed of on site, or will be treated/reused on site in accordance with all regulatory requirements.

4.0 Field Methods and Sampling Procedures

The following subsections present the sampling procedures for soil excavation and stockpile sampling procedures.

4.1 Field Quality Control Samples

Field quality control (QC) samples will be collected and analyzed during the project to assess the consistency and performance of the sampling program. Field QC samples for this project may include field duplicates, equipment rinsates, and trip blanks.

4.1.1 Field Duplicates

Field duplicates consist of two samples (an original and a duplicate) of the same matrix which are collected, to the extent possible, at the same time and location, using the same sampling techniques. The purpose of field duplicate samples is to evaluate the variability of the contaminant distribution in the sampled matrix. Field duplicates will be collected at a frequency of 1 per 10 samples and will be analyzed for the same analyses as the original sample. Field duplicates receive unique sample numbers; therefore, the identity of the each duplicate sample is "blind" to the analytical laboratory. Exact locations of duplicate samples and their identifications will be recorded in the field logbook. Duplicate samples will not be collected for waste samples.

4.1.2 Equipment Rinsate Blanks

Equipment rinsate samples will be collected only if nondisposable sample equipment is used. Rinsate samples consist of reagent grade water collected from the final rinse of the decontamination process. Rinsate samples will be collected at least once a week from the sample equipment and placed in appropriate precleaned containers that the analytical laboratory will supply and analyze for the same analyses as the field samples. Equipment rinsate samples are used to evaluate the effectiveness of the decontamination procedure and potential cross-contamination during sampling events. This project will utilize disposable sampling equipment where possible, therefore eliminating the need for collection of equipment rinsate samples. Equipment rinsate samples will be collected once per sampling event (from nondisposable sampling equipment) to verify that decontamination procedures are effectively implemented.

4.1.3 Trip Blanks

Trip blanks are hydrochloric acid (HCl)-preserved organic-free water prepared by the laboratory in 40-milliliter volatile organic analysis vials that will be carried into the field, stored with the

samples, and returned to the laboratory for analysis. Trip blanks will be collected and analyzed for each shipment of samples and will be used to determine whether samples have been cross-comtaminated with VOCs during sample collection and transportation. The trip blank vials must be free of any headspace. Trip blanks will be provided and analyzed for each VOC sampling and shipping event.

4.1.4 Temperature Blanks

A temperature blank is a sample container filled with tap water and stored in the cooler during sample collection and transportation. Upon receipt of the samples, the laboratory will immediately record the temperature of the temperature blank.

4.1.5 Matrix Spike/Matrix Spike Duplicate

The laboratory will analyze a matrix spike/matrix spike duplicate (MS/MSD) for every 20 project samples. In order for the laboratory to prepare a project-specific MS/MSD, field personnel will collect triple the sample volumes for water samples and double the sample volumes for soil samples at a minimum of 1 MS/MSD per 20 samples collected. Field personnel will designate 1 sample in 20 for MS/MSD analysis on the chain of custody (COC).

4.2 Sample Containers, Preservatives and Holding Time

Tables 5 and 6 list the sample containers, preservatives, and holding time requirements for this project.

4.3 Sampling Methods Requirements

The following subsections describe the sampling procedures to be used for this project.

4.3.1 XRF Survey Procedure

Soil from the bottom and sides of the excavation will be tested using XRF technology. The bottom of the excavation will be marked off in 20-foot grids. An XRF reading will be taken at each node and at the intersection of the grid and the base of the walls of the excavation. XRF readings will also be taken at 20-foot horizontal intervals at the vertical midpoint of the sidewalls. XRF procedures will conform with EPA Method 6200 (see Attachment 1).

XRF readings will be taken in situ. Site preparation will conform to Section 11.3 of EPA Method 6200. However, the moisture content of the soil (greater than [>] 25 percent approximately) may lead to errors in measurement. Also, sample homogeneity can interfere with the analysis. In either of these cases, a small portion of soil will be removed from the excavation

and processed on site (see Section 11.4, 11.5 and 11.6 of EPA Method 6200). Each sample will be handled as follows:

1. Homogenized
2. Dried either in an oven or in air
3. Ground up to passed through a 60-mesh sieve
4. Placed uniformly on an appropriate substrate
5. Analyzed by XRF

Results will be recorded in a permanently bound logbook or on preprinted forms. Copies of data will be submitted to the QC officer at the end of each day. Ten percent of all XRF samples will be submitted to an off-site laboratory for confirmation analysis by conventional laboratory methods.

4.3.2 Radiation Survey Procedure

The radiological surface scan will be performed by a certified health physicist using a sodium iodide gamma scintillation detector. The certified health physicist will traverse the subject area by following parallel, adjacent but slightly overlapping, 3- to 4-foot wide paths. While traversing the property, the surveyor will move the detector from side to side (covering the 3- to 4-foot wide area) while holding the detector as close to the ground as possible (less than 6 inches). The presence of rocks and other objects may preclude maintaining the detector at a constant height. See procedures in Attachment 2 (Oak Ridge National Laboratory, 2000). If sources or radioactivity are not removable or readily identifiable, a sample of the material may be collected and submitted to a licensed off-site laboratory for analysis by gamma spectroscopy.

Results will be recorded in a permanently bound logbook or on preprinted forms. Copies of data will be submitted to the QC officer at the end of each day.

4.3.3 Borrow Soil Sampling Procedure

Soil samples to be analyzed for environmental criteria will be collected using disposable scoops to minimize decontamination and equipment rinsate requirements. The number of borrow soil samples to be collected will be determined after the borrow source has been identified and will depend on the characteristics of the source.

Nondisposable sampling equipment may be required if soil conditions preclude the use of disposable scoops. If nondisposal equipment is used, the equipment will be decontaminated before and after sampling.

The following steps summarize the sampling procedures to be performed:

- Obtain a disposable polyethylene scoop. A new scoop shall be obtained for each discrete sample.
- Put on new, clean, and chemical-resistant disposable gloves.
- Remove approximately 2 inches of topsoil to remove any disturbed soil.
- Fill a precleaned 8-ounce wide-mouth jar with soil using the disposable scoop. (Note: For samples collected from the backhoe or excavator bucket, disposable scoops will be used to transfer the sample into the jar.) For MS/MSD samples only, fill two precleaned 8-ounce wide-mouth jars.
- Cap the jar and place a signed and dated custody seal over the lid of the jar.
- Label the jar with a sample label completed with the information described in Section 4.5.2.
- Use clear packing tape to secure the sample label to the container.
- Place the jar in a resealable bag.
- Immediately place the resealable bag containing the sample in a cooler with bagged ice.
- Record the sample number, date, time, and description of sample on the COC form and field logbook. All entries will be written in indelible black ink.

Samples will be packaged and shipped in accordance with Section 4.5 of this SAP. The laboratory will be required to composite four discrete samples into one test sample. Equal masses of representative portions from each of the discrete samples will be homogenized in a mixing bowl. If VOC analysis is required, a discrete VOC sample will be collected according to procedures referenced in Section 4.3.6.

4.3.4 Compositing Procedures

Samples to be analyzed for environmental criteria will be composited in accordance with Section 3.0 of this document (four discrete samples from the same batch of soil). The compositing will be conducted in the laboratory per instructions provided by IT. The instructions to the laboratory will be as follows:

- Open one of the associated sample jars and pour the contents into a certified precleaned container.
- Remove extraneous material such as rocks, plant material, etc. from the sample.
- Homogenize the sample with a decontaminated implement such as a trowel.
- Repeat process with the remaining three aliquots of sample in separate containers.

- Remove 100 grams of homogenized material from each of the 4 discrete samples and combine into a fifth precleaned container.
- Again homogenize the material with a decontaminated implement.
- Use the resulting mixture as the composite sample that is to be analyzed.

Sample aliquots from the composite will be taken for any tests requested.

4.3.5 Soil Sampling for Drilling Activities

Four borings will be advanced to 15 to 25 feet bgs, depending upon location. Samples will be collected every 5 feet. After drilling to the specified depth, the pilot bit will be removed. After the inside of the hollow stem is cleaned out, samples will be collected. Three brass sleeves will be used inside the split-spoon sampler. Upon retrieval, the split-spoon sampler will be opened and each end of the brass sleeves will be covered with a Teflon™ sheet and then a plastic cap. The center sleeve will be used for chemical analysis. Geotechnical tests, if necessary, will be performed on the bottom sleeve and the top sleeve will be held in reserve.

The following steps summarize soil sampling procedures:

1. Put on new, clean, chemical-resistant disposable gloves.
2. Advance a decontaminated sampler to the desired starting depth of the sample interval.
3. Release sampler tip.
4. Advance sampler to ending depth of interval.
5. Retrieve sampler.
6. Open sampler and remove brass sleeves.
7. If a VOC sample is to be collected, use an Encore™ sampler (or equivalent procedure) to remove an undisturbed sample from the middle sleeve according to procedures referenced in Section 4.3.3.
8. Cap sample sleeve with Teflon™ sheet and plastic caps.
9. Affix a signed and dated custody seal over each end of the capped sample sleeve.
10. Place a sample label on the sleeve, completed with the information described in Section 4.5.2.
11. Place the sample in a resealable bag.
12. Immediately place the resealable bag containing the sample in a cooler with bagged ice.

13. Record the sample number, date, time, and description of sample on the COC form and field logbook. Write all entries in indelible ink.

Samples will be packaged and shipped in accordance with the procedures presented in Section 4.5 of this SAP.

4.3.6 VOC Soil Sampling Procedure

Soil samples for TPH and VOC analysis will be collected using EnCore™ samplers. The standard operating procedure (SOP) for using EnCore™ samplers is presented in Attachment 3.

For those hollow-stem auger samples requiring VOC analysis, a sample for VOC analysis will be collected from the center sleeve in an EnCore™ sampler, or an equivalent container compatible with EPA Method 5035. Three EnCore™ samples will be collected: two 5-gram containers and one 25-gram container. The 5-gram containers are the primary sample, and a backup sample will be extruded into a sodium bisulfite solution in the laboratory within 48 hours of sample collection. The sample in the 25-gram container will be extruded into methanol within 48 hours of sample collection and will be set aside for high level VOC analysis, if necessary.

The EnCore™ sample, as much as practicable, will be collected from undisturbed soil, along the central axis of the sample sleeve. The soils nearest the sleeve will be avoided as this material most likely will have been disturbed by the direct push sampling process.

After removal of the VOC sample, the ends of this sleeve will then be covered with Teflon sheets, capped, labeled, and placed in a cooler with ice for transport to the laboratory.

4.3.7 Wastewater Sampling Procedure

Decontamination water samples will be collected using a disposable bailer. The samples will be collected in precleaned containers with the appropriate preservative provided by the analytical laboratory.

The following summarizes the sampling procedures that will be used:

- Obtain a disposable bailer. A new bailer shall be obtained for each sample event.
- Put on a new, clean, and chemical-resistant pair of disposable gloves.
- Lower the bailer into the container. Allow sufficient time for the bailer to fill with liquid.
- Retrieve the bailer and fill appropriate bottle(s) for analyses being requested.
- Cap the bottle(s) and wipe any moisture from the outside of the bottle(s).

- Affix a signed and dated custody seal over the cap(s) of the bottle(s).
- Place a sample label, completed with the information described in Section 4.5.2 of this SAP on the jar.
- Use clear packing tape to secure sample label to container.
- Place the bottle in a resealable bag.
- Immediately place the resealable bag containing the sample in a cooler with bagged ice.
- Record sample number, date, time, and description of sample on the COC form and field logbook. All entries will be written in indelible black ink.

Samples will be packaged and shipped in accordance with Section 4.5 of this SAP.

4.4 Decontamination Procedure

Decontamination of nondisposable sampling equipment will be performed to prevent the introduction of extraneous material into samples and to prevent cross-contamination between samples. To decontaminate all sampling equipment, it will be steam cleaned or washed with a nonphosphate detergent, such as Liquinox™ or equivalent. Decontamination water will be collected in 55-gallon drums.

The following steps will be followed for decontamination of nondisposable sample equipment:

1. **Rinse with Potable Water**. This step will decrease the gross contamination and reduce the frequency of changing of the nonphosphate detergent and water solution. Using a 5-gallon bucket about 3/4 full of water and a long handled brush is suggested for this step. Frequent changing of this water will increase its effectiveness.
2. **Wash with Nonphosphate Detergent and Water Solution**. This step will remove all visible contamination from the equipment. Using a 5-gallon bucket approximately 75 percent full of solution and a long-handled brush is suggested for this step. Dilute nonphosphate detergent as directed by the manufacturer.
3. **Rinse with Potable Water**. This step will rinse all the detergent solution away from equipment. Using a 5-gallon bucket approximately 75 percent full of water and a long handled brush is suggested for this step. Periodic changing of this water is required.
4. **Rinse with Deionized Water**. This step will rinse any detergent solution and potable water residues. Rinsing is most effective by applying the deionized water from a stainless steel Hudson-type sprayer or Nalgene™ squeeze bottle while holding equipment over a 5-gallon bucket.

4.5 Sample Handling

The following sections describe sample handling procedures.

4.5.1 Sample Number

All samples sent to an analytical laboratory will be uniquely numbered according to the following format:

XXXXXX - YYYY

Where "XXXXXX" is the six-digit IT project number and "YYYY" is a sequential number for this project. The project number is 818724. The sample number will be recorded in the field logbook and on the COC at the time of sample collection. A complete description of the sample and sampling circumstances will be recorded in the field logbook and referenced to the unique sample identification number.

4.5.2 Sample Labeling

Sample labels are necessary to prevent misidentification of samples. Labels will be filled out and affixed to sample containers at the time of sample collection. Sample labels will be completed with indelible black ink and affixed to each sample container. Each sample label will be covered with clear tape. Sample containers will be placed in resealable plastic bags to protect the sample from moisture during transportation to the laboratory. Each sample container will be labeled at a minimum with the following:

- Sample identification number
- Sample collection date (month/day/year)
- Time of collection (24-hour clock)
- Project number (i.e., 818724)
- Sampler initials
- Analyses to be performed
- Preservation (if any)
- Location (i.e., North Island)

4.5.3 Sample Packaging and Shipment

Immediately after sample collection, custody seals and sample labels will be affixed to each sample container. Sample custody seals are used to detect whether the samples have been tampered with between the time the samples were collected and analyzed. Samplers will sign, date, and place the seals on the shipping containers in such a way that it is necessary to break it

to open the containers. Seals will be affixed to containers before the samples leave the custody of sampling personnel.

Each sample will be covered in clear tape and placed in a resealable plastic bag to keep the sample container and label dry. All glass sample containers will be protected with bubble wrap, if transported by a commercial carrier.

Each cooler will be shipped with a temperature blank. A temperature blank is a sample container filled with tap water and stored in the cooler during sample collection and transportation. Upon receipt of the samples, the laboratory will immediately record the temperature of the temperature blank.

Sample cooler drain spouts will be taped from the inside and outside of cooler to prevent any leakage.

Samples shipped via commercial carrier will be packed in a sample cooler lined with a plastic bag. Ice, sealed in plastic bags, will be added in sufficient quantity to the cooler to keep the samples cooled to 4±2 degrees Celsius for the duration of the shipment to the laboratory. Saturday deliveries must be coordinated with the laboratory and the airbill and cooler marked appropriately.

The COC will be completed and signed by the laboratory-assigned courier. The cooler may then be released to courier for transportation to the laboratory.

If a commercial carrier is used, the COC form will include the airbill number in the "transfers accepted by" column and will be sealed in a resealable bag. The COC will then be taped to the inside of the sample cooler lid. The cooler will be taped shut with strapping tape; and two custody seals will be taped across the cooler lid, one seal in the front and one seal in the back. Clear tape will be applied to the custody seals to prevent accidental breakage during shipping. The samples will then shipped to the analytical laboratory. A copy of the courier airbill should be retained for documentation.

The samples will be delivered to the person in the laboratory authorized to receive samples (also referred to as the sample custodian). Upon receipt of a sample, the custodian will inspect the condition of the sample (including temperature of the cooler) and the custody seal; reconcile the information on the sample label against that on the COC record; assign a laboratory number; log in the sample in the laboratory logbook; and store it in a secured sample storage room.

The IT Project Chemist will be informed immediately of any inconsistencies between the COC and the sample containers received. Any deviations from accepted sample handling procedures will be documented and the IT Project Chemist will be informed.

5.0 Sample Custody and Documentation

In a sampling and analysis program, the integrity and traceability of the samples from the time they are collected through the time data are reported is essential. The handling of the samples taken for environmental analyses and the transfer of custody must be well documented due to the evidentiary nature of the data. A sample is considered to be in one's custody if it meets any of the following conditions:

- In actual possession or in view of the person who collected the sample
- Locked in a secure area
- Placed in an area restricted to authorized personnel

To keep the integrity and traceability of the samples, all information pertinent to a field sampling will be recorded in a field logbook. All samples will be properly labeled and custody sealed prior to transporting to the laboratory with completed COC documentation. All documents will be completed in the field at the time of the sample collection. All entries will be legibly recorded in indelible black ink. A sample COC form is presented in Attachment 4.

5.1 Chain of Custody

To establish the documentation necessary to trace sample possession from the time of collection, a COC record will be completely filled out and accompany every sample.

At a minimum, the following will be recorded on the COC:

- Project name
- Project location
- Project number (IT)
- Project contact (IT)
- Client representative (SWDIV)
- Project Manager (IT)
- Sample numbers
- Date (of sample collection)
- Time (of sample collection to the nearest minute, military time)
- Sample type (composite or grab)
- Sample description (location and matrix)
- Number of sample containers
- Analysis required
- Remarks:

  - MS/MSD samples
  - Photoionization detector readings
  - Observations specific to sample
- Item numbers (to be relinquished)
- Transfer signature (to relinquish samples)
  - The sampler will be the first person to relinquish sample possession.
- Courier/laboratory representative signature (for commercial carrier, record airbill number here)
- Date/time (of custody transfer)
- Additional remarks:
  - Transportation method
  - Laboratory name
  - Turnaround time requirement
  - Composting instruction (if needed)
- Sampler signature

Samples will be delivered to the laboratory for analysis as soon as practicable. The COC record will accompany all samples.

5.2 Analysis Request

Title 22 metals by EPA Methods 6010/7000 and TRPH by EPA Method 418.1 will be the analytical methods used for liquid sampling in this project. Analytical methods used for soil sampling for environmental analyses in this project will be as follows:

- Title 22 metals by EPA Methods 6010B/7000
- VOCs by EPA Method 8260
- Analysis of radium-226 by gamma spectroscopy

Detailed information on methods, calibration criteria, project required reporting limits, and quality control acceptance criteria are presented in Sections 6.0 and 7.0.

Analytical methods used for soil sampling for geotechnical analyses in this project will be as follows:

- Unified Soil Classification System by American Society for Testing and Materials (ASTM) D 2488 (2000)
- Water Content by ASTM D 2216
- Particle-Size Analysis by ASTM D 422
- Atterberg Limit Tests by ASTM D

5.3 Field Sample Custody

The COC will be the controlling document to ensure that sample custody is maintained. The COC will be initiated in the field by sampling personnel upon collecting a sample. Each individual who has the sample(s) in his/her possession will sign the COC. Each time the sample custody is transferred, the former custodian will sign the COC in the "Relinquished by" line, and the new custodian will sign the COC in the "Received by" line. The date, time, and name of their project or company affiliation will accompany each signature.

The waybill number or courier name will be recorded on the COC when a commercial carrier is used. The shipping container will be secured with two custody seals, thereby allowing for custody to be maintained by the shipping personnel until receipt of the laboratory.

If the laboratory sample custodian judges sample custody to be invalid (*e g*, custody seals have been broken), the laboratory will initiate a Nonconformance Report. The Project Chemist will be immediately notified. The Project Chemist will, in turn, notify the Project Manager and the Project QC Manager. The Project Manager will make a decision, in consultation with the client, as to the fate of the sample(s) in question on a case-by-case basis. The sample(s) will either be processed "as-is" with custody failure noted along with the analytical data, or rejected with resampling scheduled, if necessary. The nonconformance associated with the samples will be noted on the appropriate certificate of analysis or case history.

5.4 Field Logbooks

A permanently bound field logbook with consecutively numbered pages will be assigned to each site in this project. All entries will be executed in indelible black ink. Corrections will be made by crossing out erroneous data with a single line. The correction will be dated and initialed. The responsible sampler will sign the logbook pages at the end of each work day. Any unused portions of logbook pages will be crossed out, signed, and dated.

If it is necessary to transfer the logbook to another person, the person relinquishing the logbook will sign and date the last page used, and the person receiving the logbook will sign and date the next page to be used.

At a minimum, the logbook will contain the following information:

- Project name and location
- Date and time
- Personnel in attendance

- General weather information
- Work performed
- Field observations
- Sampling performed, including specifics such as location, type of sample, type of analyses, and sample identification
- Field analyses performed, including results, instrument checks, problems, and calibration records for field instruments
- Descriptions of deviations from SAP
- Problems encountered and corrective action taken
- Identification of field QC samples
- QC activities
- Verbal or written instructions
- Any other events that may affect the samples

5.5 Document Corrections

The original item, although erroneous, must remain legible; therefore, changes or corrections on any project documentation will be made by crossing out the item with a single line. The person making the correction will write the new information above the crossed-out item and initial and date the change. Corrections must be written clearly and legibly with indelible ink.

6.0 Laboratory Quality Control Program

This section describes analytical quality control procedures including the laboratory qualification and quality assurance (QA) program associated with environmental analytical methods.

6.1 Laboratory Quality Control Checks

The analytical laboratory must have written SOPs defining the instrumentation, instrumentation maintenance, tuning, calibration, method detection limits, QC acceptance criteria, blank requirements and stepwise procedures for each analytical method. The SOPs must be available to the analysts in the laboratory. The SOPs must meet or exceed the requirements of the methods cited in Section 7.0. The laboratory must maintain logs of all activities that have an impact on the quality of the laboratory results.

Any portion of the method that is subcontracted by the laboratory to another laboratory, or sent to another facility of the same network of laboratories, must have the prior approval of the IT Project Chemist.

The laboratory must maintain the instruments required by the methods specified for the analyses. Sufficient redundancy in equipment must be available in the laboratory to handle down-time situations.

Method substitution due to instrumental failure will not be permitted without specific approval from the IT Project Chemist.

6.1.1 Laboratory Control Samples

Laboratory control samples (LCS) are purchased samples containing known concentrations of specific target analytes. LCSs can also be prepared by spiking known amounts of target analytes into a well characterized blank matrix. For water samples, the matrix will be laboratory reagent water, and clean sand for soil.

The LCS is prepared and run with the associated samples, using the same reagents. All analytes in the LCS must meet recovery criteria. If the criteria are not met, the entire batch of samples must be reprepared, together with a new LCS, and reanalyzed.

6.1.2 Laboratory Duplicates

There are two types of duplicates, field and laboratory. Field duplicates are two samples sent from the field that are a duplicate of each other. The purpose of this is to measure the

consistency of field sampling. From the laboratory perspective, the field duplicate is treated as another field sample, and identification is withheld.

The laboratory creates the laboratory duplicate by intentionally taking two aliquots from the same sample and analyzing the aliquots in parallel. This analysis serves to measure the precision of laboratory operations. Duplicate analyses will be applied only for inorganic analyses.

6.1.3 Matrix Spikes

MS/MSD serve to determine if matrix effects are affecting recoveries. For inorganic analyses, only a single matrix spike is performed per batch. A MS/MSD is prepared by spiking a known amount of a spiking solution to two portions of a sample being run in a batch. The recoveries are compared against each other and against the known amount of the spike. From this data both accuracy and precision may be attained.

6.1.4 Surrogate Standards

Organic compound analyses include the addition, quantitation, and recovery calculation of surrogate standards. Compounds selected to serve as surrogate standards must meet all of the following requirements:

- Are not the target analytes
- Do not interfere with the determination of target analytes
- Are not naturally occurring, yet chemically similar to the target analytes
- Are compounds exhibiting similar response to target analytes

Surrogate standards are added to every analytical and QC check sample at the beginning of the sample preparation. The surrogate standard recovery is used to monitor matrix effects and losses during sample preparation. Surrogate standard control criteria are applied to all analytical and QC check samples, and if surrogate criteria are not met, re-extraction and reanalysis may be performed.

6.1.5 Internal Standards

Some organic compound analyses include the addition, quantitation, and recovery calculation of internal standards. Internal standards are usually synthetic compounds, which are similar in chemical behavior to the target analytes. They are added to sample extracts at the time of instrument analysis and are used to quantitate results through internal standards calibration procedures. Internal standard recoveries are used to correct for injection and detector variability. Gas chromatography/mass spectrometry (GC/MS) must use internal standards and have

acceptability limits for internal standard areas. Use of internal standard quantitation for gas chromatography (GC) methods is optional.

6.1.6 Method Blanks

Method blanks are prepared in the same manner as the samples, using the same reagents and glassware as are used for samples. The purpose of the method blank is to ensure that the equipment and reagents used in preparing the samples are free of contaminants that may interfere with the analysis.

The method blank must exhibit no analytes at concentrations greater than that required quantitation limits. If contaminants are found that either contribute to the apparent concentration of a particular target analyte, or interfere with the analysis, the analysis sequence must be stopped. The source of contamination must be identified and corrected, and the analysis must be repeated. Contamination in the method blank above reporting limits will require the entire associated batch of extracts or digestates be reprepared. Hence, it is very important to make sure that no such contamination is present.

6.1.7 Instrument Blanks

Instrument blanks are run to ensure that analytes from previous analyses are out of the system and do not contaminate succeeding runs. Instrument blanks must be run following calibration runs, before sample analyses are performed, and after samples containing a high concentration of potentially interfering materials are run.

Target analytes must not appear in the instrument blanks at concentrations greater than the required quantitation limits. If the laboratory consistently observes contaminants in the instrument blanks, the laboratory must investigate the source of the contamination and eliminate it, if possible.

6.1.8 Post-Digestion Spikes and the Method of Standard Addition

A post-digestion spike is used during metal analysis to assess analytical interferences that may be caused by general matrix effects or high concentrations of analytes present in the sample. A digested sample is spiked with the analyte of interest at a known concentration, and the spike recovery is used to estimate the presence and magnitude of interferences.

If a post-digestion spike recovery fails to meet acceptance criteria, the Method of Standard Addition (MSA) will be used to quantitate the sample result. The MSA technique compensates for a sample constituent that enhances or depresses the analyte signal. To perform the MSA, known amounts of a standard, at different concentrations, are added to two to three aliquots of

digested sample, and each spiked sample and the original unspiked sample are analyzed. The absorbance is then plotted against the concentration, and the resulting line is extrapolated to zero absorbance. The point of interception with the concentration axis is the indigenous concentration of the analyte in the sample.

6.2 Data Quality Indicators

The overall quality objectives of this SAP are to outline procedures for the collection and assessment of data that are within acceptable ranges of precision, accuracy, representativeness, completeness, and comparability (PARCC) to meet the project DQO. The data quality associated with environmental data is a function of the sampling plan rationale and the procedures used to collect the samples, as well as the analytical methods and instrumentation used. However, uncertainty can not be eliminated entirely from environmental data.

The analytical data will be obtained using standard EPA methods in a laboratory certified by the California Department of Health Services through the Environmental Laboratory Accreditation Program (ELAP) for all the analytical methods they are required to perform for the project. Additionally, the laboratory must successfully complete the NFESC laboratory evaluation program. The analytical data quality objective will be assessed through measures of PARCC parameters. These quality control criteria are defined in this section. In addition, analytical methods used, project required reporting limits and QC criteria are also described.

6.2.1 Accuracy

Accuracy is defined as the nearness of a result or the mean of a set of results to the true or accepted value. Analytical accuracy is measured by comparing the percent recovery of analytes spiked into a LCS to a control limit. Surrogate compound recoveries are also used to assess accuracy and method performance for each sample analyzed. The formula for calculation of accuracy is using the following equation for percent recovery (%R) of specific analytes:

$$\%R = 100 \times \frac{\text{Spiked Sample Result} - \text{Unspiked Sample Result}}{\text{Amount of Spike Added}}$$

6.2.2 Precision

Precision is a measure of the reproducibility of a set of replicate results among themselves or the agreement among repeat observations made under the same conditions. Analytical precision is the measurement of the variability associated with duplicate or replicate analyses. For this project, a LCS will be used to determine the precision of the analytical method. Total precision is the measurement of the variability associated with the entire sampling and analysis process. It

is determined by analysis of duplicate field samples and measures variability introduced by both the laboratory and field operations. Field duplicate and matrix spike duplicate samples will be used to assess field and analytical precision, and the precision measurement is determined using the relative percent difference (RPD) between the duplicate sample results. The formula of the calculation of RPD is as follows:

$$RPD = 100 \times 2 \times \frac{Result - Duplicate\ Result}{Result + Duplicate\ Result}$$

6.2.3 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is most concerned with the proper design of the sampling program.

6.2.4 Comparability

Comparability is a qualitative parameter expressing the confidence with which one data set can be compared with another. Sample data should be comparable with other measurements for similar samples and sample conditions. The objective for the quality assurance/quality control (QA/QC) program is to produce data with the greatest possible degree of comparability. The number of matrices that are sampled and the range of field conditions encountered are considered in determining comparability. Comparability is achieved by using standard methods for sampling and analysis, reporting data in standard units, normalizing results to standard conditions, and using standard and comprehensive reporting formats.

6.2.5 Completeness

Completeness is the percentage of measurements made that are judged to be valid measurements. The completeness goal is to generate a sufficient amount of valid data based on project needs. Completeness is calculated and reported for each method, matrix, and analyte combination. The number of valid results divided by the number of possible individual analyte results, expressed as a percentage, determines the completeness of the data set. For completeness requirements, valid results are all results not qualified with a "R" flag. The requirement of completeness is 95 percent for aqueous samples and 90 percent for soil samples.

$$\%\ Completeness = 100 \times \frac{Number\ of\ Valid\ Analyte\ Results}{Number\ of\ Possible\ Results}$$

6.3 Project Reporting Limits

Project required reporting limits that have been established are identified in Table 7, and precision and accuracy QC limits for each method and matrix are identified in Table 8.

7.0 Laboratory Quality Assurance

7.1 Laboratory Qualifications

The analytical laboratories selected to analyze samples for this project will be certified by the California Department of Health Services through ELAP for all the analytical methods they are required to perform for the project, with the exception of heterotrophic plate count analysis. Additionally, the laboratory must successfully complete the NFESC laboratory evaluation program prior to sampling activities and maintain the status throughout the project.

Laboratories selected for the project must be capable of providing the required turnaround times, project QC, and data deliverables required by this SAP.

7.2 Calibration

All instruments and equipment must be calibrated in accordance with the specified methods unless different instructions are included in this document.

Initial calibrations are performed when the method is first used, and again whenever the continuing calibration fail to meet their respective acceptance criteria. Additionally, if the instrument undergoes significant maintenance, the initial calibration must be repeated.

Continuing calibrations are used to verify that the instrument performance has remained within the limits set at the time of the initial calibration. The frequency of continuing calibrations is method dependent.

Table 9 presents a summary of the QC requirements for each method.

7.3 Preventive Maintenance

All instruments must be maintained in accordance with the manufacturer's recommended procedures. The laboratory must define in its QA Plan the frequency and type of instrument maintenance for each instrument. The laboratory must also record in an instrument logbook all maintenance activities.

In addition to preventive maintenance, the laboratory must keep on hand a sufficient supply of replacement parts for those parts that are known to require frequent changes due to wear and tear or due to contamination.

Whenever preventive or corrective maintenance is applied to an instrument, the laboratory must demonstrate a return to operational conditions and must recalibrate the instrument prior to resumption of sample analyses.

7.4 Training

The laboratory will have an established policy and procedure on training and documenting of the analyst's competency. Each staff member that performs sample preparation and analysis will demonstrate their proficiency through preparation and analysis of four LCSs as described in EPA SW-846 (1994b). An analyst will be considered proficient if the acceptance criteria for method accuracy and precision are met. The laboratory will maintain all training records on file.

7.5 Supply and Consumables

The laboratory will inspect supplies and consumables prior to their use in analysis. The materials specifications in the analytical methods will be used as a guideline for establishing the acceptance criteria for these materials. Purity of reagents will be monitored by analysis of method blanks. An inventory and storage system for materials and supplies will ensure use before manufacturers' expiration dates and storage under safe and chemically compatible conditions.

7.6 Software Quality Assurance

The generation, compilation, and reporting of electronic data are critical components of laboratory operations. To produce defensible data of known quality, the laboratory will develop a software QA Plan or a SOP that describe activities related to data generation, reduction, and transfer with modern tools of data acquisition, and the policies and procedures for procurement, modification, and use of computer software.

The laboratory will have procedures in place to ensure all software for data reduction, reporting, and transfer adequately and correctly performs all intended functions, and does not perform any unintended functions.

The laboratory will verify, validate, and document the proper functioning of the software immediately after any new data acquisition and/or management systems have been installed at the laboratory. The baseline verification and validation may include the following actions:

- Comparison of the computer printouts with reduced data and the raw data
- Manual calculations to confirm correctness of all computer calculations
- Comparison of analytical report to the electronic deliverable files

Baseline software validation will be documented in laboratory QA files. Continuing software verification will take place during sample analysis. To eliminate data entry errors during analytical sequence set-up, as part of data package review, the correctness of results will be checked by one manual calculation for every QC batch during data review. This verification will be documented in the QA/QC checklist for each data file.

7.6.1 Software Security

Only authorized and trained laboratory personnel will have access to the operating and data management software. Each analyst will be trained in software use for operating different functional areas of the software systems and have a password that allows access to these areas.

7.6.2 Manual Integration

Manual integration is sometimes necessary for proper compound quantitation in cases when there are overlapping or tailing peaks, and sloping baselines. When justified, manual integration can be conducted for standards, samples, and QC check samples.

Manual integration may include valley-to-valley baselines, vertical peak separation or slope integration. The type of manual integration is a judgment call of an analyst experienced in gas chromatography.

If a need for manual integration arises, the analysts will select a proper approach based on their professional judgment. Manual integration will be then conducted and documented in the data file. Once an approach has been selected, it will be consistently used for the similarly affected peaks.

Manual integration documentation will include a copy of a computer-integrated chromatogram, a copy of a manually integrated chromatogram, a brief justification description, and the name of the person who performed the manual integration. The Laboratory Manager will review and approve all manual integration performed by analysts.

8.0 Laboratory Corrective Action

The laboratory will have a QA/QC and corrective action program that addresses all out-of-control situations. Following completion of analyses, laboratory personnel will verify compliance with the minimum quality control requirements of the project and the laboratory QA/QC plan. If any of the parameters fall outside the control limits, corrective action will be implemented.

Initial corrective action is to verify that no obvious calculation errors have occurred. If appropriate, reanalysis will be performed. If the reanalysis confirms the initial out-of-control limits result, the chemist will notify the laboratory supervisor who will initiate the corrective action process. Corrective actions may include, but are not limited to, the following:

- Verification of dilution factors
- Examination of sample for nonhomogeneity
- Verification of sample preparation
- Checking of standard preparation logbook
- Verification of instrument performance
- Checking of reagent water purity
- Monitoring chemist's method performance for procedure verification

Notification and prompt involvement of the IT Project Chemist in the corrective action process is absolutely necessary in determining an appropriate resolution. Corrective action records will document all steps taken in the corrective action process, beginning with a description of the problem to a final resolution. A copy of the Corrective Action Report will be sent to the IT Project Chemist immediately and maintained in the project file at IT. All Corrective Action Reports will be maintained by the laboratory in a project file and delivered to IT as part of the hard copy deliverable.

8.1 Batch Corrective Action

Analytical laboratory processes are batch processes, and the batch is a basic unit for the frequency of some quality control elements. A batch is a group of samples of similar matrix that behave similarly with respect to the procedures being employed. The following three types of batches can be identified at the analytical laboratory:

- Preparation batch
- Instrument batch
- Sample delivery group

A preparation batch is a group of up to 20 field samples that are prepared (*e.g.*, extracted or digested) simultaneously or sequentially without interruption. Samples in each batch are of similar matrix (*e.g.*, soil, sludge, liquid waste, and water), are treated in a similar manner, and are processed with the same lots of reagents. For organic compound analyses each batch will contain a method blank, a LCS, and a MS/MSD pair. For inorganic compound analyses, each batch will contain a method blank, a LCS, a MS, and a sample duplicate. These QC check samples are not counted into the maximum batch size of 20.

An instrument batch is a group of samples, which are analyzed within the same analytical run sequence. If the continuous operation of an instrument is interrupted (shut down for maintenance, etc.), a new instrument batch must be started. The instrument batch includes an instrument blank, calibration check standards, extracts/digestates of the field samples, and QC check samples. The number of samples in the analytical batch is not limited, but the frequency of the calibration check standard and instrument blank analysis is mandated in each particular method.

For VOC analyses by GC or GC/MS, the preparation and instrument batch are the same, since the sample preparation (purge and trap) is performed as part of the instrument analysis. For these analyses, a batch is defined as a group of up to 20 field samples that are sequentially loaded on the instrument and analyzed as a single analytical run sequence. Laboratory QC check samples (method blank, a LCS, a MS/MSD pair) will be analyzed as part of the batch in addition to 20 field samples, as well as the calibration standard in accordance with method requirements.

8.2 Method Blank

The method blank measures laboratory introduced contamination for the sample batch, and batch corrective action is initiated when contamination is found. It may include reanalysis and repreparation of the blank, QC, and other samples, and assessment of the impact of the contamination on batch sample data. Although it is a goal to have no detected target analytes in the method blanks, analytes may be periodically detected in blanks due to the nature of the analysis or the reporting limit for the analyte. For example, methylene chloride, acetone, and 2-butanone may sometimes be found in blanks for VOC analysis, and the phthalate esters may sometimes be found in the blanks for semivolatile organic compound analyses.

A method blank will be considered acceptable if the following conditions are met:

- Target analytes are present at concentrations less than one half of the practical quantitation limits.

- Target analytes are present at concentrations less than 5 percent of the regulatory limits for these analytes.
- Target analytes are present at concentrations less than 5 percent of the sample results for these analytes.

If the method blank results do not meet these acceptance criteria, the laboratory will initiate corrective action.

The first step of corrective action is to assess the effect on the samples. For example, if an analyte is found only in the blank but not in any of the associated samples, or if the target analyte in the blank is less than one-twentieth the value in the sample, no corrective action is necessary.

If corrective action is required, the method blank and any samples containing the same contaminant will be reanalyzed. If the contamination remains, the contaminated samples of the batch would be re-extracted and reanalyzed with a new method blank and QC check samples.

8.3 Laboratory Control Samples

A LCS must meet the accuracy acceptance criteria for target analytes for the batch to be considered acceptable. If the target analytes are outside of the acceptance limits, corrective action will be initiated. Corrective action will include re-extraction and reanalysis of the whole batch, including method blank, samples, and QC check samples.

If MS samples are not included, a LCS/LCD pair will be analyzed with each batch of samples. If the LCS/LCD are outside method acceptance criteria for accuracy and precision, the whole batch will be re-extracted and reanalyzed, including method blanks, samples, and QC check samples.

8.4 Matrix Spikes

A MS/MSD pair is included with each batch of samples for organic compound analyses, and MS and laboratory sample duplicate are included with each batch of samples for inorganic compound analysis. These QC check samples allow the accuracy and precision of analysis and the influence of matrix effects to be evaluated.

Matrix spike data evaluation is more complex than blank or LCS data evaluation since MS measure matrix effects, in addition to sample preparation and analysis effects. Sample heterogeneity, lithological composition of soil, and the presence of interfering chemical compounds often negatively affect accuracy and precision of analysis. If the native concentration of target analytes in the sample chosen for spiking is high relative to the spiking

concentration, the differences in the native concentration between the unspiked sample and the spiked samples may contribute a significant error in the precision and accuracy. The accuracy and precision in this case are not representative of the true method and matrix performance.

If the accuracy of MS/MSD analysis is outside the acceptability limits for any target analyte the LCS will be evaluated. If the LCS accuracy limits are met, the MS/MSD recovery problem will be identified as matrix effect, and no further action will be required. If the LCS accuracy limits are not met, corrective action will be implemented, and the affected samples and associated QC samples will be reprepared and reanalyzed.

If the MS/MSD or sample/sample duplicate pair fail in precision due to observed matrix interferences, sample inhomogeneity, or the nature of the contaminant, corrective action will not be required, and the laboratory will make an appropriate notation in the case narrative.

8.5 Individual Sample Corrective Action

In addition to batch corrective action, individual samples within a batch may also require corrective action. Re-extraction and reanalysis of individual samples will take place in the following situations:

- Surrogate standard recoveries are outside acceptability limits.
- Internal standard areas for GC/MS analyses are outside acceptability limits.
- Errors have been made during sample preparation, and results of analysis are not conclusive.

9.0 Data Management

The following sections describe the requirements for the management of hard copy data and electronic data that the analytical laboratory will submit to IT.

9.1 Data Reduction, Verification and Reporting

All analytical data that the laboratory generates will be reviewed prior to reporting to ensure the validity of reported data. This internal laboratory data review process will consist of data reduction, three levels of documented review, and reporting. Review processes will be documented using appropriate checklist forms, or logbooks, that the reviewer will sign and date.

9.1.1 Data Reduction

Data reduction involves the mathematical or statistical calculations the laboratory uses to convert raw data to the reported data. The laboratory will reduce the analytical data as specified in each of the appropriate analytical methods and laboratory SOPs. For each method, all raw data results will be recorded using method-specific forms or a standardized output from each of the various instruments.

Personnel calculating the data will verify and initial the data. All raw and electronic data, notebook references, supporting documentation and correspondence will be assembled, packaged, and stored for a minimum of ten years for future use. All reports will be held client confidential. If the laboratory is unable to store project-related data for ten years, then it is the responsibility of the laboratory to contact the contractor to make alternative arrangements.

9.1.2 Laboratory Data Verification and Review

The laboratory analyst who generates the analytical data will have the primary responsibility for the correctness and completeness of data. Each step of this verification and review process will involve the evaluation of data quality based on the results of the QC data and the professional judgment of those conducting the review. This application of technical knowledge and experience to evaluate data is essential in ensuring that data of known quality are generated consistently. All data generated and reduced will follow well-documented in-house protocols.

Level 1: Technical (Peer) Data Review. Analysts will review the quality of their work based on an established set of guidelines, including the QC criteria established in each method in this SAP and as stated within the laboratory QA Manual. This review will, at a minimum, ensure that the following conditions have been met:

- Sample preparation information is correct and complete.
- Analysis information is correct and complete.
- Appropriate SOPs have been followed.
- Calculations are verified.
- There are no data transposition errors.
- Analytical results are correct and complete.
- QC samples are within established control limits.
- Blanks and laboratory control samples are within appropriate QC limits.
- Special sample preparation and analytical requirements have been met.
- Documentation is complete, for example, any anomalies and holding times have been documented and forms have been completed.

Level 2: Technical Data Review. A supervisor or data review specialist, whose function is to provide an independent review of data packages, will perform this level of review. This review will also be conducted according to an established set of guidelines and will be structured to verify the following finding of the Level 1 data review:

- All appropriate laboratory SOPs have been followed.
- Calibration data are scientifically sound, appropriate to the method, and completely documented.
- QC samples are within established guidelines.
- Qualitative identification of contaminants is correct.
- Manual integration is justified and properly documented.
- Quantitative results and calculations are correct.
- Data are qualified correctly.
- Documentation is complete, for example, any anomalies and holding times have been documented and appropriate forms have been completed.
- Data are ready for incorporation into the final report.
- The data package is complete and is in compliance with contract requirements.

The Level 2 review will be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from at least 10 percent of the samples are checked

against the sample preparation and analytical bench sheets. If no problems are found with the data package, the review will be considered complete.

If any problems are found with the data package, an additional 10 percent of the sample results will be checked against the sample preparatory and analytical bench sheets. This cycle will then be repeated until either no errors are found in the data set checked or until all data have been checked. All errors and corrections noted will be documented.

Level 3: Administrative Quality Assurance Data Review. The Laboratory QA Manager will review 10 percent of all data packages. This review should be similar to the review as provided in Level 2 except that it will provide a total overview of the data package to ensure its consistency and compliance with project requirements. All errors noted will be corrected and documented.

9.1.3 Data Reporting

All data that the laboratory reports must be reviewed in accordance with the SOP. At a minimum, this written guideline must meet the data review guidelines stated in the *Navy Installation Restoration Chemical Data Quality Manual* (NFESC, 1999).

9.1.4 Electronic Data Deliverables

Field information (date and time collected, sample identification, etc.) will be entered directly into the main database from the COC or uploaded from electronic files generated in the field.

The electronic data deliverable (EDD) will be in ASCII format and will follow the IT Environmental Management Systems electronic data transfer format specifications. The laboratory will certify that the EDD and the hard copy reports are identical. Both the EDD and the hard copy will present results to two or three significant figures. For inorganic results, two significant figures will be used for results less than (<) 10 and three significant figures for results >10. For organic results, one significant figure will be used for results <10 and two significant figures for results ≥10. The EDD for each sample delivery group is due at the same time as the hard copy, 14 days after the last sample of the sample delivery group has been delivered to the laboratory.

Upon receipt by the IT Management Information System Data Manager, electronic data will be uploaded into a temporary Access database. The uploaded data will be printed and proofread relative to the hard copy the laboratory submitted. The reader will also check for irregularities in analyte identities, concentrations, and units. The uploaded data will also be processed to compare the fields against a list of required values. If the program finds any errors, the file will

be manually edited or regenerated by the laboratory. If no errors are found, the data will be uploaded into the main database. The laboratory database will be merged with the field database, and reports will be generated from the merged database.

At project closeout, IT will submit to the Navy an electronic file compatible with the Navy Environmental Data Transfer Standards format.

9.1.5 Hard Copy

All relevant raw data and documentation, including (but not limited to) log books, data sheets, electronic files, final reports, etc. will be maintained by the laboratory for at least 7 years. IT will be notified 30 days before disposal of any relevant laboratory records.

IT will maintain copies of all COCs until receipt of the laboratory report. Laboratory reports will be logged in upon receipt and filed in chronological order. The second copy of the report will be sent for third-party data validation.

For this project, IT will request 90 percent of the data submitted in an EPA Level III equivalent data package and 10 percent submitted in an EPA Level IV equivalent data package. All data packages will be assembled in the following sequence:

- Cover page (with laboratory service identification number, IT project name and number)
- Original COC
- Sample receipt form (including cooler temperature)
- Cross-reference table
- Case narrative
- Organic raw data sequence (by test):
- Sample result forms, including method blanks
- Sample raw data after each result form (for EPA Level IV only)
- Surrogate summaries (surrogates results may appear on the sample result forms)
- QC summaries
- Tune data (for GC/MS only)
- Initial calibration (ICAL)

- Daily calibration checks, including all related continuing calibration verification (CCV)
- Resolution check standards (GC/MS and pesticides)
- QC raw data (for EPA Level IV only)
- Instrument run log
- Sample preparation log
- Standard preparation log
- Inorganic raw data sequence (by metal):
- Sample results forms, including method blanks
- Sample raw data (for EPA Level IV only)
- QC summaries
- ICAL
- Daily calibration checks, including all related CCVs
- Calibration blanks, including all related continuing calibration blanks
- Interference check standards A & B for Inductively Coupled Argon Plasma [ICAP] only)
- Detection limit check standard (Graphite Furnace Atomic Absorption only)
- QC raw data (for EPA Level IV only)
- Post-digestion spike results
- Analytical spike results
- Method of standard additions
- ICAP serial dilutions
- Instrument run log
- Sample preparation log
- Standard preparation log

The laboratory will submit two copies of the hard copy data to IT. The report pages will be numbered. The report will contain a table of contents referencing individual sections in the data package, original COC forms, a copy of all Corrective Action Reports and a case narrative

documenting the resolution of all corrective actions and non-compliant events. All IT samples will be clearly referenced to the associated quality control samples. In order to perform validation, two types of data package will be required. They will be referred to as EPA Level III and IV packages.

9.2 Data Validation

All samples with the exception of waste characterization samples will be validated. Data will be validated at 90 percent EPA Level III and 10 percent EPA Level IV. An independent data validation company will perform the data validation. The validation will be in accordance with the *EPA Laboratory Data Validation Functional Guidelines for Evaluating Organic and Inorganic Analyses* (EPA, 1994c), and QC criteria specified in this document. Data qualifiers will be utilized in accordance with the above mentioned guidelines.

The data validation company will have the following qualifications:

- A minimum of 5 years experience in the environmental data validation business
- Prior Navy Remedial Action Contract or Comprehensive Long-Term Environmental Action experience
- Navy data validation experience
- Must conduct peer reviews

Personnel must have the following qualifications:

- Data Reviewer
  - Bachelor of Science degree or higher in chemistry or related field
  - 5 years combined experience with approximately 2 years in data validation and 3 years conducting laboratory analysis in an environmental laboratory that used the EPA-approved methods being validated
- Peer Reviewer
  - Bachelor of Science degree or higher in chemistry or related field
  - 5 years combined experience with approximately 2 years in data validation and 3 years conducting laboratory analysis in an environmental laboratory that used the EPA-approved methods being validated

9.3 Data Quality Assessment Report

After data validation, data will be further evaluated by the IT Project Chemist. In the process of evaluating the data, the Project Chemist will determine which of the advisory data qualifiers provided by the independent data validator will be retained or deleted. The evaluation of data

will be based on the results of the QC samples, the level of contamination of samples indicated by the blanks analysis, and the overall indication of interference due to contamination. The following data qualifiers will be used in the report:

J	The result is estimated.
U	The analyte is not detected at or above the stated reporting limit.
R	The data are rejected.
UJ	The analyte is not detected, but there is an uncertainty about the reporting limits.

Flagging of the data will be used to alert data users to uncertainties associated with the data. The evaluation flags will be entered in a special field in the electronic database. Thus, when the processing of the data is complete, the data for each analyte will have the flag (if any) designated by the laboratory, and the flag (if any) designated by the evaluator.

10.0 Quality Assurance Oversight

QA oversight for this project will include audits of field activities and of subcontract laboratories to ensure the laboratories meets the Navy's requirements.

10.1 Laboratory Assessment and Oversight

The laboratory or laboratories selected to perform the analytical testing for this project are required to have successfully completed the NFESC laboratory evaluation process and must maintain a good standing in the program throughout the duration of the project. This process consists of review of laboratory QA Plan, analysis of Performance Evaluation (PE) samples, data package review, and on-site audit. As a result, IT will perform additional on-site audits or laboratory visits, only if deemed necessary by the Navy.

IT's oversight of the laboratory will be done through the review of the preliminary report and hardcopy data packages. The information that may be obtained from the data packages consists of the following:

- Correctness of COC procedures
- Adherence to method or SAP holding times
- Method detection limits and reporting limits
- Spiking levels, frequency, and recovery
- Accuracy of analytical operations through the LCS

10.1.1 Navy Laboratory Audit

The laboratories will successfully complete a NFESC laboratory audit. A NFESC audit conducted in the past for a different project is an acceptable qualification.

10.1.2 Technical Systems Audit

A technical systems audit is an on-site, qualitative review of the sampling or analytical system to ensure the activity is being performed in compliance with the SAP specifications, and that the collected data fulfill the project DQOs.

Laboratories performing under this program may be required to have a prequalification or undergo a periodic systems audit, depending on the scope of services to be provided, past performance, or other factors indicating a need to evaluate quality in this manner. Subsequently, the laboratories will respond to and address any project or technical concerns resulting from the audits. A follow-up audit may be performed to verify resolution of findings and observations

and to review the corrective measures taken. Laboratories found deficient will not be used on a project until the deficiencies are corrected and the laboratory accepted. Laboratories that previously qualified for the types of testing to be performed on the project will not require prequalification provided that prequalification has been within the past year and the work performed has been acceptable.

The laboratory systems audit results will be used to review laboratory operations and to ensure that any outstanding corrective actions have been addressed. A laboratory systems audit will include the following critical areas:

- Sample custody procedures
- Calibration procedures and documentation
- Completeness of data forms, notebooks, and other reporting requirements
- Data review procedures
- Storage, filing, and record keeping procedures
- QC procedures and documentation
- Operating conditions of facilities and equipment
- Documentation of training and maintenance activities
- Systems and operations overview
- Security of laboratory automated systems

After the audit, a debriefing session will be held for all participants to discuss the preliminary audit results. The auditor will then complete the audit evaluation and submit an audit report, including observations of the deficiencies and the necessary recommendations for corrective actions, to the Project Manager and the laboratory. Follow-up audits will be performed prior to completion of the project to ensure corrective actions have been taken.

10.1.3 Performance Evaluations Audit

Performance audits quantitatively assess the data a measurement system produces. A performance audit involves submitting project-specific PE samples for analysis for each analytical method used in the project. The performance audit answers questions about whether the measurement system is operating within control limits and whether the data produced will meet the project DQOs. If a concern about the laboratory performance exists, or if there is a Navy request, the contractor will administer performance evaluation samples for the target analytes.

Review of PE results include the following elements:

- Correct identification and quantitation of the PE sample analytes

- Accurate and complete reporting of the results
- Measurement system operation within established acceptance limits for accuracy

The concentrations reported for the PE samples will be compared to the known or expected concentrations spiked in the samples. The percent recovery will be calculated and the results assessed according to the acceptance limits, which are based on inter-laboratory studies. If the accuracy criteria are not met, the cause of the discrepancy will be investigated, and a second PE sample will be submitted. PE sample results review will be documented in a report to the Project Manager.

10.1.3.1 Performance Evaluation Sample Programs

The off-site laboratory will participate in the EPA PE Water Supply and Water Pollution Studies programs or equivalent programs for state certifications. Satisfactory performances in these PE programs also demonstrate proficiency in methods used to analyze project samples. The laboratory will document the corrective actions to unacceptable PE results to demonstrate resolution of the problems.

10.1.4 Magnetic Tape Audit

Magnetic tape audits involve the examination of the electronic media used in the analytical laboratory to acquire, report, and store data. These audits are used to assess the authenticity of the data generated and assess the implementation of good automated laboratory practices. The contractor may perform magnetic tape audits of the off-site laboratory when warranted by project PE samples results or by other circumstances.

10.1.5 Field Audits

The IT and SWDIV QA Officers may schedule audits of field activities at any time to evaluate the execution of sample collection, identification, and control in the field. The audit will also include observations of COC procedures, field documentation, instrument calibrations, and field measurements.

Field documents and COC forms will be reviewed to ensure that all entries are printed or written in indelible ink, dated, and signed.

Sampling operations will be reviewed and compared to the SAP and other applicable SOPs. The auditor will verify that the proper sample containers are used, the preservatives are added or are already present in the container, and the documentation of the sampling operation is adequate.

Field measurements will be reviewed by random spot-checking to determine that the instrument is within calibration, that the calibration is done at the appropriate frequency, and that the sensitivity range of the instrument is appropriate for the project.

10.2 Quality Assurance Project Plan Revision or Amendment

When circumstances arise that impact the original project DQOs, such as a significant change in work scope, the SAP will be revised or amended. The modification process will be based on EPA guidelines and direction from the Navy and QA Officer.

11.0 References

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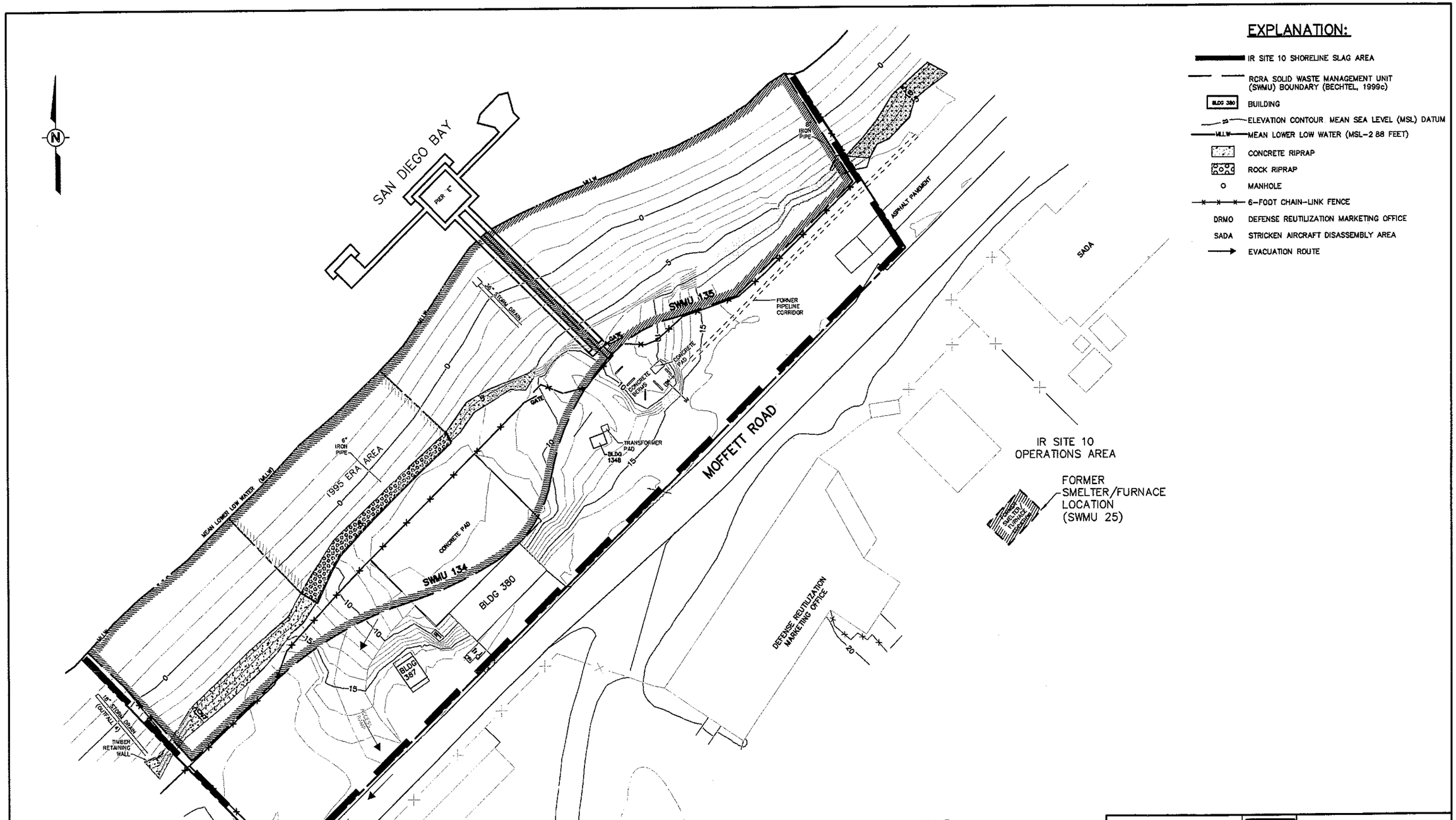
FIGURES



REVISIONS			
REV. No.	DESCRIPTION	DATE	APPROVED

SWDIV

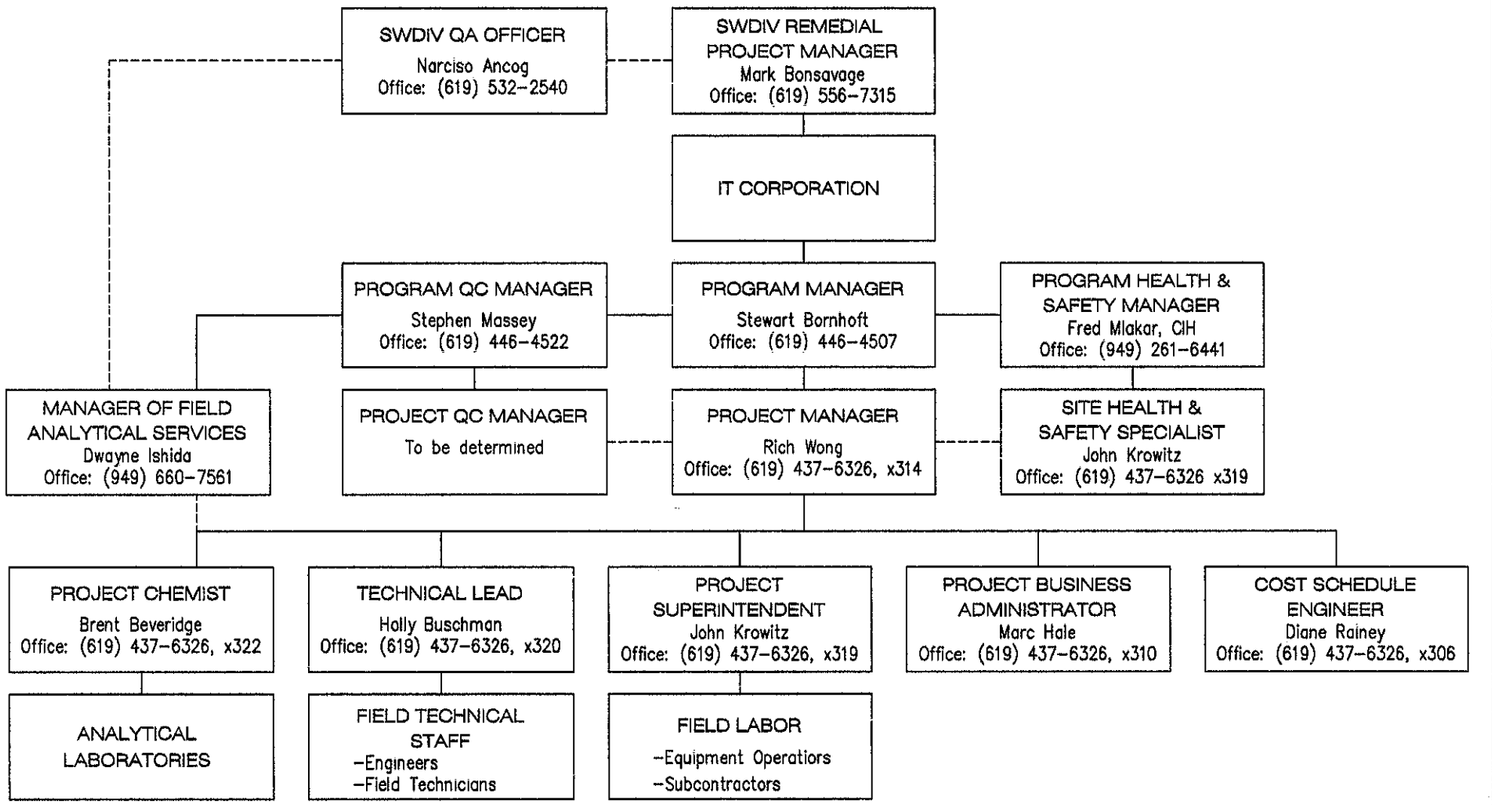
DRAWN BY D. MIRANDA — DATE 11/27/01
CHK'D BY J. KROWITZ — DATE 11/27/01
APP'D BY H. BUSCHMAN — DATE 11/27/01
PROJECT MANAGER R. WONG
AUTOCAD FILE No. 818724-B2

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SITE PLAN
SAMPLE AND ANALYSIS PLAN (SAP)

SCALE	SHEET	OF	IT PROJECT No.	DRAWING No.	REVISION
AS NOTED	–	–	818724	FIGURE 1	–



REVISIONS			
REV. No.	DESCRIPTION	DATE	APPROVED

SWDIV		IT CORPORATION	IR SITE 10 SHORELINE SLAG AREA NAVAL AIR STATION, NORTH ISLAND SAN DIEGO, CALIFORNIA
DRAWN BY D. MIRANDA	DATE 11/27/01		
CHK'D BY J. KROWITZ	DATE 11/27/01		
APP'D BY H. BUSCHMAN	DATE 11/27/01		PROJECT ORGANIZATION CHART SAMPLE AND ANALYSIS PLAN (SAP)
PROJECT MANAGER R. WONG			
AUTOCAD FILE No. 818724-A1			
SCALE AS NOTED	SHEET –	OF –	IT PROJECT No. 818724
DRAWING No. FIGURE 2	REVISION –		

TABLES

Table 1
Personnel and Responsibilities

Key Position	Responsibility
SWDIV Quality Assurance Officer (QAO)	Provides governmental oversight of IT Quality Assurance Program
	Provides quality-related directives through Contracting Officer's Technical Representative
	Provides technical and administrative oversight of IT surveillance audit activities
	Point of contact for all matters concerning quality assurance and the Navy's Laboratory Quality Assurance Program
	Prepares governmental budget estimates for all quality assurance functions included in IT contracts
	Coordinates training on matters pertaining to generation and maintenance of quality of data
	Authority to suspend project execution if QA requirements are not adequately followed
Project Chemist	Develops Sampling and Analysis Plan and QA Project Plan
	Selects qualified subcontract laboratories
	Implements chemical data QC procedures and performs auditing of field performance
	Reviews laboratory data prior to use
	Coordinates data validation of laboratory data
	Reviews data validation report
	Prepares and supports report preparation
Database Manager	Provides oversight for management of project database
	Prepares and submits NEDTS data package
Field Chemist/ Technologist	Performs all sampling in accordance with approved SAP
	Ensures that field quality assurance samples are collected as specified in the SAP
	Completes the sampling notes, forms, and sampling logs
	Coordinates laboratory and field sampling activities
	Implements corrective actions as required

IT denotes IT Corporation
NEDTS denotes Navy electronic data transmission system
QA denotes Quality Assurance
QAO denotes Quality Assurance Officer.
QC denotes Quality Control
SAP denotes Sampling and Analysis Plan

Table 2
Summary of Data Quality Objectives for Removal Action Activities at Installation Restoration (IR) Site 10, Shoreline Slag Area

Site/ Location	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
	Statement of Problem	Decisions	Inputs to the Decisions	Boundaries of the Site	Decision Rules	Limits on the Decision Errors	Optimize the Sampling Design
Evapo-transpiration (ET) cover testing	Soil to be used for the construction of the ET cover shall be characterized to document that it possesses specific geotechnical properties	Does the cover material meet the criteria specified in the RAP for use as ET cover?	Geotechnical laboratory testing of representative soil samples collected at the source	Horizontal and vertical: Dependent on size of soil stockpile at the source. Temporal: Dependent on source operations and depletion of available soil inventory	If the material meets the criteria for ET material (Table 1 of the RAP and Table 3 of this SAP), then the soil will be transported to the site for use in the construction of the ET cover. If the material does not meet the criteria for ET material then the source will be rejected	Statistically derived limits on sampling design errors are not quantifiable because a judgmental sampling design will be employed in accordance with American ASTM Standard D 75. Results will be compared to criteria for ET cover as specified in the RAP.	One representative sample will be tested to evaluate the ET material. Four discrete samples will be collected and composited into one test sample Additionally, four discrete samples will be collected and composited into one test sample to be tested for environmental contaminants. All environmental tests will be performed on the composite sample with the exception of VOCs, which will be performed on a single discrete sample.
Well installation, soil sampling	Document the lithology and refine the nature and extent of metal-impacted soil in the vicinity of planned waste consolidation area.	Does soil lithology impact mobilization of contamination or impact collection of groundwater?	The following factors will be considered in the decision-making process: • Site history • Previous analytical results Analytical and geotechnical testing results of soil samples collected from drilling activities	See Figure 9 in the RAP.	If any COPCs are detected in these samples above background concentrations, then further investigation may be recommended. If, in the professional opinion of a licensed, registered geologist, the lithology will impact the usefulness of the groundwater well adequately assess the groundwater conditions, then further work or modification of this work may be recommended.	Statistically derived limits on sampling design errors are not quantifiable because a judgmental sampling design will be employed Soil sample results will be compared to background results.	Soil samples will be collected at 5-foot intervals
Investigation-derived waste (IDW) testing	The characteristics of IDW are not known	Does the IDW meet the criteria for disposal options?	The following factors will be considered in the decision-making process: • Site history • Previous analytical results Analytical testing of the IDW	IDW generated from field activities to support this removal action	If the IDW meets the disposal facility criteria, then the material will be submitted to that facility for disposal If the IDW does not meet the disposal facility criteria, then the project team will seek an alternate disposal facility	Statistically derived limits on sampling design errors are not quantifiable because a judgmental sampling design will be employed Results will be compared to a numeric standard	One representative sample will be collected from each batch of IDW generated

ASTM denotes American Society for Testing and Materials
COPC denotes Contaminant of Potential Concern
EPA denotes United States Environmental Protection Agency.
ET denotes evapotranspiration
IDW denotes Investigation-Derived Waste
IR denotes Installation Restoration
MLLW denotes mean lower low water.
NaI denotes sodium iodide
NAS denotes Naval Air Station.
PRGs denotes EPA Region 9 Industrial Soil Preliminary Remediation Goals
RAP denotes Removal Action Plan
SAP denotes Sample and Analysis Plan
VOCs denotes volatile organic compounds
XRF denotes X-Ray Fluorescence.

Table 2
Summary of Data Quality Objectives for Removal Action Activities at Installation Restoration (IR) Site 10, Shoreline Slag Area

Site/ Location	STEP 1	STEP 2	STEP 3	STEP 4	STEP 5	STEP 6	STEP 7
	Statement of Problem	Decisions	Inputs to the Decisions	Boundaries of the Site	Decision Rules	Limits on the Decision Errors	Optimize the Sampling Design
Excavation, x-ray Fluorescence (XRF) sampling	Extent of metals-impacted soil above the site cleanup criteria is not known exactly	To what extents (both vertically and horizontally) shall the remedial excavations be advanced in order that the metals-impacted soil above the cleanup criteria is effectively removed?	The following factors will be considered in the decision-making process: • Site history • Previous analytical results XRF testing of samples collected from the excavation perimeter and base in accordance with the Sample and Analysis Plan (SAP)	Horizontal: Installation Restoration (IR) Site 10 shoreline slag waste area, approximately 4 2 acres Vertical: Slag waste is up to approximately 4 feet thick situated between 2 to 10 feet mean lower low water (MLLW) Temporal: Extent of waste is stable	If the XRF results for the contaminant of potential concern (COPC) metals are less than criteria specified in Table 3 of this SAP, then the soil tested will be left in place and excavation activities will be stopped. If the XRF results are greater than criteria specified in Table 3 of this SAP, then a 1-foot lift of soil will be removed in accordance with the Removal Action Plan (RAP) and another XRF reading will be taken.	Statistically derived limits on sampling design errors are not quantifiable because a judgmental sampling design will be employed. Results will be compared to a numeric standard [Environmental Protection Agency (EPA) Region 9 Industrial Soil Preliminary Remediation Goals (PRGs)]	XRF technology allows faster sample analysis as opposed to a fixed off-site laboratory and will allow the sample teams to collect more data in less time than with conventional laboratory analyses. More frequent testing will facilitate better coverage and evaluation of site conditions
Excavation, radiological screening	Extent of radium-226 contamination above the site cleanup criteria is not known exactly	How deep shall the remedial excavations be advanced in order that radium-226 sources above the cleanup criteria are effectively removed?	The following factors will be considered in the decision-making process: • Site history • Previous analytical results Radiological screening using handheld sodium iodide (Na-I) scintillation detectors of the excavation perimeter and bottom	Horizontal: IR Site 10 shoreline slag waste area, approximately 4 2 acres Vertical: Slag waste is up to approximately 4 feet thick situated between 2 to 10 feet MLLW, as referenced to the NAS North Island datum Temporal: Extent of waste is stable	If the radiological screening results are less than cleanup criteria (see Table 2 of the RAP) then excavation activities will be stopped. If the radiological screening results are greater than cleanup criteria (see Table 2 of the RAP), then a 2-foot lift of soil will be removed in accordance with the RAP and another radiological reading will be taken	Statistically derived limits on sampling design errors are not quantifiable because a judgmental sampling design will be employed Results will be compared to cleanup criteria (see Table 2 of the RAP)	Radiological screening of the site will allow for greater coverage of the site. Since contamination is not expected to be homogeneous, greater areal coverage of the site will yield more useful data than collection of discrete samples
Overburden soil testing	The characteristics of the overburden soil are not adequately known.	Does the fill material pose any risk for future use of the site?	The following factors will be considered in the decision-making process: • Site history • Previous analytical results Analytical testing of the fill material	Fill material anticipated for use at this site (see Figure 4 in the RAP)	If the overburden material meets the project cleanup criteria (See Table 3 of this SAP), for Title 22 metals and radiological screening, then the soil can be used to backfill the areas of waste excavation.	Statistically derived limits on sampling design errors are not quantifiable because a judgmental sampling design will be employed in accordance with American Society for Testing and Materials (ASTM) Standard D 75 Results will be compared to a numeric standard.	Representative samples will be collected from the overburden soil. Four discrete samples will be collected and composited into one test sample to be tested for environmental contaminants All environmental tests will be performed on the composite sample with the exception of volatile organic compounds (VOCs), which will be performed on a single discrete sample.
Fill/borrow soil testing	The characteristics of the fill material are not adequately known	Does the fill material pose any risk for future use of the site?	If available, the following factors will be considered in the decision-making process: • Site history • Previous analytical results Analytical testing of the fill material	Fill material anticipated for use at this site (see Figure 4 in the RAP) Temporal: Dependent on depletion of available soil inventory	If the fill material meets the project cleanup criteria (See Table 3 of this SAP), then the soil can be used to backfill the areas of waste excavation.	Statistically derived limits on sampling design errors are not quantifiable because a judgmental sampling design will be employed in accordance with ASTM Standard D 75 Results will be compared to a numeric standard	Representative samples will be collected from each fill material source Four discrete samples will be collected and composited into one test sample to be tested for environmental contaminants All environmental tests will be performed on the composite sample with the exception of VOCs, which will be performed on a single discrete sample.

Table 3
XRF Action Levels

Metal	XRF Detection Limits (mg/kg) [1]	Confirmation Laboratory Reporting Limits (mg/kg)	Action Level (mg/kg) [2]
Antimony	40	1	817
Arsenic	40	0.5	439
Cadmium	100	0.5	808
Chromium	150	1	448
Copper	50	1	75,900
Lead	20	0.3	750
Mercury	30	0.1	613
Nickel	50	2	40,800
Silver	70	1	10,200
Zinc	50	1	100,000

1 – EPA Method 6200, Table 1, Interference Free Detection Limits

2 - EPA Region 9 Preliminary Remediation Goals for Industrial Soil

Table 4
Borrow Material Criteria

Analyte Group	Acceptance Criteria (mg/kg)
TPH-purgeable	< 1,000
TPH-extractable	< 1,000
Chlorinated Pesticides	ND
PCBs	ND
VOCs	ND
SVOCs	ND
Metals (Title 22)	
Antimony	< 150
Arsenic	<20
Barium	<1,000
Beryllium	<2
Cadmium	<10
Chromium	<500
Cobalt	<800
Copper	<250
Lead	<50
Mercury	<2
Molybdenum	<3,500
Nickel	<200
Selenium	<10
Silver	<50
Thallium	<70
Vanadium	<240
Zinc	<2,500
TRPH	< 1000 mg/kg

ND – not detected at laboratory's nominal detection limits.

Table 5
Soil Sample Analytes, Analytical Methods, Container Requirements, Preservatives, and Holding Times

Analytes	Analytical Method	Matrix	Container	Preservative	Holding Time
TPH-purgeable	CA LUFT 8015M	Soil	EnCore™ sample cartridge	Cool to 4 ± 2°C	48 hours until preservation, then 14 days from sampling
TPH-extractable	CA LUFT 8015M	Soil	One 8-oz jar	Cool to 4 ± 2°C	14 days
Chlorinated Pesticides	EPA 8081A	Soil	One 8-oz jar	Cool to 4 ± 2°C	14 days
PCBs	EPA 8082	Soil	One 8-oz jar	Cool to 4 ± 2°C	14 days
VOCs	EPA 8260B	Soil	EnCore™ sample cartridge	Cool to 4 ± 2°C	48 hours until preservation, then 14 days from sampling
SVOCs	EPA 8270C	Soil	One 8-oz jar	Cool to 4 ± 2°C	14 days
Metals (Title 22)	EPA 6010B/7000	Soil	One 8-oz jar	Cool to 4 ± 2°C	6 months, except 28 days for mercury
TRPH	EPA 418.1	Soil	One 8-oz jar	Cool to 4 ± 2°C	28 days

CA LUFT denotes California leaking underground fuel tank.
EPA denotes U S. Environmental Protection Agency
oz. denotes ounce.
PCBs denotes polychlorinated biphenyls
SVOCs denotes semivolatile organic compounds.
TPH denotes total petroleum hydrocarbons
TRPH denotes total recoverable petroleum hydrocarbons
VOCs denotes volatile organic compounds

Table 6
Aqueous Sample Analytes, Analytical Methods, Container Requirements, Preservatives, and Holding Times

Analytes	Analytical Method	Matrix	Container	Preservative	Holding Time
TPH-purgeable	CA LUFT 8015M	Water	Three x 40-mL VOA vials	Cool to 4 ± 2°C, HC1, pH < 2	14 days
TPH-extractable	CA LUFT 8015M	Water	One 1-L amber glass bottle	Cool to 4 ± 2°C, HC1, pH < 2	7 days to extract 40 days to analyze
Chlorinated Pesticides	EPA 8081A	Water	One x 1-L amber glass bottle	Cool to 4 ± 2°C	7 days to extract 40 days to analyze
PCB	EPA 8082	Water	One x 1-L amber glass bottle	Cool to 4 ± 2°C	7 days to extract 40 days to analyze
VOC	EPA 8260B	Water	Three x 40-mL VOA vials	Cool to 4 ± 2°C, HCl, pH < 2	14 days
SVOC	EPA 8270C	Water	One x 1-L amber glass bottle	Cool to 4 ± 2°C	7 days to extract 40 days to analyze
Metals (Title 22)	EPA 6010B/7000	Water	One x 500-mL polyethylene bottle	HNO_3, pH<2	6 months, except 28 days for mercury
TRPH	EPA 418 1	Water	One x 1-L amber glass bottle	Cool to 4 ± 2°C	28 days

CA LUFT denotes California leaking underground fuel tank
EPA denotes U S Environmental Protection Agency
HC1 denotes hydrochloric acid
HNO_3 denotes nitric acid
L denotes liter
mL denotes milliliter
PCB denotes polychlorinated biphenyl
TPH denotes total petroleum hydrocarbon
TRPH denotes total recoverable petroleum hydrocarbon
SVOC denotes semivolatile organic compound
VOA denotes volatile organic analysis
VOC denotes volatile organic compound

Table 7
Project Required Reporting Limits

Parameter/ Method	Analyte	Water	Soil
		RL, mg/L	RL, mg/kg
TRPH – EPA Method 418.1	Waste Oil	0.5	5
		RL, µg/L	RL, mg/kg
Title 22 metals EPA Method 6010B	Antimony	500	1
	Arsenic	5	0.5
	Barium	100	1
	Beryllium	10	0.2
	Cadmium	5	0.5
	Chromium	50	1
	Cobalt	50	1
	Copper	50	1
	Lead	5	0.3
	Manganese	20	2
	Molybdenum	100	2
	Nickel	150	2
	Selenium	5	0.5
	Silver	50	1
	Thallium	400	1
	Vanadium	100	1
	Zinc	20	1
EPA Method 7470A/7471A	Mercury	0.2	0.1
Volatile Organic Compounds EPA Method 8260	Benzene	5.0	2.0
	Bromobenzene	5.0	2.0
	Bromochloromethane	5.0	2.0
	Bromodichloromethane	5.0	2.0
	Bromoform	10	2.0
	Bromomethane	5.0	2.0
	n-Butylbenzene	5.0	2.0
	sec-Butylbenzene	5.0	2.0
	tert-Butylbenzene	5.0	2.0
	Carbon Tetrachloride	5.0	2.0
	Chlorobenzene	5.0	2.0
	Chloroethane	10	2.0
	Chloroform	5.0	2.0
	Chloromethane	10	2.0
	2-Chlorotoluene	5.0	2.0
	4-Chlorotoluene	5.0	2.0
	Dibromochloromethane	5.0	2.0
	Dibromo-3-chloropropane (DBCP)	5.0	2.0
	Dibromomethane	5.0	2.0
	Dichlorodifluoromethane	10	2.0
	Dichloromethane (Methylene Chloride)	5.0	2.0
	1,2-Dichlorobenzene	5.0	2.0
	1,2-Dichloroethane	5.0	2.0
	1,3-Dichlorobenzene	5.0	2.0
	1,2-Dichloropropane	5.0	2.0
	1,3-Dichloropropane	5.0	2.0
	1,4-Dichlorobenzene	5.0	2.0
	2,2-Dichloropropane	5.0	2.0

Table 7 *(continued)*
Project Required Reporting Limits

Parameter/ Method	Analyte	Water	Soil
		RL, µg/L	RL, mg/kg
Volatile Organic Compounds EPA Method 8260 *(continued)*	1,1-Dichloroethane	5.0	2.0
	1,1-Dichloroethene	5.0	2.0
	1,1-Dichloropropene	5.0	2.0
	1,2-Dibromoethane (EDB)	5.0	2.0
	trans 1,2-Dichloroethene	5.0	2.0
	cis 1,2-Dichloroethene	5.0	2.0
	Ethylbenzene	5.0	2.0
	Hexachlorobutadiene	5.0	2.0
	Isopropylbenzene (cumene)	5.0	2.0
	4-Isopropyltoluene	5.0	2.0
	Methyl-tert-butyl ether (MTBE)	5.0	2.0
	Napthalene	5.0	2.0
	n-Propylbenzene	5.0	2.0
	Styrene	5.0	2.0
	Toluene	5.0	2.0
	Trichloroethene (TCE)	5.0	2.0
	Trichlorofluoromethane	5.0	2.0
	1,1,1,2-Tetrachloroethane	5.0	2.0
	1,1,1-Trichloroethane	5.0	2.0
	1,1,2,2-Tetrachloroethane	5.0	2.0
	Tetrachloroethene (PCE)	5.0	2.0
	1,1,2-Trichloroethane	5.0	2.0
	1,2,3-Trichlorobenzene	5.0	2.0
	1,2,3-Trichloropropane	5.0	2.0
	1,3,5-Trimethylbenzene	5.0	2.0
	1,2,4-Trichlorobenzene	5.0	2.0
	1,2,4-Trimethylbenzene	5.0	2.0
	m&p-Xylenes	5.0	2.0
	o-Xylene	5.0	2.0
	Vinyl Chloride	10	2.0
Hazardous Substances EPA Method 8260B	Acetone	100	100
	Carbon Disulfide	100	100
	2-Butanone (MEK)	100	100
	4-Methyl-2-Pentanone (MIBK)	50	50
	2-Hexanone	50	50

BTEX	*benzene, toluene, ethylbenzene, and total xylenes*	*mg/L*	*milligrams per liter*
CA LUFT	*California Leaking Underground Fuel Tank*	*RL*	*reporting limit*
EPA	*U.S. Environmental Protection Agency*	*TPH*	*total petroleum hydrocarbons*
M	*modified*	*TRPH*	*total recoverable petroleum hydrocarbons*
mg/kg	*milligrams per kilogram*	*µg/L*	*micrograms per liter*

Table 8
Quality Control Acceptance Criteria

Analyte/ Method	QC Parameter	Accuracy Water (% R)	Precision Water (% RPD)	Accuracy Soil (% R)	Precision Soil (% RPD)
TRPH EPA Method 418.1	LCS MS/MSD	75-125	≤ 30	75-125	≤ 30
Metals – EPA Method 6010B/7000	LCS				
Aluminum	MS/MSD	75-125	≤ 25	75-125	≤ 25
Antimony		75-125	≤ 25	75-125	≤ 25
Arsenic		75-125	≤ 25	75-125	≤ 25
Barium		75-125	≤ 25	75-125	≤ 25
Beryllium		75-125	≤ 25	75-125	≤ 25
Cadmium		75-125	≤ 25	75-125	≤ 25
Calcium		75-125	≤ 25	75-125	≤ 25
Chromium		75-125	≤ 25	75-125	≤ 25
Cobalt		75-125	≤ 25	75-125	≤ 25
Copper		75-125	≤ 25	75-125	≤ 25
Iron		75-125	≤ 25	75-125	≤ 25
Lead		75-125	≤ 25	75-125	≤ 25
Magnesium		75-125	≤ 25	75-125	≤ 25
Manganese		75-125	≤ 25	75-125	≤ 25
Molybdenum		75-125	≤ 25	75-125	≤ 25
Nickel		75-125	≤ 25	75-125	≤ 25
Potassium		75-125	≤ 25	75-125	≤ 25
Selenium		75-125	≤ 25	75-125	≤ 25
Silver		75-125	≤ 25	75-125	≤ 25
Sodium		75-125	≤ 25	75-125	≤ 25
Thallium		75-125	≤ 25	75-125	≤ 25
Vanadium		75-125	≤ 25	75-125	≤ 25
Zinc		75-125	≤ 25	75-125	≤ 25
Mercury		75-125	≤ 25	75-125	≤ 25
Volatile Organic Compounds					
1,1-DCA		61-145	≤ 20	59-172	≤ 30
Benzene		76-127	≤ 20	66-142	≤ 30
Chlorobenzene		75-130	≤ 20	60-133	≤ 30
TCE		71-120	≤ 20	62-137	≤ 30
Toluene		76-125	≤ 20	59-139	≤ 30
Surrogates					
Dibromofluoromethane		86-118		80-120	
Toluene-D8		88-110		81-117	
4-Bromofluorobenzene		86-115		74-121	
1,2-DCA-D4		80-120		80-120	

EPA	*U S Environmental Protection Agency*
LCS	*laboratory control sample*
MS/MSD	*matrix spike/matrix spike duplicate*
%R	*percent recovery*
% RPD	*relative percent difference*
QC	*quality control*

Table 9
Summary of Calibration Criteria and Corrective Action Procedures

Method	Applicable Parameter	QC Function	Frequency	Acceptance Criteria	Corrective Action[a]
EPA Method 418.1	Total Recoverable Petroleum Hydrocarbons	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥0 995 for linear regression	Correct problem then repeat initial calibration
		Calibration blank	After every 10 samples and at end of analysis sequence	No analytes detected ≥RL	Correct problem analyze calibration blank and previous 10 samples
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	All analyte(s) within ±10% of expected value	Repeat calibration and reanalyze all samples since last successful calibration
		Method blank	One per analytical batch	No analytes detected ≥RL	Correct problem reprep and analyze method blank and all samples prepped with the contaminated blank
		MS/MSD	One MS/MSD per every 20 IT project samples per matrix	QC acceptance criteria, Table 6-2	None
		MDL study	Once per 12 month period	Detection limits established shall be less than the reporting limits in Table 6-1	None
		Results reported between MDL and RL	None	None	None
EPA 6010B	ICP Metals	Initial multipoint calibration (minimum 3 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥0 995 for linear regression	Correct problem then repeat initial calibration
		Highest calibration standard	Before beginning a sample run	All analytes within ±5% of expected value	Correct problem repeat initial calibration
		Calibration blank	After every 10 samples and at end of analysis sequence	No analytes detected ≥RL	Correct problem analyze calibration blank and previous 10 samples
		Continuing calibration verification (Instrument Check Standard)	After every 10 samples and at the end of the analysis sequence	All analyte(s) within ±10% of expected value	Repeat calibration and reanalyze all samples since last successful calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 6-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria

Table 9 *(continued)*
Summary of Calibration Criteria and Corrective Action Procedures

Method	Applicable Parameter	QC Function	Frequency	Acceptance Criteria	Corrective Action[a]
EPA 6010B (continued)	ICP Metals	Method blank	One per analytical batch	No analytes detected ≥ RL	Correct problem reprep and analyze method blank and all samples prepped with the contaminated blank
		Interference check solution (ICS)	Beginning and end of an analytical run or twice during an 8 hour period, whichever is more frequent	Within ±20% of expected value	Terminate analysis; correct problem; reanalyze ICS; reanalyze all affected samples
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 6-2	Correct problem then reprep and analyze the LCS and all samples in the affected batch
		Dilution test	Each new sample matrix	1:4 dilution must agree within ±10% of the original determination	Perform post digestion spike addition
		Post digestion spike addition	When dilution test fails	Recovery within 75-125% of expected results	Correct problem then reanalyze post digestion spike addition
		MS/MSD	One MS/MSD per every 20 project samples per matrix	QC acceptance criteria, Table 6-2	None
		MDL study	Once per 12 month period	Detection limits established shall be < the RLs in Table 6-1	None
SW7470A SW7471A	Mercury	Initial multipoint calibration (minimum 5 standards and a blank)	Daily initial calibration prior to sample analysis	Correlation coefficient ≥ 0 995 for linear regression	Correct problem repeat initial calibration
		Second-source calibration check standard	Once per initial daily multipoint calibration	Analyte within ±10% of expected value	Correct problem repeat initial calibration
		Calibration blank	Once per initial daily multipoint calibration	No analyte detected ≥ RL	Correct problem reanalyze calibration blank and all samples prepped with blank
		Continuing calibration verification	After every 10 samples and at the end of the analysis sequence	The analyte within ±20% of expected value	Correct problem repeat calibration and reanalyze all samples since last successful calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once per analyst	QC acceptance criteria, Table 6-2	Recalculate results; locate and fix problem with system and then rerun demonstration for those analytes that did not meet criteria

Table 9 *(continued)*
Summary of Calibration Criteria and Corrective Action Procedures

Method	Applicable Parameter	QC Function	Frequency	Acceptance Criteria	Corrective Action[a]
SW7470A SW7471A (continued)	Mercury	Method blank	One per analytical batch	No analytes detected ≥ RL	Correct problem reprep and analyze blank and all samples prepped with the contaminated blank
		LCS for the analyte	One LCS per analytical batch	QC acceptance criteria, Table 6-2	Correct problem reprep and analyze LCS and all samples in affected batch
		New matrix check; five-fold dilution test	Each new sample matrix	Five times dilution sample result must be ±10% of the undiluted sample result	Perform recovery test
		Recovery test	When new matrix check fails	Recovery within 85-115% of expected results	Run all samples by the method of standard addition
		MS/MSD	One MS/MSD per every 20 project samples per matrix	QC acceptance criteria, Table 6-2	None
		MDL study	Once per 12 month period	Detection limits established shall be < the RLs in Table 6-1	None
EPA Methods 8260B and 8270C		Five-point initial calibration for target analytes	Initial calibration prior to sample analysis	8260B: The minimum average SPCC RF for Chloromethane, 1,1-Dichloroethane, Bromoform is 0 1; for Chlorobenzene and 1,1,2,2-Tetrachloroethane is 0 30 8270C: The minimum average SPCC RF is 0 050 8260B and 8270C: RSD is less than or equal to 15% for target analytes, and is less than or equal to 30% for CCC[1]	Correct problem, then repeat initial calibration
		Second-source calibration verification	Once per five-point initial calibration	Less than 25% difference for all target analytes and CCCs	Correct problem, then repeat initial calibration.
		Daily calibration verification	Before sample analysis and every 12 hours of analysis time	Less than 20% difference for all target analytes and CCCs	Correct problem, then repeat initial calibration
		Demonstrate ability to generate acceptable accuracy and precision using four replicate analyzes of a QC check sample	Once	QC acceptance criteria per method's requirements	Re-calculate results; locate and fix the problem, if exists, re-run demonstration of those analytes that did not meet acceptance criteria.

Table 9 *(continued)*
Summary of Calibration Criteria and Corrective Action Procedures

Method	Applicable Parameter	QC Function	Frequency	Acceptance Criteria	Corrective Action[a]
EPA Methods 8260B and 8270C (continued)		Check of mass spectral ion intensities (tuning procedure) using BFB (8260B) and DFTPP (8270C)	Prior to initial calibration and calibration verification	Must meet the method's requirements before samples are analyzed	Re-tune instrument and verify the tune acceptability
		Internal Standards	During data acquisition of calibration standard, samples and QC check samples	Areas within -50% to +100% of last calibration verification (12 hours) for each	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.
		Method blank	One per analytical batch (8260B) and one per preparation batch (8270C)	No analytes detected above the RL	Correct problem, then re-extract and reanalyze method blank and all samples processed with the contaminated blank.
		MS/MSD	One MS/MSD pair conducted on Navy samples per analytical/preparation batch	Advisory recovery limits: 70-130%	Identify problem If not related to matrix interference, re-extract and reanalyze MS/MSD and all associated batch samples.
		LCS or LCS/LCD pair if there is not enough sample for MS/MSD	One LCS or LCS/LCD per analytical/preparation batch	Advisory recovery limits: 70-130%	Correct problem, then re-extract and reanalyze the LCS (LCS/LCD) and all associated batch samples.
		Surrogate standards	Every sample, spiked sample, standard, and method blank	QC acceptance criteria per method's requirements (per Method 8260B Table 8 and Method 8270A Table 8[2])	Correct problem, then re-extract and reanalyze all affected samples
		MDL study	Once per 12-month period	Detection limits established will be below the RLs	Correct problem, repeat the MDL study

[a] All corrective actions shall be documented, and all records shall be maintained by the laboratory

[1] If RSD for any analyte is >15%, regression fit may be used for the calibration curve for that analyte Acceptance criteria for first order regression is $r^2 \geq 0.99$

[2] For Method 8270C use the surrogate standard acceptance criteria of Method 8270A, Revision 1, July 1992

DUP/MSD	*duplicate/matrix spike*
EPA	*U S Environmental Protection Agency*
ICP	*inductively coupled plasma*
ICS	*instrument check standard*
LCS	*laboratory control sample*
MDL	*method detection limit*
MS/MSD	*matrix spike/matrix spike duplicate*
%RSD	*percent relative standard deviation*
TRPH	*total recoverable petroleum hydrocarbons*
QC	*quality control*
RL	*reporting limit*

ATTACHMENT 1
EPA METHOD 6200

METHOD 6200

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT

1.0 SCOPE AND APPLICATION

1.1 This method is applicable to the in situ and intrusive analysis of the 26 analytes listed in Table 1 for soil and sediment samples. Some common elements are not listed in Table 1 because they are considered "light" elements that cannot be detected by field portable x-ray fluorescence (FPXRF). They are: lithium, beryllium, sodium, magnesium, aluminum, silicon, and phosphorus. Most of the analytes listed in Table 1 are of environmental concern, while a few others have interference effects or change the elemental composition of the matrix, affecting quantitation of the analytes of interest. Generally elements of atomic number 16 or greater can be detected and quantitated by FPXRF.

1.2 Detection limits depend on several factors, the analyte of interest, the type of detector used, the type of excitation source, the strength of the excitation source, count times used to irradiate the sample, physical matrix effects, chemical matrix effects, and interelement spectral interferences. General instrument detection limits for analytes of interest in environmental applications are shown in Table 1. These detection limits apply to a clean matrix of quartz sand (silicon dioxide) free of interelement spectral interferences using long (600-second) count times. These detection limits are given for guidance only and will vary depending on the sample matrix, which instrument is used, and operating conditions. A discussion of field performance-based detection limits is presented in Section 13.4 of this method. The clean matrix and field performance-based detection limits should be used for general planning purposes, and a third detection limit discussed, based on the standard deviation around single measurements, should be used in assessing data quality. This detection limit is discussed in Sections 9.7 and 11.3.

1.3 Use of this method is restricted to personnel either trained and knowledgeable in the operation of an XRF instrument or under the supervision of a trained and knowledgeable individual. This method is a screening method to be used with confirmatory analysis using EPA-approved methods. This method's main strength is as a rapid field screening procedure. The method detection limits (MDL) of FPXRF are above the toxicity characteristic regulatory level for most RCRA analytes. If the precision, accuracy, and detection limits of FPXRF meet the data quality objectives (DQOs) of your project, then XRF is a fast, powerful, cost effective technology for site characterization.

2.0 SUMMARY OF METHOD

2.1 The FPXRF technologies described in this method use sealed radioisotope sources to irradiate samples with x-rays. X-ray tubes are used to irradiate samples in the laboratory and are beginning to be incorporated into field portable instruments. When a sample is irradiated with x-rays, the source x-rays may undergo either scattering or absorption by sample atoms. This later process is known as the photoelectric effect. When an atom absorbs the source x-rays, the incident radiation dislodges electrons from the innermost shells of the atom, creating vacancies. The electron vacancies are filled by electrons cascading in from outer electron shells. Electrons in outer shells have higher energy states than inner shell electrons, and the outer shell electrons give off energy as they cascade down into the inner shell vacancies. This rearrangement of electrons results in emission of x-rays characteristic of the given atom. The emission of x-rays, in this manner, is termed x-ray fluorescence.

Three electron shells are generally involved in emission of x-rays during FPXRF analysis of environmental samples: the K, L, and M shells. A typical emission pattern, also called an emission spectrum, for a given metal has multiple intensity peaks generated from the emission of K, L, or M shell electrons. The most commonly measured x-ray emissions are from the K and L shells; only metals with an atomic number greater than 57 have measurable M shell emissions.

Each characteristic x-ray line is defined with the letter K, L, or M, which signifies which shell had the original vacancy and by a subscript alpha (α) or beta (β), which indicates the higher shell from which electrons fell to fill the vacancy and produce the x-ray. For example, a K_α line is produced by a vacancy in the K shell filled by an L shell electron, whereas a K_β line is produced by a vacancy in the K shell filled by an M shell electron. The K_α transition is on average 6 to 7 times more probable than the K_β transition; therefore, the K_α line is approximately 7 times more intense than the K_β line for a given element, making the K_α line the choice for quantitation purposes.

The K lines for a given element are the most energetic lines and are the preferred lines for analysis. For a given atom, the x-rays emitted from L transitions are always less energetic than those emitted from K transitions. Unlike the K lines, the main L emission lines (L_α and L_β) for an element are of nearly equal intensity. The choice of one or the other depends on what interfering element lines might be present. The L emission lines are useful for analyses involving elements of atomic number (Z) 58 (cerium) through 92 (uranium).

An x-ray source can excite characteristic x-rays from an element only if the source energy is greater than the absorption edge energy for the particular line group of the element, that is, the K absorption edge, L absorption edge, or M absorption edge energy. The absorption edge energy is somewhat greater than the corresponding line energy. Actually, the K absorption edge energy is approximately the sum of the K, L, and M line energies of the particular element, and the L absorption edge energy is approximately the sum of the L and M line energies. FPXRF is more sensitive to an element with an absorption edge energy close to but less than the excitation energy of the source. For example, when using a cadmium-109 source, which has an excitation energy of 22.1 kiloelectron volts (keV), FPXRF would exhibit better sensitivity for zirconium which has a K line energy of 15.7 keV than to chromium, which has a K line energy of 5.41 keV.

2.2 Under this method, inorganic analytes of interest are identified and quantitated using a field portable energy-dispersive x-ray fluorescence spectrometer. Radiation from one or more radioisotope sources or an electrically excited x-ray tube is used to generate characteristic x-ray emissions from elements in a sample. Up to three sources may be used to irradiate a sample. Each source emits a specific set of primary x-rays that excite a corresponding range of elements in a sample. When more than one source can excite the element of interest, the source is selected according to its excitation efficiency for the element of interest.

For measurement, the sample is positioned in front of the probe window. This can be done in two manners using FPXRF instruments: in situ or intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. The sample cup is then placed on top of the window inside a protective cover for analysis.

Sample analysis is then initiated by exposing the sample to primary radiation from the source. Fluorescent and backscattered x-rays from the sample enter through the detector window and are converted into electric pulses in the detector. The detector in FPXRF instruments is usually either a solid-state detector or a gas-filled proportional counter. Within the detector, energies of the characteristic x-rays are converted into a train of electric pulses, the amplitudes of which are linearly

proportional to the energy of the x-rays. An electronic multichannel analyzer (MCA) measures the pulse amplitudes, which is the basis of qualitative x-ray analysis. The number of counts at a given energy per unit of time is representative of the element concentration in a sample and is the basis for quantitative analysis. Most FPXRF instruments are menu-driven from software built into the units or from personal computers (PC).

The measurement time of each source is user-selectable. Shorter source measurement times (30 seconds) are generally used for initial screening and hot spot delineation, and longer measurement times (up to 300 seconds) are typically used to meet higher precision and accuracy requirements.

FPXRF instruments can be calibrated using the following methods: internally using fundamental parameters determined by the manufacturer, empirically based on site-specific calibration standards (SSCS), or based on Compton peak ratios. The Compton peak is produced by backscattering of the source radiation. Some FPXRF instruments can be calibrated using multiple methods.

3.0 DEFINITIONS

3.1 FPXRF: Field portable x-ray fluorescence.

3.2 MCA: Multichannel analyzer for measuring pulse amplitude.

3.3 SSCS: Site specific calibration standard.

3.4 FP: Fundamental parameter.

3.5 ROI: Region of interest.

3.6 SRM: Standard reference material. A standard containing certified amounts of metals in soil or sediment.

3.7 eV: Electron Volt. A unit of energy equivalent to the amount of energy gained by an electron passing through a potential difference of one volt.

3.8 Refer to Chapter One and Chapter Three for additional definitions.

4.0 INTERFERENCES

4.1 The total method error for FPXRF analysis is defined as the square root of the sum of squares of both instrument precision and user- or application-related error. Generally, instrument precision is the least significant source of error in FPXRF analysis. User- or application-related error is generally more significant and varies with each site and method used. Some sources of interference can be minimized or controlled by the instrument operator, but others cannot. Common sources of user- or application-related error are discussed below.

4.2 Physical matrix effects result from variations in the physical character of the sample. These variations may include such parameters as particle size, uniformity, homogeneity, and surface condition. For example, if any analyte exists in the form of very fine particles in a coarser-grained matrix, the analyte's concentration measured by the FPXRF will vary depending on how fine particles are distributed within the coarser-grained matrix. If the fine particles "settle" to the bottom of the sample cup, the analyte concentration measurement will be higher than if the fine particles are not

mixed in well and stay on top of the coarser-grained particles in the sample cup. One way to reduce such error is to grind and sieve all soil samples to a uniform particle size thus reducing sample-to-sample particle size variability. Homogeneity is always a concern when dealing with soil samples. Every effort should be made to thoroughly mix and homogenize soil samples before analysis. Field studies have shown heterogeneity of the sample generally has the largest impact on comparability with confirmatory samples.

4.3 Moisture content may affect the accuracy of analysis of soil and sediment sample analyses. When the moisture content is between 5 and 20 percent, the overall error from moisture may be minimal. However, moisture content may be a major source of error when analyzing samples of surface soil or sediment that are saturated with water. This error can be minimized by drying the samples in a convection or toaster oven. Microwave drying is not recommended because field studies have shown that microwave drying can increase variability between FPXRF data and confirmatory analysis and because metal fragments in the sample can cause arcing to occur in a microwave.

4.4 Inconsistent positioning of samples in front of the probe window is a potential source of error because the x-ray signal decreases as the distance from the radioactive source increases. This error is minimized by maintaining the same distance between the window and each sample. For the best results, the window of the probe should be in direct contact with the sample, which means that the sample should be flat and smooth to provide a good contact surface.

4.5 Chemical matrix effects result from differences in the concentrations of interfering elements. These effects occur as either spectral interferences (peak overlaps) or as x-ray absorption and enhancement phenomena. Both effects are common in soils contaminated with heavy metals. As examples of absorption and enhancement effects; iron (Fe) tends to absorb copper (Cu) x-rays, reducing the intensity of the Cu measured by the detector, while chromium (Cr) will be enhanced at the expense of Fe because the absorption edge of Cr is slightly lower in energy than the fluorescent peak of iron. The effects can be corrected mathematically through the use of fundamental parameter (FP) coefficients. The effects also can be compensated for using SSCS, which contain all the elements present on site that can interfere with one another.

4.6 When present in a sample, certain x-ray lines from different elements can be very close in energy and, therefore, can cause interference by producing a severely overlapped spectrum. The degree to which a detector can resolve the two different peaks depends on the energy resolution of the detector. If the energy difference between the two peaks in electron volts is less than the resolution of the detector in electron volts, then the detector will not be able to fully resolve the peaks.

The most common spectrum overlaps involve the K_β line of element Z-1 with the K_α line of element Z. This is called the K_α/K_β interference. Because the K_α:K_β intensity ratio for a given element usually is about 7:1, the interfering element, Z-1, must be present at large concentrations to cause a problem. Two examples of this type of spectral interference involve the presence of large concentrations of vanadium (V) when attempting to measure Cr or the presence of large concentrations of Fe when attempting to measure cobalt (Co). The V K_α and K_β energies are 4.95 and 5.43 keV, respectively, and the Cr K_α energy is 5.41 keV. The Fe K_α and K_β energies are 6.40 and 7.06 keV, respectively, and the Co K_α energy is 6.92 keV. The difference between the V K_β and Cr K_α energies is 20 eV, and the difference between the Fe K_β and the Co K_α energies is 140 eV. The resolution of the highest-resolution detectors in FPXRF instruments is 170 eV. Therefore, large amounts of V and Fe will interfere with quantitation of Cr or Co, respectively. The presence of Fe is a frequent problem because it is often found in soils at tens of thousands of parts per million (ppm).

4.7 Other interferences can arise from K/L, K/M, and L/M line overlaps, although these overlaps are less common. Examples of such overlap involve arsenic (As) K_α/lead (Pb) L_α and sulfur (S) K_α/Pb M_α. In the As/Pb case, Pb can be measured from the Pb L_β line, and As can be measured from either the As K_α or the As K_β line; in this way the interference can be corrected. If the As K_β line is used, sensitivity will be decreased by a factor of two to five times because it is a less intense line than the As K_α line. If the As K_α line is used in the presence of Pb, mathematical corrections within the instrument software can be used to subtract out the Pb interference. However, because of the limits of mathematical corrections, As concentrations cannot be efficiently calculated for samples with Pb:As ratios of 10:1 or more. This high ratio of Pb to As may result in no As being reported regardless of the actual concentration present.

No instrument can fully compensate for this interference. It is important for an operator to understand this limitation of FPXRF instruments and consult with the manufacturer of the FPXRF instrument to evaluate options to minimize this limitation. The operator's decision will be based on action levels for metals in soil established for the site, matrix effects, capabilities of the instrument, data quality objectives, and the ratio of lead to arsenic known to be present at the site. If a site is encountered that contains lead at concentrations greater than ten times the concentration of arsenic it is advisable that all critical soil samples be sent off site for confirmatory analysis by an EPA-approved method.

4.8 If SSCS are used to calibrate an FPXRF instrument, the samples collected must be representative of the site under investigation. Representative soil sampling ensures that a sample or group of samples accurately reflects the concentrations of the contaminants of concern at a given time and location. Analytical results for representative samples reflect variations in the presence and concentration ranges of contaminants throughout a site. Variables affecting sample representativeness include differences in soil type, contaminant concentration variability, sample collection and preparation variability, and analytical variability, all of which should be minimized as much as possible.

4.9 Soil physical and chemical effects may be corrected using SSCS that have been analyzed by inductively coupled plasma (ICP) or atomic absorption (AA) methods. However, a major source of error can be introduced if these samples are not representative of the site or if the analytical error is large. Another concern is the type of digestion procedure used to prepare the soil samples for the reference analysis. Analytical results for the confirmatory method will vary depending on whether a partial digestion procedure, such as SW-846 Method 3050, or a total digestion procedure, such as Method 3052 is used. It is known that depending on the nature of the soil or sediment, Method 3050 will achieve differing extraction efficiencies for different analytes of interest. The confirmatory method should meet the project data quality objectives.

XRF measures the total concentration of an element; therefore, to achieve the greatest comparability of this method with the reference method (reduced bias), a total digestion procedure should be used for sample preparation. However, in the study used to generate the performance data for this method, the confirmatory method used was Method 3050, and the FPXRF data compared very well with regression correlation coefficients (r^2 often exceeding 0.95, except for barium and chromium. See Table 9 in Section 17.0). The critical factor is that the digestion procedure and analytical reference method used should meet the data quality objectives (DQOs) of the project and match the method used for confirmation analysis.

4.10 Ambient temperature changes can affect the gain of the amplifiers producing instrument drift. Gain or drift is primarily a function of the electronics (amplifier or preamplifier) and not the detector as most instrument detectors are cooled to a constant temperature. Most FPXRF instruments have a built-in automatic gain control. If the automatic gain control is allowed to make

periodic adjustments, the instrument will compensate for the influence of temperature changes on its energy scale. If the FPXRF instrument has an automatic gain control function, the operator will not have to adjust the instrument's gain unless an error message appears. If an error message appears, the operator should follow the manufacturer's procedures for troubleshooting the problem. Often, this involves performing a new energy calibration. The performance of an energy calibration check to assess drift is a quality control measure discussed in Section 9.2.

If the operator is instructed by the manufacturer to manually conduct a gain check because of increasing or decreasing ambient temperature, it is standard to perform a gain check after every 10 to 20 sample measurements or once an hour whichever is more frequent. It is also suggested that a gain check be performed if the temperature fluctuates more than 10 to 20°F. The operator should follow the manufacturer's recommendations for gain check frequency.

5.0 SAFETY

5.1 Proper training for the safe operation of the instrument and radiation training should be completed by the analyst prior to analysis. Radiation safety for each specific instrument can be found in the operators manual. Protective shielding should never be removed by the analyst or any personnel other than the manufacturer. The analyst should be aware of the local state and national regulations that pertain to the use of radiation-producing equipment and radioactive materials with which compliance is required. Licenses for radioactive materials are of two types; (1) general license which is usually provided by the manufacturer for receiving, acquiring, owning, possessing, using, and transferring radioactive material incorporated in a device or equipment, and (2) specific license which is issued to named persons for the operation of radioactive instruments as required by local state agencies. There should be a person appointed within the organization that is solely responsible for properly instructing all personnel, maintaining inspection records, and monitoring x-ray equipment at regular intervals. A copy of the radioactive material licenses and leak tests should be present with the instrument at all times and available to local and national authorities upon request. X-ray tubes do not require radioactive material licenses or leak tests, but do require approvals and licenses which vary from state to state. In addition, fail-safe x-ray warning lights should be illuminated whenever an x-ray tube is energized. Provisions listed above concerning radiation safety regulations, shielding, training, and responsible personnel apply to x-ray tubes just as to radioactive sources. In addition, a log of the times and operating conditions should be kept whenever an x-ray tube is energized. Finally, an additional hazard present with x-ray tubes is the danger of electric shock from the high voltage supply. The danger of electric shock is as substantial as the danger from radiation but is often overlooked because of its familiarity.

5.2 Radiation monitoring equipment should be used with the handling of the instrument. The operator and the surrounding environment should be monitored continually for analyst exposure to radiation. Thermal luminescent detectors (TLD) in the form of badges and rings are used to monitor operator radiation exposure. The TLDs should be worn in the area of most frequent exposure. The maximum permissible whole-body dose from occupational exposure is 5 Roentgen Equivalent Man (REM) per year. Possible exposure pathways for radiation to enter the body are ingestion, inhaling, and absorption. The best precaution to prevent radiation exposure is distance and shielding.

5.3 Refer to Chapter Three for guidance on some proper safety protocols.

6.0 EQUIPMENT AND SUPPLIES

6.1 <u>FPXRF Spectrometer</u>: An FPXRF spectrometer consists of four major components: (1) a source that provides x-rays; (2) a sample presentation device; (3) a detector that converts x-

ray-generated photons emitted from the sample into measurable electronic signals; and (4) a data processing unit that contains an emission or fluorescence energy analyzer, such as an MCA, that processes the signals into an x-ray energy spectrum from which elemental concentrations in the sample may be calculated, and a data display and storage system. These components and additional, optional items, are discussed below.

6.1.1 Excitation Sources: Most FPXRF instruments use sealed radioisotope sources to produce x-rays in order to irradiate samples. The FPXRF instrument may contain between one and three radioisotope sources. Common radioisotope sources used for analysis for metals in soils are iron (Fe)-55, cadmium (Cd)-109, americium (Am)-241, and curium (Cm)-244. These sources may be contained in a probe along with a window and the detector; the probe is connected to a data reduction and handling system by means of a flexible cable. Alternatively, the sources, window, and detector may be included in the same unit as the data reduction and handling system.

The relative strength of the radioisotope sources is measured in units of millicuries (mCi). All other components of the FPXRF system being equal, the stronger the source, the greater the sensitivity and precision of a given instrument. Radioisotope sources undergo constant decay. In fact, it is this decay process that emits the primary x-rays used to excite samples for FPXRF analysis. The decay of radioisotopes is measured in "half-lives." The half-life of a radioisotope is defined as the length of time required to reduce the radioisotopes strength or activity by half. Developers of FPXRF technologies recommend source replacement at regular intervals based on the source's half-life. The characteristic x-rays emitted from each of the different sources have energies capable of exciting a certain range of analytes in a sample. Table 2 summarizes the characteristics of four common radioisotope sources.

X-ray tubes have higher radiation output, no intrinsic lifetime limit, produce constant output over their lifetime, and do not have the disposal problems of radioactive sources but are just now appearing in FPXRF instruments. An electrically-excited x-ray tube operates by bombarding an anode with electrons accelerated by a high voltage. The electrons gain an energy in electron volts equal to the accelerating voltage and can excite atomic transitions in the anode, which then produces characteristic x-rays. These characteristic x-rays are emitted through a window which contains the vacuum required for the electron acceleration. An important difference between x-ray tubes and radioactive sources is that the electrons which bombard the anode also produce a continuum of x-rays across a broad range of energies in addition to the characteristic x-rays. This continuum is weak compared to the characteristic x-rays but can provide substantial excitation since it covers a broad energy range. It has the undesired property of producing background in the spectrum near the analyte x-ray lines when it is scattered by the sample. For this reason a filter is often used between the x-ray tube and the sample to suppress the continuum radiation while passing the characteristic x-rays from the anode. This filter is sometimes incorporated into the window of the x-ray tube. The choice of accelerating voltage is governed by the anode material, since the electrons must have sufficient energy to excite the anode, which requires a voltage greater than the absorption edge of the anode material. The anode is most efficiently excited by voltages 2 to 2.5 times the edge energy (most x-rays per unit power to the tube), although voltages as low as 1.5 times the absorption edge energy will work. The characteristic x-rays emitted by the anode are capable of exciting a range of elements in the sample just as with a radioactive source. Table 3 gives the recommended operating voltages and the sample elements excited for some common anodes.

6.1.2 Sample Presentation Device: FPXRF instruments can be operated in two modes: in situ and intrusive. If operated in the in situ mode, the probe window is placed in direct contact with the soil surface to be analyzed. When an FPXRF instrument is operated in the intrusive mode, a soil or sediment sample must be collected, prepared, and placed in a sample cup. For most FPXRF instruments operated in the intrusive mode, the probe is rotated so that the window faces upward. A protective sample cover is placed over the window, and the sample cup is placed on top of the window inside the protective sample cover for analysis.

6.1.3 Detectors: The detectors in the FPXRF instruments can be either solid-state detectors or gas-filled, proportional counter detectors. Common solid-state detectors include mercuric iodide (HgI_2), silicon pin diode and lithium-drifted silicon Si(Li). The HgI_2 detector is operated at a moderately subambient temperature controlled by a low power thermoelectric cooler. The silicon pin diode detector also is cooled via the thermoelectric Peltier effect. The Si(Li) detector must be cooled to at least -90 °C either with liquid nitrogen or by thermoelectric cooling via the Peltier effect. Instruments with a Si(Li) detector have an internal liquid nitrogen dewar with a capacity of 0.5 to 1.0 liter. Proportional counter detectors are rugged and lightweight, which are important features of a field portable detector. However, the resolution of a proportional counter detector is not as good as that of a solid-state detector. The energy resolution of a detector for characteristic x-rays is usually expressed in terms of full width at half-maximum (FWHM) height of the manganese K_α peak at 5.89 keV. The typical resolutions of the above mentioned detectors are as follows: HgI_2-270 eV; silicon pin diode-250 eV; Si(Li)–170 eV; and gas-filled, proportional counter-750 eV.

During operation of a solid-state detector, an x-ray photon strikes a biased, solid-state crystal and loses energy in the crystal by producing electron-hole pairs. The electric charge produced is collected and provides a current pulse that is directly proportional to the energy of the x-ray photon absorbed by the crystal of the detector. A gas-filled, proportional counter detector is an ionization chamber filled with a mixture of noble and other gases. An x-ray photon entering the chamber ionizes the gas atoms. The electric charge produced is collected and provides an electric signal that is directly proportional to the energy of the x-ray photon absorbed by the gas in the detector.

6.1.4 Data Processing Units: The key component in the data processing unit of an FPXRF instrument is the MCA. The MCA receives pulses from the detector and sorts them by their amptitudes (energy level). The MCA counts pulses per second to determine the height of the peak in a spectrum, which is indicative of the target analyte's concentration. The spectrum of element peaks are built on the MCA. The MCAs in FPXRF instruments have from 256 to 2,048 channels. The concentrations of target analytes are usually shown in parts per million on a liquid crystal display (LCD) in the instrument. FPXRF instruments can store both spectra and from 100 to 500 sets of numerical analytical results. Most FPXRF instruments are menu-driven from software built into the units or from PCs. Once the data–storage memory of an FPXRF unit is full, data can be downloaded by means of an RS-232 port and cable to a PC.

6.2 Spare battery chargers.

6.3 Polyethylene sample cups: 31 millimeters (mm) to 40 mm in diameter with collar, or equivalent (appropriate for FPXRF instrument).

6.4 X-ray window film: Mylar™, Kapton™, Spectrolene™, polypropylene, or equivalent; 2.5 to 6.0 micrometers (µm) thick.

6.5 Mortar and pestle: glass, agate, or aluminum oxide; for grinding soil and sediment samples.

6.6 Containers: glass or plastic to store samples.

6.7 Sieves: 60-mesh (0.25 mm), stainless-steel, Nylon, or equivalent for preparing soil and sediment samples.

6.8 Trowels: for smoothing soil surfaces and collecting soil samples.

6.9 Plastic bags: used for collection and homogenization of soil samples.

6.10 Drying oven: standard convection or toaster oven, for soil and sediment samples that require drying.

7.0 REAGENTS AND STANDARDS

7.1 Pure Element Standards: Each pure, single-element standard is intended to produce strong characteristic x-ray peaks of the element of interest only. Other elements present must not contribute to the fluorescence spectrum. A set of pure element standards for commonly sought analytes is supplied by the instrument manufacturer, if required for the instrument; not all instruments require the pure element standards. The standards are used to set the region of interest (ROI) for each element. They also can be used as energy calibration and resolution check samples.

7.2 Site-specific Calibration Standards: Instruments that employ fundamental parameters (FP) or similar mathematical models in minimizing matrix effects may not require SSCS. If the FP calibration model is to be optimized or if empirical calibration is necessary, then SSCSs must be collected, prepared, and analyzed.

7.2.1 The SSCS must be representative of the matrix to be analyzed by FPXRF. These samples must be well homogenized. A minimum of ten samples spanning the concentration ranges of the analytes of interest and of the interfering elements must be obtained from the site. A sample size of 4 to 8 ounces is recommended, and standard glass sampling jars should be used.

7.2.2 Each sample should be oven-dried for 2 to 4 hours at a temperature of less than 150°C. If mercury is to be analyzed, a separate sample portion must remain undried, as heating may volatilize the mercury. When the sample is dry, all large, organic debris and nonrepresentative material, such as twigs, leaves, roots, insects, asphalt, and rock should be removed. The sample should be ground with a mortar and pestle and passed through a 60-mesh sieve. Only the coarse rock fraction should remain on the screen.

7.2.3 The sample should be homogenized by using a riffle splitter or by placing 150 to 200 grams of the dried, sieved sample on a piece of kraft or butcher paper about 1.5 by 1.5 feet in size. Each corner of the paper should be lifted alternately, rolling the soil over on itself and toward the opposite corner. The soil should be rolled on itself 20 times Approximately 5 grams of the sample should then be removed and placed in a sample cup for FPXRF analysis. The rest of the prepared sample should be sent off site for ICP or AA analysis. The method use for confirmatory analysis should meet the data quality objectives of the project.

7.3 Blank Samples: The blank samples should be from a "clean" quartz or silicon dioxide matrix that is free of any analytes at concentrations above the method detection limits. These

samples are used to monitor for cross-contamination and laboratory-induced contaminants or interferences.

7.4 Standard Reference Materials: Standard reference materials (SRM) are standards containing certified amounts of metals in soil or sediment. These standards are used for accuracy and performance checks of FPXRF analyses. SRMs can be obtained from the National Institute of Standards and Technology (NIST), the U.S. Geological Survey (USGS), the Canadian National Research Council, and the national bureau of standards in foreign nations. Pertinent NIST SRMs for FPXRF analysis include 2704, Buffalo River Sediment; 2709, San Joaquin Soil; and 2710 and 2711, Montana Soil. These SRMs contain soil or sediment from actual sites that has been analyzed using independent inorganic analytical methods by many different laboratories.

8.0 SAMPLE COLLECTION, PRESERVATION, AND STORAGE

Sample handling and preservation procedures used in FPXRF analyses should follow the guidelines in Chapter Three, Inorganic Analytes.

9.0 QUALITY CONTROL

9.1 Refer to Chapter One for additional guidance on quality assurance protocols. All field data sheets and quality control data should be maintained for reference or inspection.

9.2 Energy Calibration Check: To determine whether an FPXRF instrument is operating within resolution and stability tolerances, an energy calibration check should be run. The energy calibration check determines whether the characteristic x-ray lines are shifting, which would indicate drift within the instrument. As discussed in Section 4.10, this check also serves as a gain check in the event that ambient temperatures are fluctuating greatly (> 10 to 20°F).

The energy calibration check should be run at a frequency consistent with manufacturers recommendations. Generally, this would be at the beginning of each working day, after the batteries are changed or the instrument is shut off, at the end of each working day, and at any other time when the instrument operator believes that drift is occurring during analysis. A pure element such as iron, manganese, copper, or lead is often used for the energy calibration check. A manufacturer-recommended count time per source should be used for the check.

9.2.1 The instrument manufacturer's manual specifies the channel or kiloelectron volt level at which a pure element peak should appear and the expected intensity of the peak. The intensity and channel number of the pure element as measured using the radioactive source should be checked and compared to the manufacturer's recommendation. If the energy calibration check does not meet the manufacturer's criteria, then the pure element sample should be repositioned and reanalyzed. If the criteria are still not met, then an energy calibration should be performed as described in the manufacturer's manual. With some FPXRF instruments, once a spectrum is acquired from the energy calibration check, the peak can be optimized and realigned to the manufacturer's specifications using their software.

9.3 Blank Samples: Two types of blank samples should be analyzed for FPXRF analysis: instrument blanks and method blanks. An instrument blank is used to verify that no contamination exists in the spectrometer or on the probe window.

9.3.1 The instrument blank can be silicon dioxide, a Teflon block, a quartz block, "clean" sand, or lithium carbonate. This instrument blank should be analyzed on each working day before and after analyses are conducted and once per every twenty samples. An

instrument blank should also be analyzed whenever contamination is suspected by the analyst. The frequency of analysis will vary with the data quality objectives of the project. A manufacturer-recommended count time per source should be used for the blank analysis. No element concentrations above the method detection limits should be found in the instrument blank. If concentrations exceed these limits, then the probe window and the check sample should be checked for contamination. If contamination is not a problem, then the instrument must be "zeroed" by following the manufacturer's instructions.

9.3.2 A method blank is used to monitor for laboratory-induced contaminants or interferences. The method blank can be "clean" silica sand or lithium carbonate that undergoes the same preparation procedure as the samples. A method blank must be analyzed at least daily. The frequency of analysis will depend on the data quality objectives of the project. To be acceptable, a method blank must not contain any analyte at a concentration above its method detection limit. If an analyte's concentration exceeds its method detection limit, the cause of the problem must be identified, and all samples analyzed with the method blank must be reanalyzed.

9.4 Calibration Verification Checks: A calibration verification check sample is used to check the accuracy of the instrument and to assess the stability and consistency of the analysis for the analytes of interest. A check sample should be analyzed at the beginning of each working day, during active sample analyses, and at the end of each working day. The frequency of calibration checks during active analysis will depend on the data quality objectives of the project. The check sample should be a well characterized soil sample from the site that is representative of site samples in terms of particle size and degree of homogeneity and that contains contaminants at concentrations near the action levels. If a site-specific sample is not available, then an NIST or other SRM that contains the analytes of interest can be used to verify the accuracy of the instrument. The measured value for each target analyte should be within ±20 percent (%D) of the true value for the calibration verification check to be acceptable. If a measured value falls outside this range, then the check sample should be reanalyzed. If the value continues to fall outside the acceptance range, the instrument should be recalibrated, and the batch of samples analyzed before the unacceptable calibration verification check must be reanalyzed.

9.5 Precision Measurements: The precision of the method is monitored by analyzing a sample with low, moderate, or high concentrations of target analytes. The frequency of precision measurements will depend on the data quality objectives for the data. A minimum of one precision sample should be run per day. Each precision sample should be analyzed 7 times in replicate. It is recommended that precision measurements be obtained for samples with varying concentration ranges to assess the effect of concentration on method precision. Determining method precision for analytes at concentrations near the site action levels can be extremely important if the FPXRF results are to be used in an enforcement action; therefore, selection of at least one sample with target analyte concentrations at or near the site action levels or levels of concern is recommended. A precision sample is analyzed by the instrument for the same field analysis time as used for other project samples. The relative standard deviation (RSD) of the sample mean is used to assess method precision. For FPXRF data to be considered adequately precise, the RSD should not be greater than 20 percent with the exception of chromium. RSD values for chromium should not be greater than 30 percent.

The equation for calculating RSD is as follows:

$$RSD = (SD/\text{Mean Concentration}) \times 100$$

where:

RSD	=	Relative standard deviation for the precision measurement for the analyte
SD	=	Standard deviation of the concentration for the analyte
Mean Concentration	=	Mean concentration for the analyte

The precision or reproducibility of a measurement will improve with increasing count time, however, increasing the count time by a factor of 4 will provide only 2 times better precision, so there is a point of diminishing return. Increasing the count time also improves the detection limit, but decreases sample throughput.

9.6 Detection Limits: Results for replicate analyses of a low-concentration sample, SSCS, or SRM can be used to generate an average site-specific method detection and quantitation limits. In this case, the method detection limit is defined as 3 times the standard deviation of the results for the low-concentration samples and the method quantitation limit is defined as 10 times the standard deviation of the same results. Another means of determining method detection and quantitation limits involves use of counting statistics. In FPXRF analysis, the standard deviation from counting statistics is defined as $SD = (N)^{1/2}$, where SD is the standard deviation for a target analyte peak and N is the net counts for the peak of the analyte of interest (i.e., gross counts minus background under the peak). Three times this standard deviation would be the method detection limit and 10 times this standard deviation would be the method quantitation limit. If both of the above mentioned approaches are used to calculate method detection limits, the larger of the standard deviations should be used to provide the more conservative detection limits.

This SD based detection limit criteria must be used by the operator to evaluate each measurement for its useability. A measurement above the average calculated or manufacturer's detection limit, but smaller than three times its associated SD, should not be used as a quantitative measurement. Conversely, if the measurement is below the average calculated or manufacturer's detection limit, but greater than three times its associated SD. It should be coded as an estimated value.

9.7 Confirmatory Samples: The comparability of the FPXRF analysis is determined by submitting FPXRF-analyzed samples for analysis at a laboratory. The method of confirmatory analysis must meet the project and XRF measurement data quality objectives. The confirmatory samples must be splits of the well homogenized sample material. In some cases the prepared sample cups can be submitted. A minimum of 1 sample for each 20 FPXRF-analyzed samples should be submitted for confirmatory analysis. This frequency will depend on data quality objectives. The confirmatory analyses can also be used to verify the quality of the FPXRF data. The confirmatory samples should be selected from the lower, middle, and upper range of concentrations measured by the FPXRF. They should also include samples with analyte concentrations at or near the site action levels. The results of the confirmatory analysis and FPXRF analyses should be evaluated with a least squares linear regression analysis. If the measured concentrations span more than one order of magnitude, the data should be log-transformed to standardize variance which is proportional to the magnitude of measurement. The correlation coefficient (r^2) for the results should be 0.7 or greater for the FPXRF data to be considered screening level data. If the r^2 is 0.9 or greater and inferential statistics indicate the FPXRF data and the confirmatory data are statistically equivalent at a 99 percent confidence level, the data could potentially meet definitive level data criteria.

10.0 CALIBRATION AND STANDARDIZATION

10.1 Instrument Calibration: Instrument calibration procedures vary among FPXRF instruments. Users of this method should follow the calibration procedures outlined in the operator's manual for each specific FPXRF instrument. Generally, however, three types of calibration procedures exist for FPXRF instruments: FP calibration, empirical calibration, and the Compton peak ratio or normalization method. These three types of calibration are discussed below.

10.2 Fundamental Parameters Calibration: FP calibration procedures are extremely variable. An FP calibration provides the analyst with a "standardless" calibration. The advantages of FP calibrations over empirical calibrations include the following:

- No previously collected site-specific samples are required, although site-specific samples with confirmed and validated analytical results for all elements present could be used.

- Cost is reduced because fewer confirmatory laboratory results or calibration standards are required.

However, the analyst should be aware of the limitations imposed on FP calibration by particle size and matrix effects. These limitations can be minimized by adhering to the preparation procedure described in Section 7.2. The two FP calibration processes discussed below are based on an effective energy FP routine and a back scatter with FP (BFP) routine. Each FPXRF FP calibration process is based on a different iterative algorithmic method. The calibration procedure for each routine is explained in detail in the manufacturer's user manual for each FPXRF instrument; in addition, training courses are offered for each instrument.

10.2.1 Effective Energy FP Calibration: The effective energy FP calibration is performed by the manufacturer before an instrument is sent to the analyst. Although SSCS can be used, the calibration relies on pure element standards or SRMs such as those obtained from NIST for the FP calibration. The effective energy routine relies on the spectrometer response to pure elements and FP iterative algorithms to compensate for various matrix effects.

Alpha coefficients are calculated using a variation of the Sherman equation, which calculates theoretical intensities from the measurement of pure element samples. These coefficients indicate the quantitative effect of each matrix element on an analyte's measured x-ray intensity. Next, the Lachance Traill algorithm is solved as a set of simultaneous equations based on the theoretical intensities. The alpha coefficients are then downloaded into the specific instrument.

The working effective energy FP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of sampling. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. A manufacturer-recommended count time per source should be used for the calibration check. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A percent difference (%D) is then calculated for each target analyte. The %D should be within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the

line or the y-intercept value for the analyte. The SRM or SSCS is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

The equation to calibrate %D is as follows:

$$\%D = ((C_s - C_k) / C_k) \times 100$$

where:

%D = Percent difference
C_k = Certified concentration of standard sample
C_s = Measured concentration of standard sample

10.2.2 BFP Calibration: BFP calibration relies on the ability of the liquid nitrogen-cooled, Si(Li) solid-state detector to separate the coherent (Compton) and incoherent (Rayleigh) backscatter peaks of primary radiation. These peak intensities are known to be a function of sample composition, and the ratio of the Compton to Rayleigh peak is a function of the mass absorption of the sample. The calibration procedure is explained in detail in the instrument manufacturer's manual. Following is a general description of the BFP calibration procedure.

The concentrations of all detected and quantified elements are entered into the computer software system. Certified element results for an NIST SRM or confirmed and validated results for an SSCS can be used. In addition, the concentrations of oxygen and silicon must be entered; these two concentrations are not found in standard metals analyses. The manufacturer provides silicon and oxygen concentrations for typical soil types. Pure element standards are then analyzed using a manufacturer-recommended count time per source. The results are used to calculate correction factors in order to adjust for spectrum overlap of elements.

The working BFP calibration curve must be verified before sample analysis begins on each working day, after every 20 samples are analyzed, and at the end of the analysis. This verification is performed by analyzing either an NIST SRM or an SSCS that is representative of the site-specific samples. This SRM or SSCS serves as a calibration check. The standard sample is analyzed using a manufacturer-recommended count time per source to check the calibration curve. The analyst must then adjust the y-intercept and slope of the calibration curve to best fit the known concentrations of target analytes in the SRM or SSCS.

A %D is then calculated for each target analyte. The %D should fall within ±20 percent of the certified value for each analyte. If the %D falls outside this acceptance range, then the calibration curve should be adjusted by varying the slope of the line the y-intercept value for the analyte. The standard sample is reanalyzed until the %D falls within ±20 percent. The group of 20 samples analyzed before an out-of-control calibration check should be reanalyzed.

10.3 Empirical Calibration: An empirical calibration can be performed with SSCS, site-typical standards, or standards prepared from metal oxides. A discussion of SSCS is included in Section 7.2; if no previously characterized samples exist for a specific site, site-typical standards can be used. Site-typical standards may be selected from commercially available characterized soils or from SSCS prepared for another site. The site-typical standards should closely approximate the site's soil matrix with respect to particle size distribution, mineralogy, and contaminant analytes. If neither SSCS nor site-typical standards are available, it is possible to make gravimetric standards

by adding metal oxides to a "clean" sand or silicon dioxide matrix that simulates soil. Metal oxides can be purchased from various chemical vendors. If standards are made on site, a balance capable of weighing items to at least two decimal places is required. Concentrated ICP or AA standard solutions can also be used to make standards. These solutions are available in concentrations of 10,000 parts per million, thus only small volumes have to be added to the soil.

An empirical calibration using SSCS involves analysis of SSCS by the FPXRF instrument and by a conventional analytical method such as ICP or AA. A total acid digestion procedure should be used by the laboratory for sample preparation. Generally, a minimum of 10 and a maximum of 30 well characterized SSCS, site-typical standards, or prepared metal oxide standards are required to perform an adequate empirical calibration. The number of required standards depends on the number of analytes of interest and interfering elements. Theoretically, an empirical calibration with SSCS should provide the most accurate data for a site because the calibration compensates for site-specific matrix effects.

The first step in an empirical calibration is to analyze the pure element standards for the elements of interest. This enables the instrument to set channel limits for each element for spectral deconvolution. Next the SSCS, site-typical standards, or prepared metal oxide standards are analyzed using a count time of 200 seconds per source or a count time recommended by the manufacturer. This will produce a spectrum and net intensity of each analyte in each standard. The analyte concentrations for each standard are then entered into the instrument software; these concentrations are those obtained from the laboratory, the certified results, or the gravimetrically determined concentrations of the prepared standards. This gives the instrument analyte values to regress against corresponding intensities during the modeling stage. The regression equation correlates the concentrations of an analyte with its net intensity.

The calibration equation is developed using a least squares fit regression analysis. After the regression terms to be used in the equation are defined, a mathematical equation can be developed to calculate the analyte concentration in an unknown sample. In some FPXRF instruments, the software of the instrument calculates the regression equation. The software uses calculated intercept and slope values to form a multiterm equation. In conjunction with the software in the instrument, the operator can adjust the multiterm equation to minimize interelement interferences and optimize the intensity calibration curve.

It is possible to define up to six linear or nonlinear terms in the regression equation. Terms can be added and deleted to optimize the equation The goal is to produce an equation with the smallest regression error and the highest correlation coefficient. These values are automatically computed by the software as the regression terms are added, deleted, or modified. It is also possible to delete data points from the regression line if these points are significant outliers or if they are heavily weighing the data. Once the regression equation has been selected for an analyte, the equation can be entered into the software for quantitation of analytes in subsequent samples. For an empirical calibration to be acceptable, the regression equation for a specific analyte should have a correlation coefficient of 0.98 or greater or meet the DQOs of the project.

In an empirical calibration, one must apply the DQOs of the project and ascertain critical or action levels for the analytes of interest. It is within these concentration ranges or around these action levels that the FPXRF instrument should be calibrated most accurately. It may not be possible to develop a good regression equation over several orders of analyte concentration.

10.4 Compton Normalization Method: The Compton normalization method is based on analysis of a single, certified standard and normalization for the Compton peak. The Compton peak is produced from incoherent backscattering of x-ray radiation from the excitation source and is present in the spectrum of every sample. The Compton peak intensity changes with differing matrices. Generally, matrices dominated by lighter elements produce a larger Compton peak, and those dominated by heavier elements produce a smaller Compton peak. Normalizing to the Compton peak can reduce problems with varying matrix effects among samples. Compton normalization is similar to the use of internal standards in organics analysis. The Compton normalization method may not be effective when analyte concentrations exceed a few percent.

The certified standard used for this type of calibration could be an NIST SRM such as 2710 or 2711. The SRM must be a matrix similar to the samples and must contain the analytes of interests at concentrations near those expected in the samples. First, a response factor has to be determined for each analyte. This factor is calculated by dividing the net peak intensity by the analyte concentration. The net peak intensity is gross intensity corrected for baseline interference. Concentrations of analytes in samples are then determined by multiplying the baseline corrected analyte signal intensity by the normalization factor and by the response factor. The normalization factor is the quotient of the baseline corrected Compton K_α peak intensity of the SRM divided by that of the samples. Depending on the FPXRF instrument used, these calculations may be done manually or by the instrument software.

11.0 PROCEDURE

11.1 Operation of the various FPXRF instruments will vary according to the manufacturers' protocols. Before operating any FPXRF instrument, one should consult the manufacturer's manual. Most manufacturers recommend that their instruments be allowed to warm up for 15 to 30 minutes before analysis of samples. This will help alleviate drift or energy calibration problems later on in analysis

11.2 Each FPXRF instrument should be operated according to the manufacturer's recommendations. There are two modes in which FPXRF instruments can be operated: in situ and intrusive. The in situ mode involves analysis of an undisturbed soil sediment or sample. Intrusive analysis involves collection and preparation of a soil or sediment sample before analysis. Some FPXRF instruments can operate in both modes of analysis, while others are designed to operate in only one mode. The two modes of analysis are discussed below.

11.3 For in situ analysis, one requirement is that any large or nonrepresentative debris be removed from the soil surface before analysis. This debris includes rocks, pebbles, leaves, vegetation, roots, and concrete. Another requirement is that the soil surface be as smooth as possible so that the probe window will have good contact with the surface. This may require some leveling of the surface with a stainless-steel trowel. During the study conducted to provide data for this method, this modest amount of sample preparation was found to take less than 5 minutes per sample location. The last requirement is that the soil or sediment not be saturated with water. Manufacturers state that their FPXRF instruments will perform adequately for soils with moisture contents of 5 to 20 percent but will not perform well for saturated soils, especially if ponded water exists on the surface. Another recommended technique for *in situ* analysis is to tamp the soil to increase soil density and compactness for better repeatability and representativeness. This condition is especially important for heavy element analysis, such as barium. Source count times for in situ analysis usually range from 30 to 120 seconds, but source count times will vary among instruments and depending on required detection limits.

11.4 For intrusive analysis of surface or sediment, it is recommended that a sample be collected from a 4- by 4-inch square that is 1 inch deep. This will produce a soil sample of approximately 375 grams or 250 cm^3, which is enough soil to fill an 8-ounce jar. The sample should be homogenized, dried, and ground before analysis. The sample can be homogenized before or after drying. The homogenization technique to be used after drying is discussed in Section 4.2. If the sample is homogenized before drying, it should be thoroughly mixed in a beaker or similar container, or if the sample is moist and has a high clay content, it can be kneaded in a plastic bag. One way to monitor homogenization when the sample is kneaded in a plastic bag is to add sodium fluorescein dye to the sample. After the moist sample has been homogenized, it is examined under an ultraviolet light to assess the distribution of sodium fluorescein throughout the sample. If the fluorescent dye is evenly distributed in the sample, homogenization is considered complete; if the dye is not evenly distributed, mixing should continue until the sample has been thoroughly homogenized. During the study conducted to provide data for this method, the homogenization procedure using the fluorescein dye required 3 to 5 minutes per sample. As demonstrated in Sections 13.5 and 13.7, homogenization has the greatest impact on the reduction of sampling variability. It produces little or no contamination Often, it can be used without the more labor intensive steps of drying, grinding, and sieving given in Sections 11.5 and 11.6. Of course, to achieve the best data quality possible all four steps must be followed.

11.5 Once the soil or sediment sample has been homogenized, it should be dried. This can be accomplished with a toaster oven or convection oven. A small aliquot of the sample (20 to 50 grams) is placed in a suitable container for drying. The sample should be dried for 2 to 4 hours in the convection or toaster oven at a temperature not greater than 150°C. Microwave drying is not a recommended procedure. Field studies have shown that microwave drying can increase variability between the FPXRF data and confirmatory analysis. High levels of metals in a sample can cause arcing in the microwave oven, and sometimes slag forms in the sample. Microwave oven drying can also melt plastic containers used to hold the sample.

11.6 The homogenized dried sample material should be ground with a mortar and pestle and passed through a 60-mesh sieve to achieve a uniform particle size. Sample grinding should continue until at least 90 percent of the original sample passes through the sieve. The grinding step normally takes an average of 10 minutes per sample. An aliquot of the sieved sample should then be placed in a 31.0-mm polyethylene sample cup (or equivalent) for analysis. The sample cup should be one-half to three-quarters full at a minimum. The sample cup should be covered with a 2.5 µm Mylar (or equivalent) film for analysis. The rest of the soil sample should be placed in a jar, labeled, and archived for possible confirmation analysis. All equipment including the mortar, pestle, and sieves must be thoroughly cleaned so that any cross-contamination is below the MDLs of the procedure or DQOs of the analysis.

12.0 DATA ANALYSIS AND CALCULATIONS

Most FPXRF instruments have software capable of storing all analytical results and spectra. The results are displayed in parts per million and can be downloaded to a PC, which can provide a hard copy printout. Individual measurements that are smaller than three times their associated SD should not be used for quantitation.

13.0 METHOD PERFORMANCE

13.1 This section discusses four performance factors, field-based method detection limits, precision, accuracy, and comparability to EPA-approved methods. The numbers presented in Tables 4 through 9 were generated from data obtained from six FPXRF instruments. The soil samples analyzed by the six FPXRF instruments were collected from two sites in the United States.

The soil samples contained several of the target analytes at concentrations ranging from nondetect to tens of thousands of mg/kg.

13.2 The six FPXRF instruments included the TN 9000 and TN Lead Analyzer manufactured by TN Spectrace; the X-MET 920 with a SiLi detector and X-MET 920 with a gas-filled proportional detector manufactured by Metorex, Inc.; the XL Spectrum Analyzer manufactured by Niton; and the MAP Spectrum Analyzer manufactured by Scitec. The TN 9000 and TN Lead Analyzer both have a HgI_2 detector. The TN 9000 utilized an Fe-55, Cd-109, and Am-241 source. The TN Lead Analyzer had only a Cd-109 source. The X-Met 920 with the SiLi detector had a Cd-109 and Am-241 source. The X-MET 920 with the gas-filled proportional detector had only a Cd-109 source. The XL Spectrum Analyzer utilized a silicon pin-diode detector and a Cd-109 source. The MAP Spectrum Analyzer utilized a solid-state silicon detector and a Cd-109 source.

13.3 All data presented in Tables 4 through 9 were generated using the following calibrations and source count times. The TN 9000 and TN Lead Analyzer were calibrated using fundamental parameters using NIST SRM 2710 as a calibration check sample. The TN 9000 was operated using 100, 60, and 60 second count times for the Cd-109, Fe-55, and Am-241 sources, respectively. The TN Lead analyzer was operated using a 60 second count time for the Cd-109 source. The X-MET 920 with the Si(Li) detector was calibrated using fundamental parameters and one well characterized site-specific soil standard as a calibration check. It used 140 and 100 second count times for the Cd-109 and Am-241 sources, respectively. The X-MET 920 with the gas-filled proportional detector was calibrated empirically using between 10 and 20 well characterized site-specific soil standards. It used 120 second times for the Cd-109 source. The XL Spectrum Analyzer utilized NIST SRM 2710 for calibration and the Compton peak normalization procedure for quantitation based on 60 second count times for the Cd-109 source. The MAP Spectrum Analyzer was internally calibrated by the manufacturer. The calibration was checked using a well-characterized site-specific soil standard. It used 240 second times for the Cd-109 source

13.4 Field-Based Method Detection Limits: The field-based method detection limits are presented in Table 4. The field-based method detection limits were determined by collecting ten replicate measurements on site-specific soil samples with metals concentrations 2 to 5 times the expected method detection limits. Based on these ten replicate measurements, a standard deviation on the replicate analysis was calculated. The method detection limits presented in Table 4 are defined as 3 times the standard deviation for each analyte.

The field-based method detection limits were generated by using the count times discussed earlier in this section. All the field-based method detection limits were calculated for soil samples that had been dried and ground and placed in a sample cup with the exception of the MAP Spectrum Analyzer. This instrument can only be operated in the in situ mode, meaning the samples were moist and not ground.

Some of the analytes such as cadmium, mercury, silver, selenium, and thorium were not detected or only detected at very low concentrations such that a field-based method detection limit could not be determined. These analytes are not presented in Table 4. Other analytes such as calcium, iron, potassium, and titanium were only found at high concentrations (thousands of mg/kg) so that reasonable method detection limits could not be calculated. These analytes also are not presented in Table 4.

13.5 Precision Measurements: The precision data is presented in Table 5. Each of the six FPXRF instruments performed 10 replicate measurements on 12 soil samples that had analyte concentrations ranging from nondetects to thousands of mg/kg. Each of the 12 soil samples underwent 4 different preparation techniques from in situ (no preparation) to dried and ground in a

sample cup. Therefore, there were 48 precision data points for five of the instruments and 24 precision points for the MAP Spectrum Analyzer. The replicate measurements were taken using the source count times discussed at the beginning of this section.

For each detectable analyte in each precision sample a mean concentration, standard deviation, and RSD was calculated for each analyte. The data presented in Table 5 is an average RSD for the precision samples that had analyte concentrations at 5 to 10 times the MDL for that analyte for each instrument. Some analytes such as mercury, selenium, silver, and thorium were not detected in any of the precision samples so these analytes are not listed in Table 5. Some analytes such as cadmium, nickel, and tin were only detected at concentrations near the MDLs so that an RSD value calculated at 5 to 10 times the MDL was not possible.

One FPXRF instrument collected replicate measurements on an additional nine soil samples to provide a better assessment of the effect of sample preparation on precision. Table 6 shows these results. The additional nine soil samples were comprised of three from each texture and had analyte concentrations ranging from near the detection limit of the FPXRF analyzer to thousands of mg/kg. The FPXRF analyzer only collected replicate measurements from three of the preparation methods; no measurements were collected from the *in situ* homogenized samples. The FPXRF analyzer conducted five replicate measurements of the in situ field samples by taking measurements at five different points within the 4-inch by 4-inch sample square. Ten replicate measurements were collected for both the intrusive undried and unground and intrusive dried and ground samples contained in cups. The cups were shaken between each replicate measurement.

Table 6 shows that the precision dramatically improved from the in situ to the intrusive measurements. In general there was a slight improvement in precision when the sample was dried and ground. Two factors caused the precision for the in situ measurements to be poorer. The major factor is soil heterogeneity. By moving the probe within the 4-inch by 4-inch square, measurements of different soil samples were actually taking place within the square. Table 6 illustrates the dominant effect of soil heterogeneity. It overwhelmed instrument precision when the FPXRF analyzer was used in this mode. The second factor that caused the RSD values to be higher for the in situ measurements is the fact that only five versus ten replicates were taken. A lesser number of measurements caused the standard deviation to be larger which in turn elevated the RSD values.

13.6 Accuracy Measurements: Five of the FPXRF instruments (not including the MAP Spectrum Analyzer) analyzed 18 SRMs using the source count times and calibration methods given at the beginning of this section. The 18 SRMs included 9 soil SRMs, 4 stream or river sediment SRMs, 2 sludge SRMs, and 3 ash SRMs. Each of the SRMs contained known concentrations of certain target analytes. A percent recovery was calculated for each analyte in each SRM for each FPXRF instrument. Table 7 presents a summary of this data. With the exception of cadmium, chromium, and nickel, the values presented in Table 7 were generated from the 13 soil and sediment SRMs only. The 2 sludge and 3 ash SRMs were included for cadmium, chromium, and nickel because of the low or nondetectable concentrations of these three analytes in the soil and sediment SRMs.

Only 12 analytes are presented in Table 7. These are the analytes that are of environmental concern and provided a significant number of detections in the SRMs for an accuracy assessment. No data is presented for the X-MET 920 with the gas-filled proportional detector. This FPXRF instrument was calibrated empirically using site-specific soil samples. The percent recovery values from this instrument were very sporadic and the data did not lend itself to presentation in Table 7.

Table 8 provides a more detailed summary of accuracy data for one FPXRF instrument (TN 9000) for the 9 soil SRMs and 4 sediment SRMs. Table 8 shows the certified value, measured

value, and percent recovery for five analytes. These analytes were chosen because they are of environmental concern and were most prevalently certified for in the SRM and detected by the FPXRF instrument. The first nine SRMs are soil and the last 4 SRMs are sediment. Percent recoveries for the four NIST SRMs were often between 90 and 110 percent for all analytes.

13.7 Comparability: Comparability refers to the confidence with which one data set can be compared to another. In this case, FPXRF data generated from a large study of six FPXRF instruments was compared to SW-846 Methods 3050 and 6010 which are the standard soil extraction for metals and analysis by inductively coupled plasma. An evaluation of comparability was conducted by using linear regression analysis. Three factors were determined using the linear regression. These factors were the y-intercept, the slope of the line, and the coefficient of determination (r^2).

As part of the comparability assessment, the effects of soil type and preparation methods were studied. Three soil types (textures) and four preparation methods were examined during the study. The preparation methods evaluated the cumulative effect of particle size, moisture, and homogenization on comparability. Due to the large volume of data produced during this study, linear regression data for six analytes from only one FPXRF instrument is presented in Table 9. Similar trends in the data were seen for all instruments.

Table 9 shows the regression parameters for the whole data set, broken out by soil type, and by preparation method. The soil types are as follows: soil 1--sand; soil 2--loam; and soil 3--silty clay. The preparation methods are as follows: preparation 1--in situ in the field; preparation 2--in situ, sample collected and homogenized; preparation 3--intrusive, with sample in a sample cup but sample still wet and not ground; and preparation 4--sample dried, ground, passed through a 40-mesh sieve, and placed in sample cup

For arsenic, copper, lead, and zinc, the comparability to the confirmatory laboratory was excellent with r^2 values ranging from 0.80 to 0.99 for all six FPXRF instruments. The slopes of the regression lines for arsenic, copper, lead, and zinc, were generally between 0.90 and 1.00 indicating the data would need to be corrected very little or not at all to match the confirmatory laboratory data. The r^2 values and slopes of the regression lines for barium and chromium were not as good as for the other for analytes, indicating the data would have to be corrected to match the confirmatory laboratory.

Table 9 demonstrates that there was little effect of soil type on the regression parameters for any of the six analytes. The only exceptions were for barium in soil 1 and copper in soil 3. In both of these cases, however, it is actually a concentration effect and not a soil effect causing the poorer comparability. All barium and copper concentrations in soil 1 and 3, respectively, were less than 350 mg/kg.

Table 9 shows there was a preparation effect on the regression parameters for all six analytes. With the exception of chromium, the regression parameters were primarily improved going from preparation 1 to preparation 2. In this step, the sample was removed from the soil surface, all large debris was removed, and the sample was thoroughly homogenized. The additional two preparation methods did little to improve the regression parameters. This data indicates that homogenization is the most critical factor when comparing the results. It is essential that the sample sent to the confirmatory laboratory match the FPXRF sample as closely as possible.

Section 11.0 of this method discusses the time necessary for each of the sample preparation techniques. Based on the data quality objectives for the project, an analyst must decide if it is worth the extra time required to dry and grind the sample for small improvements in comparability.

Homogenization requires 3 to 5 minutes Drying the sample requires one to two hours Grinding and sieving requires another 10 to 15 minutes per sample. Lastly, when grinding and sieving is conducted, time must be allotted to decontaminate the mortars, pestles, and sieves. Drying and grinding the samples and decontamination procedures will often dictate that an extra person be on site so that the analyst can keep up with the sample collection crew. The cost of requiring an extra person on site to prepare samples must be balanced with the gain in data quality and sample throughput.

13.8 The following documents may provide additional guidance and insight on this method and technique:

13.8.1 Hewitt, A.D. 1994. "Screening for Metals by X-ray Fluorescence Spectrometry/Response Factor/Compton K_α Peak Normalization Analysis." *American Environmental Laboratory*. Pages 24-32.

13.8.2 Piorek, S., and J.R. Pasmore 1993. "Standardless, In Situ Analysis of Metallic Contaminants in the Natural Environment With a PC-Based, High Resolution Portable X-Ray Analyzer." *Third International Symposium on Field Screening Methods for Hazardous Waste and Toxic Chemicals*. Las Vegas, Nevada. February 24-26, 1993. Volume 2, Pages 1135-1151.

14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operation. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical management for Waste Reduction* available from the American Chemical Society's Department of Government Relations and Science Policy, 1155 16th Street N.W., Washington D.C. 20036, (202) 872-4477.

15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. The Agency urges laboratories to protect the air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

16.0 REFERENCES

1. Metorex. X-MET 920 User's Manual.

2. Spectrace Instruments. 1994. Energy Dispersive X-ray Fluorescence Spectrometry: An Introduction.

3. TN Spectrace. Spectrace 9000 Field Portable/Benchtop XRF Training and Applications Manual.

4. Unpublished SITE data, recieved from PRC Environment Management, Inc.

17.0 TABLES, DIAGRAMS, FLOWCHARTS, AND VALIDATION DATA

The pages to follow contain Tables 1 through 9 and a method procedure flow diagram.

TABLE 1
INTERFERENCE FREE DETECTION LIMITS

Analyte	Chemical Abstract Series Number	Detection Limit in Quartz Sand (milligrams per kilogram)
Antimony (Sb)	7440-36-0	40
Arsenic (As)	7440-38-0	40
Barium (Ba)	7440-39-3	20
Cadmium (Cd)	7440-43-9	100
Calcium (Ca)	7440-70-2	70
Chromium (Cr)	7440-47-3	150
Cobalt (Co)	7440-48-4	60
Copper (Cu)	7440-50-8	50
Iron (Fe)	7439-89-6	60
Lead (Pb)	7439-92-1	20
Manganese (Mn)	7439-96-5	70
Mercury (Hg)	7439-97-6	30
Molybdenum (Mo)	7439-93-7	10
Nickel (Ni)	7440-02-0	50
Potassium (K)	7440-09-7	200
Rubidium (Rb)	7440-17-7	10
Selenium (Se)	7782-49-2	40
Silver (Ag)	7440-22-4	70
Strontium (Sr)	7440-24-6	10
Thallium (Tl)	7440-28-0	20
Thorium (Th)	7440-29-1	10
Tin (Sn)	7440-31-5	60
Titanium (Ti)	7440-32-6	50
Vanadium (V)	7440-62-2	50
Zinc (Zn)	7440-66-6	50
Zirconium (Zr)	7440-67-7	10

Source: References 1, 2, and 3

TABLE 2
SUMMARY OF RADIOISOTOPE SOURCE CHARACTERISTICS

Source	Activity (mCi)	Half-Life (Years)	Excitation Energy (keV)	Elemental Analysis Range	
Fe-55	20-50	2.7	5.9	Sulfur to Chromium Molybdenum to Barium	K Lines L Lines
Cd-109	5-30	1.3	22.1 and 87.9	Calcium to Rhodium Tantalum to Lead Barium to Uranium	K Lines K Lines L Lines
Am-241	5-30	458	26.4 and 59.6	Copper to Thulium Tungsten to Uranium	K Lines L Lines
Cm-244	60-100	17.8	14.2	Titanium to Selenium Lanthanum to Lead	K Lines L Lines

Source: Reference 1, 2, and 3

TABLE 3
SUMMARY OF X-RAY TUBE SOURCE CHARACTERISTICS

Anode Material	Recommended Voltage Range (kV)	K-alpha Emission (keV)	Elemental Analysis Range	
Cu	18-22	8.04	Potassium to Cobalt Silver to Gadolinium	K Lines L Lines
Mo	40-50	17.4	Cobalt to Yttrium Europium to Radon	K Lines L Lines
Ag	50-65	22.1	Zinc to Technicium Ytterbium to Neptunium	K Lines L Lines

Source: Reference 4

Notes: The sample elements excited are chosen by taking as the lower limit the same ratio of excitation line energy to element absorption edge as in Table 2 (approximately 0.45) and the requirement that the excitation line energy be above the element absorption edge as the upper limit (L2 edges used for L lines). K-beta excitation lines were ignored.

TABLE 4
FIELD-BASED METHOD DETECTION LIMITS (mg/kg)[a]

Analyte	Instrument					
	TN 9000	TN Lead Analyzer	X-MET 920 (SiLi Detector)	X-MET 920 (Gas-Filled Detector)	XL Spectrum Analyzer	MAP Spectrum Analyzer
Antimony	55	NR	NR	NR	NR	NR
Arsenic	60	50	55	50	110	225
Barium	60	NR	30	400	NR	NR
Chromium	200	460	210	110	900	NR
Cobalt	330	NR	NR	NR	NR	NR
Copper	85	115	75	100	125	525
Lead	45	40	45	100	75	165
Manganese	240	340	NR	NR	NR	NR
Molybdenum	25	NR	NR	NR	30	NR
Nickel	100	NR	NA	NA	NA	NR
Rubidium	30	NR	NR	NR	45	NR
Strontium	35	NR	NR	NR	40	NR
Tin	85	NR	NR	NR	NR	NR
Zinc	80	95	70	NA	110	NA
Zirconium	40	NR	NR	NR	25	NR

Source: Reference 4

[a] MDLs are related to the total number of counts taken. See Section 13.3 for count times used to generate this table.
NR Not reported.
NA Not applicable; analyte was reported but was not at high enough concentrations for method detection limit to be determined.

TABLE 5
PRECISION

Analyte	Average Relative Standard Deviation for Each Instrument at 5 to 10 Times the MDL					
	TN 9000	TN Lead Analyzer	X-MET 920 (SiLi Detector)	X-MET 920 (Gas-Filled Detector)	XL Spectrum Analyzer	MAP Spectrum Analyzer
Antimony	6.54	NR	NR	NR	NR	NR
Arsenic	5.33	4.11	3.23	1.91	12.47	6.68
Barium	4.02	NR	3.31	5.91	NR	NR
Cadmium	29.84[a]	NR	24 80[a]	NR	NR	NR
Calcium	2.16	NR	NR	NR	NR	NR
Chromium	22.25	25.78	22.72	3.91	30.25	NR
Cobalt	33.90	NR	NR	NR	NR	NR
Copper	7.03	9.11	8.49	9.12	12.77	14.86
Iron	1.78	1.67	1.55	NR	2.30	NR
Lead	6.45	5.93	5.05	7.56	6.97	12.16
Manganese	27.04	24.75	NR	NR	NR	NR
Molybdenum	6.95	NR	NR	NR	12.60	NR
Nickel	30.85[a]	NR	24.92[a]	20.92[a]	NA	NR
Potassium	3.90	NR	NR	NR	NR	NR
Rubidium	13.06	NR	NR	NR	32.69[a]	NR
Strontium	4.28	NR	NR	NR	8.86	NR
Tin	24.32[a]	NR	NR	NR	NR	NR
Titanium	4.87	NR	NR	NR	NR	NR
Zinc	7.27	7.48	4.26	2.28	10.95	0.83
Zirconium	3.58	NR	NR	NR	6.49	NR

Source: Reference 4

[a] These values are biased high because the concentration of these analytes in the soil samples was near the detection limit for that particular FPXRF instrument.
NR Not reported.
NA Not applicable; analyte was reported but was below the method detection limit.

TABLE 6
PRECISION AS AFFECTED BY SAMPLE PREPARATION

Analyte	Average Relative Standard Deviation for Each Preparation Method		
	In Situ-Field	Intrusive-Undried and Unground	Intrusive-Dried and Ground
Antimony	30.1	15.0	14.4
Arsenic	22.5	5.36	3.76
Barium	17.3	3.38	2.90
Cadmium[a]	41.2	30.8	28.3
Calcium	17.5	1.68	1.24
Chromium	17.6	28.5	21.9
Cobalt	28.4	31.1	28.4
Copper	26.4	10.2	7.90
Iron	10.3	1.67	1.57
Lead	25.1	8.55	6.03
Manganese	40.5	12.3	13.0
Mercury	ND	ND	ND
Molybdenum	21.6	20.1	19.2
Nickel[a]	29.8	20.4	18.2
Potassium	18.6	3.04	2.57
Rubidium	29.8	16.2	18.9
Selenium	ND	20.2	19.5
Silver[a]	31.9	31.0	29.2
Strontium	15.2	3.38	3.98
Thallium	39.0	16.0	19.5
Thorium	NR	NR	NR
Tin	ND	14.1	15.3
Titanium	13.3	4.15	3.74
Vanadium	NR	NR	NR
Zinc	26.6	13.3	11.1
Zirconium	20.2	5.63	5.18

Source: Reference 4

[a] These values may be biased high because the concentration of these analytes in the soil samples was near the detection limit.
ND Not detected.
NR Not reported.

TABLE 7
ACCURACY

Analyte	Instrument															
	TN 9000				TN Lead Analyzer				X-MET 920 (SiLi Detector)				XL Spectrum Analyzer			
	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec.	SD	n	Range of % Rec.	Mean % Rec	SD	n	Range of % Rec.	Mean % Rec.	SD
Sb	2	100-149	124.3	NA	--	--	--	--	--	--	--	--	--	--	--	--
As	5	68-115	92.8	17.3	5	44-105	83.4	23.2	4	9.7-91	47.7	39.7	5	38-535	189.8	206
Ba	9	98-198	135.3	36.9	--	--	--	--	9	18-848	168.2	262	--	--	--	--
Cd	2	99-129	114.3	NA	--	--	--	--	6	81-202	110.5	45.7	--	--	--	--
Cr	2	99-178	138.4	NA	--	--	--	--	7	22-273	143.1	93.8	3	98-625	279.2	300
Cu	8	61-140	95.0	28.8	6	38-107	79.1	27.0	11	10-210	111.8	72.1	8	95-480	203.0	147
Fe	6	78-155	103.7	26.1	6	89-159	102.3	28.6	6	48-94	80.4	16.2	6	26-187	108.6	52.9
Pb	11	66-138	98.9	19.2	11	68-131	97.4	18.4	12	23-94	72.7	20.9	13	80-234	107.3	39.9
Mn	4	81-104	93.1	9.70	3	92-152	113.1	33.8	--	--	--	--	--	--	--	--
Ni	3	99-122	109.8	12.0	--	--	--	--	--	--	--	--	3	57-123	87.5	33.5
Sr	8	110-178	132.6	23.8	--	--	--	--	--	--	--	--	7	86-209	125.1	39.5
Zn	11	41-130	94.3	24.0	10	81-133	100.0	19.7	12	46-181	106.6	34.7	11	31-199	94.6	42.5

Source: Reference 4

n Number of samples that contained a certified value for the analyte and produced a detectable concentration from the FPXRF instrument.
SD Standard deviation.
NA Not applicable; only two data points, therefore, a SD was not calculated.
%Rec. Percent recovery.
-- No data.

TABLE 8
ACCURACY FOR TN 9000[a]

Standard Reference Material	Arsenic			Barium			Copper			Lead			Zinc		
	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.	Cert. Conc.	Meas. Conc.	%Rec.
RTC CRM-021	24.8	ND	NA	586	1135	193.5	4792	2908	60.7	144742	149947	103.6	546	224	40.9
RTC CRM-020	397	429	92.5	22.3	ND	NA	753	583	77.4	5195	3444	66.3	3022	3916	129.6
BCR CRM 143R	--	--	--	--	--	--	131	105	80.5	180	206	114.8	1055	1043	99.0
BCR CRM 141	--	--	--	--	--	--	32.6	ND	NA	29.4	ND	NA	81.3	ND	NA
USGS GXR-2	25.0	ND	NA	2240	2946	131.5	76.0	106	140.2	690	742	107.6	530	596	112.4
USGS GXR-6	330	294	88.9	1300	2581	198.5	66.0	ND	NA	101	80.9	80.1	118	ND	NA
NIST 2711	105	104	99.3	726	801	110.3	114	ND	NA	1162	1172	100.9	350	333	94.9
NIST 2710	626	722	115.4	707	782	110.6	2950	2834	96.1	5532	5420	98.0	6952	6476	93.2
NIST 2709	17.7	ND	NA	968	950	98.1	34.6	ND	NA	18.9	ND	NA	106	98.5	93.0
NIST 2704	23.4	ND	NA	414	443	107.0	98.6	105	106.2	161	167	103.5	438	427	97.4
CNRC PACS-1	211	143	67.7	--	772	NA	452	302	66.9	404	332	82.3	824	611	74.2
SARM-51	--	--	--	335	466	139.1	268	373	139.2	5200	7199	138.4	2200	2676	121.6
SARM-52	--	--	--	410	527	128.5	219	193	88.1	1200	1107	92.2	264	215	81.4

Source: Reference 4

[a] All concentrations in milligrams per kilogram.
%Rec. Percent recovery.
ND Not detected.
NA Not applicable.
-- No data.

TABLE 9
REGRESSION PARAMETERS FOR COMPARABILITY[1]

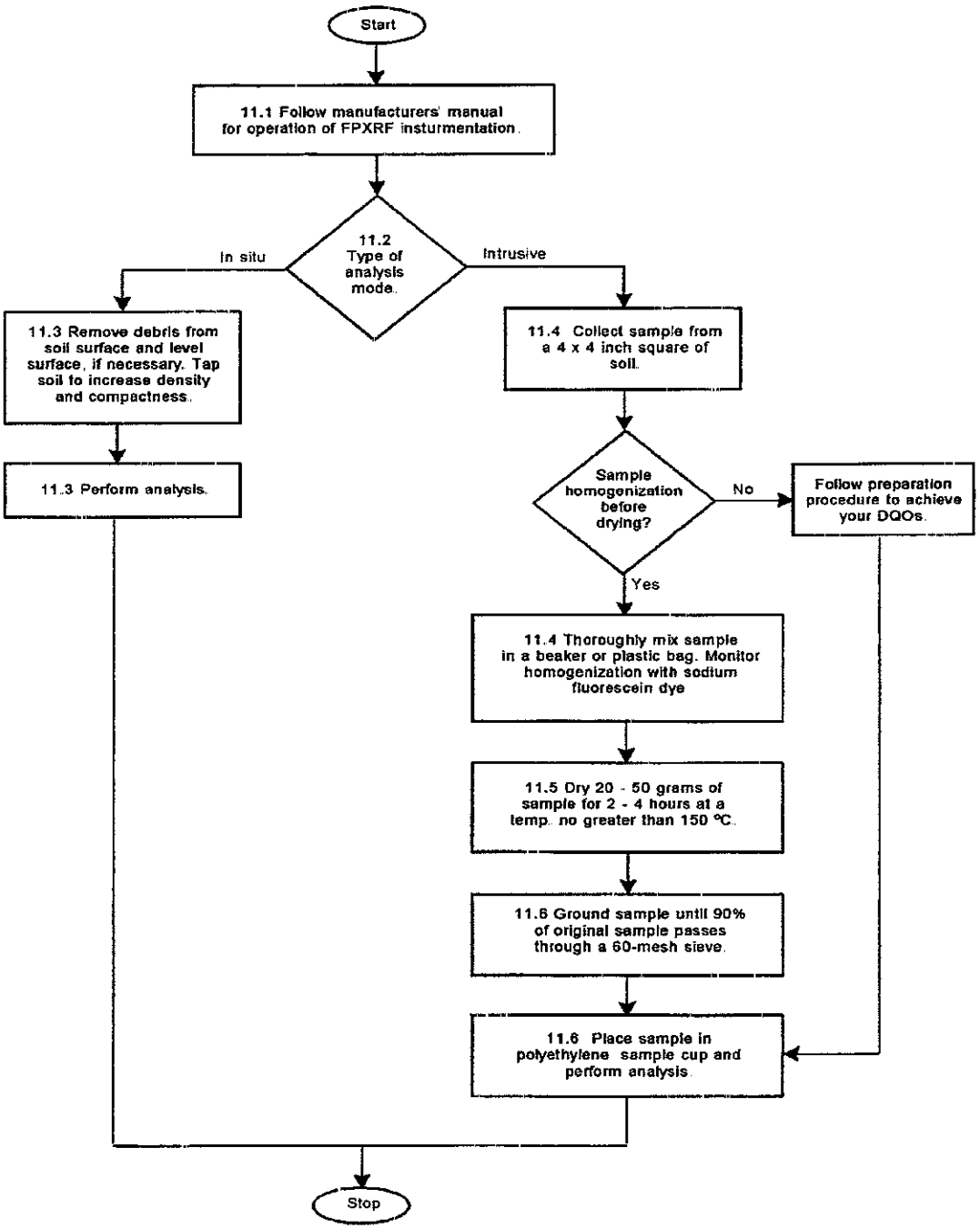
	Arsenic				Barium				Copper			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	824	0.94	1.62	0.94	1255	0.71	60.3	0.54	984	0.93	2.19	0.93
Soil 1	368	0.96	1.41	0.95	393	0.05	42.6	0.11	385	0.94	1.26	0.99
Soil 2	453	0.94	1.51	0.96	462	0.56	30.2	0.66	463	0.92	2.09	0.95
Soil 3	—	—	—	—	400	0.85	44.7	0.59	136	0.46	16.60	0.57
Prep 1	207	0.87	2.69	0.85	312	0.64	53.7	0.55	256	0.87	3.89	0.87
Prep 2	208	0.97	1.38	0.95	315	0.67	64.6	0.52	246	0.96	2.04	0.93
Prep 3	204	0.96	1.20	0.99	315	0.78	64.6	0.53	236	0.97	1.45	0.99
Prep 4	205	0.96	1.45	0.98	313	0.81	58.9	0.55	246	0.96	1.99	0.96

	Lead				Zinc				Chromium			
	n	r^2	Int.	Slope	n	r^2	Int.	Slope	n	r^2	Int.	Slope
All Data	1205	0.92	1.66	0.95	1103	0.89	1.86	0.95	280	0.70	64.6	0.42
Soil 1	357	0.94	1.41	0.96	329	0.93	1.78	0.93	—	—	—	—
Soil 2	451	0.93	1.62	0.97	423	0.85	2.57	0.90	—	—	—	—
Soil 3	397	0.90	2.40	0.90	351	0.90	1.70	0.98	186	0.66	38.9	0.50
Prep 1	305	0.80	2.88	0.86	286	0.79	3.16	0.87	105	0.80	66.1	0.43
Prep 2	298	0.97	1.41	0.96	272	0.95	1.86	0.93	77	0.51	81.3	0.36
Prep 3	302	0.98	1.26	0.99	274	0.93	1.32	1.00	49	0.73	53.7	0.45
Prep 4	300	0.96	1.38	1.00	271	0.94	1.41	1.01	49	0.75	31.6	0.56

Source: Reference 4

[1] Log-transformed data
n Number of data points
r^2 Coefficient of determination
Int. Y-intercept
— No applicable data

FIELD PORTABLE X-RAY FLUORESCENCE SPECTROMETRY FOR THE DETERMINATION OF ELEMENTAL CONCENTRATIONS IN SOIL AND SEDIMENT



ATTACHMENT 2
RADIATION SURVEY PROCEDURES

These radiation survey procedures are incorporated as a reference from procedures used by Oak Ridge National Laboratory. As such, the approvals section of each procedure will not be completed for this project.

SITE PREPARATION FOR RADIOLOGICAL SURVEYING

1.0 PURPOSE

This procedure describes the methods for classification of survey units, clearing a site and establishing a grid system for referencing radiological survey activities.

2.0 APPLICABILITY

This procedure applies to all site surveying activities for which survey unit classification and grid referencing is necessary. When facilities or sites are not owned by the organization performing the surveys, consent from the site or equipment owner should be obtained before conducting the surveys. All appropriate local, State, and Federal officials as well as the site owner and other affected parties should be notified of the survey schedule.

3.0 OTHER DOCUMENTS

3.1 Site-specific project plans
3.2 Environmental Implementation Guide for Radiological Survey Procedures (February 1997 Draft)
3.3 Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), EPA- 402-R-97-016, NUREG - 1575.

4.0 EQUIPMENT AND MATERIALS

4.1 Chalk
4.2 Tape
4.3 Grease pencil

APPROVALS	
Author	Date
Supervisor	Date
Group Leader	Date
Section Head	Date

4.4 Grid point markers (stakes, hubs, spikes, flags, etc.)
4.5 Moving and clearing equipment as necessary
4.6 Survey equipment (optional)

5.0 RESPONSIBILITY

5.1 The site team leader is responsible for the following:

5.1.1 Assuring site area classifications have been made and are appropriate
5.1.2 Determining the degree of clearing needed;
5.1.3 Determining the gridding requirements;
5.1.4 Supervising onsite clearing and gridding activities to assure compliance with condition of survey plans and subcontract agreements.

5.2 Survey personnel are responsible for establishing indoor grids not already in place and outdoor grids of small land areas.

5.3 Gridding of open land areas will usually be performed by a professional land survey organization under subcontract arrangements.

5.4 Removal or relocation of equipment and materials which may entail special precautions to prevent damage or maintain inventory accountability should be performed by the property owner whenever possible.

6.0 DEFINITIONS

APPROVALS	
Author	Date
Supervisor	Date
Group Leader	Date
Section Head	Date

6.1 **Class 1 areas**: Areas that have, or had prior to remediation, a potential for radioactive contamination (based on site operating history) or known contamination (based on previous radiological surveys).

6.2 **Class 2 areas:** These areas have, or had prior to remediation, a potential for radioactive contamination or known contamination, but are not expected to exceed the cleanup guideline.

6.3 **Class 3 areas:** Any impacted areas that are not expected to contain any residual radioactivity, or are expected to contain levels of residual radioactivity at a small fraction of the DCGL , based on site operating history and previous radiological surveys.

6.4 **DCGL:** Derived concentration guideline level. These derived levels are presented in terms of surface or mass activity concentrations. DCGLs usually refer to average levels of radiation or radioactivity above appropriate background levels. DCGLs applicable to building or other structural and miscellaneous surfaces are expressed in units of activity per surface area (typically Bq/m^2 or dpm/100 cm^2) or concentration per mass over a given area or survey unit (typically pCi/g or Bq/g averaged over 100 m^2 or survey unit).

6.5 **Reference grid:** A survey reference coordinate system consists of a grid of intersecting lines, referenced to a fixed site location or benchmark. Typically, the lines are arranged in a perpendicular pattern, dividing the survey location into squares or blocks of equal area; however, other types of patterns (*e.g* ,three-dimensional, polar) may be used.

6.6 **Survey unit:** The survey unit is the primary entity for demonstrating compliance with the release criterion. It is a physical area consisting of structures or land areas of specified size and shape for which a separate decision will be made as to whether or not that area exceeds the release criterion. This decision is made as a result of the final status survey.

7.0 PROCEDURE

7.1 Delineate areas to be cleared and gridded according to area classification.

7.1.1 Refer to project plan or survey plan for previously identified area classifications. Grid spacing and the amount of clearing required are dependent on area classification and measurement density.

7.1.2 Examples of Class 1 areas include: 1) site areas previously subjected to remedial actions, 2) locations where leaks or spills are known to have occurred, 3) former burial or disposal sites, 4) waste storage sites, and 5) areas with contaminants in discrete solid pieces of material high specific activity.

Note: areas containing contamination in excess of the cleanup guideline prior to remediation should be classified as Class 1 areas.

7.1.3 To justify changing an area's classification from Class 1 to Class 2, the existing data (from the scoping surveys, or characterization surveys) should provide a high degree of confidence that no individual measurement would exceed the cleanup guideline (no area averaging or hot spots allowed). Other justifications for this change in an area's classification may be appropriate based on the outcome of the DQO process.

7.1.4 Examples of areas that might be classified as Class 2 for the final status survey include: 1) locations where radioactive materials were present in an unsealed form (*e.g.*, process facilities), 2) potentially contaminated transport routes, 3) areas downwind from stack release points, 4) upper walls and ceilings of some buildings or rooms subjected to airborne radioactivity, 5) areas where low concentrations of radioactive materials were handled, and 6) areas on the perimeter of former contamination control areas.

7.1.5 Examples of areas that might be classified as Class 3 include buffer zones around Class 1 or Class 2 areas, and areas with very low potential for residual contamination but insufficient information to justify a non-impacted classification.

7.2 Define survey units

7.2.1 Survey units should be limited in size based on classification, exposure pathway modeling assumptions, and site-specific conditions. The suggested areas for survey units are as follows:

Classification	Suggested Area	
Class 1		
	Structures up to 100 m^2 floor area	Land areas up to 2,000 m^2
Class 2		
	Structures 100 to 1,000 m^2	Land areas 2,000 to 10,000 m^2
Class 3	Structures no limit	Land areas no limit

Note: Dividing the site into survey units is critical only for the final status survey. Scoping, characterization, and remedial action support surveys may be performed without dividing the site into survey units.

7.2.2 A survey unit should not include areas that have different classifications. The survey unit=s characteristics should be generally consistent with exposure pathway modeling that is used to convert dose or risk into radionuclide concentrations.

1. For indoor areas classified as Class 1, each room may be designated as a survey unit. Indoor areas may also be subdivided into several survey units of different classification, such as separating floors and lower walls from upper walls and ceilings (and other upper horizontal surfaces) or subdividing a large warehouse based on floor area.

b. The limitation on survey unit size for Class 1 and Class 2 areas ensures that each area is assigned an adequate number of data points.

c. Special considerations may be necessary for survey units with structure surface areas less than 10 m^2 or land areas less than 100 m^2. In this case, the number of data points obtained from the statistical tests is

unnecessarily large and not appropriate for smaller survey unit areas. Instead, some specified level of survey effort should be determined based on the DQO process and with the concurrence of the responsible regulatory agency. The data generated from these smaller survey units should be obtained based on judgment, rather than on systematic or random design, and compared individually to the DCGLs.

7.3 Clear indoor area.

7.3.1 Remove or relocate equipment and material which impede the radiological survey.

a In the case of private property surveys, this should be done by the property owner when possible to avoid potential damage by the subcontractor.

b. When radiological history indicates, check all equipment and material removed for potential contamination.

7.3.2 Provide access to potentially contaminated interior surfaces such as drains, ductwork, tanks, pits, and equipment by removing covers or disassembling equipment. Scaffolding, cranes, lifts, or ladders may be necessary to reach some surfaces, and dismantling portions of the building may be required

Note: Removing or relocating certain furnishings, such as lab benches and hoods, to obtain access to potentially contaminated floors and walls may also be necessary. The amount of effort and resources dedicated to such removal or relocation activities should be commensurate with the potential for contamination. Where the potential is low, a few spot-checks may be sufficient to provide confidence that covered areas are free of contamination. In other cases, complete removal may be warranted

7.4 Clear outdoor area.

7.4.1 The extent of site clearing required in specific areas will be primarily dependent upon the potential for radioactive contamination existing in those areas.

a. Where the radiological history and/or results of previous surveys do not indicate potential contamination of an area (Class 3), it may be sufficient to perform only minimum clearing to establish a reference grid system.

b. Class 1 Areas where contamination is known to exist or which have a high potential for contamination must be completely cleared to provide access to all surfaces.

c. Findings as the survey progresses may require that additional clearing be performed.

7.4.2 Clearing includes providing access to potentially contaminated interior surfaces such as drains, tanks, pits, etc.

7.4.3 When clearing open land areas, caution must be exercised to prevent relocations of surface contamination or damage to site features such as drainage ditches, utilities, fences, and buildings

7.4.4 An important consideration prior to clearing is the possibility of bio-uptake and consequent radiological contamination of the material to be cleared. Special precautions to avoid exposure of personnel involved in clearing activities may be necessary.

1. Initial radiological screening surveys should be performed to ensure that cleared material or equipment is not contaminated. Potential ecological damage that might result from an extensive survey should be considered.

2. If a survey is likely to result in significant or permanent damage to the environment, appropriate environmental analyses should be conducted prior to initiating the survey. In addition, environmental hazards such as poison ivy, ticks carrying Lyme disease, and poisonous snakes, spiders, or insects should be noted. These hazards can affect the safety and health of the workers as well as the schedule for performing the survey.

7.5 Define indoor grid.

Note: The Visual Sample Plan computer program may be used to determine grid shape, spacing and density, based on the DQOs process.

7.5.1 Select grid baseline, usually the longest dimension of the survey unit.

7.5.2 If the area has already been gridded as part of the owner's decontamination and survey activities, this grid may be used to provide consistency and easy comparison of measurements.

7.5.3 Determine grid dimensions based on the following:

a. Potential for contamination; Use a basic grid system of 1 or 2 meters per block for Class 1 or Class 2 areas. Gridding of Class 3 areas may also be necessary to facilitate referencing of survey locations to a

common system or origin but, for practical purposes, may typically be at larger intervals e g, 5 to 10 meters for large structural surfaces.

b. facilitate selection of measurement and sampling locations

3. provide a mechanism for referencing a measurement to a specific location so that the same survey point can be relocated.

7.5.5 Metric units are preferred for the grid, but English units may be followed if an acceptable grid system has been pre-established

7.5.6 Mark grid blocks on the floor and lower wall (up to 2 m) using a chalk line or other appropriate marking system.

a. Use one of the inside corners of the building as the starting point for referencing the grid.

7.5.7 Mark grid points (grid line intersections) with paint, tape, or grease pencil.

a. Ask owner's permission before using paint or other markers which may deface the surface.

7.5.8 Identify grid points using an alpha-numeric system.

a. Lines perpendicular to the baseline are identified alphabetically.

b. Lines parallel to the baseline are identified by a number indicating the distance from the baseline.

Note: If data collected during the survey are going to be contoured or treated spatially, then use a numbering system based on x,y,(z) coordinates.

7.5.9 Any location within a grid system may be designated by measuring the distance from the point of intersect to a grid marker.

7.5.10 Small rooms (< 10 m^2) do not require gridding.

7.5.11 Upper walls and ceiling areas are not usually gridded.

a. Reference measurements on these surfaces to prominent building features or to locations corresponding to the gridded floor and lower walls.

7.6 Prepare open land grid system.

Note: It is recommended that the grid system be tied into the local state/plane coordinate system such that the data can be imported into computerized

mapping systems based on the local coordinate system. This will also facilitate global positioning system-based surveys

7.6.1 Use a basic grid interval of 10 m for Class 1 or Class 2 areas

a This interval may be decreased or increased depending on the total property area and the radiological history.

7.6.2 Grid points (also called grid line intersections) include points where the grid lines intersect with buildings and property boundaries

a. These points are marked using stakes, hubs, spikes, point, flags, or survey tape, depending on the characteristics and routine uses of the surface.

7.6.3 Reference the grid using a specific grid point identified on the grid marker as point 0,0.

a. This point is generally near the center or at a corner of the property.

7.6.4 Reference the coordinates of other grid points to the 0,0 point using alpha-numeric identifiers.

a. The numeric identifier indicates the distance in meters or feet from the reference point.

b. The alphabetic identifier indicates the direction from the reference point, i.e., N(north), S(south), E(east), W(west), or L(left of baseline) and R(right of baseline).

7.6.5 Label the grid point markers with the coordinates of the grid point.

7.6.6 Any location within a grid system may be designated by measuring the distance and direction from the point of interest to a grid point marker.

7.6.7 The field map may be used for noting grid coordinates.

CALIBRATION OF PORTABLE GAMMA SCINTILLATION DETECTORS

1.0 PURPOSE

The purpose of this procedure is to provide a method for the laboratory calibration, field check, and on-site cross-calibration of portable gamma scintillation detectors.

2.0 APPLICABILITY

This procedure applies to calibration of portable gamma scintillation detectors.

3.0 OTHER DOCUMENTS

3.1 REFERENCES

3.1.1 *Radiation Protection Instrumentation Test and Calibration*, ANSI N323-1978, American National Standards Institute (for guidance only)
3.1.2 Victoreen Model 490 THYAC III instruction manual
3.1.3 Instrument Inventory and Calibration Control procedure manual
3.1.4 Procedure TE-022, Pressurized Ionization Chamber (PIC) Operation

4.0 EQUIPMENT AND MATERIALS

4.1 EQUIPMENT

4.1.1 Portable gamma scintillation detector (Victoreen Model 490 THYAC III) and ratemeter with 489-55 NaI(Tl) scintillation probe
4.1.2 Depleted uranium check source (approximately 21,000 gross cpm using portable gamma scintillation detector).
4.1.3 Field van logbook
4.1.4 Instrument calibration logbook
4.1.5 Instrument Inventory and Calibration Control computer program

4.1.6 Pressurized ionization chamber (PIC)

APPROVALS	
Author	Date
Supervisor	Date
Group Leader	Date
Section Head	Date

5.0 RESPONSIBILITY

5.1 The electronics technician is responsible for:

5.1.1 collecting the instrument and sending it for calibration;

5.1.2 verifying the instrument identification and probe numbers and that a calibration tag has been affixed to the instrument following calibration and upon receipt of the instrument;

5.1.3 entering the location, status, date, date of calibration, and date of next calibration into the instrument calibration logbook;

5.1.4 entering the above data into the Instrument Inventory and Calibration Control (IICC) computer program as documented in the IICC procedures manual.

5.2 The field technician is responsible for performing a field operation check daily for any instrument used.

Note: High voltage may be adjusted only by the electronics technician

6.0 PROCEDURE

6.1 The electronics technician obtains a primary laboratory calibration every six months and immediately following any significant adjustment to or maintenance of the instrument.

6.2 Perform a field check in an area that is not contaminated by following these steps:

6.2.1 Enter the following in the field logbook:

a. instrument number
b. source number
c. date
d location at which check was made
e. initials of person making the check.

6.2.2 Check battery condition by setting the range switch to BAT position and observing THYAC III meter.

a. If battery condition is acceptable, record this in the field logbook.

b. Replace battery if indicator IS NOT in the "Battery Check" region. See instruction manual for Model 490, THYAC III.

6.2.3 Set the Response switch to MEDIUM position and the Range switch to the appropriate position (maximum up-scale deflection without going off scale).

6.2.4 Take a reading for background and record the cpm in the field logbook.

6.2.5 Place probe in contact with the depleted uranium check source, read gross cpm, and record in the field logbook.

6.2.6 Calculate net cpm and record in the field logbook

a. This reading must be within laboratory-accepted limits (approximately ±20%) of the reading taken during the previous field check.

b. If the reading is out of the acceptable range, change batteries and repeat steps 6.2.2 through 6.2.5.

c. If the reading is still out of acceptable range, return the instrument to the ETS electronics technician for repair and recalibration and note that it was removed from service in the field logbook.

6.3 Perform a cross-calibration with the PIC if necessary according Procedure SU-021, Reference 3.1.4.

Note: The Instrument Inventory and Calibration Control (IICC) computer program is used by the electronics technician to provide automated backup to the instrument calibration logbook. Its use is documented in the Instrument Inventory and Calibration Control Procedures manual located in the instrumentation office.

CONTROL OF RADIOACTIVE SOURCES

1.0 PURPOSE

This procedure specifies the requirements for control of radioactive sources including handling, storage, and accountability.

2.0 APPLICABILITY

This procedure applies to the control of all radioactive sources used by ETS personnel for instrument calibration and field checking. These sources are subject to the federal regulations listed in Reference 3.1.1.

3.0 OTHER DOCUMENTS

3.1 REFERENCES

3.1.1 Code of Federal Regulations (1989), Title 10 CFR Part 20 "Standards for Protection Against Radiation".

3.2 APPENDICES

3.2.1 Appendix 1: Quantities for Determining Exempt and Nonexempt Radioactive Sources

4.0 EQUIPMENT AND MATERIALS

None

5.0 RESPONSIBILITY

APPROVALS	
Author	Date
Supervisor	Date
Group Leader	Date
Section Head	Date

5.1 All persons using radioactive sources are responsible for the handling, storage and accounting practices listed in this procedure.

5.1.1 It is the responsibility of all personnel to report any off-normal occurrence involving radioactive sources to their supervisor and the ORNL/ETS safety officer.

5.2 The ORNL source custodian issues sources, inventories sources and maintains an inventory list, arranges leak-tests for sources, and stores non-issued sources.

5.3 The field source custodian checks out a source from the ORNL source custodian and is responsible for the source until its return.

5.4 The ORNL/ETS safety officer reports any unusual or off-normal occurrence concerning radioactive sources to ORNL-LSD and to the WASTREN Environmental and Radiation Protection (E&RP) Radiation safety officer.

6.0 DEFINITIONS

6.1 **Exempt sources:** sources that have activity equal to or less than that specified in Appendix 1

6.2 **Nonexempt sources: sources** that have activity greater than the levels listed in Appendix 1

6.3 **Radioactive source:** radioactive material that is manufactured, using a man-made or enhanced radioactive isotope, for the purpose of calibrating or checking the operation of various electronic measuring devices. This does <u>not</u> include reference materials, samples or reagents

6.4 **Sealed source:** a discrete amount of radioactive material that is a.) bonded wholly within an inactive material, or b.) sealed in an inactive container or capsule, or c.) plated on an inactive material, in order to prevent dispersion of the radioactive material during routine use

7.0 PROCEDURE

7.1 LABELING

7.1.1 All nonexempt radioactive sources have a unique identification number

7.1.2 Radioactive sources (except depleted uranium sources used for field surveys) are labeled with the radiation symbol, isotope, and activity.

a. The radiation symbol may be on the container in which the source is kept rather than on the source itself.

7.2 HANDLING

7.2.1 Do not eat, drink, smoke or chew while handling radioactive sources.

7.3 STORAGE

7.3.1 Store all radioactive sources in the instrumentation office cabinet unless in use or permanently affixed to an instrument.

a. The ORNL source custodian controls access to the storage cabinet.

7.3.2 Sources assigned to team leaders for field use are kept in a locked drawer in the field van.

7.3.3 Lock the system check sources for the Opposed Crystal System (OCS) van in the source pig (lead-lined container) of the van when not in use.

7.4 ACCOUNTABILITY

7.4.1 All sources must be controlled in such a way that they may be accounted for at all times.

7.4.2 Sources checked out from the ORNL source custodian are documented when removed from the storage cabinet and when returned.

a. A source inventory data base is kept by the ORNL source custodian.

b. Any person checking out a source from the ORNL source custodian becomes a field source custodian and is responsible for that source.

7.5 DISPOSAL

7.5.1 Dispose of radioactive sources according to the regulations outlined in Reference 3.1.1

7.6 LEAK TESTING

7.6.1 The ORNL source custodian delivers non-exempt sources to WASTREN at least one every six months for leak-testing.

7.7 RECORDS

7.7.1 The ORNL source custodian keeps an inventory record showing assigned location of each radioactive source, field source custodian, and date of last inventory.

7.7.2 An inventory of ORNL/ETS radiation sources is transferred to the WASTREN source custodian upon request.

7.8 TRAINING

7.8.1 All employees that handle radioactive sources are trained internally on the job.

7.8.2 Employees using nonexempt sources are provided with source handling training by the ORNL source custodian.

Appendix 1. Quantities for Determining Exempt and Nonexempt Radioactive Sources

Material	Microcuries
Americium-241	0.01
Antimony-122	100
Antimony-124	10
Antimony-125	10
Arsenic-73	100
Arsenic-74	10
Arsenic-76	10
Arsenic-77	100
Barium-131	10
Barium-133	10
Barium-140	10
Bismuth-210	1
Bromine-82	10
Cadmium-109	10
Cadmium-115m	10
Cadmium-115	100
Calcium-45	10
Calcium-47	10
Carbon-14	100
Cerium-141	100
Cerium-143	100
Cerium-144	1
Cesium-131	1,000
Cesium-134m	100
Cesium-134	1
Cesium-135	10
Cesium-136	10
Cesium-137	10
Chlorine-36	10
Chlorine-38	10
Chromium-51	1,000
Cobalt-58m	10
Cobalt-58	10
Cobalt-60	1
Copper-64	100
Dysprosium-165	10
Dysprosium-166	100
Erbium-169	100
Erbium-171	100
Europium-152 9.2 h	100
Europium-152 13 yr	1
Europium-154	1
Europium-155	10
Fluorine-18	1,000
Gadolinium-153	10
Gadolinium-159	100
Gallium-72	10
Germanium-71	100
Gold-198	100
Gold-199	100
Hafnium-181	10
Holmium-166	100
Hydrogen-3	1,000
Indium-113m	100
Indium-114m	10
Indium-115m	100
Indium-115	10
Iodine-125	1
Iodine-126	1
Iodine-129	0.1
Iodine-131	1
Iodine-132	10
Iodine-133	1
Iodine-134	10
Iodine-135	10
Iridium-192	10
Iridium-194	100
Iron-55	100
Iron-59	10
Krypton-85	100
Krypton-87	10
Lanthanum-140	10
Lutetium-177	100
Manganese-52	10
Manganese-54	10
Manganese-56	10
Mercury-197m	100
Mercury-197	100
Mercury-203	10
Molybdenum-99	100
Neodymium-147	100
Neodymium-149	100
Nickel-59	100
Nickel-63	10
Nickel-65	100
Niobium-93m	10
Niobium-95	10
Niobium-97	10
Osmium-185	10
Osmium-191m	100
Osmium-191	100
Osmium-193	100
Palladium-103	100
Palladium-109	100
Phosphorus-32	10
Platinum-191	100
Platinum-193	100
Platinum-193m	100
Platinum-197m	100
Platinum-197	100
Plutonium-239	0.01
Polonium-210	0.1
Potassium-42	10
Praseodymium-142	100
Praseodymium-143	100
Promethium-147	10
Promethium-149	10
Radium-226	0.01
Rhenium-186	100
Rhenium-188	100
Rhodium-103m	100

Appendix 1 (continued)

Material	Microcuries
Rhodium-105	100
Rubidium-86	10
Rubidium-87	10
Ruthenium-97	100
Ruthenium-103	10
Ruthenium-105	10
Ruthenium-106	1
Samarium-151	10
Samarium-153	100
Scandium-46	10
Scandium-47	100
Scandium-48	10
Selenium-75	10
Silicon-31	100
Silver-105	10
Silver-110m	1
Silver-111	100
Sodium-24	10
Strontium-85	10
Strontium-89	1
Strontium-90	0.1
Strontium-91	10
Strontium-92	10
Sulphur-35	100
Tantalum-182	10
Technetium-96	10
Technetium-97m	100
Technetium-97	100
Technetium-99m	100
Technetium-99	10
Tellurium-125m	10
Tellurium-127m	10
Tellurium-127	100
Tellurium-129m	10

Material	Microcuries
Tellurium-129	100
Tellurium-131m	10
Tellurium-132	10
Terbium-160	10
Thallium-200	100
Thallium-201	100
Thallium-202	100
Thallium-204	10
Thorium (natural)	100
Thulium-170	10
Thulium-171	10
Tin-113	10
Tin-125	10
Tungsten-181	10
Tungsten-185	10
Tungsten-187	100
Uranium (natural)	100
Uranium-233	0.01
Uranium-234-Uranium-235	0.01
Vanadium-48	10
Xenon-131m	1,000
Xenon-133	100
Xenon-135	100
Ytterbium-175	100
Yttrium-90	10
Yttrium-91	10
Yttrium-92	100
Yttrium-93	100
Zinc-65	10
Zinc-69m	100
Zinc-69	1,000
Zirconium-93	10
Zirconium-95	10
Zirconium-97	10

Any alpha emitting radionuclide not listed here or mixtures of alpha emitters of unknown composition: 0.01 microcuries

Any radionuclide other than alpha emitting radionuclides not listed here or mixtures of beta emitters of unknown composition: 0.1 microcuries

Source: Title 10 CFR Part 20, Appendix 3

GAMMA SCINTILLATION DETECTOR OPERATION

1.0 PURPOSE

This procedure briefly describes the operation of gamma scintillation detectors. For more detailed information about the instrument, refer to the manufacturer's instruction manual.

2.0 APPLICABILITY

This procedure applies to scintillation survey instruments used for detecting gamma radiation.

3.0 OTHER DOCUMENTS

3.1 REFERENCES

3.1.1 *Instrumentation Manual for Model 490, THYAC III* Victoreen, Inc., Cleveland, OH.

3.1.2 Procedure TE-022, Pressurized Ionization Chamber (PIC) Operation

3.1.3 Procedure TE-073, Equipment Decontamination

3.2 APPENDICES

3.2.1 Appendix 1: Conversion Formulas for Victoreen Instruments

3.3 EXHIBITS

3.3.1 Exhibit 1: Survey Method

APPROVALS	
Author	Date
Supervisor	Date
Group Leader	Date
Section Head	Date

4.0 EQUIPMENT AND MATERIALS

4.1 EQUIPMENT

4.1.1 Portable ratemeter, or data logging ratemeter
4.1.2 Batteries
4.1.3 Gamma scintillation probe, [1.25 in. by 1.50 in. sodium iodide (thallium activated) scintillation crystal], to match corresponding ratemeter
4.1.4 Headphone set that attaches to ratemeter
4.1.5 6-ft nylon cord (or equivalent) attached to the top of the scintillation probe for use in handling the probe while surveying

5.0 RESPONSIBILITY

5.1 The field technician is responsible for following this procedure, working in a safe manner and reporting any malfunctions to the instrument technician.

6.0 PROCEDURE

6.1 EQUIPMENT SET UP

6.1.1 Remove the ratemeter and corresponding probe from storage and visually check for physical damage. If physically damaged, do not use; report damage to the instrument technician.

6.1.2 Attach the headphone set to the phone connector on the ratemeter. The headphone provides an audio indication of gamma radiation intensity.

6.1.3 Initially set the range at the highest level (x 1000). If the meter reading is less than 10% of full scale, switch to the next lower level (x 100). Repeat this procedure until the reading is over 10% of full scale.

6.2 PERFORM FIELD CHECK PRIOR TO USE

6.2.1 Check the battery condition by setting the Range switch to the "BAT" position and observing the meter. The indicator should be in the "Battery Check" region or battery replacement is mandatory.

6.2.2 Enter in the logbook the instrument number, battery check, source ID number, date, location at which the field check is made, and initials of person making the check.

6.2.3 Set the Response switch to the "MEDIUM" position and the Range switch to the appropriate position (usually x10 in background areas).

6.2.4 Determine the background level and record the background cpm in the logbook. This is usually done at a reference site for the area to be surveyed.

6.2.5 With the probe in the sleeve, place the depleted uranium check source with the engraved side up near the end of the probe. Record the gross cpm in the logbook.

6.2.6 Calculate the net cpm by subtracting the background cpm from the gross cpm. Record the net cpm in the logbook. The net cpm reading must be within laboratory accepted limits (approximately ±20% of the reading taken during the previous field check).

6.2.7 If the net cpm is within the acceptable range, the instrument is now ready for use. If the net cpm is out of the acceptable range, change batteries and repeat steps 6.2.5 and 6.2.6. If the reading is still out of the acceptable range, return the instrument to the instrument technician.

6.3 DISCRETE MEASUREMENTS (GAMMA SCINTILLOMETER)

6.3.1 Place the scintillometer probe against or at a specified distance from the surface to be surveyed.

6.3.2 Observe the count rate as displayed on the rate meter. Note the average value in cpm and record.

6.3.3 When the survey is complete, turn the instrument off. Clean and decontaminate before storage (see Procedure TE-073).

6.4 FIELD SCAN SURVEY PROCEDURES

6.4.1 During inclement weather, cover each probe and ratemeter with a plastic sample bag and secure at the open end with tape; ensure cable connections are covered. Remove the bags prior to prolonged storage to prevent damage from condensation.

6.4.2 Traverse the area to be surveyed by following parallel, adjacent but slightly overlapping, 3- to 4-ft wide paths. While traversing the property, the surveyor should move the detector from side to side (covering a 3- to 4-ft wide area) while holding it as close to the ground as possible (less than 6 in.); see Exhibit 1, Survey Method. The presence of rocks and other objects may not permit holding the detector at a constant height.

6.4.3 Note background locations and the high, low and average gamma readings.

Enter the observed detector response (cpm) on the field sheets and on the field map for the appropriate surveyed site.

6.4.4 Use the detector's audio response to assist in identifying areas of anomalous radiation levels.

a. Delineate elevated areas at 1000 cpm above the highest background reading.
b. Record the lowest, highest and mode gamma count rate, and surface area for each elevated area.

6.4.5 A lead shield may be used in areas with high gamma emanation.

6.4.6 When the entire survey site has been scanned, turn the instrument off. Clean and decontaminate before storage (see Procedure TE-073).

7.0 Convert scintillometer count rates (kcpm) to exposure rates (μR/h), using a correlation between a scintillometer and a Pressured Ionization Chamber (PIC) (Procedure TE-022).

7.1 Calculate exposure rates for sites with no derived conversion factor.

7.1.1 Direct Conversion: requires a conversion factor (CF) obtained by dividing the scintillometer count rate by the corresponding exposure rate in μR/h, measured with a PIC

$$CF = y \div x$$

Where:
x = PIC value in μR/h
y = gamma scintillometer value in kcpm

7.1.2 Divide the resulting factor into the remaining scintillometer rates.

7.1.3 Calculate a separate conversion factor for representative and contaminated areas or areas with grossly different gamma readings.

7.2 Calculate exposure rates for sites with predetermined conversion factor. Refer to Appendix 2, Conversion Formulas for the appropriate formulas.

$$y = mx + b$$

Where:
y = gamma exposure rate in μR/h

x = gamma scintillometer value in kcpm
m, b = site specific constants

Appendix 1 Conversion for Victoreen Instruments

Durango, CO:	$y = 1.55x + 5.28$
Fall City, TX:	$y = 0.989x + 5.30$
Grand Junction, CO:	$y = 1.69x + 3.45$
Green River, UT:	$y = 1.60x + 7.34$
Gunnison, CO:	$y = 1.47x + 10.33$
Lowman, ID:	$y = 1.98 + 5.92$
Naturita, Nucla, Vancorum, Slickrock, Dove Creek, CO:	$y = 1.80x + 5.64$
Maybell, Craig, CO:	$y = 1.71x + 7.40$
Monticello, UT:	$y = 1.46x + 7.20$
Rifle, CO:	$y = 1.56x + 6.89$

Exhibit 1. Survey Method

PRESSURIZED IONIZATION CHAMBER (PIC) OPERATION

1.0 PURPOSE

This procedure briefly describes the operation of the pressurized ionization chamber (PIC). For more detailed information about the instrument, refer to the manufacturer's instruction manual.

2.0 APPLICABILITY

This procedure applies to the operation of the PIC, which is used to convert the gamma exposure rate reading measured by the gamma scintillation detector expressed in kcpm to gamma exposure rate expressed in μR/h.

3.0 OTHER DOCUMENTS

3.1 REFERENCES

3.1.1 *Operational Manual RS-112 Environmental Radiation Monitor System*, , Reuter Stokes Inc , Cleveland, OH , May 1990

3.1.2 Procedure SU-021, Calibration of Pressurized Ionization Chamber.

3.1.3 Volume 29, Code of Federal Regulations, Part 710 - transporation of hazardous materials

3.2 EXHIBITS

3.2.1 Exhibit 1: Pressurized Ionization Chamber (PIC)

APPROVALS	
Author	Date
Supervisor	Date
Group Leader	Date
Section Head	Date

4.0 EQUIPMENT AND MATERIALS

4.1 EQUIPMENT

Reuter Stokes Portable Environmental Radiation Monitor Model RSS-112. This system includes the following:

4.1.1 Sensor head
4.1.2 Digital display/instrumentation pack
4.1.3 AC adaptor
4.1.4 Timer (stopwatch or laptop)
4.1.5 Tripod
4.1.6 Gamma scintillometer

5.0 RESPONSIBILITY

It is the responsibility of the field personnel and their supervisors to follow this procedure while using the PIC.

The PIC must have annual calibration performed and documented.

6.0 DEFINITIONS

6.1 **LCD:** liquid crystal display
6.2 **PIC:** pressurized ionization chamber.
6.3 **µR/h:** micro Roentgen per hour, a measure of ions produced per unit air.

7.0 PROCEDURE

7.1 TRANSPORTATION

7.1.1 Contact a certified DOT shipper about shipping this instrument using common carriers or transporting the instrument in government vehicles to comply with 49 CFR 710.

WARNING: The sensor head contains 25 atmospheres of high quality argon gas, and the battery pack contains lithium batteries.

7.2 INSTRUMENT SET UP AND OPERATION

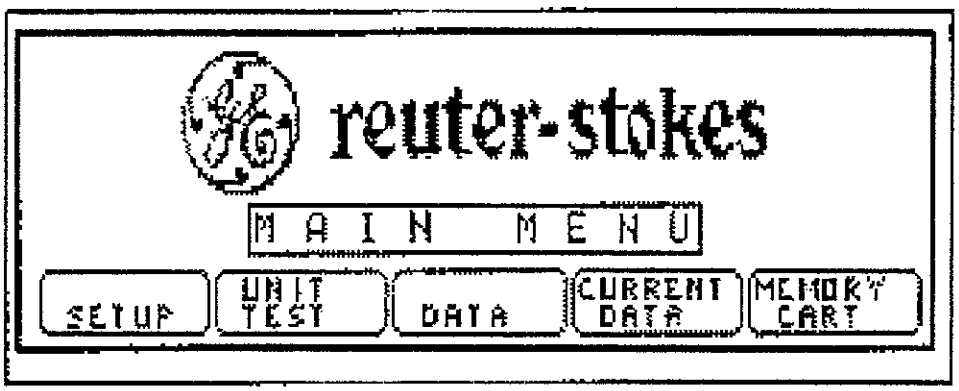
7.2.1 Place the PIC sensor head on the location to be measured. The head faces are numbered 1-4. Always place face #1 in the general direction of north.

a. The instrument comes with a tripod. This may be used when collection of data at 1 meter or the sensor head may be placed directly on the surface.

7.2.2 Ensure that all switches are OFF.

Connect the sensor head to the instrument using the provided cable. If power is available, use the AC adaptor to save battery life.

7.2.3 Turn the ELECTROMETER switch located on the rear of the



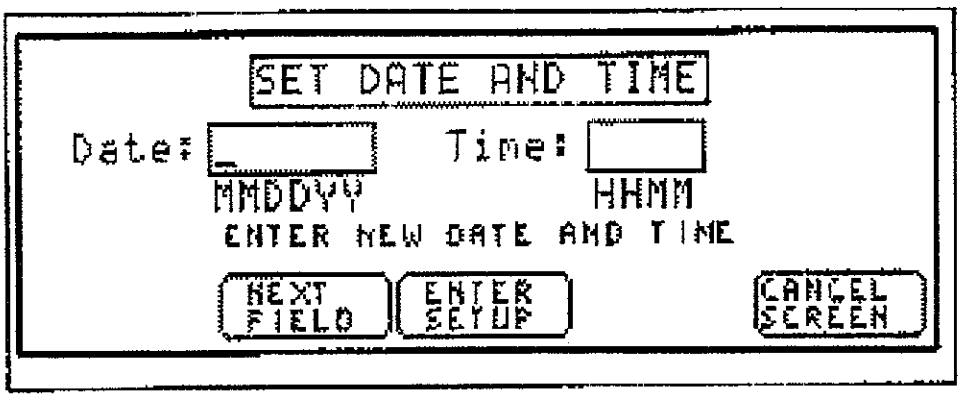
instrumentation pack to "ZERO". This applies power to the sensor and electronics. Within 3 seconds, the LCD should display the main menu.

7.2.4 Measure the zero offset by pressing the "CURRENT DATA" key. This reading should be less than 3 μR/h. If not, adjust the zero offset with the potentiometer located on the sensor head adjacent to the cable connection.

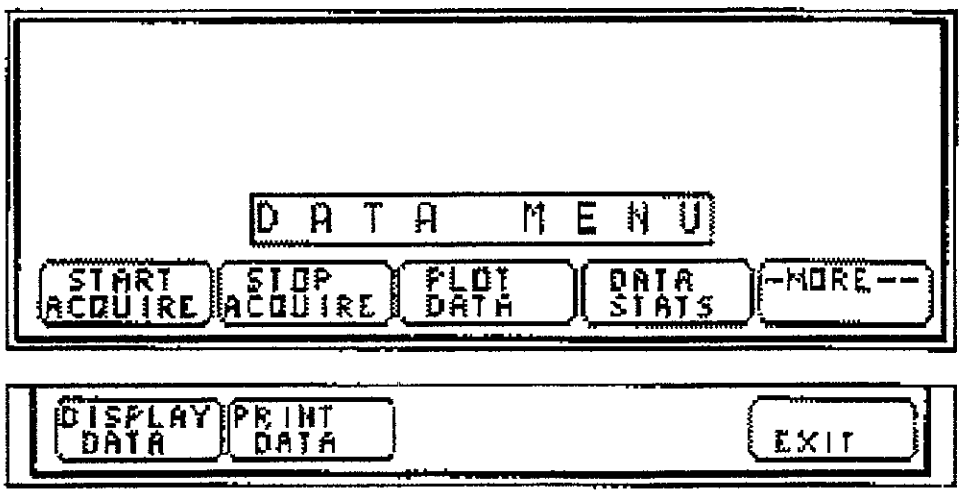
7.2.5 Turn the rotary switch to "READ". In about 10 seconds the protective interlock circuit will remove the electrometer protection.

NOTE Wait about 20 seconds for the system to stabilize before collecting data.

7.2.6 Press the "SETUP" key to access the date/time menu, the readouts menu, menu, and the alarm menu. Check with the team leader if any parameters need to be changed for the particular project. The default readout is in μR/h, and the default integrating period is five seconds. The internal buffer holds 220 data points, so an integrated reading using the internal buffer would total 18 minutes. Shorter times can be taken using a stop watch or other counter, or by calculating the amount of 5 sec. data points required. For example, a 5



minute reading would be 300 seconds / 5 seconds pre point = 60 points on the "PLOT DATA" readout.

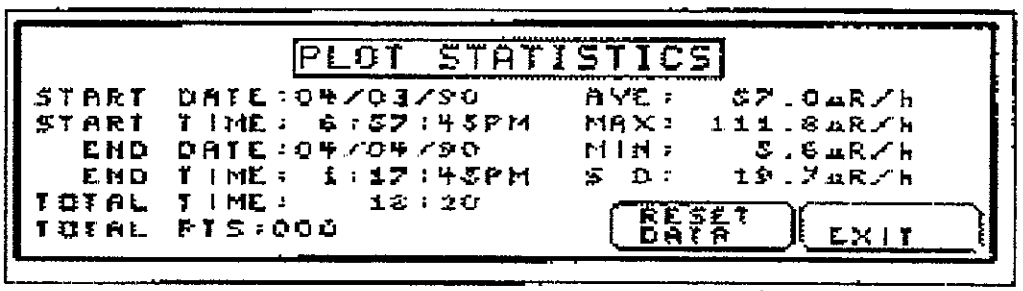


7.2.7 Step through the menu and press the "EXIT SETUP" button.

7.2.8 From the "MAIN MENU", depress the "DATA" menu.

7.2.9 From the "DATA" menu, press "ACQUIRE DATA", then press "DATA STATS". This screen provides statistical data on the internal data buffer.

From this screen, the average, maximum, minimum, standard deviation, start



date/time, end date/time, total time and total points can be recorded.

7.2.10 Press "RESET DATA" button to begin another measurement.

7.2.11 Read and record the PIC measurement.

7.2.12 When through, press the "EXIT" button, this will take you to the "DATA MENU". Press the "STOP ACQUIRE" button if you are still collecting data. Press the "EXIT" button to go to the "MAIN MENU"

7.2.13 Turn instrument of by rotating the knob on the rear of the case to "OFF"

7.3 CORRELATION WITH GAMMA SCINTILLATION DETECTOR

7.3.1 Remove the sensor head and place the scintillometer probe 15 cm above the surface of the assigned sensor head location; read and record the scintillometer measurement.

7.3.2 A direct correlation can be made between a single pic measurement and a single gamma scintillometer reading.

a. Readings are taken with both the gamma scintillation detector and the PIC to determine a conversion factor for each study area, until a conversion equation has been determined by linear regression.

b Calculate a conversion factor (CF) as follows:

$$CF = G_I/P_I$$

where:

G_1 = gamma scintillation detector reading in kcpm at Location 1

P_1 = PIC reading in μR/h at Location 1

c. Calculate a separate conversion factor for representative and contaminated areas, and where they are grossly different gamma range readings for individual contaminated regions.

d. Correlation between the PIC and the scintillometer is assumed to be linear according to the equation:

$$Y = X/CF$$

where:

Y = μR/h
X = scintillometer data in kcpm
CF = conversion factor

7.3.3 When a statistically valid number of measurements have been collected from a range of gamma readings, a linear regression can be used to generate a conversion equation.

7.3.4 When all desired measurements have been taken, turn off the instrument.

7.4 EQUIPMENT USE DURING INCLEMENT CONDITIONS

7.4.1 Cover each sensor head and the monitor with large plastic storage bags.

7.4.2 Secure the bag at the open end with tape.

7.4.3 Use the instrument as indicated in Sect. 7.2

7.4.4 Remove the bags prior to prolonged storage.

Exhibit 1. Pressurized Ionization Chamber (PIC)

ATTACHMENT 3
ENCORE™ SAMPLERS STANDARD OPERATING PROCEDURE

SOIL SAMPLING WITH METHANOL PRESERVATION FOR VOLATILE ORGANIC COMPOUND ANALYSIS

STANDARD OPERATING PROCEDURE

1.0 Purpose

1.1 This Standard Operating Procedure (SOP) establishes the protocol for soil sampling with methanolic preservation according to EPA Method 5035 for volatile organic compound (VOC) analyses. IT Corporation (IT) personnel will use this SOP for collection of soil and oily waste samples with high VOC concentrations as defined by the data quality objectives (DQOs). High concentration samples are those in excess 200 microgram/kilogram (µg/kg). Sample collected with methanolic preservation will be analyzed by gas chromatography methods (EPA Methods 8015B, 8021B) or gas chromatography/mass spectrometry (EPA Method 8260B). Sample introduction techniques will be purge and trap. Additional sample aliquots will be collected into empty containers for dry weight determination.

2.0 References

2.1 Test Methods for Evaluating Solid Waste, USEPA Office of Solid Waste, SW-846, Final Update III, December 1996

2.2 USEPA Memorandum "Clarification Regarding Use of SW-846 Methods," August 7, 1998

2.3 IT SOP 3.1, Surface and Shallow Subsurface Soil Sampling

2.4 IT SOP 3.2, Subsurface Soil Sampling While Drilling

2.5 IT SOP 10.3, Split Spoon Sampling

2.6 IT SOP 1.1, Chain of Custody

2.7 IT SOP 2.1, Sample Handling, Packaging and Shipping

2.8 IT SQP 10.2, Corrective Action

2.9 IT SQP 4.2, Records Management

3.0 Definitions

3.1 Methanol Blank

A methanol blank is used to detect ambient VOC contamination and cross contamination between samples during sample handling and shipping. A methanol blank is prepared by the laboratory and shipped together with the sample containers to the field. After the samples are collected, the methanol blank is shipped together with the samples back to the laboratory. At the laboratory it is carried through the entire sample preparation and analysis process.

3.2 Matrix Spike and Matrix Spike Duplicate

Matrix spike (MS) and matrix spike duplicate (MSD) are quality control (QC) check samples that measure matrix-specific effects and method performance. A matrix spike sample is prepared at the laboratory by adding a known quantity of target analytes to a sample prior to analysis.

3.3 Field Duplicate

Field duplicates are samples collected at the same time from the same source. They are used to evaluate the sampling precision and the overall quality of sample collection.

4.0 Supplies and Reagents

4.1.1 Supplies and reagents are the instruments, chemicals and other materials necessary to perform analysis. The required list of supplies and reagents is as follows:

- Methanol, CH_3OH, purge and trap quality or equivalent
- Sample containers, pre-cleaned 40 milliliter (ml) vials with Teflon®-lined septum caps
- Calibrated top-loading balance, 0.01 gram (g) sensitivity, preferably battery operated
- Balance weights, 10g and/or 100g
- Disposable 5ml plastic syringes with barrels smaller than the neck of the sample vial; the needle end of the barrel is cut off with a hacksaw prior to sampling
- Plastic scoops, or stainless steel spoons, or wooden tongue depressors
- Chain of custody forms
- Disposable nitrile gloves
- Safety glasses
- Coolers for sample shipping

- Sealable plastic bags
- Ice
- Packing material, such as absorbent pads
- Shipping tape
- Chain of custody seals
- Shipping labels
- Paper towels or Kimwipes
- Disposable pipettes and bulbs
- Small hacksaw

5.0 Procedure

5.1 Responsibilities

5.1.1 The Project QC Manager is responsible for monitoring the sampling activities, assuring that the requirements of this SOP are met, and complete documentation of sampling activities.

5.1.2 The Project Manager is responsible for ensuring that proper supplies, reagents, and adequate space are available for sampling activities; for assigning qualified and trained personnel for sampling; and for integrating sampling activities into the project schedule.

5.1.3 The Project Chemist is responsible for laboratory selection and coordination, identification and preparation of field supplies, sampling per this SOP requirements, field quality control, sample handling in the field and shipping to the laboratory, and training and documentation of other project staff in the use of this SOP.

5.2 Vial Preparation

5.2.1 Sample vials preserved with methanol must be prepared prior to sample collection either by the laboratory or by the Project Chemist. Vial field preparation procedure steps are as follows:

- Obtain pre-cleaned vials.
- Add 5ml of methanol to each vial.

- Tightly seal the vial with the Teflon®-lined septum cap to prevent evaporation of methanol.
- Affix a label on each vial, identify each vial on the label with a unique identification (ID) number.
- Verify the balance calibration by weighing the 10g and the 100g weights and document in the Vial Tracking Log. A copy of the Vial Tracking Log is enclosed as Attachment 1. The weights should be within 0.01g.
- Weigh the prepared vial to the nearest 0.01g, record the weight on the label and the Vial Tracking Log. Store vials on ice or in a refrigerator until use.

5.2.2 The laboratory in charge of vial preparation and subsequent sample analysis will prepare the vials using a laboratory SOP, and ship the vials with methanol in a cooler with ice to IT. In addition to the vials necessary for field and QC sample collection, the laboratory will include at least 5% more vials with methanol for use as blanks and as a backup in case of leakage. The laboratory will also supply a container with methanol for use in the field, and a listing of the vial IDs cross-referenced with their weights. The laboratory will also provide pre-cleaned empty (without methanol) vials for sample collection for dry weight determination.

5.2.3 Project personnel will weigh vials in the field on the day they are to be used and record the weight in the Vial Tracking Log. If the initial weight measurements are made at the laboratory and the subsequent measurements are made in the field, or if both measurements are made in the field, the loss of 0.2g or more indicates the vial is leaking. This vial will not be used for sample collection. Use of a backup vial or preparation of a new vial per section 5.2.1 will be required in this case.

5.3 Field Sampling

5.3.1 Wear disposable plastic gloves and safety glasses during sample collection activities. Before field samples are collected, field personnel will determine the syringe volume corresponding to a 5g weight of collected soil by using a disposable plastic syringe with the needle end of the barrel cut off. Push the barrel into the soil in the area to be sampled until the soil level reaches the 3ml mark on the barrel. Extrude the soil with the plunger onto a piece of paper and weigh. Repeat sample collection until the length of the barrel needed to collect 5.0±0.5g of soil is determined.

5.3.2 Collect soil samples one at a time using grab soil sample collection methods as defined in the project SAP. These methods may include surface and shallow subsurface sampling per IT SOP 3.1, subsurface sampling while drilling per IT SOP 3.2, split spoon sampling per IT SOP 10.3, or any other sampling procedure as defined in the project SAP.

5.3.3 Collect 5.0±0.5g of soil into a syringe barrel from a grab sample as expediently as possible to minimize the soil exposure to the atmospheric air. Clean the outside surface of the barrel with a paper towel.

5.3.4 Quickly extrude the soil plug into a sample vial with methanol, clean the vial threads of any soil particles and seal the vial with the Teflon®-lined septum cap. Add more methanol if the solvent is fully absorbed into the soil, or the amount of methanol is not sufficient to fully cover the soil plug. Label the vial with the sample ID, put it in a sealable bag and place on ice.

5.3.5 With the same syringe collect 10-20g of soil into a clean, labeled vial for dry weight determination. Dispose of the used syringe into an appropriate receptacle.

5.3.6 Using the above-described procedure, collect additional samples for MS/MSD analysis. In addition to the field sample ID, clearly identify these samples on the vial label as "MS" and "MSD."

5.3.7 Collect field duplicates as unhomogenized split samples obtained as two aliquots of the same soil sample in two separate syringe barrels.

5.3.8 Once all field and QC samples have been collected, weigh the samples again and record the weight in the Vial Tracking Log. This step may be omitted if the laboratory is responsible for the final weight determination as specified in the Project Agreement Memorandum with the laboratory.

5.3.9 During sampling follow the chain of custody procedures as required by IT SOP 1.1.

5.3.10 Package the samples per IT SOP 2.1. Enclose the chain of custody form and a copy of the Vial Tracking Log in the cooler. Ship the sample coolers as required by IT SOP 2.1. No special labeling is required because the small volumes of methanol shipped are exempt of special

labeling under the small quantity provision.

5.2.11 The laboratory will keep samples in a secure refrigerator at 4±2°C until the time of analysis. Soil samples must be analyzed within 14 days from the day of collection. Analytical procedures will be according to EPA Method 5035 and laboratory SOP.

6.0 Quality Control

6.1 Methanol blank will be analyzed to determine if there are any ambient or cross-contamination that could have affected the samples during samples collection, handling and shipping. One methanol blank will be used for each cooler with samples.

6.2 Unless otherwise required in the project SAP, a MS/MSD pair will be collected at a frequency of one pair for every 20 samples, and field duplicates will be collected at a 10% frequency.

6.3 In order to minimize soil exposure to air, it is crucial for this procedure that samples are collected one at a time. To prevent ambient contamination and eliminate a possibility of mixing the caps of the pre-weighed vials, the vial must be opened one at a time immediately prior to collecting soil into a syringe.

7.0 Corrective Action

7.1 Corrective action for problems with sample collection may include re-sampling, preparation of new vials with methanol, and other actions as appropriate. Corrective action will be documented according to IT Standard Quality Procedure (SQP) 10.2.

8.0 Records

8.1 Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files according to IT SQP 4.2

9.0 Attachments

9.1 Attachment 1: Vial Tracking Log

ATTACHMENT 1

Vial Tracking Log

Vial Tracking Log

Balance calibration at 10g:
Balance calibration at 100g:

Vial No.	Vial with methanol, g	Vial with methanol (prior to sampling) g	Vial with methanol and soil, g (Use only if more methanol was added in the field)	Vial with methanol and soil final weight, g
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				
17				
18				
19				
20				

Vials prepared by: **Date:**

Sampled by: **Date:**

SOIL SAMPLING WITH ENCORE ™ SAMPLER FOR VOLATILE ORGANIC COMPOUND ANALYSIS

STANDARD OPERATING PROCEDURE

1.0 Purpose

1.1 This Standard Operating Procedure (SOP) establishes the protocol for EnCore™ soil sampling according to EPA Method 5035 for volatile organic compound (VOC) analyses. IT Corporation (IT) personnel will use this SOP for collection of soil and oily waste samples with low VOC concentrations as defined by the data quality objectives (DQOs). Low concentration samples are those ranging from 0.5 microgram/kilogram (µg/kg) to 200 µg/kg. Sample collected in Encore™ samplers will be analyzed by gas chromatography methods (EPA Methods 8015B, 8021B) or gas chromatography/mass spectrometry (EPA Method 8260B). Sample introduction techniques will be purge and trap technique. Additional sample aliquots will be collected into empty containers for dry weight determination.

2.0 References

2.1 Test Methods for Evaluating Solid Waste, USEPA Office of Solid Waste, SW-846, Final Update III, December 1996
USEPA Memorandum "Clarification Regarding Use of SW-846 Methods," August 7, 1998
2.2 IT SOP 3.1, Surface and Shallow Subsurface Soil Sampling
2.3 IT SOP 3.2, Subsurface Soil Sampling While Drilling
2.4 IT SOP 10.3, Split Spoon Sampling
2.5 IT SOP 1.1, Chain of Custody
2.6 IT SOP 2.1, Sample Handling, Packaging and Shipping
2.7 IT SQP 10.2, Corrective Action
2.8 IT SQP 4.2, Records Management

3.0 Definitions

3.1 EnCore™ Sampler

3.1.1 The EnCore™ sampler cartridge is a disposable volumetric sampling system designed to collect, store, and deliver soil samples hermetically. No chemical preservation of the sample is

performed in the field. Extrusion and extraction of the soil is done in the laboratory. Since the sample is never exposed to the atmosphere after sampling, the loss of the VOCs during sample transport, storage and analysis are negligible. The EnCore™ samplers come in two sizes for sample volumes of approximately 25 or 5 grams.

3.1.2 The associated device is the EnCore™ T-handle Sampling Tool, which is used with the EnCore™ cartridges.

3.1.3 The EnCore™ sampler is not designed to store solvent or free product. Soil conditions with heavy latent solvents may require different sampling techniques due to the potential interaction with the coring body.

3.2 Matrix Spike and Matrix Spike Duplicate

Matrix spike (MS) and matrix spike duplicate (MSD) are quality control (QC) check samples that measure matrix-specific effects and method performance. A matrix spike sample is prepared at the laboratory by adding a known quantity of target analytes to a sample prior to sample digestion or extraction.

3.3 Field Duplicate

Field duplicates are samples collected at the same time from the same source. They are used to evaluate the sampling precision and the overall quality of sample collection.

4.0 Supplies and Reagents

4.1.1 Supplies and reagents are the instruments, chemicals and other and materials necessary to perform analysis. The required list of supplies and reagents is as follows:

- EnCore™ sampler cartridge made by En Chem, Inc., 1795 Industrial Drive, Green Bay, WI 54302 or equivalent
- EnCore™ T-handle Sampling Tool made by En Chem, Inc., 1795 Industrial Drive, Green Bay, WI 54302 or equivalent
- Sample containers: pre-cleaned 40-milliliter (mL) vials with caps
- Plastic scoops, or stainless steel spatula, or wooden tongue depressors
- Chain of custody forms
- Disposable nitrile gloves
- Safety glasses
- Coolers for sample shipping
- Ice

- Packing material, such as absorbent pads
- Shipping tape
- Chain of custody seals
- Sample and shipping labels
- Paper towels or Kimwipes

5.0 Procedure

5.1 Responsibilities

5.1.1 The Project QC Manager is responsible for monitoring the sampling activities, assuring that the requirements of this SOP are met, and complete documentation of sampling activities.

5.1.2 The Project Manager is responsible for ensuring that proper supplies, reagents, and adequate space are available for sampling activities; for assigning qualified and trained personnel for sampling; and for integrating sampling activities into the project schedule

5.1.3 The Project Chemist is responsible for laboratory selection and coordination, identification and preparation of field supplies, sampling per this SOP requirements, field quality control, sample handling in the field and shipping to the laboratory, and training and documentation of other project staff in the use of this SOP.

5.2 EnCore ™ Assembly

5.2.1 Prior to taking the sample, test the plunger for free movement by pushing the plunger rod down until it rests against the tabs.

5.2.2 The locking lever on the EnCore™ T-handle must be depressed as the cartridge is inserted, and the slots on the cartridge with the locking pins in the T-handle must be lined up. Take a cartridge out of the bag and save the bag for future use. Plunger end first, insert the cartridge into T-handle with locking tabs aligned, and twist the cartridge clockwise to lock it in place.

5.2.3 If faulty components are detected during assembling process, discard the cartridge and assemble the device with a new cartridge.

5.3 Field Sampling

5.3.1 Collect soil samples one at a time using grab soil sample collection methods as defined in the project SAP. These methods may include surface and shallow subsurface sampling per IT

SOP 3.1, subsurface sampling while drilling per IT SOP 3.2, split spoon sampling per IT SOP 10.3, or any other sampling procedure as defined in the project SAP.

5.3.2 Wear disposable gloves and safety glasses during sample collection activities. Apply EnCore™ to freshly exposed surface soil or to one end of a sleeve core as soon as it is brought to the surface. Holding the device with the T-handle up and the cartridge down, insert the sampling device into the soil. Look down the viewing hole to make sure the plunger o-ring is visible indicating that the cartridge is full. If the o-ring is not visible, apply more pressure to fill up the crtridge. Withdraw sampling device from soil and wipe of excess dirt from cartridge body.

5.3.3 Cap the cartridge core while it is still on the T-handle. Push or twist cap on until the groves are seated over the ridge of the coring body.

5.3.4 Remove the capped sampler by pushing the locking lever down on T-handle, and twisting and pulling the sampler from T-handle. Lock the plunger by rotating plunger rod until the wings rest against the tabs. Attach the label and place the cartridge in the EnCore™ sampler bag.

5.3.5 Collect three EnCore™ samples for each location. In addition, collect 10-20g of soil into a clean, labeled vial for dry weight determination.

5.3.6 Store the EnCore™ sampler bag in a cooler with ice until it can be delivered to the laboratory or packaged for shipment.

5.3.8 Using the above-described procedure, collect two additional samples for MS/MSD analysis. In addition to the field sample ID, clearly identify these samples on the vial label as "MS" and "MSD."

5.3.9 Collect field duplicates as unhomogenized split samples obtained as two aliquots of the same soil in two EnCore™ sample cartridges.

5.3.10 During sampling follow the chain of custody procedures as required by IT SOP 1.1.

5.3.11 Package the samples per IT SOP 2.1; enclose the chain of custody form and ship the sample coolers as required by IT SOP 2.1.

5.3.12 Soil samples will be shipped to the laboratory for analysis or preservation within the 48 hour holding time unless otherwise specified in the SAP. Preserved samples can be held up to 14 days for analysis. The laboratory will keep samples in a secure refrigerator at

4±2°C until the time of analysis. Analytical procedures will be according to EPA Method 5035 and laboratory SOP.

6.0 Quality Control

6.1 Unless otherwise required in the project SAP, a MS/MSD pair will be collected at a frequency of one pair for every 20 samples, and field duplicates will be collected at a 10% frequency.

7.0 Corrective Action

7.1 Corrective action for problems with sample collection may include re-sampling, preparation of new vials with methanol, and other actions as appropriate. Corrective action will be documented according to IT Standard Quality Procedure (SQP) 10.2.

8.0 Records

8.1 Records generated as a result of implementation of this SOP will be controlled and maintained in the project record files according to IT SQP 4.2

9.0 Attachments

None

ATTACHMENT 4
CHAIN-OF-CUSTODY FORM

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD*

Reference Document No. 545664
Page 1 of ____

Project Name/No. [1] _____
Sample Team Members [2] _____
Profit Center No. [3] _____
Project Manager [4] _____
Purchase Order No. [6] _____
Required Report Date [11] _____

Samples Shipment Date [7] _____
Lab Destination [8] _____
Lab Contact [9] _____
Project Contact/Phone [12] _____
Carrier/Waybill No. [13] _____

Bill to: [5] _____
Report to: [10] _____

ONE CONTAINER PER LINE

Sample Number [14]	Sample Description/Type [15]	Date/Time Collected [16]	Container Type [17]	Sample Volume [18]	Pre-servative [19]	Requested Testing Program [20]	Condition on Receipt [21]	Disposal Record No. [22]

FOR LAB USE ONLY

FOR LAB USE ONLY

Special Instructions: [23]

Possible Hazard Identification: [24]
Non-hazard ☐ Flammable ☐ Skin Irritant ☐ Poison B ☐ Unknown ☐

Sample Disposal: [25]
Return to Client ☐ Disposal by Lab ☐ Archive _____ (mos.)

Turnaround Time Required: [26]
Normal ☐ Rush ☐

QC Level: [27]
I. ☐ II. ☐ III. ☐ Project Specific (specify): _____

1. Relinquished by [28] (Signature/Affiliation)	Date: Time:	1. Received by [28] (Signature/Affiliation)	Date: Time:
2. Relinquished by (Signature/Affiliation)	Date: Time:	2. Received by (Signature/Affiliation)	Date: Time:
3. Relinquished by (Signature/Affiliation)	Date: Time:	3. Received by (Signature/Affiliation)	Date: Time:

Comments: [29]

White: To accompany samples
Yellow: Field copy
*See back of form for special instructions.

Chain-of-Custody Form
Page 1 of 2

INTERNATIONAL TECHNOLOGY CORPORATION

ANALYSIS REQUEST AND CHAIN OF CUSTODY RECORD (cont.)*

Reference Document No.[30] _____
Page____of____

Project Name _____ Project No. _____ Samples Shipment Date _____

ONE CONTAINER PER LINE

Sample[14] Number	Sample[15] Description/Type	Date/Time[16] Collected	Container[17] Type	Sample[18] Volume	Pre-[19] servative	Requested Testing[20] Program	Condition on[21] Receipt	Disposal[22] Record No.
							FOR LAB USE ONLY	
							FOR LAB USE ONLY	
							FOR LAB USE ONLY	
							FOR LAB USE ONLY	
							FOR LAB USE ONLY	
							FOR LAB USE ONLY	
							FOR LAB USE ONLY	
							FOR LAB USE ONLY	

White: To accompany samples
Yellow: Field copy
*See back of form for special instruction

Chain-of-Custody Form

APPENDIX C
ENVIRONMENTAL CONDITIONS REPORT

ENVIRONMENTAL CONDITIONS REPORT
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Prepared for:

U. S. Department of the Navy
Southwest Division
Naval Facilities Engineering Command
Environmental Division
1220 Pacific Highway
San Diego, California 92132-5190

Prepared by:

IT Corporation
4005 Port Chicago Highway
Concord, California 94520-1120

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Attachment 1 Site Photographs

Acronyms and Abbreviations

AIMTech	Advanced Infrastructure Management Technologies
ECR	Environmental Conditions Report
IR	Installation Restoration
IT	IT Corporation
NAS	Naval Air Station
NTCRA	non-time critical removal action
Ogden	Ogden Environmental and Energy Services
OHM	OHM Remediation Services Corp.
Pier E	Pier Echo
RAP	Removal Action Plan

1.0 Introduction

This Environmental Conditions Report (ECR) has been prepared by IT Corporation (IT) under Contract Task Order 0028 of Southwest Division, Naval Facilities Engineering Command, Environmental Remedial Action Contract N62474-98-D-2076 in support of the non-time critical removal action (NTCRA) at Installation Restoration (IR) Site 10, the Shoreline Slag Area at Naval Air Station (NAS) North Island.

1.1 Objective

The objective of this removal action is to build a rock revetment and evapotranspiration cover to contain slag waste from IR Site 10. This ECR has been prepared to document existing buildings, plant and animal life, and waste materials. A full site description and background information can be found in Section 1.0 of the Removal Action Plan (RAP).

2.0 Existing Site Conditions

A site walk was conducted by IT personnel on May 2001 to assess conditions at the site. The following sections describe the condition of the site prior to commencement of removal action activities.

2.1 Site Setting

The shoreline slag area is bound on the northwest side by the San Diego Bay and on the southeast side by Moffett Road. Figure 2 in the RAP illustrates the site layout in detail.

2.2 Buildings and Structures

Buildings and structures located in the area include Pier Echo (Pier E), Building 380, Building 387, and Building 1348. Pier E is a concrete structure that extends approximately 200 feet from the shoreline bluff into the shipping canal of San Diego Bay (see Photos 1 and 1A). Buildings 380, 387, and 1348 are located on top of the bluff adjoining the shoreline. The Public Works Commission uses Building 380 for paper incineration (see Photo 2). A fenced, 1-foot-thick concrete pad (approximately 120 x 75 feet) located behind Building 380 is used for storage and parking (see Photo 3). Building 387, located approximately 75 feet southwest of Building 380, houses telecommunications equipment (see Photos 4 and 5). Building 1348 is approximately 80 feet south of the southeast end of Pier E and houses a sewage lift station (see Photo 6). A transformer pad is directly adjacent to Building 1348 (see Photo 6).

On the northeast side of Pier E, a stretch of chain-link fencing (approximately 40 feet long) on the beach extends from the bay to the shoreline bluff (see Photo 7). Rock riprap and concrete riprap overlie portions of the face of the shoreline bluff southwest of Pier E (see Photo 8).

2.3 Utilities

Utilities in the general area of the Shoreline Slag Area include electrical, sewer, water, and storm water lines.

Underground utilities at the site and in the immediate vicinity are shown on Figure 4 of the RAP. Utilities located at the top of the shoreline bluff include various water supply, electrical, and telephone conduits and a 4-inch natural gas pipeline that parallels the northwest side of Moffett Road. A 36-inch diameter concrete storm water drain discharges to the intertidal zone about 90 feet from the shoreline bluff and 25 feet southwest of Pier E (see Photo 9). A second concrete

storm water drain, 18 inches in diameter, terminates at Outfall 4 in the intertidal zone immediately southwest of the site boundary.

A 6-inch diameter decommissioned iron sewer pipe formerly associated with a septic tank underlying the concrete pad behind Building 380 terminates in the intertidal zone in the former Emergency Removal Action area. As shown in Figure 4 of the RAP, the septic tank is connected by piping that extends to a sewage lift station (Building 1348), which is connected to the main NAS North Island sanitary sewer. A second iron sewer pipe, approximately 8 inches in diameter, also serviced a former septic tank at the top of the shoreline bluff. The abandoned sewer pipe is exposed in the intertidal zone near the northeastern boundary of the site (see Photo 10).

2.4 Plant and Animal Life

The area surrounding the Shoreline Slag Area is generally industrial and contains man-made structures such as parking lots, buildings, and roadways. A biological survey of the area was performed on April 29, 2000 (Ogden Environmental and Energy Services [Ogden], 2000) to identify potentially sensitive plant or animal species present at or in the immediate vicinity of the site that could be impacted by the planned NTCRA.

2.4.1 Plant Life

The disturbed habitat on the roadside of the slopes to the beach is dominated by red-stemmed filaree *(Erodium cicutarium)*, beach primrose *(Camissonia cheiranthifolia)*, telegraph weed *(Heterotheca grandiflora)*, *Acacia* sp., sea fig *(Carpobrotus chilensis)*, and *Carpobrotus edulis* (Ogden, 2000). Other plant species observed included black mustard *(Brassica nigra)*, several ornamental agave *(Agave* spp.), sweet yellow clover *(Melilotus officinalis)*, deerweed *(Lotus scoparius)*, and several species of nonnative grasses. In areas with less disturbance near fences around buildings and along the slope perimeter, several individuals of Nuttall's lotus *(Lotus nuttallianus)* were identified (Ogden, 2000). A total of 34 individual Nuttall's lotus plants were identified.

The sandy beach between the steep slope and San Diego Bay is sparsely vegetated near the base of the slope with sea rocket *(Cakile maritima)*. Cover of sea rocket on the beach is less than 5 percent (Ogden, 2000). Examples of vegetation along the shoreline bluff are depicted in Photos 7 and 11.

The survey conducted by Ogden indicated that the NTCRA would potentially impact 34 *Lotus nuttulianus* (Nuttall's lotus) plants in the vicinity of the site. The Nuttall's lotus plant is

classified as a Federal species of special concern and is considered by the California Native Plant Society to be extremely rare.

2.4.2 Animal Life

Wildlife species observed on or over the site include side-blotched lizard *(Uta stansburiana)*, European starling *(Sturnus vulgaris)*, Anna's hummingbird *(Calypte anna)*, mourning dove *(Zenaida macroura)*, and California ground squirrel *(Spermophilus beecheyi)* (Ogden, 2000). Although no San Diego black-tailed jackrabbits *(Lepus californicus bennettii)* were observed on site, droppings that appear to be from jackrabbits were found on site and were previously sighted in the vicinity (Ogden, 2000). The brown pelican *(Pelecanus occidentalis)*, western gull *(Larus occidentalis)*, and royal tern *(Sterna maxima)* were also observed flying over the site and over adjacent San Diego Bay (Ogden, 2000).

Pier pilings, rocks, and other structures on site supported numerous marine invertebrates including mussels, oysters, clams, chitons, snails, and whelks (Ogden, 2000).

2.5 Historic and Archaeological Sites

Archaeological testing was performed at NAS North Island in 1995 (Gross et al., 1996). The IR Site 10 Shoreline Slag Area does not exhibit any characteristics for preservation under the Archaeological Resources Protection Act. The archaeological testing was performed at the same time a National Register Assessment was conducted for the IR Site 10 Shoreline Slag Area (Gross et al., 1996). The IR Site 10 Shoreline Slag Area does not exhibit any characteristics for preservation under the National Historic Preservation Act.

2.6 Waste Materials

The physical appearance of the slag wastes disposed of at the shoreline bluff varies as a function of metal types, the degree of incineration/melting to which the metals were subjected, the relative percentages of metals or ash present, and the extent of alteration due to weathering (OHM Remediation Services Corp. [OHM], 1999). Metal debris associated with the slag wastes ranged from identifiable undeformed mechanical parts to fragments encompassed by completely melted material. The slag wastes include friable, unconsolidated ash with metal debris; unconsolidated ash mixed with artificial fill material; well-indurated welded material with metal, glass, and/or ceramic inclusions; and unconsolidated metal debris.

The areal extent of slag wastes disposed at the shoreline bluff has been conservatively approximated at 17,343 square feet (Advanced Infrastructure Management Technologies [AIMTech], 2001). The volume of slag waste material is estimated to range from 1,290 to 2,580

cubic yards, calculated using the average waste thickness of 2 to 4 feet obtained from field measurements (AIMTech, 2001). The maximum observed overburden thickness is approximately 4 feet (OHM, 1999).

3.0 References

Advanced Infrastructure Management Technologies, 2001, *Final Extended Remedial Investigation/RCRA Facility Investigation, Site 10: Shoreline Slag Area, San Diego, California*, with Space and Naval Warfare Systems Command, September.

Gross, G.T., M. Robins-Wade, and J.L.R. Whitehouse, 1996, *Archaeological Testing and National Register Assessment for Sites at NAS North Island, San Diego, California*.

Ogden Environmental and Energy Services, 2000, Letter summarizing biological resources identified at Installation Restoration (IR) Site 10, Naval Air Station (NAS) North Island, May 17.

OHM Remediation Services Corp., 1999, *Technical Memorandum: Supplemental Field Investigation, IR Site 10 Shoreline Slag Area, Naval Air Station North Island, San Diego, California*, July 23.

ATTACHMENT 1
SITE PHOTOGRAPHS

Photo 1 – View of Pier Echo (Pier E) facing west.

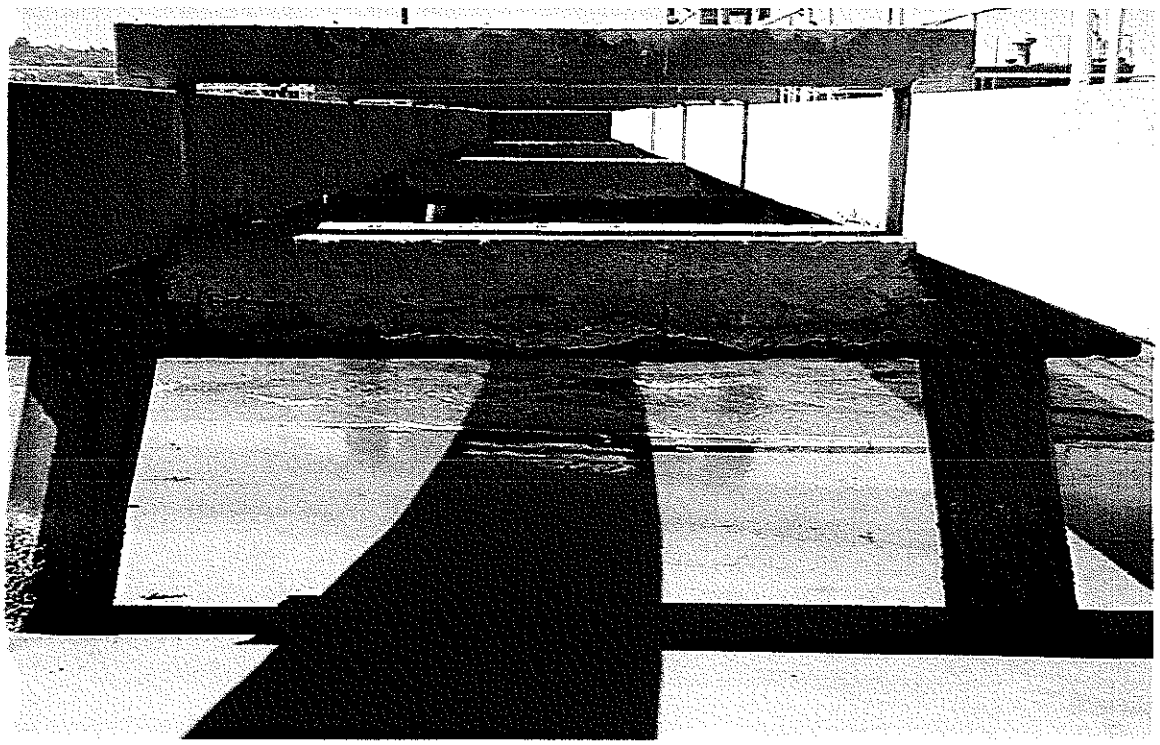

Photo 1A - Underside of Pier E facing northwest.

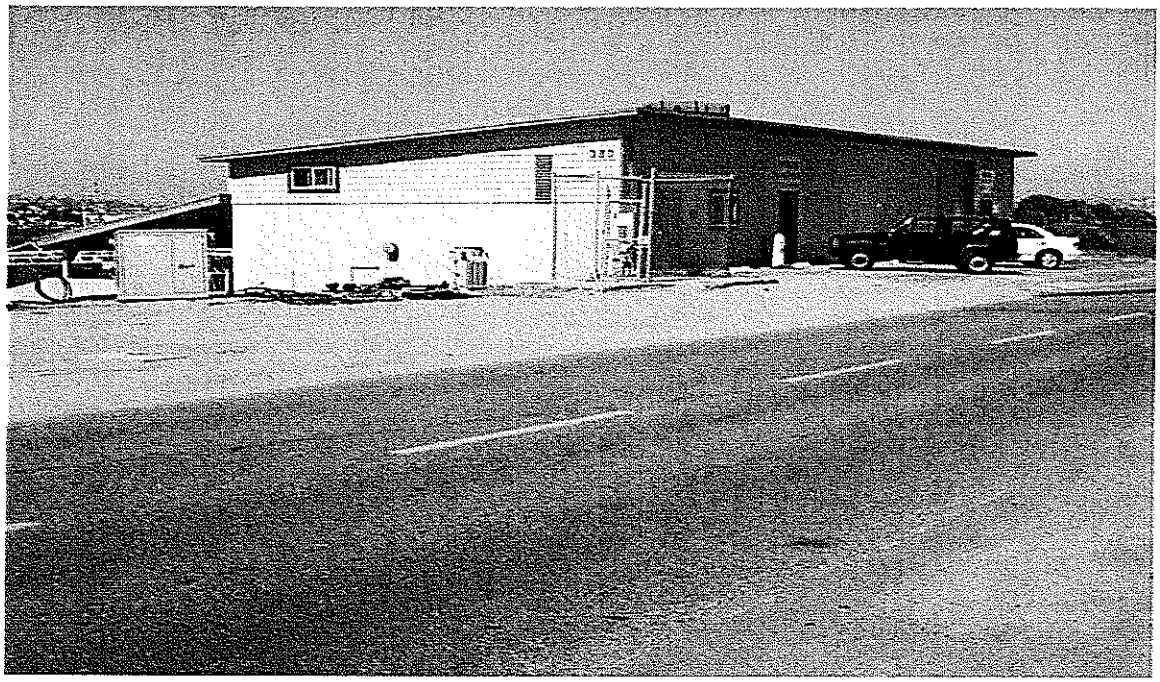

Photo 2 – Building 380, facing north. Moffet road in foreground, concrete pad depicted in Photo 2 in rear of Building 380.

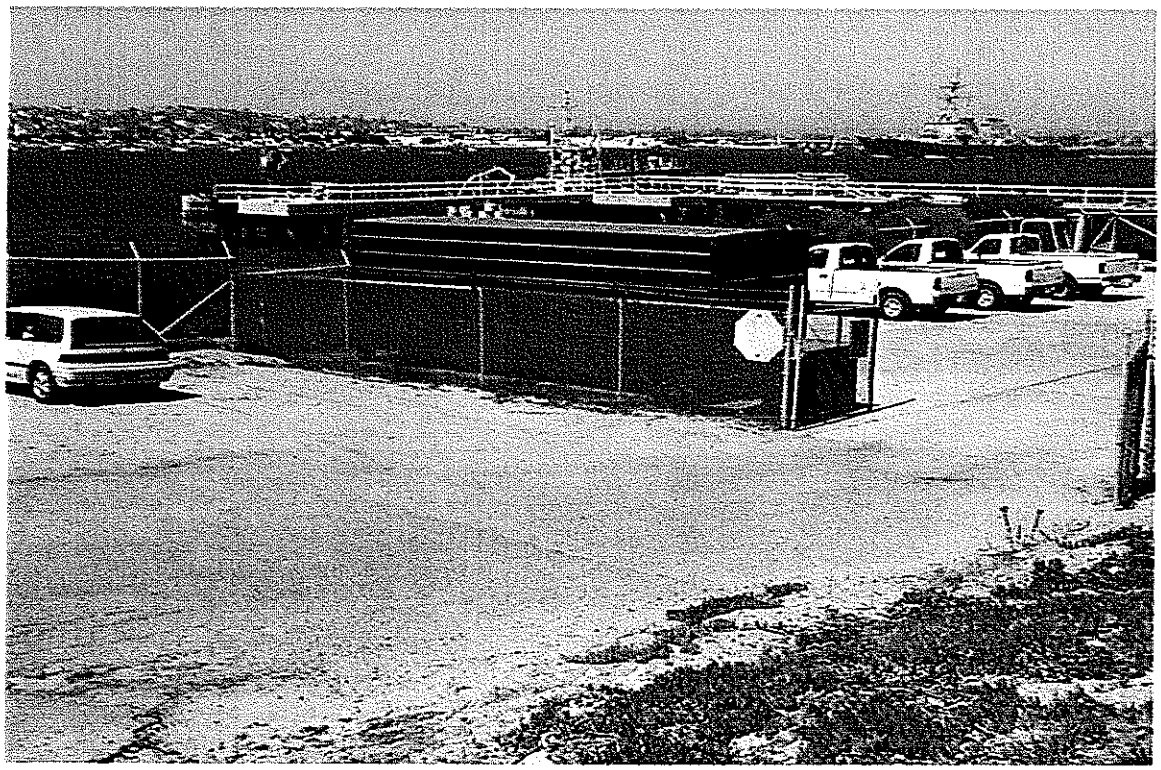

Photo 3 – Fenced concrete pad (120 by 75 feet) behind Building 380 used for storage and parking (Pier E in background). Facing north.

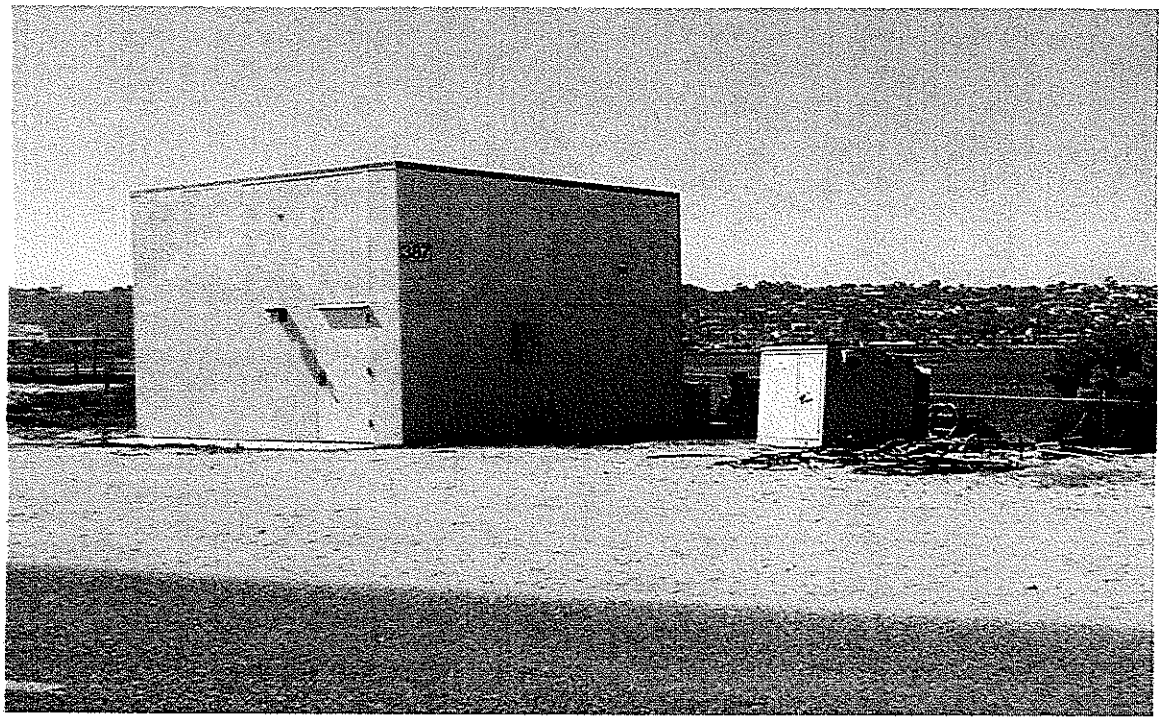

Photo 4 - Building 387, facing northwest. Moffet road in foreground.

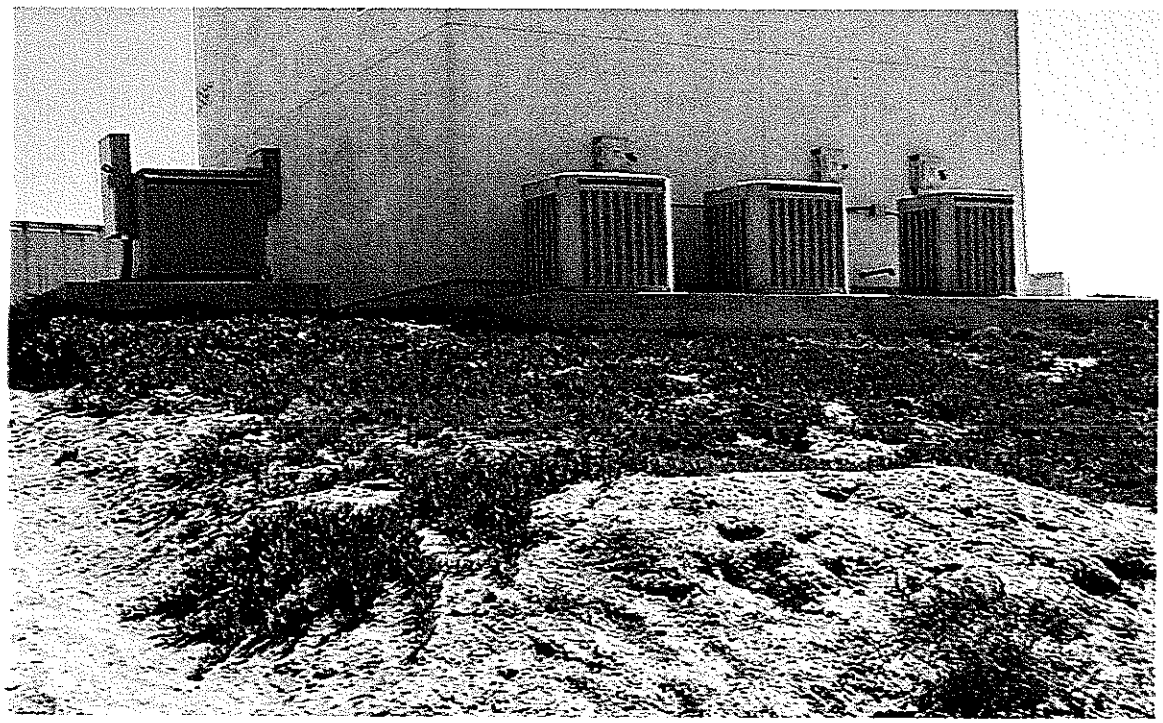

Photo 5 – Rear of Building 387, facing southwest.

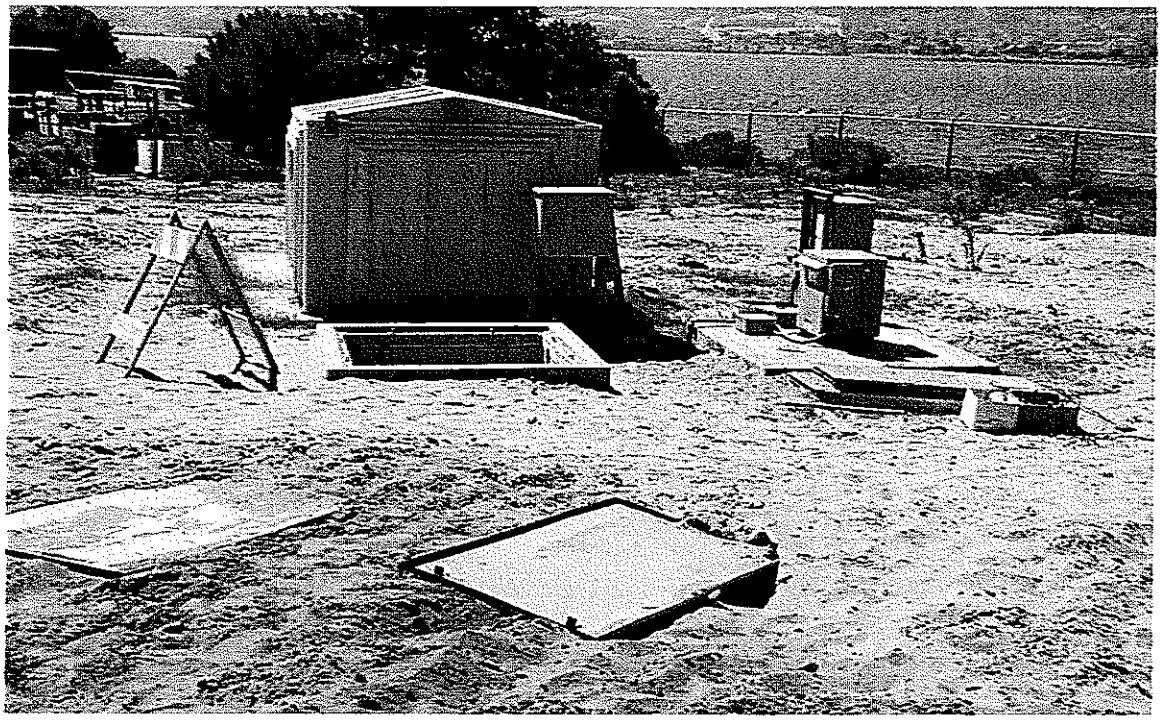

Photo 6 - Building 1348 and adjacent transformer pad, facing west.

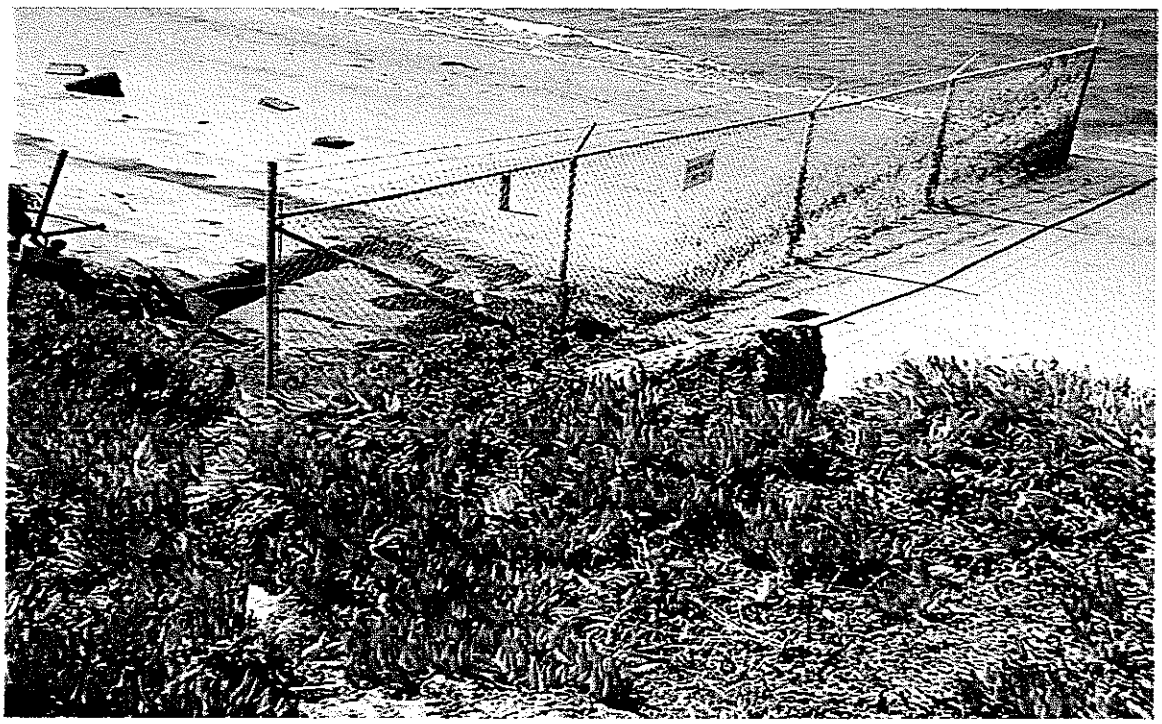

Photo 7 – Fence on northeast side of Pier E between shoreline bluff and San Diego Bay. Facing west.

Photo 8 – Rock and concrete riprap along shoreline bluff in solid waste management unit 134(southwest of
Pier E).

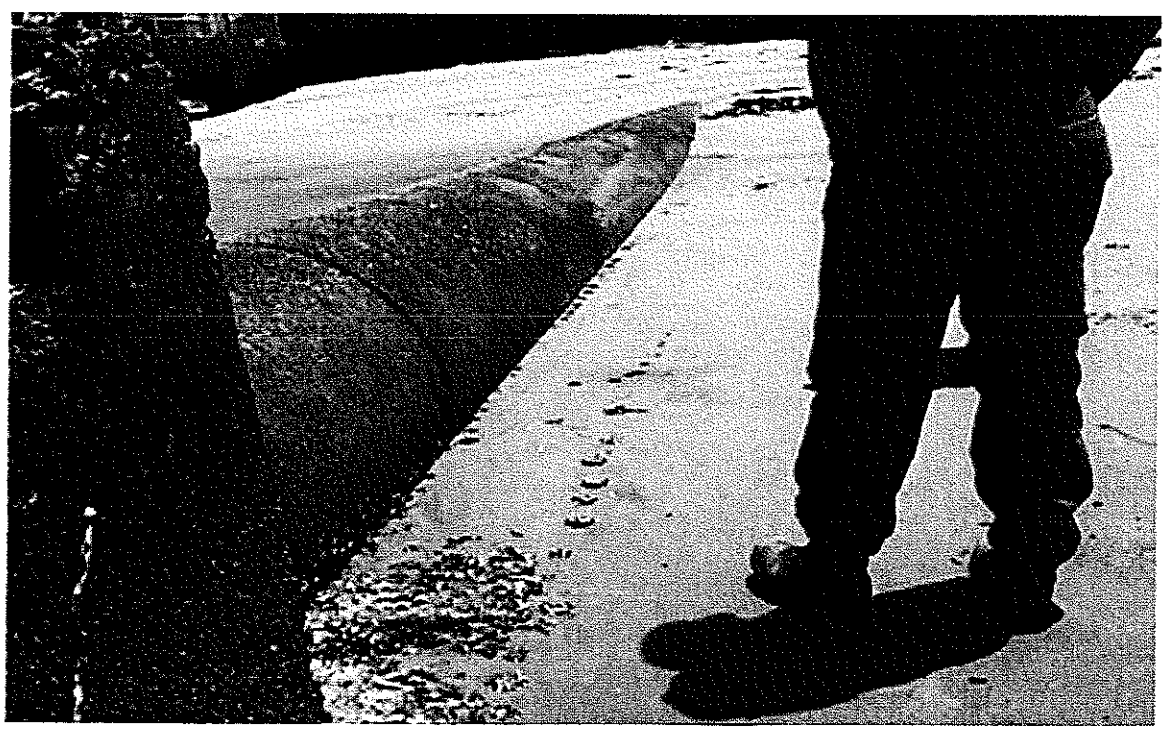

Photo 9 – A 36-inch-inch storm drain to the west of Pier E. Looking southeast (toward shoreline bluff).

Photo 10 – Fence on northeast side of Pier E between shoreline bluff and San Diego Bay with exposed slag waste and ash on bluff. An 8-inch iron pipe (in foreground of fence). Facing east.

Photo 11 – Example of vegetation along shoreline bluff.

APPENDIX D
PROJECT QUALITY CONTROL PLAN

PROJECT QUALITY CONTROL PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Prepared for:

U. S. Department of the Navy
Southwest Division
Naval Facilities Engineering Command
Environmental Division
1220 Pacific Highway
San Diego, California 92132-5190

Prepared by:

IT Corporation
4005 Port Chicago Highway
Concord, California 94520-1120

PROJECT QUALITY CONTROL PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Approved by: Stephen P. Massey
Stephen P. Massey
IT Program Quality Control Manager

Date: 7-8-02

Approved by: Richard L. Wong
Richard L. Wong, C.E.G., C.H.G.
IT Project Manager

Date: 7·8·02

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Attachment 2 Alternate Project QC Manager Letter of Designation
Attachment 3 QC Organization Chart
Attachment 4 Definable Features of Work Matrix
Attachment 5 Testing Plan and Log
Attachment 6 Resume for Project QC Manager
Attachment 7 CQM Training Certificate
Attachment 8 Project Cost and Charge Control

Acronyms and Abbreviations

IT	IT Corporation
PQCP	Project Quality Control Plan
QC	quality control
QCPP	Quality Control Program Plan
SOP	standard operating procedures
SQP	standard quality procedures

1.0 Introduction

This Project Quality Control Plan (PQCP) was prepared to describe the quality control (QC) procedures that IT Corporation (IT) will implement during remediation activities at Installation Restoration Site 10, Shoreline Slag Area, Naval Air Station North Island, San Diego, California.

This PQCP will be used in conjunction with the IT Quality Control Program Plan (QCPP) prepared under Contract Task Order 0028 of Remedial Action Contract N62474-98-D-2076 (IT, 2000a) and with the IT Standard Quality Procedures (SQPs) and Standard Operating Procedures (SOPs) Manual (IT, 2000b), as applicable. Section 2.0 of this PQCP describes the portions of the QCPP that are applicable to this project and any site-specific modifications to the QCPP. Section 3.0 lists applicable SQPs and SOPs.

2.0 Quality Control Program Plan

The following portions of the QCPP are applicable to the work that will be conducted under this project, with modifications as noted:

- Management Policy Statement: applicable in its entirety
- Section 1.0 – Introduction: applicable in its entirety
- Section 2.0 – Organization and Responsibilities: applicable in its entirety
- Section 3.0 – Quality Control Management: applicable in its entirety
- Section 4.0 – Personnel Training and Qualification: applicable in its entirety
- Section 5.0 – Instructions, Procedures, and Drawings: applicable in its entirety
- Section 6.0 – Document Control: applicable in its entirety
- Section 7.0 – Procurement: applicable in its entirety
- Section 8.0 – Chemical Data Quality: applicable in its entirety
- Section 9.0 – Field Sampling and Quality Control: applicable as described in the project Sampling and Analysis Plan (SAP)
- Section 10.0 – Laboratory Analysis: applicable in its entirety
- Section 11.0 – Report Preparation: applicable in its entirety
- Section 12.0 – Review of Work Activities: applicable in its entirety
- Section 13.0 – Inspections: applicable in its entirety
- Section 14.0 – Calibration and Maintenance of Measuring and Test Equipment: applicable in its entirety
- Section 15.0- Test Controls: applicable in its entirety
- Section 16.0- Nonconformance Control and Corrective Actions: applicable in its entirety
- Section 17.0- Change Control: not applicable (see Section 3.3)
- Section 18.0 – Audits and Surveillance: applicable with the following modification: Sections 18.1 through 18.8 do not apply
- Section 19.0 – Records Management: applicable in its entirety

3.0 Procedures

These sections list SQPs/SOPs that may be implemented on the project.

3.1 Standard Quality Procedures

The following IT SQPs will be available at the job site to support this project:

- SQP 1.1 - Contractor Quality Control Program
- SQP 3.2 - Indoctrination and Training
- SQP 4.1 - Document Control
- SQP 4.2 - Records Management
- SQP 5.1 – Preparation, Revision and Approval of Plans and Procedures
- SQP 6.1 - Preparation, Review, and Approval of Procurement Documents
- SQP 7.1 - Quality Inspections and Inspection Records
- SQP 7.2 - Receipt Inspection
- SQP 8.2 - Calibration and Maintenance of Measuring and Test Equipment
- SQP 9.1- Control of Test
- SQP 10.1 - Nonconformance Control
- SQP 10.2 - Corrective Action
- SQP 12.1 - Quality Audits
- SQP 12.2 - Management Assessment
- SQP 12.3 - Quality Surveillances
- SQP 13.1 - Coordination of Subcontracted Analytical Laboratories.

3.2 Standard Operating Procedures

The following IT SOP will be available at the job site to support this project:

- SOP 1.1 - Chain of Custody
- SOP 2.1 - Sample Handling, Packaging, and Shipping
- SOP 3.1 - Surface and Shallow Subsurface Soil Sampling
- SOP 3.2 - Subsurface Soil Sampling While Drilling
- SOP 3.3 - Soil Screening for Petroleum Hydrocarbons with the Infracal TOG/TPH Analyzer
- SOP 3.5 - Soil Sampling with Encore Sampler for Volatile Organic Compounds
- SOP 5.1 - Water Level Measurements in Monitoring Wells
- SOP 5.2 - Nonaqueous Phase Liquid Measurement in Monitoring Wells
- SOP 6.1 - Sampling Equipment and Well Material Decontamination
- SOP 6.2 - Drilling and Heavy Equipment Decontamination
- SOP 7.1 - Surface and Subsurface Geophysics

- SOP 8.1 - Monitoring Well Installation
- SOP 8.2 - Monitoring Well Development
- SOP 8.3 - Bore Hole and Well Abandonment
- SOP 9.1 - Groundwater Sampling
- SOP 10.1 - Soil Organic Vapor Sampling
- SOP 10.2 - Cone Penetration Testing and Hydropunch Groundwater Sampling
- SOP 11.1 - Aquifer Testing
- SOP 12.1 - Soil Stockpiling
- SOP 13.1 - Indoor Air Quality Sampling Using Summa Canisters
- SOP 14.1 - Hollow-Stem Auger Drilling
- SOP 14.2 - Mud Rotary Drilling
- SOP 14.3 - Air Rotary Drilling
- SOP 14.4 - Dual Tube Percussion Drilling
- SOP 17.1 - Sample Labeling
- SOP 17.2 - Sample Numbering
- SOP 18.1 - Field QC Sampling
- SOP 19.1 - On-Site Sample Storage
- SOP 23.1 - Land Surveying.

3.3 Project Cost and Change Control

During the course of the removal action, changes to the SOPs and/or the RAP will be documented using the Work Variance Form in Attachment 8.

IT Corporation has revised the Project Cost and Change Control that will be used for this contract. Therefore, as indicated in Section 2, Section 17.0 (Change Control) of the QCPP has been eliminated and replaced with draft guidelines presented in Attachment 8.

4.0 References

IT Corporation, 2000a, *Quality Control Program Plan for Environmental Remedial Actions, Revision 0,* August.

IT Corporation, 2000b, *Standard Quality Procedures and Standard Operating Procedures Manual, Revision 2,* August.

ATTACHMENT 1
PROJECT QC MANAGER LETTER OF DESIGNATION

PROJECT QUALITY CONTROL PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA
Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

QUALITY CONTROL MANAGER
LETTER OF DESIGNATION

July 8, 2002

Quality Control Manager:

This letter will serve to assign you as IT Corporation's Quality Control (QC) Manager for the above-captioned contract task order. In the case where you are not able to perform the QC Manager's duties, Mr. John Krowitz will serve as your Alternate QC Manager. In the role of QC Manager, you have the responsibilities and authorities designated in Section 2.1.3 of the Program Quality Control Program Plan (QCPP), Revision 2. Additionally, you are granted stop work authority and will exercise this authority consistent with the QCPP, Section 16.4. You are granted the authority to approve submittals that have been certified by qualified submittal reviewers, as identified in the QC Organization Chart for this contract task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work. In this capacity, you will report directly to me and will administer the established requirements of the contract task order Project QC Plan.

If you have any questions or require additional information, please contact me at (619) 446-4522.

Sincerely,
IT CORPORATION

Stephen Massey
Program QC Manager

ATTACHMENT 2
ALTERNATE PROJECT QC MANAGER LETTER OF DESIGNATION

PROJECT QUALITY CONTROL PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA
Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

ALTERNATE QUALITY CONTROL MANAGER
LETTER OF DESIGNATION

July 8, 2002

Mr. John Krowitz:

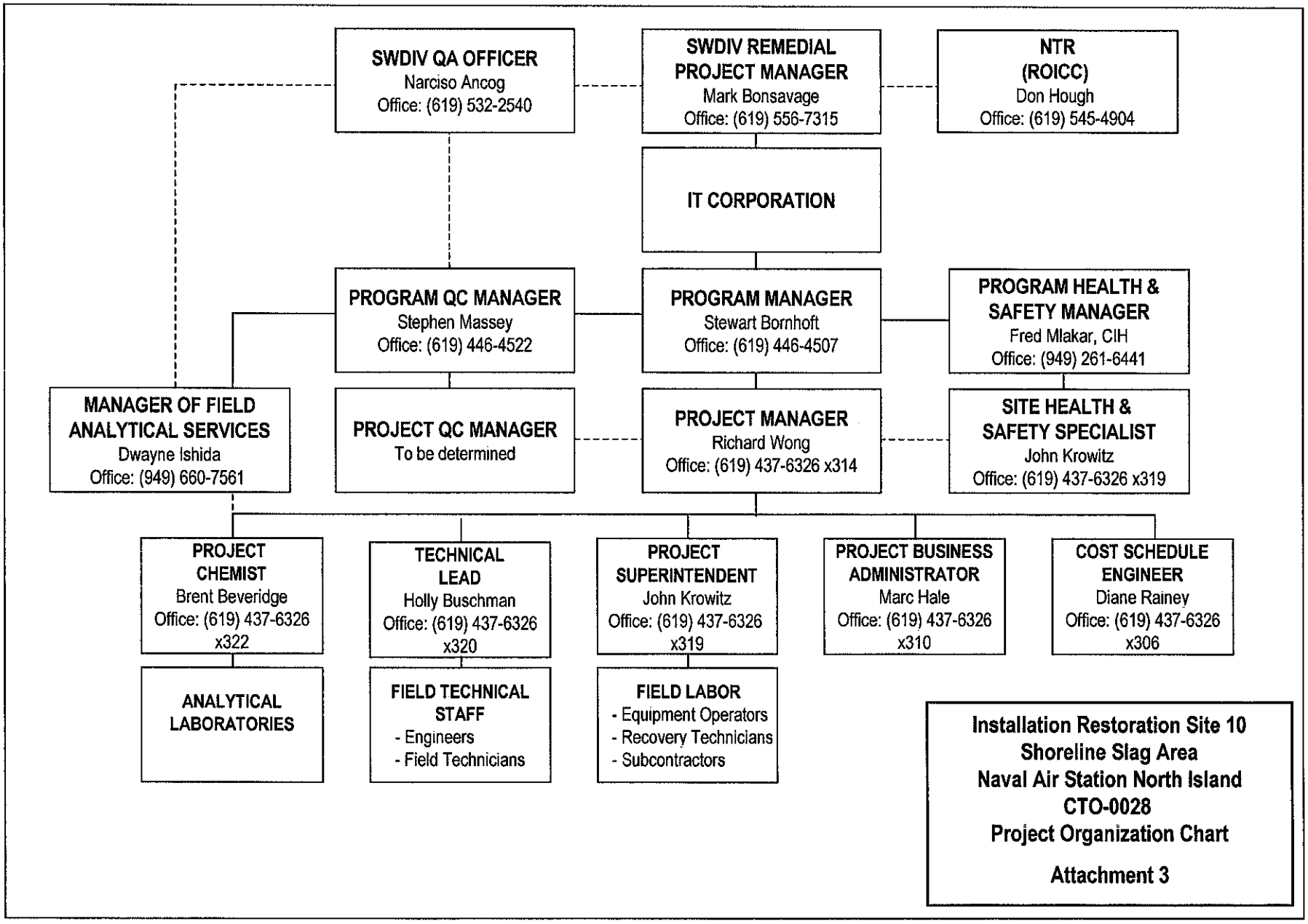
This letter will serve to assign you as IT Corporation's Alternate Quality Control (QC) Manager for the above-captioned contract task order. In the case where the designated QC Manager is unable to perform the QC Manager's duties, you will serve in that capacity. In this role, you will have the responsibilities and authorities designated in Section 2.1.3 of the Quality Control Program Plan (QCPP). Additionally, you will have Stop Work authority and will exercise this authority consistent with the QCPP, Section 16.4. You are granted the authority to approve submittals that have been certified by qualified submittal reviewers, as identified on the QC Organization Chart for this contract task order and as necessary to ensure the quality of the work, and direct the removal and/or replacement of nonconforming materials or work. You will be authorized to act as an alternate for 14 consecutive working days or 30 nonconsecutive working days at a maximum. In the case where it is believed that these time periods will be exceeded, you must notify me so that I may arrange with Southwest Division and the Resident Officer in Charge of Construction to have this position replaced. You will report directly to me and will administer the established requirements of the delivery order Project QC Plan.

If you have any questions or require additional information, please contact me at (619) 446-4522.

Sincerely,
IT CORPORATION

Stephen Massey
Program QC Manager

ATTACHMENT 3
QC ORGANIZATION CHART



Installation Restoration Site 10
Shoreline Slag Area
Naval Air Station North Island
CTO-0028
Project Organization Chart

Attachment 3

ConcDP-F:\818724 North Island CTO 28\Site IR 10\Append D\orgcht.ppt

ATTACHMENT 4
DEFINABLE FEATURES OF WORK MATRIX

DEFINABLE FEATURES OF WORK MATRIX
INSTALLATION RESTORATION SITE 10
SHORELINE SLAG AREA
NAS NORTH ISLAND

Specification Section	Section No.	Feature of Work	Task Lead	Preparatory Meeting	Preparatory Inspection	Initial Inspection	Follow-Up Inspection	Completion Inspection
RAP	4.2.1	Conduct Geophysical/Utility Survey	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager
RAP	4.2.3	Mobilize Personnel and Equipment/Setup Temporary Facilities	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	4.2.6	Clear and Grub Existing Vegetation and Debris	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	4.2.6, 6.3.1	Install Bldg. 380 Access Ramp	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	5.1.1	Excavate Waste Consolidation Area (WCA)	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	5.1.2	Excavate Slag Wastes and Place in WCA	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	5.1.3	Land Survey	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager
RAP	5.1.3.1	Confirmation Sampling	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager
RAP	5.1.3.2	Backfill Excavations	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	5.2	Install Evapostranspiration (ET) Cover	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager
RAP	5.3	Construct Rock Revetment	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	6.3	Site Restoration	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	6.1.1	Install Four Groundwater Monitoring Wells	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager
RAP	6.1.4.2	Groundwater Monitoring Well Development	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager
RAP	6.1.3	Groundwater Monitoring Well Surface Completion	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	5.2.1.2	Landscape ET Cover	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager
RAP	6.3	Demobilize Personnel and Equipment	John Krowitz	John Krowitz	Project QC Manager	John Krowitz	Project QC Manager	Project QC Manager
RAP	6.2	Complete Full Site Radiological Scan	Holly Buschman	Holly Buschman	Project QC Manager	Holly Buschman	Project QC Manager	Project QC Manager

RAP denotes Removal Action Plan.

ATTACHMENT 5
TESTING PLAN AND LOG

TESTING PLAN AND LOG

CONTRACT NUMBER	PROJECT TITLE AND LOCATION	CONTRACTOR
N62474-98-D2076	Non Time-Critical Removal Action, Installation Restoration Site 10	The IT Group

SPECIFICATION SECTION AND PARAGRAPH NUMBER	ITEM OF WORK	TEST REQUIRED	ACCREDITED/APPROVED LAB		SAMPLED BY	TESTED BY	LOCATION OF TEST		DATE COMPLETED	DATE FORWARDED TO CONTR. OFF	REMARKS
			YES	NO			ON SITE	OFF SITE			
RAP 5.2.1.1 and 6.3.1		Compaction	X		Sub	Sub		X			ASTM method D 1557
RAP 6.3.1		Field Density	X		Sub	Sub	X				ASTM Method D 1556

Abbreviations:
RAP - Removal Action Plan

ATTACHMENT 6
RESUME FOR PROJECT QC MANAGER

The resume for Project Quality Control Manager will be provided at a future date.

ATTACHMENT 7
CQM TRAINING CERTIFICATE

A CQM training certificate will be provided at a future date.

ATTACHMENT 8
PROJECT COST AND CHARGE CONTROL

Attachment 8 includes the following documents:

- A Project Cost and Change Control Flow Chart
- A Responsibility Matrix
- A Work Variance Form and Example
- A Notice of Potential Impact (NOPI) Checklist and Example Correspondence
- A Request for Additional Funds (RAF) Checklist and Example Correspondence

1

PLAN AND PERFORM THE SCOPE OF WORK

- o CTO SOW
- o Modification(s)
- o Procurement Plan
- o Technical Assumptions
- o Schedule and WBS

Cost/Productivity Tracking and Forecasting

2A

***Would - Does - Did* COST TO PERFORM TASK EXCEED BUDGET?**

No

No

2B

CHANGE OR VARIANCE FROM SCOPE?

Scope/Quantity Tracking & Change Control

Project Controllable

Yes

3

Yes

Project Uncontrollable

PREPARE AND SUBMIT WORK VARIANCE REPORT (WVR)

WVR internally documents the following:

- o In Scope, Unbudgeted Tasks (2A)
- o In Scope Cost Growth (2A)
- o Task Not in Scope/Scope Growth (2B)
- o Changes to Project Work Plan or SAP (2B)
- o Flag Variances >10% or $10K (Pos & Neg)

Key Work Varience Elements

- *o Form merely documents.*
- *o Does not seek $ by itself.*
- *o Relies on PM judgement.*
- *o May put Co. at risk < 24 hrs.*
- *o Does NOT require Navy approval*
- *o Encourages coord. with Navy.*
- *o Requires coordination w/PMO.*
- *o May provide documentation to support NOPI/RAF.*

Internal to Project (Above dashed line)

PMO Involvement (Below Dashed line)

4

ACTIONS REQUIRED BASED ON WORK VARIANCE?

Prevent Surprises

5A

PROJECT TEAM TRACKS AND REPORTS IMPACTS

(e.g., Scope, Cost and Schedule)

- o Monitor (No notification to Navy); or
- o E-mail notification to Navy Contracts
- o Obtain Tech Direction Letter, if needed
- o Action: Explain Variances >10% or $10K of budget in Monthly Reports (Pos & Neg)

"NOPI; no additional dollars are needed now"

"RAF; additional dollars are needed by (Date) "

5B

PREPARE AND SUBMIT NOTIFICATION OF POTENTIAL IMPACT (NOPI)

- o Provide current contract status (i.e , scope, funding, and change summary)
- o Change description(s)
- o Provide and substantiate estimated quantity/cost/ schedule impact range(s) at task completion
- o Advise whether or not funds MAY be required & when
- o Specify and request SWDIV action
- o Provide response date

and/ or

5C

PREPARE AND SUBMIT REQUEST FOR ADDITIONAL FUNDS (RAF)

- o Provide current contract status (i.e., scope, funding, and change summary)
- o Change description(s)
- o Attach support documentation
- o Request revision to contract price and schedule
- o Specify requested actions
- o Specify response date, and planned measures or actions in the event of non-response

Hank

6

PMO CONTRACTS MANAGER SUBMITS REQUEST TO SWDIV

- o PM drafts and signs
- o Note: Do not "surprise" Navy with NOPI/RAF

Typical SWDIV Actions

- o Issue Letter of Technical Direction
- o Issue RFP to IT Corp
- o Issue Contract Mod

PROJECT COST AND CHANGE CONTROL

04/23/02-19

PROJECT COST AND CHANGE CONTROL

No.	Task	Responsibility	Related Documents	Time Frame
1.	**PLAN AND PERFORM THE SCOPE OF WORK**	***PM (L)***, Project Team (TL, S, CSE, PBA, QC, HSO, etc.)	CTO SOW, Modification(s), Technical Assumptions, Work Plan	CTO Period of Performance (POP)
2A.	**WOULD – DOES – DID COST TO PERFORM TASK EXCEED BUDGET?**	***PM (L)***, Project Team	Estimate, Project WBS and Budgets, Production Curves, Cost Reports	Within 4 Hrs. of change identification
2B	**CHANGE OR VARIANCE FROM SCOPE?**	***PM (L)***, Project Team	CTO SOW, Technical Assumptions, Work Plan	Within 4 Hrs. of change identification
3	**PREPARE AND SUBMIT WORK VARIANCE REPORT**	***PM(L)***, Project Team; DPM, KM	Work Variance Report **(See Example)**	Notify PMO DPM or KM within 24 hours of variance identification
4.	**ACTIONS REQUIRED BASED ON WORK VARIANCE?**	***PM(L)***, KM, DPM PM	Work Variance Report	Disposition made within 24 hours of PM notification
5A	**PROJECT TEAM TRACKS AND REPORTS IMPACTS**	***S(L)***, TL, CSE, PBA	Daily Production Report; CQC Meeting Minutes; Monthly Project Reports	Daily, Weekly, Monthly
5B.	**PREPARE AND SUBMIT NOTIFICATION OF POTENTIAL IMPACT (NOPI)**	***PM(L)***, KM, DPM, E, SWDIV RPM, SWDIV KS	Notification of Potential Impact (NOPI) **(See Example)**	TBD
5C.	**PREPARE AND SUBMIT REQUEST FOR ADDITIONAL FUNDS (RAF)**	***PM(L)***, KM, DPM, E, SWDIV RPM, SWDIV KS	Request for Additional Funds (RAF) **(See Example)**	TBD
6	**PMO CONTRACTS MANAGER SUBMITS REQUEST TO SWDIV**	***KM(L)***, PM	NOPI, RAF, 75% Letter, if required	TBD

RESPONSIBLITY CODES:

PROJECT: PM= Project Manager; TL= Tech Lead; S= Superintendent; CSE= Cost/Schedule Engineer; PBA= Project Business Accountant, QC= Quality Control Manager, HSO= Health & Safety Officer

PMO: KM= IT EFA West Contracts Manager; DPM= Deputy Program Manager; E= PMO Estimating Manager; SA= Subcontracts Administrator

SWDIV: SWDIV RPM= SWDIV Remedial Project Manager, SWDIV KS= SWDIV Contracts Specialist; SWDIV ROICC= SWDIV Resident Officer In Charge of Construction

NOTE: The final guideline, *Project Cost and Change Control*, will consist of the flow chart, this Responsibility Matrix, and Exhibits. The Exhibits will consist of a PDF example and MS Word Template.

Work Variance

Project Name: _____ **DCN:** _____

Project Number: _____ **Project Manager:** _____ **WV #:** _____

Contract Number: _____ **SWDIV RPM:** _____ **Date:** _____

CTO Number: _____ **SWDIV CS:** _____

Item: _____ **Primary WBS:** _____

Description *(Include recommended action to resolve changed condition and action taken to date)*

Reason for Change

Technical Justification

Estimated Cost Impact	Estimated Schedule Impact	WBS Information
		☐ WBS Code Opened to Capture Cost **Task Title:** _____ **WBS Code:** _____

Applicable Document(s)

PMO Disposition of Work Variance

Type of Change: _____

- ☐ Monitor; No notice to Navy Review by_____ (Date)
- ☐ E-Mail Notification to Navy
- ☐ Notice of Potential Impact (NOPI)
- ☐ Request for Additional Funds (RAF)
- ☐ Other (Please Comment)

Additional Comments

Approvals

Project Manager _____ **Date:** _____

PMO Contracts Manager _____ **Date:** _____

This form documents a newly discovered or developing situation. Submitting a Work Variance (WV) to the PMO allows a PM to direct a variation in work that may put the company at financial risk **for up to one business day**. During that time, the PM gathers additional information, assesses the situation and coordinates with the IT Contracts Administration Manager (and others, as appropriate) to determine further actions

Close coordination with the Client is expected throughout the process.

However, a WV form does not require Client review or approval; it depends solely on the good judgement of the PM to act in the best interest of the Client and the company. By itself, a **WV does not seek anything** (though it may provide the documentation to support a request for additional funding or guidance)

Work Variance

Page ____ of ____

Project Name: IR Site 9, Steam Enhanced SVE and Free Product Recovery **DCN:** ____

Project Number: 823694 **Project Manager:** Merry Coons **WV #:** ____

Contract Number: N62474-98-D-2076 **SWDIV RPM:** William Collins **Date:** 5/14/01

CTO Number: 47 **SWDIV CS:** Rick Phillips

Item: Traffic Barriers **Primary WBS:** 33220990

Description *(Include recommended action to resolve changed condition and action taken to date)*
Add ballards around PWC transformer at the site and install traffic barriers along 3rd Street West.
To-date, the ballards have been installed for an approximate cost of $2500. One proposal has been received for guard rails to be installed along 3rd Street West for approximately $22,000. IT is pursuing additional options, including having PWC install an asphalt burm.

Reason for Change
A waste hauler damaged a PWC-owned transformer at the site, prompting a traffic-hazard analysis of the entire project site. It was determined that ballards should be installed around the transformer and a traffic barrier installed along 3rd Street West.

Technical Justification
The Navy requested the analysis and that action be taken to prevent future traffic incidents.

Estimated Cost Impact	Estimated Schedule Impact	WBS Information
Cost: up to ~ $25,000 Sched: no impact	No schedule impact	☐ WBS Code Opened to Capture Cost **Task Title:** Traffic Control and Barrier **WBS Code:** Code opened: 33220990

Applicable Document(s)
See att'd CQC mtg minutes, emails, and traffic hazard analysis

PMO Disposition of Work Variance

Type of Change: ____

- ☐ Monitor; No notice to Navy Review by____ (Date)
- ☐ E-Mail Notification to Navy
- ☐ Notice of Potential Impact (NOPI)
- ☐ Request for Additional Funds (RAF)
- ☐ Other (Please Comment)

Additional Comments

Approvals
Project Manager Merry Coons **Date:** 5/14/01
PMO Contracts Manager ____ **Date:** ____

This form documents a newly discovered or developing situation. Submitting a Work Variance (WV) to the PMO allows a PM to direct a variation in work that may put the company at financial risk **for up to one business day**. During that time, the PM gathers additional information, assesses the situation and coordinates with the IT Contracts Administration Manager (and others, as appropriate) to determine further actions

Close coordination with the Client is expected throughout the process.

However, a WV form does not require Client review or approval; it depends solely on the good judgement of the PM to act in the best interest of the Client and the company. By itself, a **WV does not seek anything** (though it may provide the documentation to support a request for additional funding or guidance).

NOTICE OF POTENTIAL IMPACT (NOPI) CHECKLIST

Each item must be considered and possibly addressed prior to submittal:

BACKGROUND	
	Definition of Original Scope
CONTRACT STATUS	
	Award Value with Modifications
	Funding Status (LOC/LOF)
	Last Notification
DEFINITION OF CHANGE	
	Baseline contract requirement, assumed quantity, resource requirements, and associated tasks (reference specific WBS Codes and Tasks)
	Summary of condition, dates, and circumstances causing change or increase
	Actual or resultant projected quantity, additional resources and impacts to associated tasks (reference specific WBS Codes and Tasks). This is a direct comparison.
	List of assumptions and level of confidence relative to revised task requirements
REQUESTED REVISION TO CONTRACT PRICE, DELIVERY SCHEDULE, AND FUNDING REQUIREMENTS	
	Ballpark cost impact range for Cost to Complete and Estimate at Completion
	Impact offset by cost savings (if information is available)
	Ballpark schedule impacts relative to baseline schedule
	Actions being implemented to mitigate impacts, or "to attempt to get the project back on schedule"
	Too early in project to estimate impacts (Provide rationale for this position)
ACTION REQUESTED	
	Information Only
	Technical Direction
	Request RFP
RESPONSE DATE REQUIRED	
	Impact of Non-Response

November 16, 2000

812575-ITNHO-____

Ms., Code 06B2.TB
Contracting Officer
BRAC Operations, SWDiv
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, CA 92132-5190

Addressee: Ms. Contract Specialist, Code 06CH.JHP

Contract: N62474-98-D-2076, Environmental Remedial Contract

Contract Task Order: No. 00

Subject: Notice of Potential Impact (NOPI)
Description, Location

Dear Ms. Contract Specialist,

IT Corporation (IT) hereby provides written notification of potential impacts on the cost and schedule of the above referenced contract task order (CTO).

BACKGROUND (Definition of Original Scope)

Original estimates for this project reflected an emergency response scenario and project-specific documentation was limited to conceptual designs. Since the design has now been completed, project requirements clarified, and field conditions confirmed, IT is now in a better position to accurately forecast complete project cost ramifications.

CONTRACT STATUS

Negotiated Funding for this CTO totals $_____, with authorized funding totaling $_____. Based on our latest Monthly Progress Report (reflecting costs through MO, DAY, YR), actual project costs total approximately $_____ and the projected estimate at completion is approximately $_____.

DEFINITION OF CHANGE

Address the following areas:

1. **Summary of condition, dates, and circumstances causing the change or increase**
   Recommendation: Consider attaching a table to support the following WBS and task-specific comparisons:
2. **Baseline contract requirement, assumed quantity, resource requirements (labor, equipment, materials), and associated tasks**
3. **Actual or resultant projected quantity, additional resources and impacts to associated tasks additional (tests, sampling and analysis, etc.), collectively necessary to complete task.**
4. **List of assumptions and level of confidence relative to revised task requirements**

REQUESTED ADJUSTMENTS TO THE CONTRACT PRICE, DELIVERY SCHEDULE, OTHER PROVISIONS

1. **Cost Impact Range**

IT anticipates that additional funding in the range of $_____ to _____ will be required to complete this CTO. (DETAILS)

-OR-

2. **IT anticipates impact Offset by Cost Savings**

-OR-

3. **Too Early in Project to Define**

At this time the work scope for CTO XX is estimated to be less than ___% complete. There may be **insufficient** funds available to complete the current scope of work. However, due to the relatively early stage of this CTO, it is not determinable yet whether this additional cost will be offset by cost savings from other planned activities.

This potential change will result in a variance to the schedule of ____ days/weeks.

We will continue to evaluate the magnitude of these impacts and refine the cost and schedule ramifications. A detailed estimate will then be submitted to the Navy, as appropriate.

RESPONSE REQUIRED

It is expected that current funding limitations will be reached by _____. To avoid negative schedule impact your response is requested not later than _____.

Should you have any questions, or require additional information, please contact the undersigned at (925) 288-9898.

Sincerely,
IT CORPORATION

Brenda L. Safreed
Contract Administration Manager
EFA West, PMO

Project Manager
CTO No.0025

ec: SWDiv RPM, Code 06CH.MO
SWDiv Lead RPM Code 06CH.DD
ROICC PE, Code N7E3
SWDiv Admin. Records
pc: Project File

REQUEST FOR ADDITIONAL FUNDS (RAF) CHECKLIST

BACKGROUND	
	Definition of Original Scope
CONTRACT STATUS	
	Award Value with Modifications
	Funding Status (LOC/LOF)
	Last Notification
DEFINITION OF CHANGE	
	Nature/date/circumstances
Elements of Performance Affected	
	WBS/Tasks
	Labor, Material or Both (Added, Deleted, Changed)
	Delay Impacts
	Last Notification
SUPPORTING DOCUMENTS ATTACHED	
	Cost estimate with technical assumptions
	Executed Field Work Variance
	Letter of Technical Direction
	Previously submitted and acknowledged
REQUESTED REVISION TO CONTRACT PRICE, DELIVERY SCHEDULE, AND FUNDING REQUIREMENTS	
	Dollar value required
	Estimate attached
	Schedule extension
ACTION REQUESTED	
	Request for Cost Estimate
	Forward RFP
	Funding Modification
RESPONSE DATE REQUIRED	
	Impact of Non-Response

May 15, 2000

762325-ITNHO-1017-1

Ms. Theodoris Brousard, Code 06B2.TB
Department of the Navy
BRAC Operations, Southwest Division
Naval Facilities Engineering Command
1220 Pacific Highway
San Diego, California 92132-5190

Addressee: Ms. Marietta Ocomen, Code 06CM.MO

Delivery Order No.: 0034

Contract: N62474-93-D-2151, Environmental Remedial Contract

Subject: Request For Additional Funding, Delivery Order No. 0034, Environmental Baseline Survey Sampling and Analysis, Naval Air Station Alameda, Alameda Point, California

Dear Ms. Ocomen:

IT Corporation (IT) hereby requests additional funding for the subject Delivery Order (DO).

(DEFINE REQUIREMENT)

Considerable progress has been made towards completion of the Environmental Baseline Survey report despite continued regulatory issues. In support of the Navy's effort to expedite transfer of certain portions of the base, IT is concurrently preparing Phase 2A, 2B, and 2C Sampling Reports (Parcel Evaluation Data Summaries) for Zones 1, 2, 4, 5, 16, 18, 19, and 23 (with additional zones to follow). Funding for this DO is currently being expended at a rate of approximately $40,000 per month in support of this effort.

At this current rate, the available funding for this DO (excluding award fee) will be expended by the end of May 2000. In order to maintain the current level of effort through the end of the Navy's fiscal year (September 30, 2000), approximately $160,000 in additional funding (excluding award fee) is required. Pending the Navy's concurrence, IT will prepare a detailed estimate for this additional effort. IT also requests a corresponding extension of the period of performance to September 30, 2000

Should you have questions or require additional information, please contact the undersigned at (925) 288-9898.

Sincerely,
IT CORPORATION

Dennis R. Julio, P.E.
Project Manager
D.O. 0034

Brenda L. Safreed
Contract Administration Manager
EFA West PMO

cc: Ms. Ann Klimek, BLTL, Code 06CA.AK
Mr. Dan Baden, IT
Mr. Kevin Hartmann, IT
Ms. Patricia Nelson, IT
Project File

APPENDIX E
STORM WATER POLLUTION PREVENTION PLAN

STORM WATER POLLUTION PREVENTION PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Prepared for:

U. S. Department of the Navy
Southwest Division
Naval Facilities Engineering Command
Environmental Division
1220 Pacific Highway
San Diego, California 92132-5190

Prepared by:

IT Corporation
4005 Port Chicago Highway
Concord, California 94520-1120

STORM WATER POLLUTION PREVENTION PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Prepared by: Shane Austin
Shane Austin
Project Engineer

Date: 07/08/02

Approved by: Richard J. Wong
Rich Wong
Project Manager

Date: 7·8·02

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Figure 2 Site Vicinity Map
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Attachment 1 Notice of Intent (NOI)
Attachment 2 Applicable Best Management Practice Procedures
Attachment 3 Schedule
Attachment 4 Inspection Checklist and Log

Acronyms and Abbreviations

Bechtel	Bechtel National, Inc
BMP	Best Management Practice
IR	Installation Restoration
NAS	Naval Air Station
NTCRA	non-time critical removal action
NOI	Notice of Intent
Pier E	Pier Echo
POL	petroleum, oils, and lubricants
RAP	Removal Action Plan
RCRA	Resource Conservation and Recovery Act
RWQCB	Regional Water Quality Control Board
SWMU	solid waste management unit
SWPPP	Storm Water Pollution Prevention Plan
SWRCB	State Water Resources Control Board
WCA	Waste Consolidation Area

1.0 Introduction

This Storm Water Pollution Prevention Plan (SWPPP) was prepared to support the activities involved with a non-time-critical removal action (NTCRA) for Installation Restoration (IR) Site 10 Shoreline Slag Area located at Naval Air Station (NAS) North Island, California. This NTCRA is to be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act and Chapter 6.8 of the California Health and Safety Code. This SWPPP was developed to fulfill the substantive requirements set forth in the State Water Resources Control Board (SWRCB), Order No. 99-08-DWQ, National Pollutant Discharge Elimination System General Permit No. CAS000002. Adherence to the General Permit is required where clearing, grading, and excavation results in a land disturbance of 5 or more acres. The work to be conducted at the IR Site 10 Shoreline Slag Area will involve clearing, excavating, soil placement and grading within an area of up to 5 acres.

As required by the General Construction Permit, a Notice of Intent (NOI) will be submitted prior to beginning the removal activities at the Site. A copy of the NOI will be provided in Attachment 1. The General Construction Permit also requires that a SWPPP be retained and implemented on the construction site. This SWPPP will be made available to the Regional Water Quality Control Board (RWQCB) for review upon request.

2.0 Objectives

The objectives of the SWPPP are to identify pollutant sources that may affect the quality of discharged storm water associated with construction activity from the site; and to identify, construct, and implement storm water pollution prevention measures to reduce pollutants in storm water discharges from the construction site both during construction and after construction is completed.

This SWPPP and the accompanying Removal Action Plan (RAP) include best management practices (BMPs) to address source reduction and treatment of storm water discharges. BMPs for construction activities and pollutant source control will be implemented as described in detail in the following documents:

- California Storm Water Best Management Practice Handbooks, Construction Activity Best Management Practice Handbook, published by the Storm Water Quality Task Force dated 1993.
- Caltrans Storm Water Quality Handbooks, *Construction Site Best Management Practices Manual*, prepared by the State of California Department of Transportation dated 2000.

Specific BMPs referenced in this document are included in Attachment 2.

3.0 Project Background And Site Description

This section includes a brief background of the project and descriptions of the site condition prior to beginning construction, and the planned final site conditions following the completion of the project.

3.1 Site Background

The Shoreline Slag Area adjoins the shipping channel of San Diego Bay on the northwest portion of NAS North Island. The 4.1-acre site includes the coastal portion of IR Site 10 between Pier Echo (Pier "E") and Moffett Road, across from the Defense Reutilization Marketing Office. The part of the Shoreline Slag Area that extends southwest of Pier E has been designated as Resource Conservation and Recovery Act (RCRA) solid waste management unit (SWMU) 134 (Bechtel National, Inc. [Bechtel], 1999). SWMU 135 encompasses the portion of the site located northeast of Pier E (Bechtel, 1999).

The remedial action to be conducted at the Shoreline Slag Area will consist of the transport of slag wastes underlying the shoreline bluff to an on-site waste consolidation area (WCA) and the construction of a rock revetment liner system for a portion of the shoreline. The location of the identified slag waste area is shown in Figure 3 of the accompanying RAP. Refer to the RAP for detailed information on the remediation activities.

3.2 Pre-Existing Conditions

The area to be disturbed for this action includes the Shoreline Slag Area as well as stockpiling and staging areas located outside the Shoreline Slag Area boundary. Figure 1 identifies the location of the proposed stockpiling and staging areas. The stockpile locations will include an existing stone stockpile area currently being used by another contractor (Area A, Figure 1), and two additional areas located at the north and south ends of the Shoreline Slag Area (Areas B and C, Figure 1). A staging area for support facilities and personnel will be located across Moffett Road in the asphalt lot of Building 290 (Area D, Figure 1). For the purposes of this report the Shoreline Slag Area, staging area, and north and south stockpile areas will be referred to as the Site.

The Site is moderately vegetated and is approximately 1,600 feet long and 150 feet wide (5.5 acres). There are 3 buildings, 2 paved parking lots, and a section of jog path on the Site, resulting in it being approximately 22 percent impervious. The runoff coefficient for the site is about 0.40 (Department of Public Works, 2001). The existing drainage patterns at the Site and

adjacent area are shown in Figure 2. There are no off-site drainage areas that discharge onto the project site; water from Moffett Road is directed into an existing storm drain inlet. The storm drain inlet structure is connected to the San Diego Bay by a 36-inch culvert beneath the surface. The total area contributing to the storm runoff discharge to this inlet from the construction and adjacent areas is about 1.0 acre.

The primary drainage pattern for the existing Site consists of sheet flow across the surface towards the west to San Diego Bay (Figure 2). Prior to entering the bay, the shoreline bluff slopes at approximately 2H: 1V to 4H: 1V (Horizontal to Vertical). A portion of the existing shoreline bluff is lined with riprap or concrete rubble while the remaining section along the Site has no protection (Figure 2). The San Diego Bay is the only surface water body that will receive storm water runoff from IR Site 10 and is no more than 150 feet west of the site.

3.3 Planned Completion Conditions

There are currently no plans to expand the site beyond the present boundary, therefore, natural drainage patterns outside the site will remain unchanged. If the work does expand outside the boundary, a pathway for run-on may be created and will need to be addressed at that time. There will be an increase in the percentage of impervious areas, due to the construction of an additional access road to Pier E. An increase in total run-off is anticipated due to the increase in impervious areas and the grading and drainage improvements, which may decrease the overall surface water time of concentration. If the time of concentration is decreased, then there will be a potential increase in the runoff coefficient. The value for the runoff coefficient is expected to be between 0.40 and 0.42 after the completion of construction. The permanent BMPs to be installed for surface water conveyance and erosion control are discussed in Section 4.2 of this document.

4.0 Drainage Controls

This section discusses the determination and implementation of the BMPs to control erosion and sedimentation during construction and post construction. Site-specific BMPs are described in further detail while general practice BMPs are itemized.

4.1 Preconstruction

Prior to beginning construction, key field project team members will review and discuss the BMP planning and training methods to be implemented during the construction phase.

4.2 Construction

The primary BMP used for erosion and sediment control during construction will be schedule. Attachment 3 contains a copy of the proposed schedule, actual schedule dates will depend on the start date. It is anticipated that the majority of construction will be conducted in the dry season between June and October. Construction may potentially be conducted in the wet season; therefore, the appropriate BMPs will need to be implemented. No work will be conducted on days that heavy rains are eminent during this period. BMPs listed in this section will be installed as needed during construction and maintained until they are no longer necessary.

Site-specific BMPs to reduce the amount of sediment and pollutant transport in storm water discharge from the slag excavation and construction of the WCA include the following:

- Slag excavation will be limited daily to only the area that can be excavated to a visually clean level and transported to the WCA.
- The WCA will not be placed within 10 feet of the shoreline bluff to minimize raveling onto the beach below.
- The WCA will be compacted or covered with plastic sheeting daily to minimize wind erosion.
- Surface water diversion measures will be installed around the WCA and excavation areas.

Additional standard practice BMPs were identified for use during the construction phase of this project. These BMPs were taken from the Caltrans Construction Site BMP Manual and are listed below under the Caltrans group designation.

- **Soil Stabilization**
  - SS-1, Scheduling

- SS-2, Preservation of Existing Vegetation
- SS-5, Soil Binders
- SS-9, Earth Dikes/Drainage Swales and Lined Ditches

- **Sediment Control**
  - SC-1, Silt Fence
  - SC-6, Gravel Bags
  - SC-8, Sandbag Barriers
  - SC-10, Storm Drain Inlet Protection

- **Tracking Control**
  - TC-1, Stabilized Construction Entrance/Exit

- **Wind Erosion**
  - WE-1, Wind Erosion Control

- **Non-Storm Water Control**
  - NS-3, Paving and Grinding Operations

- **Waste Management and Material Pollution Control**
  - WM-3, Stockpile Management

A copy of each of the above-listed BMPs is presented in Attachment 2.

4.3 Post-Construction

As a result of the slag removal and placement activities, the majority of the Shoreline Slag Area will require grading to achieve the proposed completed surface. The proposed grading design for the Shoreline Slag Area is shown in Figure 3. The new surface features include the WCA west of Building 380, riprap along the shoreline bluff for the WCA and Building 380, and access roads for Pier E and the concrete pad behind Building 380. Additional drainage structures will be added to convey surface water away from the WCA and access roads. The location and type of drainage structure planned for the Site are also shown in Figure 3. The stockpile areas located beyond the Shoreline Slag Area boundary will be returned to their preconstruction conditions. To reduce surface erosion all disturbed areas will be revegetated with seed mixes approved by NAS North Island representatives.

5.0 Potential Sources and Control Practice

According to the SWRCB, SWPPPs pertaining to construction sites require the following descriptions regarding source identification:

- A description of potential sources that are likely to add significant quantities of pollutants to storm water discharges
- A description of potential sources that may result in non-storm water discharges from the site

Potential sources for adding contaminants to storm water and the control practice are discussed as follows:

- **Spill or leakage of fuels used by construction equipment** — Diesel fuel will be stored on site in an aboveground tank or truck-mounted tank for daily fueling of construction equipment. Control practices will include providing secondary containment around the aboveground fuel tank and fueling area. The secondary containment for the fuel tank may consist of sandbags and earthen berms with plastic sheeting to collect storm water and spills within the bermed containment area. The containment will be designed to contain 1.5 times the storage tank capacity. Any fluid collecting within the containment area will be periodically transferred to a holding tank and transported off site to an on-base treatment/recycling facility.
- **Leakage of petroleum, oils, and lubricants (POLs) used by construction equipment on site** — Control practices to reduce the amount of POLs produced at the site will include periodic checks to ensure that equipment is well maintained and free of leaks. Additionally, mechanical maintenance and repair of construction equipment, other than fueling and routine greasing, will not be performed on site.
- **Contaminants from soil excavated from the remedial action site** — The characteristics of soils excavated from the remedial action site are discussed in the accompanying RAP. Control practices will include covering the waste consolidation area with plastic sheeting during storm events and temporarily berming the surrounding area to divert storm water run-on and contain storm water runoff.

Aside from the soil excavated from the remedial action site, no other potential pollutants or hazardous materials will be treated, stored, or disposed of on the construction site. Additionally, all "contact" storm water will be treated as discussed above. No non-storm water discharge is expected. All construction-related nonhazardous wastes (excluding materials from the remedial

action site) will be collected in roll-off bins and hauled away periodically for proper off-site disposal.

It should be noted that the primary control practice for minimizing and preventing potential storm water pollution discussed above will be the diversion of storm water away from the active construction area that has not been covered with clean soil.

In addition to the specific control practice discussed above, other applicable BMPs, as identified in the Caltrans Construction Site BMP Manual, are listed as follows:

- **Non-Storm Water Control**
  - NS-8, Vehicle and Equipment Cleaning
  - NS-9, Vehicle and Equipment Fueling
  - NS-10, Vehicle and Equipment Maintenance
- **Waste Management and Material Pollution Control**
  - WM-1, Material Delivery and Storage
  - WM-2, Material Use
  - WM-4, Spill Prevention and Control
  - WM-5, Solid Waste Management
  - WM-6, Hazardous Waste Management
  - WM-7, Contaminated Soil Management
  - WM-8, Concrete Waste Management
  - WM-9, Sanitary/Septic Waste Management

A copy of each of the above-listed BMPs is presented in Attachment 2.

6.0 Inspections

This section describes the necessary monitoring and reporting and the personnel responsible for the work.

6.1 Monitoring and Reporting

Inspections of the drainage system will be conducted before and after each storm event by the project site supervisor or his designee for the duration of the construction. Inspections will cover the items presented in this SWPPP and the applicable BMPs in Attachment 2. Records of the inspections will be kept in field notebooks and placed on file for at least 3 years. A record of each inspection will include the date of the inspection, the individual(s) who performed the inspection, and the observations. The inspection results will be used to evaluate the performance of the BMPs and determine if any corrective action is required. Dependent upon the level of action required, a modification to the SWPPP may be generated. This modification will be included as an attachment to the SWPPP and be submitted to the appropriate agencies. A copy of the inspection checklist and inspection log to be used during this project is included in Attachment 4.

Incidents of noncompliance will be reported to the RWQCB within 30 days of identification of noncompliance. An annual inspection will not be conducted due to the scheduled project duration. Similarly, an annual certification of compliance will not be required.

6.2 Responsible Personnel

This section lists the names and contact numbers for the responsible persons as required in the General Construction Permit.

Name (Title)	Contact Number	Responsibility
Rich Wong (Project Manager)	(619) 437-6326 ext. 314	To verify full compliance with the General Construction Permit and implementation of all elements of the SWPPP
John Krowitz (Site Superintendent)	(619) 437-6326 ext. 319	Inspection of the construction sites prior to anticipated storm events and after actual storm events to identify areas contributing to discharge.
Holly Buschman (Technical Lead)	(619) 437-6326 ext. 320	To verify that no materials other than storm water are discharged in quantities that will have an adverse effect on receiving waters or storm drain systems.

7.0 References

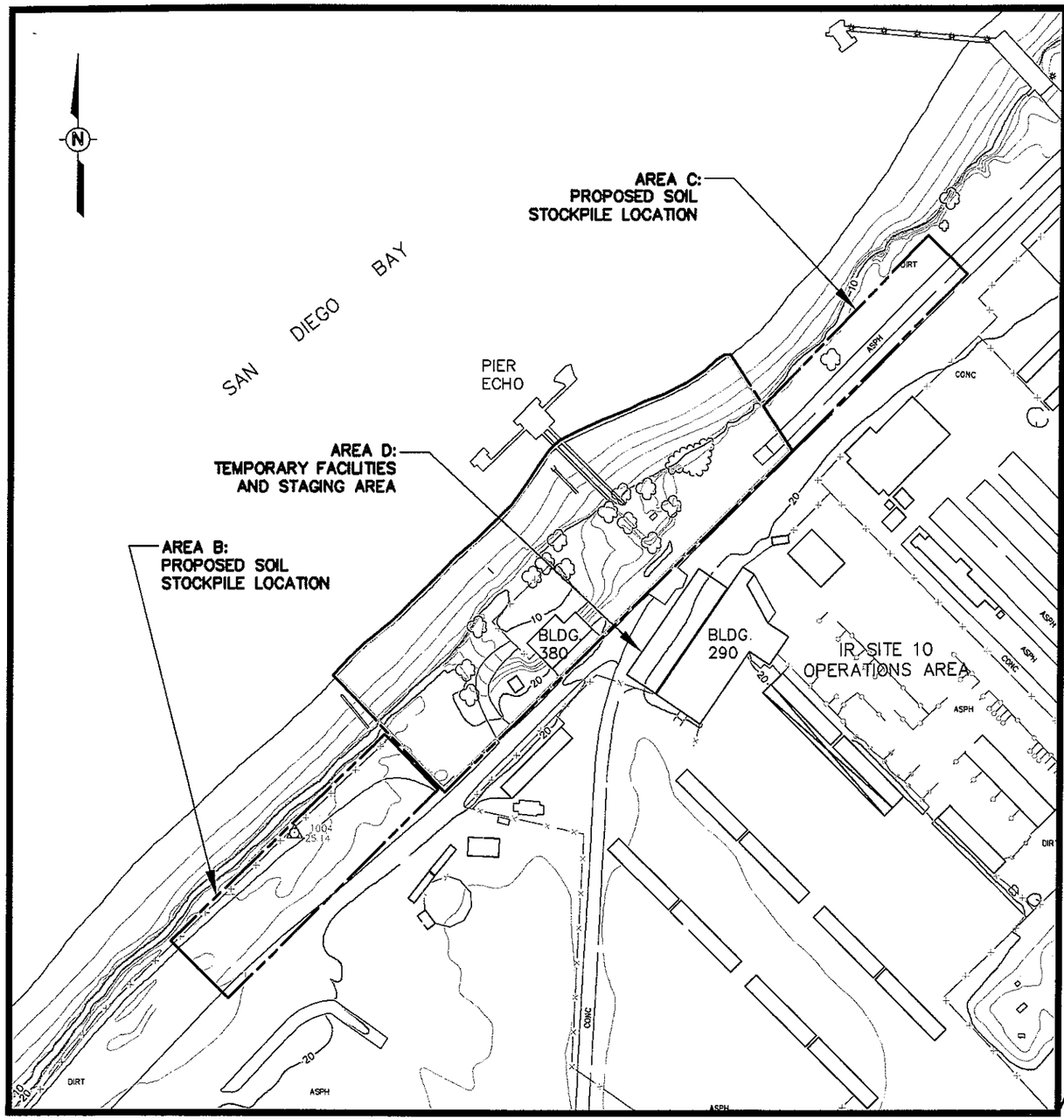
Bechtel National, Inc., 1999a, *Draft Interim Measures Assessment/Current Conditions Report, Naval Air Station North Island, Coronado, California*, May.

California Department of Transportation, Storm Water Quality Handbooks, 2000, *Construction Site Best Management Practices Manual*, November.

Department of Public Works, 2001, *San Diego County Hydrology Manual*, September.

Storm Water Quality Task Force, 1993, California Storm Water Best Management Practice Handbooks, March.

FIGURES



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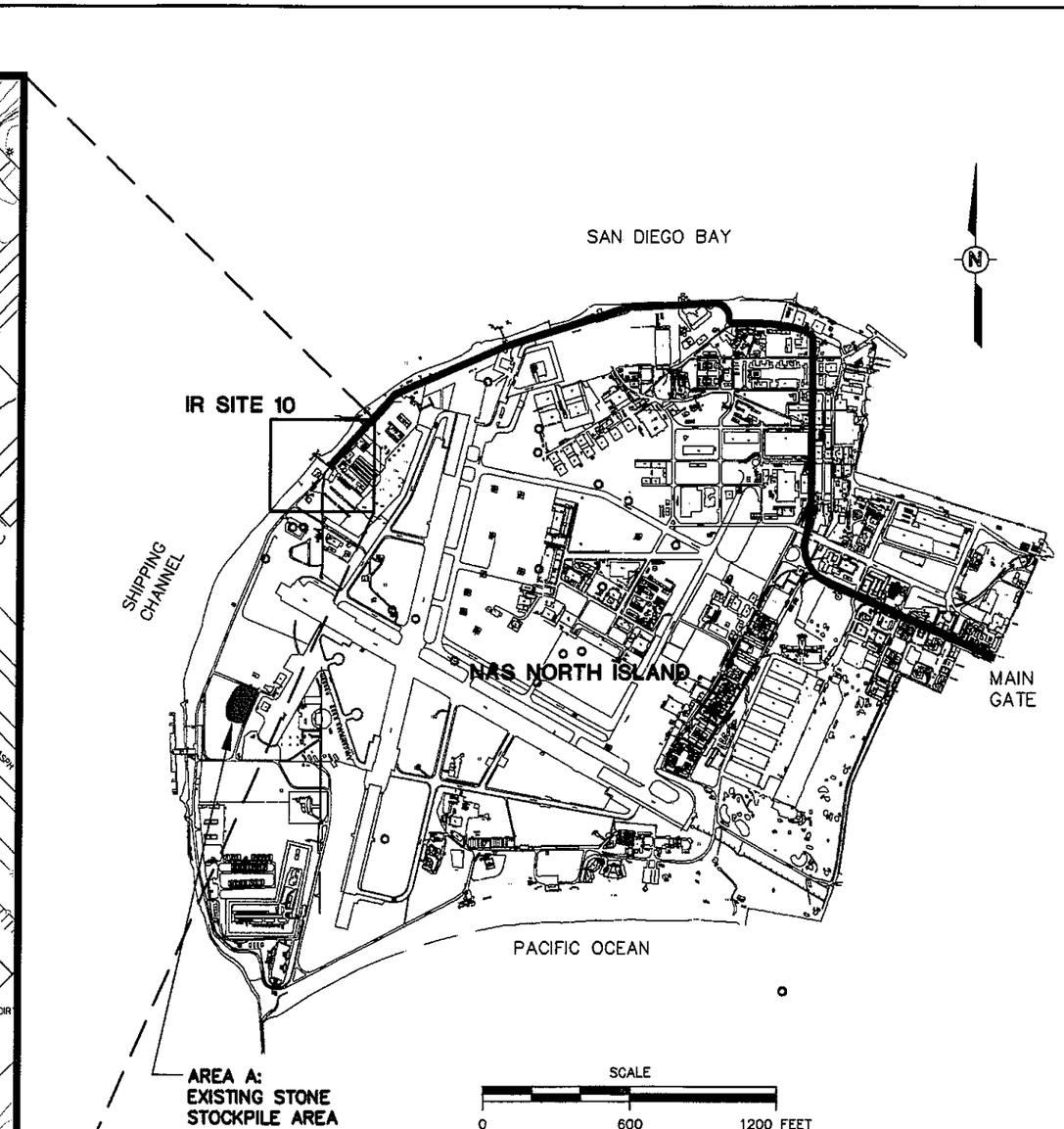

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REVISIONS			
REV. No.	DESCRIPTION	DATE	APPROVED

SWDIV			
DRAWN BY S. AUSTIN	DATE 4/19/02		
CHK'D BY M. WILLIAMS	DATE 4/19/02		
APP'D BY H. BUSCHMAN	DATE 4/19/02		
PROJECT MANAGER R. WONG			
AUTOCAD FILE No. 818724-B26			
SCALE AS NOTED	SHEET –	OF –	

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

VICINITY MAP
STORM WATER POLLUTION PREVENTION PLAN

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 1	–

SAN DIEGO BAY

PIER ECHO

MOFFETT RD.

BLDG. 380

BLDG 290

IR SITE 10 OPERATIONS AREA

ASPH

CONC

DIRT

LEGEND:

OVERLAND FLOW DIRECTION

EXISTING CATCH BASIN

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC. (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

NAVY PUBLIC WORKS CENTER UNDERGROUND UTILITY INFORMATION (BECHTEL, 1999a)

SCALE

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REVISIONS			
REV. No.	DESCRIPTION	DATE	APPROVED

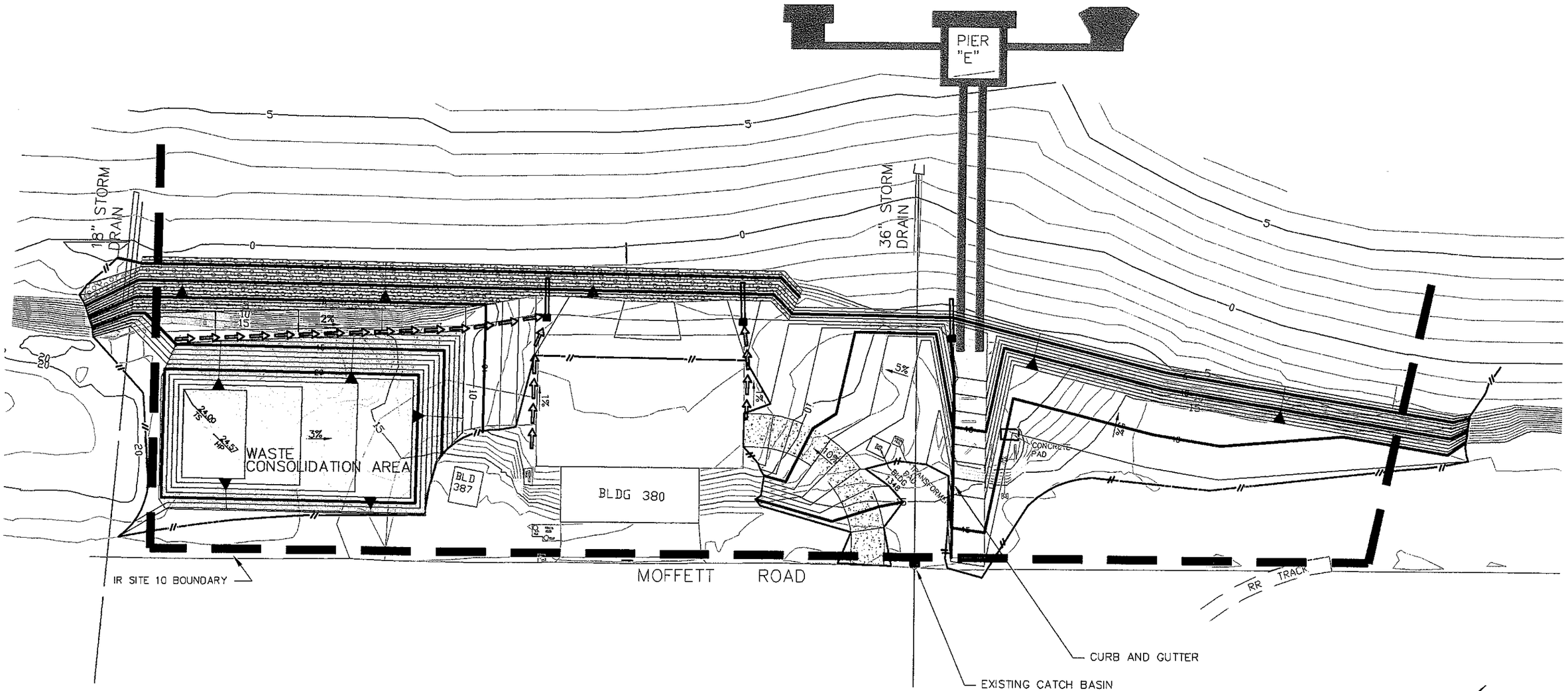
SWDIV		
DRAWN BY S. AUSTIN	DATE 4/19/02	
CHK'D BY M. WILLIAMS	DATE 4/19/02	
APP'D BY H. BUSCHMAN	DATE 4/19/02	
PROJECT MANAGER R. WONG		
AUTOCAD FILE No. 818724-B25		
SCALE AS NOTED	SHEET –	OF –

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SITE VICINITY MAP
STORM WATER POLLUTION PREVENTION PLAN

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 2	–



LEGEND:

- PIER 'E' ACCESS RAMP
- BLDG 380 NEW ACCESS RAMP
- E.T COVER OVER CONSOLIDATED WASTE
- ROCK REVETMENT
- CONCRETE DRAINAGE DITCH
- CATCH BASIN AND STORM DRAIN OUTFALL

NOTES:

UTILITIES TO REMAIN

DRAINAGE DITCH PER SDRSD PLAN D-75, TYPE A

CURB AND GUTTER PER SDRSD PLAN G-2

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES INC (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

NAVY PUBLIC WORKS CENTER UNDERGROUND UTILITY INFORMATION (BECHTEL, 1999a)

SCALE

0 60 120 FEET

REVISIONS			
REV. No.	DESCRIPTION	DATE	APPROVED

SWDIV

DRAWN BY S. AUSTIN	DATE 4/19/02	
CHK'D BY M. WILLIAMS	DATE 4/19/02	
APP'D BY H. BUSCHMAN	DATE 4/19/02	
PROJECT MANAGER R. WONG		
AUTOCAD FILE No. 818724-B27		
SCALE AS NOTED	SHEET —	OF —

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

FINAL DRAINAGE PLAN
STORM WATER POLLUTION PREVENTION PLAN

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 3	—

ATTACHMENT 1
NOTICE OF INTENT (NOI)

The Notice of Intent will be submitted at a later date.

ATTACHMENT 2
APPLICABLE BEST MANAGEMENT PRACTICE PROCEDURES

BMPs are grouped by Caltrans designation:

Soil Stabilization

SS-1 Scheduling
SS-2 Preservation of Existing Vegetation
SS-5 Soil Binders
SS-9 Earth Dikes/Drainage Swales and Lined Ditches

Sediment Control

SC-1 Silt Fence
SC-6 Gravel Bags
SC-8 Sandbag Barriers
SC-10 Storm Drain Inlet Protection

Tracking Control

TC-1 Stabilized Construction Entrance/Exit

Wind Erosion

WE-1 Wind Erosion Control

Non-Storm Water Control

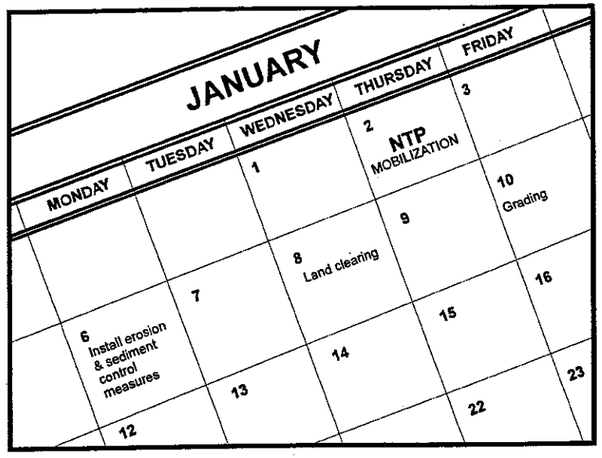
NS-3 Paving and Grinding Operations
NS-8 Vehicle and Equipment Cleaning
NS-9 Vehicle and Equipment Fueling
NS-10 Vehicle and Equipment Maintenance

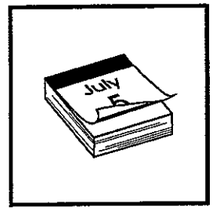
Waste Management and Material Pollution Control

WM-1 Material Delivery and Storage
WM-2 Material Use
WM-3 Stockpile Management
WM-4 Spill Prevention and Control
WM-5 Solid Waste Management
WM-6 Hazardous Waste Management
WM-7 Contaminated Soil Management
WM-8 Concrete Waste Management
WM-9 Sanitary/Septic Waste Management

Scheduling

SS-1





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

This best management practice (BMP) involves developing, for every project, a schedule that includes sequencing of construction activities with the implementation of construction site BMPs such as temporary soil stabilization (erosion control) and temporary sediment controls measures. The purpose is to reduce the amount and duration of soil exposed to erosion by wind, rain, runoff and vehicle tracking, and to perform the construction activities and control practices in accordance with the planned schedule.

Appropriate Applications

Construction sequencing shall be scheduled to minimize land disturbance for all projects during the rainy season.

Limitations

None identified.

Standards and Specifications

Plan the project and develop a schedule or to layout the construction plan. The schedule shall clearly show how the rainy season relates to soil-disturbing and re-stabilization activities. The construction schedule shall be incorporated into the SWPPP or WPCP.

The schedule shall include detail on the rainy season implementation and deployment of:

- temporary soil stabilization BMPs,
- temporary sediment control BMPs,
- tracking control BMPs,
- wind erosion control BMPs,
- non-storm water BMPs, and

- waste management and materials pollution control BMPs

Schedule shall also include dates for significant long-term operations or activities that may have planned non-storm water discharges such as dewatering, sawcutting, grinding, drilling, boring, crushing, blasting, painting, hydro-demolition, mortar mixing, bridge cleaning, etc.

Schedule work to minimize soil disturbing activities during the rainy season.

Work out the sequencing and timetable for the start and completion of each item such as site clearing and grubbing, grading, excavation, paving, pouring foundations, installing utilities, etc., to minimize the active construction area during the rainy season.

Schedule major grading operations for the non-rainy season when practical.

Stabilize non-active areas as soon as practical.

Monitor the weather forecast for rainfall.

When rainfall is predicted, adjust the construction schedule to allow the implementation of soil stabilization and sediment controls and sediment treatment controls on all disturbed areas prior to the onset of rain.

Be prepared year-round to deploy soil stabilization and sediment control and sediment treatment control practices as required by Section 2 of this Manual. Erosion may be caused during dry seasons by unseasonal rainfall, wind and vehicle tracking. Keep the site stabilized year-round, and retain and maintain rainy season sediment trapping devices in operational condition.

Sequence trenching activities so that most open portions are closed before new trenching begins.

Incorporate staged seeding and re-vegetation of graded slopes as work progresses.

Consider scheduling when establishing permanent vegetation (appropriate planting time for specified vegetation).

Apply permanent erosion control to areas deemed substantially complete during the project's defined seeding window.

Maintenance and Inspection

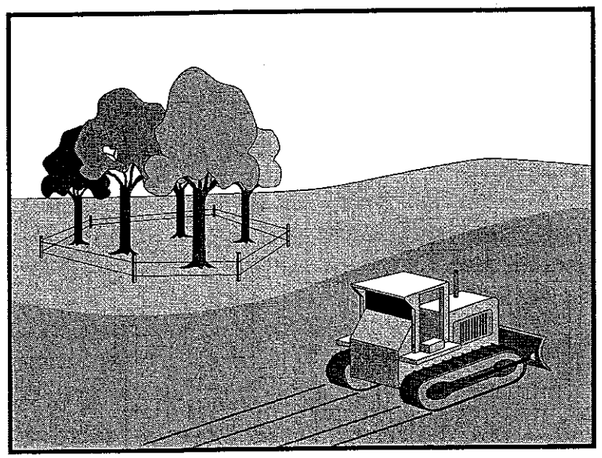
Verify that work is progressing in accordance with the schedule. If progress deviates, take corrective actions.

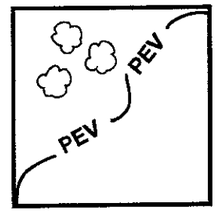
Amend the schedule when changes are warranted or when directed by the Resident Engineer (RE).

The Special Provisions require annual submittal of rainy season implementation schedule. Amend the schedule prior to the rainy season to show updated information on the deployment and implementation of construction site BMPs.

Preservation of Existing Vegetation

SS-2





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Preservation of existing vegetation is the identification and protection of desirable vegetation that provides erosion and sediment control benefits.

Appropriate Applications

Preserve existing vegetation at areas on a site where no construction activity is planned or will occur at a later date.

On a year-round basis, temporary fencing shall be provided prior to clearing and grubbing operations or other soil-disturbing activities in areas where no construction activity is planned or will occur at a later date.

No grading or disturbances shall occur in areas identified on the plans to be preserved, especially on areas designated as Environmentally Sensitive Areas (ESAs).

Limitations

Protection of existing vegetation requires planning, and may limit the area available for construction activities.

Standards and Specifications

Timing

Preservation of existing vegetation shall be provided prior to the commencement of clearing and grubbing operations or other soil-disturbing activities in areas where no construction activity is planned or will occur at a later date.

Preservation of existing vegetation shall conform to scheduling requirements set forth in the special provisions.

Design and Layout

Mark areas to be preserved with temporary fencing made of orange polypropylene that is stabilized against ultraviolet light. The temporary fencing shall be at least one meter wide and shall have openings not larger than 50mm by 50mm.

Fence posts shall be either wood or metal, at the Contractor's discretion, as appropriate for the intended purpose. The post spacing and depth shall be adequate to completely support the fence in an upright position.

Minimize the disturbed areas by locating temporary roadways to avoid stands of trees and shrubs and to follow existing contours to reduce cutting and filling.

Consider the impact of grade changes to existing vegetation and the root zone.

Installation

Construction materials, equipment storage, and parking areas shall be located where they will not cause root compaction.

Keep equipment away from trees to prevent trunk and root damage.

Maintain existing irrigation systems.

Employees and subcontractors shall be instructed to honor protective devices. No heavy equipment, vehicular traffic, or storage piles of any construction materials shall be permitted within the drip line of any tree to be retained. Removed trees shall not be felled, pushed, or pulled into any retained trees. Fires shall not be permitted within 30 m (100 ft) of the drip line of any retained trees. Any fires shall be of limited size, and shall be kept under continual surveillance. No toxic or construction materials - including paint, acid, nails, gypsum board, chemicals, fuels, and lubricants - shall be stored within 15 m (50 ft) of the drip line of any retained trees, nor disposed of in any way which would injure vegetation.

Trenching and Tunneling

Trenching shall be as far away from tree trunks as possible, usually outside of the tree drip line or canopy. Curve trenches around trees to avoid large roots or root concentrations. If roots are encountered, consider tunneling under them. When trenching and/or tunneling near or under trees to be retained, tunnels shall be at least 450 mm (18 in) below the ground surface, and not below the tree center to minimize impact on the roots.

Tree roots shall not be left exposed to air; they shall be covered with soil as soon as possible, protected, and kept moistened with wet burlap or peat moss until the tunnel and/or trench can be completed.

The ends of damaged or cut roots shall be cut off smoothly.

Trenches and tunnels shall be filled as soon as possible. Careful filling and tamping will eliminate air spaces in the soil which can damage roots.

Remove any trees intended for retention if those trees are damaged seriously enough to affect their survival. If replacement is desired or required, the new tree shall be of similar species, and of at least 50 mm (2 in) caliper, unless otherwise required by the contract documents.

After all other work is complete, fences and barriers shall be removed last. This is because protected trees may be destroyed by carelessness during the final cleanup and landscaping.

Maintenance and Inspection

During construction, the limits of disturbance shall remain clearly marked at all times. Irrigation or maintenance of existing vegetation shall conform to the requirements in the landscaping plan. If damage to protected trees still occurs, maintenance guidelines described below shall be followed:

Serious tree injuries shall be attended to by an arborist.

Any damage to the crown, trunk, or root system of a retained tree shall be repaired immediately.

Damaged roots shall be immediately cut clean.

If bark damage occurs, all loosened bark shall be cut back into the undamaged area, with the cut tapered at the top and bottom, and drainage provided at the base of the wood. Cutting of the undamaged area shall be as limited as possible.

Soil which has been compacted over a tree's root zone shall be aerated by punching holes 300 mm (12 in) deep with an iron bar, and moving the bar back and forth until the soil is loosened. Holes shall be placed 450 mm (18 in) apart throughout the area of compacted soil under the tree crown.

Stressed or damaged broadleaf trees shall be fertilized to aid recovery.

Trees shall be fertilized in the late fall or early spring.

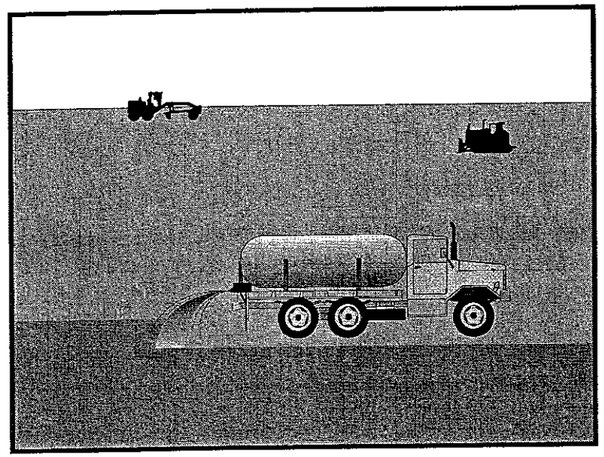
Fertilizer shall be applied to the soil over the feeder roots and in accordance with label instructions, but never closer than 1 m (3 ft) to the trunk. The

fertilized area shall be increased by one-fourth of the crown area for conifers that have extended root systems.

During construction, District Environmental shall be contacted to ensure that ESAs are protected.

Soil Binders

SS-5



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Soil binders consist of applying and maintaining polymeric or lignin sulfonate soil stabilizers or emulsions. Soil binders are materials applied to the soil surface to temporarily prevent water-induced erosion of exposed soils on construction sites. Soil binders typically also provide dust, wind and soil stabilization (erosion control) benefits. This is one of five temporary soil stabilization alternatives to consider.

Appropriate Applications

Soil binders are applied to disturbed areas requiring short-term temporary protection. Because soil binders can often be incorporated into the work, they may be a good choice for areas where grading activities will soon resume.

Limitations

Soil binders are temporary in nature and may need reapplication.

Soil binders require a minimum curing time until fully effective, as prescribed by the manufacturer, which may be 24 hours or longer.

Soil binders will generally experience spot failures during heavy rainfall events. If runoff penetrates the soil at the top of a slope treated with a soil binder, it is likely that the runoff will undercut the stabilized soil layer and discharge at a point further down slope.

Soil binders do not hold up to pedestrian or vehicular traffic across treated areas.

Soil binders may not penetrate soil surfaces made up primarily of silt and clay, particularly when compacted.

Some soil binders may not perform well with low relative humidity. Under rainy conditions, some agents may become slippery or leach out of the soil.

May not cure if low temperatures occur within 24 hours of application.

Standards and Specifications

General Considerations

Regional soil types will dictate appropriate soil binders to be used.

A soil binder must be environmentally benign (non-toxic to plant and animal life), easy to apply, easy to maintain, economical, and shall not stain paved or painted surfaces.

Some soil binders are compatible with existing vegetation.

Performance of soil binders depends on temperature, humidity, and traffic across treated areas.

Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, and existing vegetation.

Selecting a Soil Binder

Properties of common soil binders used for erosion control are provided on Table 1. Use Table 1 to select an appropriate soil binder.

Factors to consider when selecting a soil binder include the following:

Suitability to situation - Consider where the soil binder will be applied; if it needs a high resistance to leaching or abrasion, and whether it needs to be compatible with any existing vegetation. Determine the length of time soil stabilization will be needed, and if the soil binder will be placed in an area where it will degrade rapidly. In general, slope steepness is not a discriminating factor for the listed soil binders. The soil binders in Table 1 may also be used for dust control using the provided dust control application rates. The dust control application rates will not be adequate to provide protection from water-induced erosion.

Soil types and surface materials - Fines and moisture content are key properties of surface materials. Consider a soil binder's ability to penetrate, likelihood of leaching, and ability to form a surface crust on the surface materials.

Frequency of application - The frequency of application can be affected by subgrade conditions, surface type, traffic volumes, climate, and maintenance schedule. Frequent applications could lead to high costs. Application frequency may be minimized if the soil binder has good penetration, low evaporation, and good longevity. Consider also that frequent application will require frequent equipment clean-up.

After considering the above factors, the soil binders in Table 1 will be generally appropriate as follows:

Copolymer. Appropriate for long term soil stabilization in areas where cross-traffic might occur, or where stabilization needs to be achieved in conjunction with preserving existing vegetation. Longevity can be up to 2 years, it has a high resistance to abrasion, and is compatible with existing vegetation. However, it is also relatively costly which makes it less desirable for short-term or frequent applications.

Lignin sulfonate: Appropriate for short- or medium-term soil stabilization applications in low traffic areas. The moderate relative cost makes it less desirable to reapply frequently, though it typically lasts longer than psyllium or guar. With only moderate penetration and a low resistance to abrasion, it would be more suited to areas which will not be disturbed frequently by construction activities.

Psyllium/Guar: Appropriate for typical soil stabilizing situations or short-term applications. Because of the relatively low cost, they can be applied more frequently. Their high penetration provides good stabilization but their moderate resistance to abrasion limits their longevity. They are not very compatible with vegetation.

Applying Soil Binders

After selecting an appropriate soil binder, the untreated soil surface must be prepared before applying the soil binder. The untreated soil surface must contain sufficient moisture to assist the agent in achieving uniform distribution. In general, the following steps shall be followed:

Follow manufacturer's recommendations for application rates, pre-wetting of application area, and cleaning of equipment after use.

Prior to application, roughen embankment and fill areas. Track walking shall only be used where rolling is impractical.

Soil binders shall not be applied during or immediately before rainfall.

Avoid over-spray onto the traveled way, sidewalks, lined drainage channels, sound walls, and existing vegetation.

Do not apply soil binders to frozen soil, areas with standing water, under freezing or rainy conditions, or when the temperature is below 4°C (40°F).

More than one treatment is often necessary, although the second treatment may be diluted or have a lower application rate.

Generally, soil binders require a minimum curing time of 24 hours before they are fully effective. Refer to manufacturer's instructions for specific cure times.

For liquid agents:

- Crown or slope ground to avoid ponding.
- Uniformly pre-wet ground at 0.14 to 1.4 l/m^2 (0.03 to 0.3 gal/yd^2) or according to manufacturer's recommendations.
- Apply solution under pressure. Overlap solution 150 to 300 mm (6 to 12 in).
- Allow treated area to cure for the time recommended by the manufacturer; typically, at least 24 hours.
- Apply second treatment before first treatment becomes ineffective, using 50% application rate.
- In low humidities, reactivate chemicals by re-wetting with water at 0.5 to 0.9 l/m^2 (0.1 to 0.2 gal/yd^2).

Maintenance and Inspection

Reapplying the selected soil binder may be needed for proper maintenance.

High traffic areas shall be inspected on a daily basis, and lower traffic areas should be inspected on a weekly basis.

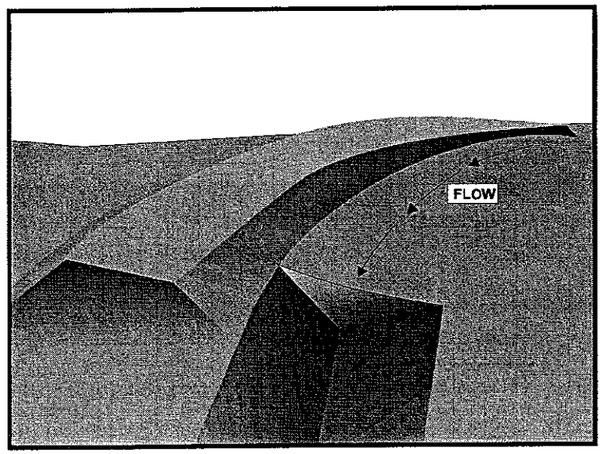
After any rainfall event, the Contractor is responsible for maintaining all slopes to prevent erosion.

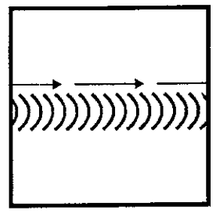
Table 1
Properties of Soil Binders for Erosion Control

Chemicals	Copolymer	Lignin Sulfonate	Psyllium	Guar
Comments	- Forms semi-permeable transparent crust. - Resists ultraviolet radiation and moisture induced breakdown.	- Paper industry waste product - Acts as dispersing agent - Best in dry climates - Can be slippery	- Effective on dry, hard soils - Forms a crust	- Effective on dry, hard soils - Forms a crust
Relative Cost	High	Moderate	Low	Low
Environmental Hazard	Low	Low	Low	Low
Penetration	Moderate	Moderate	High	High
Evaporation	Moderate	Moderate	Moderate	Moderate
Resistance to Leaching	Low	High	High	High
Resistance to Abrasion	High	Low	Moderate	Moderate
Longevity	1 to 2 years	6 months to 1 year	3 to 6 months	3 to 6 months
Minimum Curing Time before Rain	24 hours	24 hours	24 hours	24 hours
Compatibility with Existing Vegetation	Good	Poor	Poor	Poor
Mode of Degradation	Chemically Degradable	Biologically/Physically/ Chemically Degradable	Biologically Degradable	Biologically Degradable
Labor Intensive	No	No	No	No
Specialized Application Equipment	Yes	Yes	Yes	Yes
Liquid/Powder	Liquid	Powder	Powder	Powder
Surface Crusting	Yes	Yes, but dissolves on rewetting	Yes, but dissolves on rewetting	Yes, but dissolves on rewetting
Clean-Up	Solvents	Solvents	Water	Water
Erosion Control Application Rate	Apply 800-1,000 l/ha (85-110 gal/ac).	Apply 5,600-6,500 l/ha (600-700 gal/ac).	Apply 170 kg/ha (150 lb./ac) with 560-2,200 kg/ha (500-2,000 lbs./ac) fiber mulch.	Apply 110-220 kg/ha (100-200 lbs./ac) with 560-2,200 kg/ha (500-2,000 lbs./ac) fiber mulch.
Dust Control Application Rate	Apply 280-520 L/ha (30-55 gal/ac).	Loosen surface 25-50mm (1-2 in). Need 4-8% fines. Apply 470-1,900 l/ha (50-200 gal/ac).	Apply 170 k/ha (150 lbs /ac).	Apply at 45-70 k/ha (40-60 lbs./ac).

Earth Dikes/Drainage Swales and Lined Ditches

SS-9





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are structures that intercept, divert and convey surface run-on, generally sheet flow, to prevent erosion.

Appropriate Applications

Earth dikes/drainage swales and lined ditches may be used to:

- Convey surface runoff down sloping land
- Intercept and divert runoff to avoid sheet flow over sloped surfaces
- Divert and direct runoff towards a stabilized watercourse, drainage pipe or channel.
- To intercept runoff from paved surfaces.

Earth dikes/drainage swales and lined ditches also may be used:

- Below steep grades where runoff begins to concentrate
- Along roadways and facility improvements subject to flood drainage.
- At the top of slopes to divert run-on from adjacent or undisturbed slopes.
- At bottom and mid-slope locations to intercept sheet flow and convey concentrated flows.

This BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Resident Engineer (RE).

Earth Dikes/Drainage Swales and Lined Ditches

SS-9

Limitations

Earth dikes/drainage swales and lined ditches are not suitable as sediment trapping devices.

May be necessary to use other soil stabilization and sediment controls, such as check dams, plastics, and blankets, to prevent scour and erosion in newly graded dikes, swales and ditches.

Standards and Specifications

Care must be applied to correctly size and locate earth dikes, drainage swales and lined ditches. Excessively steep, unlined dikes and swales are subject to erosion and gully formation.

Conveyances shall be stabilized.

Use a lined ditch for high flow velocities.

Select flow velocity based on careful evaluation of the risks due to erosion of the measure, soil types, over topping, flow backups, washout, and drainage flow patterns for each project site.

Compact any fills to prevent unequal settlement.

Do not divert runoff from the Highway right-of-way onto other property.

When possible, install and utilize permanent dikes, swales and ditches early in the construction process.

Provide stabilized outlets.

Maintenance and Inspections

Inspect temporary measures prior to the rainy season, after rainfall events, and regularly (approximately once per week) during the rainy season.

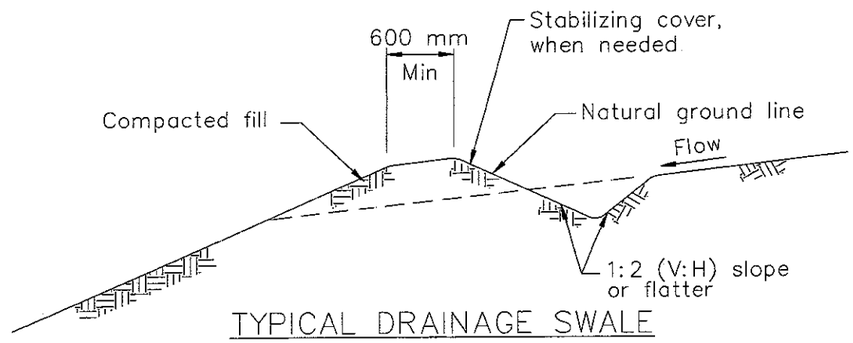
Inspect ditches and berms for washouts. Replace lost riprap, damaged linings or soil stabilizers as needed.

Inspect channel linings, embankments, and beds of ditches and berms for erosion and accumulation of debris and sediment. Remove debris and sediment, and repair linings and embankments as needed or as directed by the Engineer.

Temporary conveyances shall be completely removed as soon as the surrounding drainage area has been stabilized, or at the completion of construction.

Earth Dikes/Drainage Swales and Lined Ditches

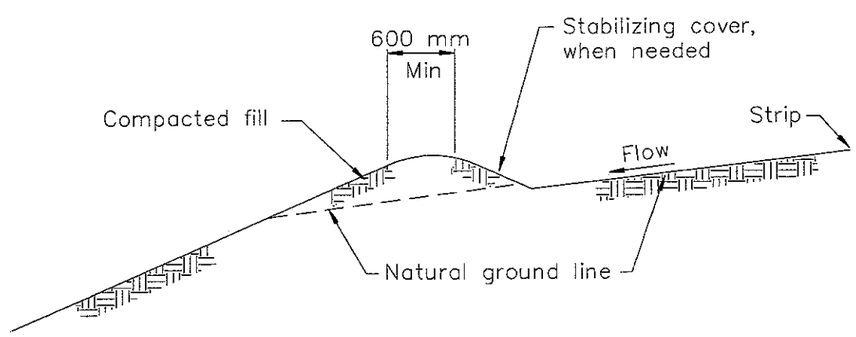
SS-9



TYPICAL DRAINAGE SWALE
NOT TO SCALE

NOTES:

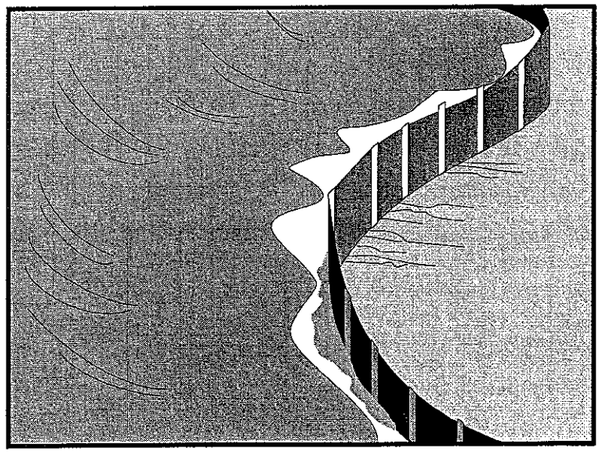
1. Stabilize inlet, outlets and slopes.
2. Properly compact the subgrade, in conformance with Section 19--5 of the Caltrans Standard Specifications.

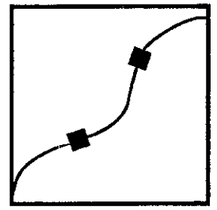


TYPICAL EARTH DIKE
NOT TO SCALE

Silt Fence

SC-1





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

A silt fence is a temporary linear sediment barrier of permeable fabric designed to intercept and slow the flow of sediment-laden sheet flow runoff. Silt fences allow sediment to settle from runoff before water leaves the construction site.

Appropriate Applications

Silt fences are placed:

Below the toe of exposed and erodible slopes.

Down-slope of exposed soil areas.

Around temporary stockpiles.

Along streams and channels.

Limitations

Not effective unless trenched and keyed in.

Not intended for use as mid-slope protection on slopes greater than 1:4 (V:H)

Must be maintained.

Must be removed and disposed of.

Standards and Specifications

General

Don't use below slopes subject to creep, slumping, or landslides.

Don't use in streams, channels, or anywhere flow is concentrated.

Don't use silt fences to divert flow.

Design and Layout

The maximum length of slope draining to any point along the silt fence shall be 61 m (200 ft) or less.

Slope of area draining to fence shall be less than 1:1 (V:H).

Limit to locations suitable for temporary ponding or deposition of sediment.

Fabric life span generally limited to between five and eight months. Longer periods may require fabric replacement.

Silt fences shall not be used in concentrated flow areas.

Lay out in accordance with Page 5 of this BMP.

For slopes steeper than 1:2 (V:H) and that contain a high number of rocks or large dirt clods that tend to dislodge, it may be necessary to install additional protection immediately adjacent to the bottom of the slope, prior to installing silt fence. Additional protection may be a chain link fence or a cable fence.

For slopes adjacent to water bodies or Environmentally Sensitive Areas (ESAs), additional temporary soil stabilization BMPs shall be used.

Materials

Silt fence fabric shall be woven polypropylene with a minimum width of 900 mm and a minimum tensile strength of 0.45 kN. The fabric shall conform to the requirements in ASTM designation D4632 and shall have an integral reinforcement layer. The reinforcement layer shall be a polypropylene, or equivalent, net provided by the manufacturer. The permittivity of the fabric shall be between 0.1 sec^{-1} and 0.15 sec^{-1} in conformance with the requirements in ASTM designation D4491.

Wood stakes shall be commercial quality lumber of the size and shape shown on the plans. Each stake shall be free from decay, splits or cracks longer than the thickness of the stake or other defects that would weaken the stakes and cause the stakes to be structurally unsuitable.

Staples used to fasten the fence fabric to the stakes shall be not less than 45 mm long and shall be fabricated from 1.57 mm or heavier wire. The wire used to fasten the tops of the stakes together when joining 2 sections of fence shall be 3.05 mm or heavier wire. Galvanizing of the fastening wire will not be required.

Installation

Generally, silt fences shall be used in conjunction with soil stabilization source controls up slope to provide effective control.

Trenches shall not be excavated wider and deeper than necessary for proper installation of the temporary linear sediment barriers.

Excavation of the trenches shall be performed immediately before installation of the temporary linear sediment barriers.

Construct silt fences with a set-back of at least 1m from the toe of a slope. Where a silt fence is determined to be not practicable due to specific site conditions, the silt fence may be constructed at the toe of the slope, but shall be constructed as far from the toe of the slope as practicable.

Construct the length of each reach so that the change in base elevation along the reach does not exceed 1/3 the height of the barrier; in no case shall the reach exceed 150 meters.

Cross barriers shall be a minimum of 1/3 and a maximum of 1/2 the height of the linear barrier.

Bottom of the silt fence shall be keyed-in.

Install in accordance with Page 5 of this BMP.

Maintenance and Inspection

Repair undercut silt fences.

Repair or replace split, torn, slumping, or weathered fabric.

Inspect silt fence when rain is forecast. Perform necessary maintenance, or maintenance required by the Resident Engineer (RE).

Inspect silt fence following rainfall events. Perform maintenance as necessary, or as required by the RE.

Maintain silt fences to provide an adequate sediment holding capacity. Sediment shall be removed when the sediment accumulation reaches one-third (1/3) of the barrier height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.

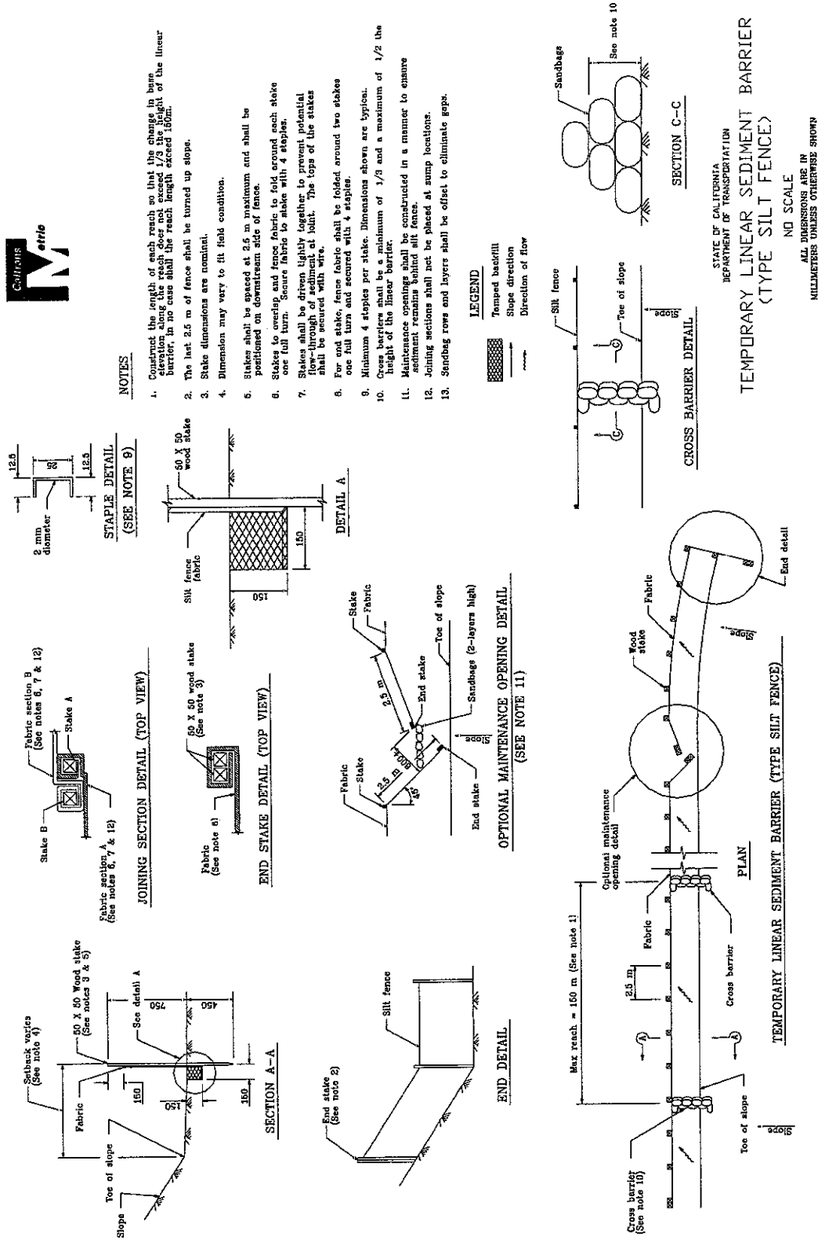
Silt fences that are damaged and become unsuitable for the intended purpose, as determined by the RE, shall be removed from the site of work, disposed of outside the highway right-of-way in conformance with the Standard Specifications, and replaced with new silt fence barriers.

Holes, depressions or other ground disturbance caused by the removal of the temporary silt fences shall be backfilled and repaired in conformance with the Standard Specifications.

Remove silt fence when no longer needed or as required by the RE. Fill and compact post holes and anchorage trench, remove sediment accumulation, and grade fence alignment to blend with adjacent ground.

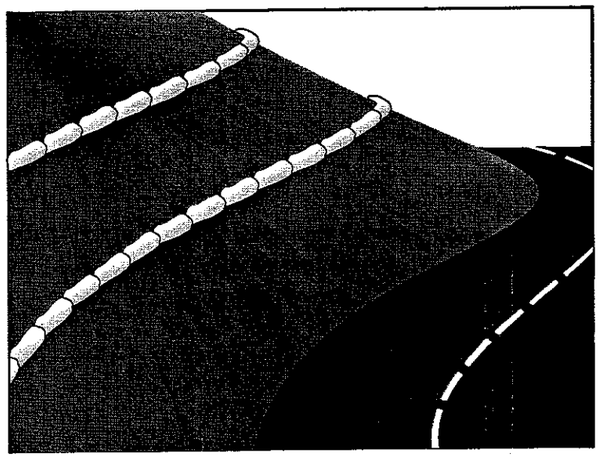
Silt Fence

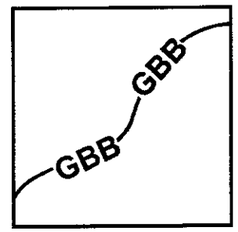
SC-1



Gravel Bag Berm

SC-6





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

A gravel bag berm consist of a single row of gravel bags that are installed end-to-end to form a barrier across a slope to intercept runoff, reduce runoff velocity, release runoff as sheet flow, and provide some sediment removal.

Appropriate Applications

Along the face and at grade breaks of exposed and erodible slopes to shorten slope length and spread runoff as sheet flow.

BMP may be implemented on a project-by-project basis with other BMPs when determined necessary and feasible by the Resident Engineer (RE).

Limitations

Although this BMP will remove some sediment, it is not to be used in place of a linear sediment barrier (i.e., a silt fence, sandbag barrier, or straw bale barrier).

Degraded gravel bags may rupture when removed, spilling contents.

Installation can be labor intensive.

Limited durability for long term projects.

Standards and Specifications

Materials

Bag Material: Bags shall be woven polypropylene, polyethylene or polyamide fabric or burlap, minimum unit weight 135 g/m^2 (four ounces per square yard), mullen burst strength exceeding 2,070 kPa (300 psi) in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70 percent in conformance with the requirements in ASTM designation D4355.

Bag Size: Each gravel-filled bag shall have a length of 450 mm (18 in), width of 300 mm (12 in), thickness of 75 mm (3 in), and mass of approximately 15 kg (33 lb). Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the Resident Engineer (RE) for approval prior to deployment.

Fill Material: Fill material shall be one-half to one-inch Class 2 aggregate base, clean and free from clay and deleterious material, conforming to the provisions in Section 26-1.02 "Class 2 Aggregate Base," of the Standard Specifications. Fill material is subject to approval by the RE.

Installation

Install along a level contour.

Tightly abut bags

Maintenance and Inspection

Inspect gravel bag berms before and after each rainfall event, and weekly throughout the rainy season.

Reshape or replace gravel bags as needed, or as directed by the RE.

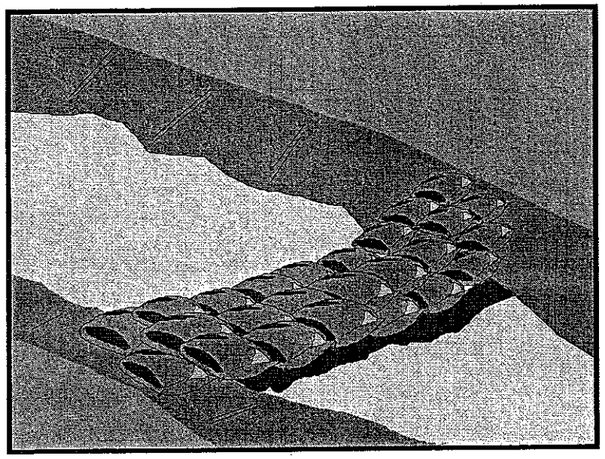
Repair washouts or other damages as needed, or as directed by the RE.

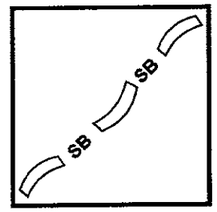
Inspect gravel bag berms for sediment accumulations and remove sediments when accumulation reaches one-third of the berm height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.

Remove gravel bag berms when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilized the area. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.

Sandbag Barrier

SC-8





BMP Objectives

- ○ Soil Stabilization
- ● Sediment Control
- ○ Tracking Control
- ○ Wind Erosion Control
- ○ Non-Storm Water Management
- ○ Materials and Waste Management

Definition and Purpose

A sandbag barrier is a temporary linear sediment barrier consisting of stacked sandbags, designed to intercept and slow the flow of sediment-laden sheet flow runoff. Sandbag barriers allow sediment to settle from runoff before water leaves the construction site. Sandbags can also be used where flows are moderately concentrated, such as ditches, swales, and storm drain inlets (see BMP SC-10, Storm Drain Inlet Protection) to divert and/or detain flows.

Appropriate Applications

- Along the perimeter of a site.
- Along streams and channels.
- Below the toe of exposed and erodible slopes.
- Down slope of exposed soil areas.
- Around stockpiles.
- Across channels to serve as a barrier for utility trenches or provide a temporary channel crossing for construction equipment, to reduce stream impacts.
- Parallel to a roadway to keep sediment off paved areas.
- At the top of slopes to divert roadway runoff away from disturbed slopes.
- To divert or direct flow or create a temporary sediment basin.
- During construction activities in stream beds when the contributing drainage area is less than 2 ha (5 ac).

- When extended construction period limits the use of either silt fences or straw bale barriers.
- Along the perimeter of vehicle and equipment fueling and maintenance areas or chemical storage areas.
- To capture and detain non-storm water flows until proper cleaning operations occur.
- When site conditions or construction sequencing require adjustments or relocation of the barrier to meet changing field conditions and needs during construction.
- To temporarily close or continue broken, damaged or incomplete curbs
- This BMP may be implemented on a project-by-project basis in addition to other BMPs when determined necessary and feasible by the Resident Engineer (RE).

Limitations

- Limit the drainage area upstream of the barrier to 2 ha (5 ac).
- Degraded sandbags may rupture when removed, spilling sand.
- Installation can be labor intensive.
- Limited durability for long term projects.
- When used to detain concentrated flows, maintenance requirements increase.

Standards and Specifications

Materials

- ***Sandbag Material:*** Sandbag shall be woven polypropylene, polyethylene or polyamide fabric, minimum unit weight 135 g/m^2 (four ounces per square yard), mullen burst strength exceeding 2,070 kPa (300 psi) in conformance with the requirements in ASTM designation D3786, and ultraviolet stability exceeding 70 percent in conformance with the requirements in ASTM designation D4355. Use of burlap is not acceptable.
- ***Sandbag Size:*** Each sand-filled bag shall have a length of 450 mm (18 in), width of 300 mm (12 in), thickness of 75 mm (3 in), and mass of approximately 15 kg (33 lb.). Bag dimensions are nominal, and may vary based on locally available materials. Alternative bag sizes shall be submitted to the Resident Engineer (RE) for approval prior to deployment.
- ***Fill Material:*** All sandbag fill material shall be non-cohesive, Class 1 or Class 2 permeable material free from clay and deleterious material, conforming to the provisions in Section 68-1.025 "Permeable Material," of

the Standard Specifications. The requirements for the Durability Index and Sand Equivalent do not apply. Fill material is subject to approval by the RE.

Installation

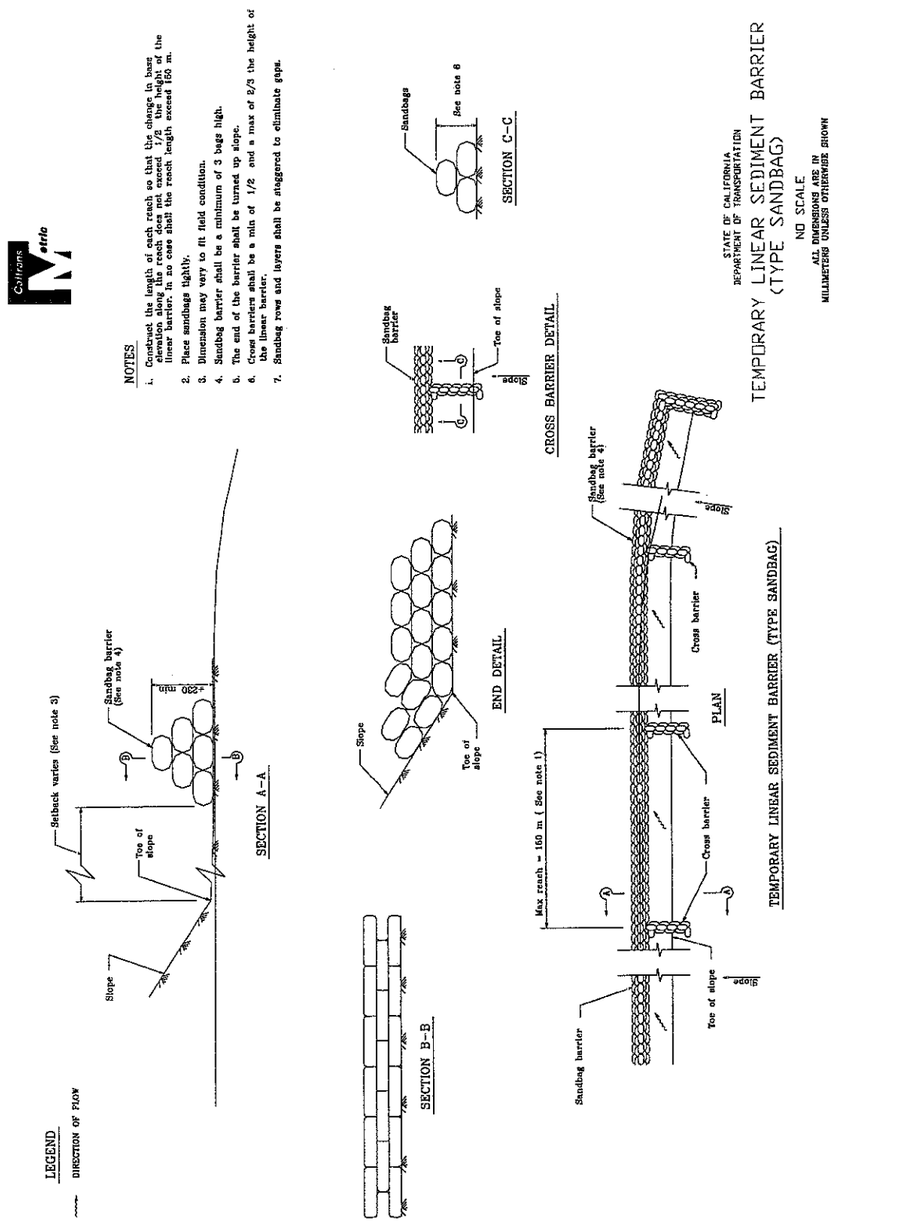
- When used as a linear control for sediment removal:
  - Install along a level contour
  - Turn ends of sandbag row up slope to prevent flow around the ends.
  - Generally, sandbag barriers shall be used in conjunction with temporary soil stabilization controls up slope to provide effective control.
  - Install as shown in Page 4 of this BMP.
- When used for concentrated flows:
  - Stack sandbags to required height using a pyramid approach as shown in Page 4 of this BMP.
  - Upper rows of sandbags shall overlap joints in lower rows.
- Construct sandbag barriers with a set-back of at least 1m from the toe of a slope. Where it is determined to be not practicable due to specific site conditions, the sandbag barrier may be constructed at the toe of the slope, but shall be constructed as far from the toe of the slope as practicable.

Maintenance and Inspection

- Inspect sandbag barriers before and after each rainfall event, and weekly throughout the rainy season.
- Reshape or replace sandbags as needed, or as directed by the RE.
- Repair washouts or other damages as needed, or as directed by the RE.
- Inspect sandbag barriers for sediment accumulations and remove sediments when accumulation reaches one-third the barrier height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.
- Remove sandbags when no longer needed. Remove sediment accumulation, and clean, re-grade, and stabilized the area.

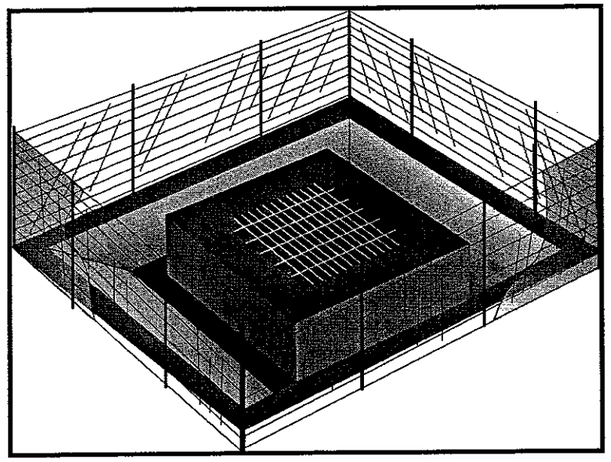
Sandbag Barrier

SC-8



Storm Drain Inlet Protection

SC-10



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Devices used at storm drain inlets that are subject to runoff from construction activities to detain and/or to filter sediment-laden runoff to allow sediment to settle and/or to filter sediment prior to discharge of storm water into storm water drainage systems or watercourses.

Appropriate Applications

Where ponding will not encroach into highway traffic.

Where sediment laden surface runoff may enter an inlet.

Where disturbed drainage areas have not yet been permanently stabilized.

Where the drainage area is 0.4 ha (1 ac) or less.

Appropriate during wet and snow-melt seasons.

Limitations

Use only when ponding will not encroach into highway traffic or onto erodible surfaces and slopes. If safety is a concern, use other methods of temporary protection to prevent sediment-laden storm water and non-storm water discharges to enter the storm drain system.

Sediment removal may be difficult in high flow conditions or if runoff is heavily sediment laden. If high flow conditions are expected, use other on-site sediment trapping techniques in conjunction with inlet protection.

Frequent maintenance is required.

For drainage areas larger than 0.4 ha (1ac), runoff shall be routed to a sediment trapping device designed for larger flows. See BMPs SC-2, "Desilting Basin", and SC-3 "Sediment Traps".

Filter fabric fence inlet protection appropriate in open areas is subject to sheet flow and for flows not exceeding 0.014 m^3/s (0.5 cfs).

Sandbag barriers for inlet protection are applicable when sheet flows or concentrated flows exceed 0.014 m^3/s (0.5 cfs), and it is necessary to allow for overtopping to prevent flooding.

Excavated drop inlet sediment traps are appropriate where relatively heavy flows are expected and overflow capability is needed.

Standards and Specifications

Identify existing and/or planned storm drain inlets that have the potential to receive sediment-laden surface runoff. Determine if storm drain inlet protection is needed, and which method to use.

Methods and Installation

DI Protection Type 1 - Filter Fabric Fence - The filter fabric fence (Type 1) protection is illustrated in Page 4. Similar to constructing a silt fence. See BMP SC-1, "Silt Fence". Do not place filter fabric underneath the inlet grate since the collected sediment may fall into the drain inlet when the fabric is removed or replaced.

DI Protection Type 2 - Excavated Drop Inlet Sediment Trap - The excavated drop inlet sediment trap (Type 2) is illustrated in Page 5. Similar to constructing a temporary silt fence, See BMP SC-1, "Silt Fence". Size excavated trap to provide a minimum storage capacity calculated at the rate of 130 m^3/ha (67 yd^3/ac) of drainage area.

DI Protection Type 3 - Sandbag Barrier - The sandbag barrier (Type 3) is illustrated in Page 6. Flow from a severe storm shall not overtop the curb. In areas of high clay and silts, use filter fabric and gravel as additional filter media. Construct sandbags in accordance with BMP SC-8, "Sandbag Barrier".

Maintenance and Inspection

General

Inspect all inlet protection devices before and after every rainfall event, and weekly during the rest of the rainy season. During extended rainfall events, inspect inlet protection devices at least once every 24 hours.

Inspect the storm drain inlet after severe storms in the rainy season to check for bypassed material.

Remove all inlet protection devices within thirty days after the site is stabilized, or when the inlet protection is no longer needed.

- Bring the disturbed area to final grade and smooth and compact it. Appropriately stabilize all bare areas around the inlet.
- Clean and re-grade area around the inlet and clean the inside of the storm drain inlet as it must be free of sediment and debris at the time of final inspection.

Requirements by Method

Type 1 - Filter Fabric Fence

- Make sure the stakes are securely driven in the ground and are in good shape (i.e., not bent, cracked, or splintered, and are reasonably perpendicular to the ground). Replace damaged stakes.
- Replace or clean the fabric when the fabric becomes clogged with sediment. Make sure the fabric does not have any holes or tears. Repair or replace fabric as needed or as directed by the Resident Engineer (RE).
- At a minimum, remove the sediment behind the fabric fence when accumulation reaches one-third the height of the fence or barrier height. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.

Type 2 - Excavated Drop Inlet Sediment Trap

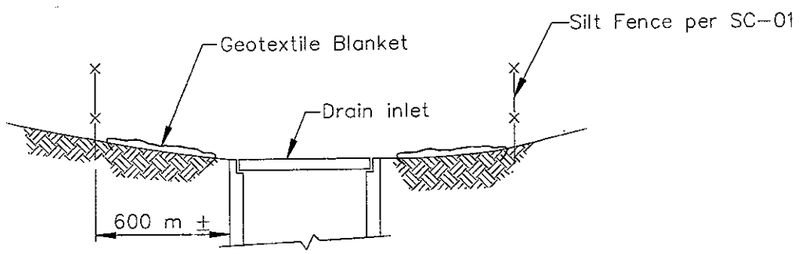
- Remove sediment from basin when the volume of the basin has been reduced by one-half.

Type 3 - Sandbag Barrier

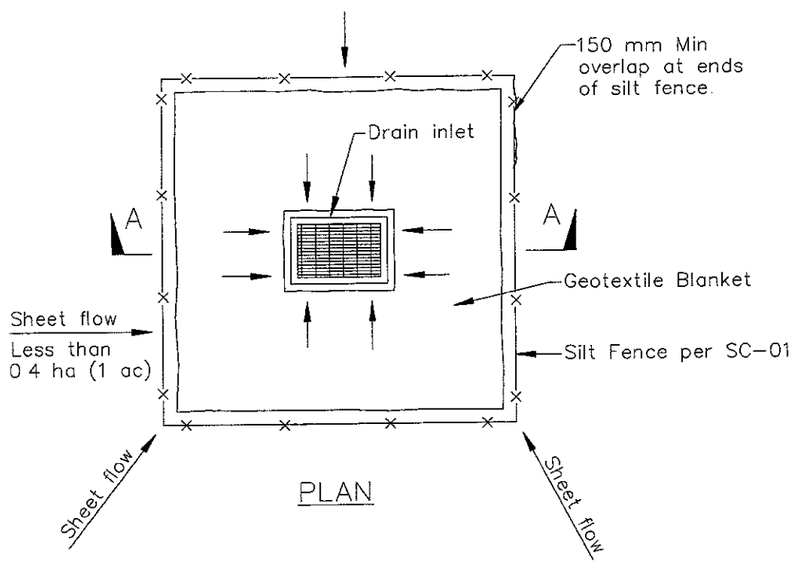
- Inspect bags for holes, gashes, and snags.
- Check sandbags for proper arrangement and displacement. Remove the sediment behind the barrier when it reaches one-third the height of the barrier. Removed sediment shall be incorporated in the project at locations designated by the RE or disposed of outside the highway right-of-way in conformance with the Standard Specifications.

Storm Drain Inlet Protection

SC-10



SECTION A–A



PLAN

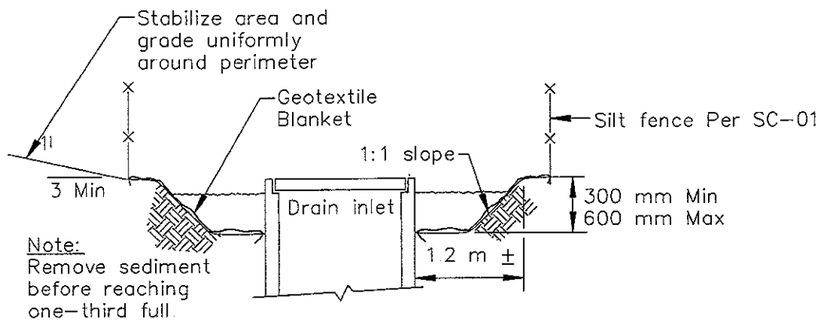
DI PROTECTION TYPE 1
NOT TO SCALE

NOTES:

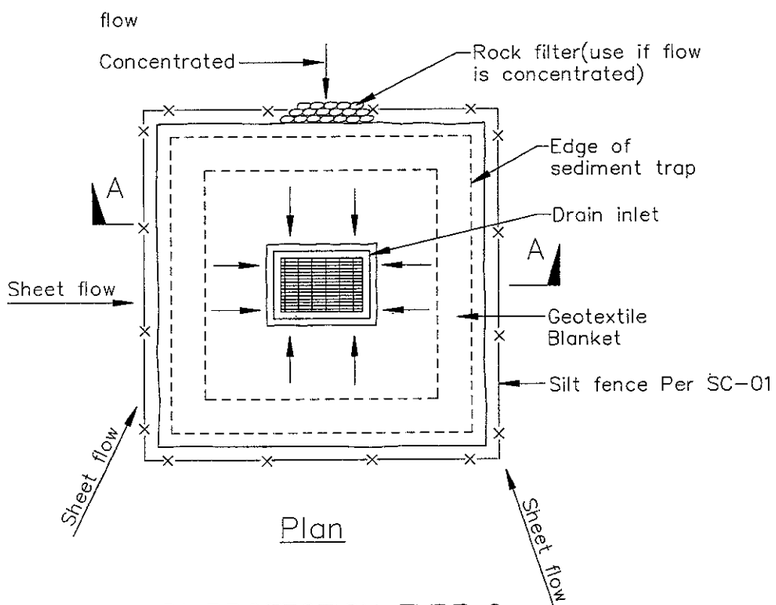
1 For use in areas where grading has been completed and final soil stabilization and seeding are pending.
2 Not applicable in paved areas.
3 Not applicable with concentrated flows

Storm Drain Inlet Protection

SC-10



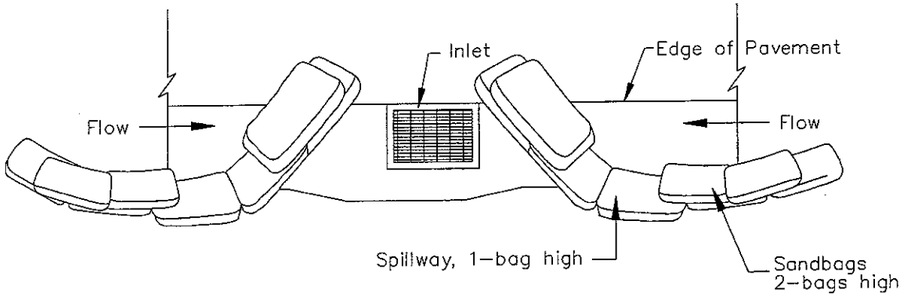
Section A–A



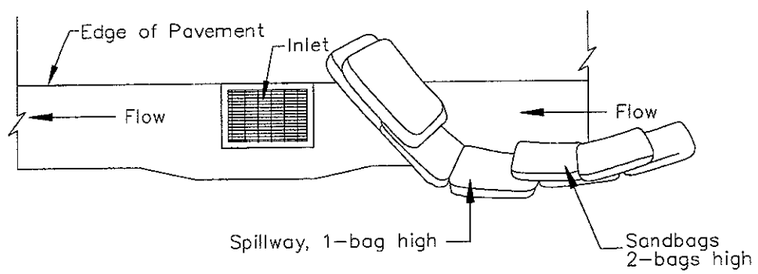
Plan

DI PROTECTION TYPE 2
NOT TO SCALE

Notes
1. For use in cleared and grubbed and in graded areas.
2. Shape basin so that longest inflow area faces longest length of trap.
3. For concentrated flows, shape basin in 2:1 ratio with length oriented towards direction of flow.



TYPICAL PROTECTION FOR INLET ON SUMP

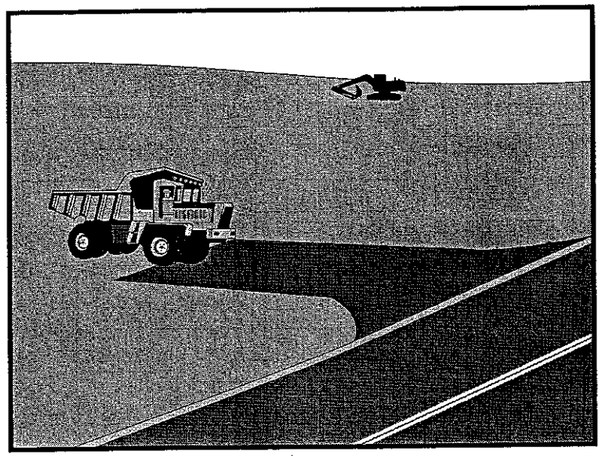


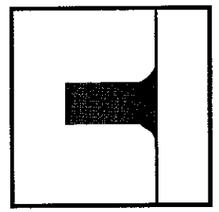
TYPICAL PROTECTION FOR INLET ON GRADE

NOTES:

1. Intended for short–term use
2. Use to inhibit non–storm water flow
3. Allow for proper maintenance and cleanup
4. Bags must be removed after adjacent operation is completed
5. Not applicable in areas with high silts and clays without filter fabric

Stabilized Construction Entrance/Exit TC-1





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

A stabilized construction access is a defined point of entrance/exit to a construction site that is stabilized to reduce the tracking of mud and dirt onto public roads by construction vehicles.

Appropriate Applications

Use at construction sites:

- where dirt or mud is tracked onto public roads
- adjacent to water bodies
- where poor soils are encountered
- where dust is a problem during dry weather conditions.

This BMP may be implemented on a project-by-project basis in addition to other BMPs when determined necessary and feasible by the Resident Engineer (RE).

Limitations

Site conditions will dictate design and need.

Standards and Specifications

Limit the points of entrance/exit to the construction site.

Limit speed of vehicles to control dust.

Properly grade each construction entrance/exit to prevent runoff from leaving the construction site.

Route runoff from stabilized entrances/exits through a sediment-trapping device before discharge.

Stabilized Construction Entrance/Exit TC-1

Design stabilized entrance/exit to support heaviest vehicles and equipment that will use it.

Select construction access stabilization (aggregate, asphaltic concrete, concrete) based on longevity, required performance, and site conditions. The use of asphalt concrete (AC) grindings for stabilized construction access/roadway is not allowed.

Use of constructed or constructed/manufactured steel plates with ribs for entrance/exit access is allowed with written approval of the RE.

If aggregate is selected, place crushed aggregate over geotextile fabric to at least 300 mm (12 in) depth, or place aggregate to a depth recommended by a geotechnical engineer. A crushed aggregate greater than 75 mm (3 inches) but smaller than 150 mm (6 inches) shall be used.

Designate combination or single purpose entrances and exits to the construction site. Require all employees, subcontractors and others to use them.

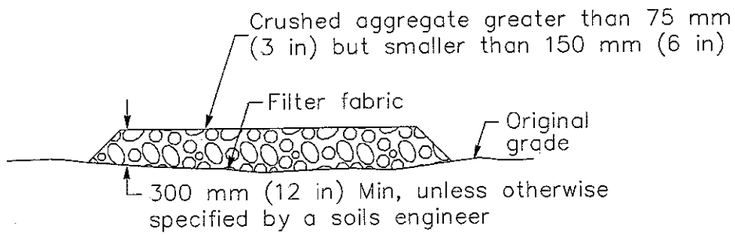
Require that all employees, subcontractors, and suppliers utilize the stabilized construction access.

Maintenance and Inspection

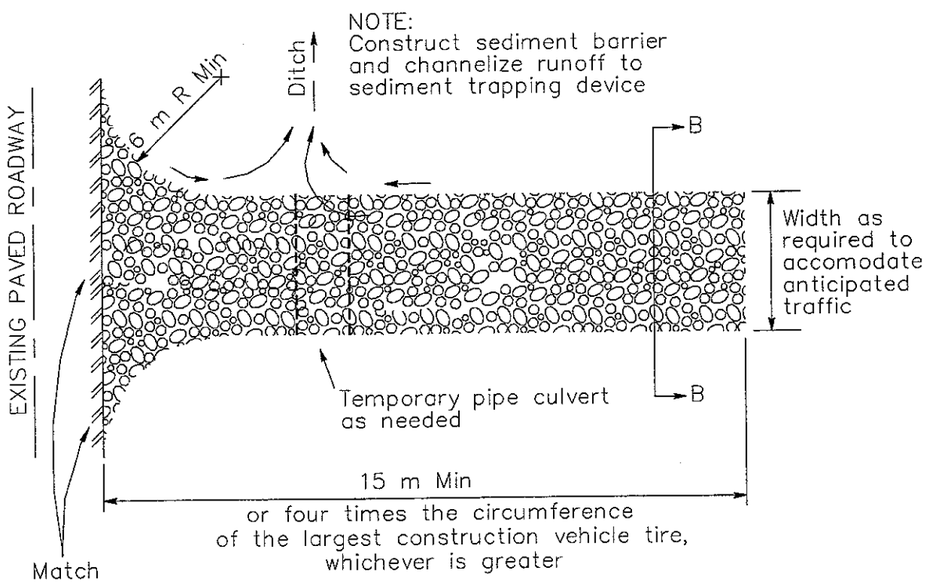
Inspect routinely for damage and assess effectiveness of the BMP. Repair if access is clogged with sediment or as directed by the RE.

Keep all temporary roadway ditches clear.

Stabilized Construction Entrance/Exit TC-1



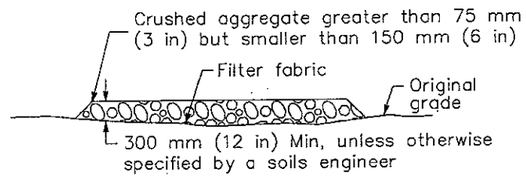
SECTION B–B
NTS



PLAN
NTS

Stabilized Construction Entrance/Exit (Type 1)

Stabilized Construction Entrance/Exit TC-1



SECTION B–B
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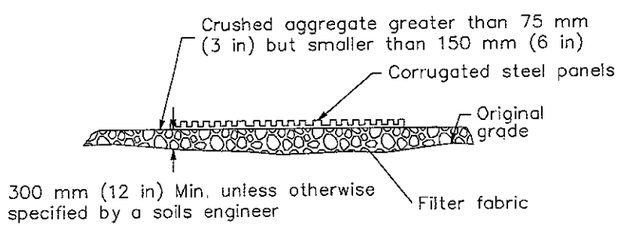
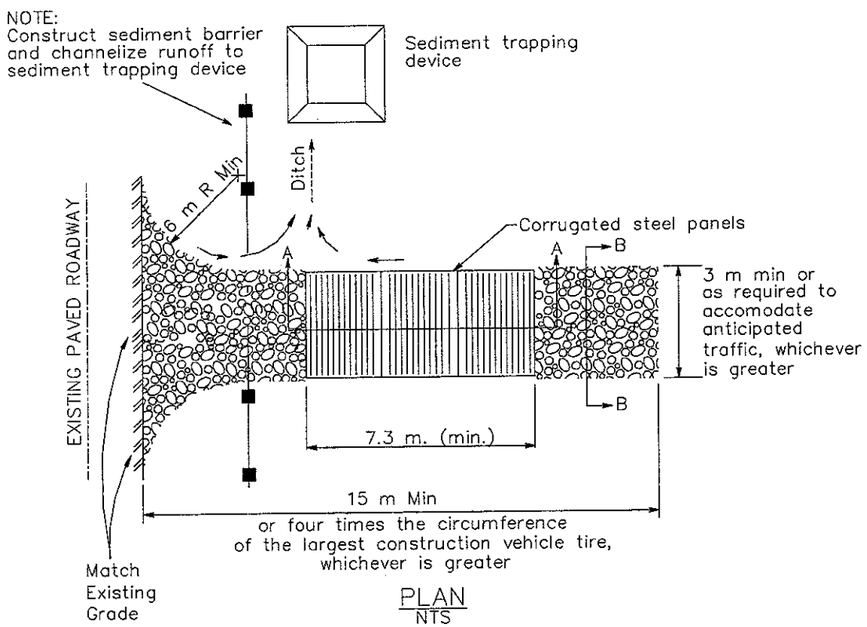


SECTION A–A
NOT TO SCALE

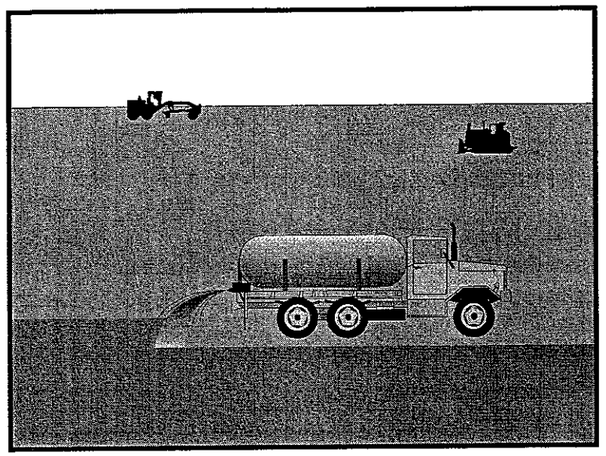


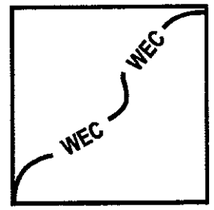
PLAN
NTS

Stabilized Construction Entrance/Exit (Type 2)

Wind Erosion Control

WE-1





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Wind erosion control consists of applying water or other dust palliatives as necessary to prevent or alleviate dust nuisance. Dust control shall be applied in accordance with Caltrans standard practices. Covering of small stockpiles or areas is an alternative to applying water or other dust palliatives.

Appropriate Applications

This practice is implemented on all exposed soils subject to wind erosion.

Limitations

Effectiveness depends on soil, temperature, humidity and wind velocity.

Standards and Specifications

Water shall be applied by means of pressure-type distributors or pipelines equipped with a spray system or hoses and nozzles that will ensure even distribution.

All distribution equipment shall be equipped with a positive means of shutoff.

Unless water is applied by means of pipelines, at least one mobile unit shall be available at all times to apply water or dust palliative to the project.

If reclaimed waste water is used, the sources and discharge must meet California Department of Health Services water reclamation criteria and the Regional Water Quality Control Board requirements. Non-potable water shall not be conveyed in tanks or drain pipes that will be used to convey potable water and there shall be no connection between potable and non-potable supplies. Non-potable tanks, pipes and other conveyances shall be marked "NON-POTABLE WATER - DO NOT DRINK."

Materials applied as temporary soil stabilizers and soil binders will also provide wind erosion control benefits.

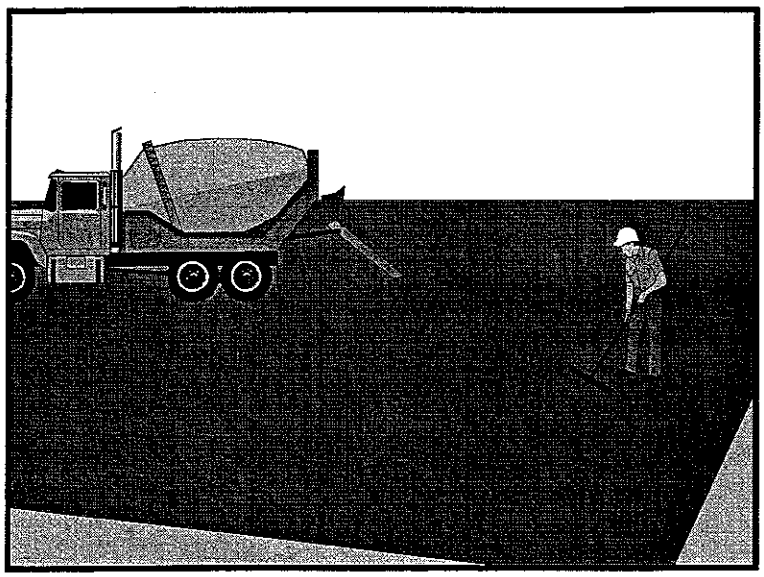
Maintenance and Inspection

Check areas protected to ensure coverage.

Implement requirements of Section 10 of the Caltrans Standard Specifications as appropriate.

Paving and Grinding Operations

NS-3



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Procedures that minimize pollution of storm water runoff during paving operations, including new paving and preparation of existing paved surfaces for overlays.

Appropriate Applications

These procedures are implemented where paving, surfacing, resurfacing, or sawcutting, may pollute storm water runoff or discharge to the storm drain system or watercourses.

Limitations

Finer solids are not effectively removed by filtration systems.

Paving opportunities may be limited during wet weather.

Standards and Specifications

Substances used to coat asphalt transport trucks and asphalt trucks and asphalt spreading equipment shall not contain soap and shall be non-foaming and non-toxic.

Place drip pans or absorbent materials under paving equipment while not in use, to catch and/or contain drips and leaks. See also BMP WM-10, "Liquid Waste Management".

When paving involves asphaltic concrete (AC), the following steps shall be implemented to prevent the discharge of grinding residue, uncompacted or loose AC, tack coats, equipment cleaners, or unrelated paving materials:

- Minimize the washing of sand or gravel from new asphalt into storm drains, streets, and creeks by sweeping where practical.
- Old or spilled asphalt must be disposed as approved by the Resident Engineer (RE).

- AC grindings, pieces, or chunks used in embankments or shoulder backing must not be allowed to enter any storm drains or watercourses. Apply temporary perimeter controls until structure is stabilized or permanent controls are in place. Examples of temporary perimeter controls can be found in the following BMPs: SS-10, "Earth Dikes/Drainage Swales & Ditches"; SC-1, "Silt Fence"; or SC-5, "Fiber Rolls".
- Collect and remove all broken asphalt and recycle when practical; otherwise, dispose in accordance with Standard Specification 7-1.13.
- Any AC chunks and pieces used in embankments must be placed above the water table and covered by at least 0.3m (1 ft) of material.
- Use only non-toxic substances to coat asphalt transport trucks and asphalt spreading equipment.

Drainage inlet structures and manholes shall be covered with filter fabric during application of seal coat, tack coat, slurry seal, and/or fog seal.

Seal coat, tack coat, slurry seal, or fog seal shall not be applied if rainfall is predicted to occur during the application or curing period.

Clean asphalt coated equipment off-site whenever possible. When cleaning dry, hardened asphalt from equipment, manage hardened asphalt debris as described in BMP WM-5, "Solid Waste Management". Any cleaning on site shall follow BMP NS-8, "Vehicle and Equipment Cleaning".

Do not wash sweepings from exposed aggregate concrete into a storm drain system. Collect and return to aggregate base stockpile, or dispose of properly.

Allow aggregate rinse to settle. Then, either allow rinse water to dry in a temporary pit as described in BMP WM-08, "Concrete Waste Management", or pump the water to the sanitary sewer if allowed by the local wastewater authority.

Do not allow saw-cut Portland Concrete Cement (PCC) slurry to enter storm drains or watercourses. Residue from grinding operations shall be picked up by means of a vacuum attachment to the grinding machine, shall not be allowed to flow across the pavement, and shall not be left on the surface of the pavement. See also BMP WM-8, "Concrete Waste Management"; and BMP WM-10, "Liquid Waste Management".

Pavement Grinding and Removal

Collect digout material by mechanical or manual methods. This material may be recycled if approved by the RE for use as shoulder backing or base material at locations approved by the RE.

If digout material cannot be recycled, transport the material back to a Maintenance facility or approved storage site.

Digout activities shall not be conducted in the rain.

When approved by the RE, stockpile material removed from roadways away from drain inlets, drainage ditches, and watercourses.

Disposal of PCC and AC waste shall be in conformance with Section 15-3.02 of the Standard Specifications. See also BMP WM-8, "Concrete Waste Management".

Thermoplastic Striping

All thermoplastic striper and pre-heater equipment shutoff valves shall be inspected to ensure that they are working properly to prevent leaking thermoplastic from entering drain inlets, the storm water drainage system, or watercourses.

The pre-heater shall be filled carefully to prevent splashing or spilling of hot thermoplastic. Leave six inches of space at the top of the pre-heater container when filling thermoplastic to allow room for material to move when the vehicle is deadheaded.

Contractor shall not pre-heat, transfer, or load thermoplastic near drain inlets or watercourses.

Clean truck beds daily of loose debris and melted thermoplastic. When possible recycle thermoplastic material. Thermoplastic waste shall be disposed of in accordance with Standard Specification 7-1.13.

Raised/Recessed Pavement Marker Application and Removal

Do not transfer or load bituminous material near drain inlets, the storm water drainage system or watercourses.

Melting tanks shall be loaded with care and not filled to beyond six inches from the top to leave room for splashing when vehicle is deadheaded.

When servicing or filling melting tanks, ensure all pressure is released before removing lids to avoid spills.

On large scale projects, use mechanical or manual methods to collect excess bituminous material from the roadway after removal of markers.

Waste shall be disposed of in accordance with Standard Specification 7-1.13.

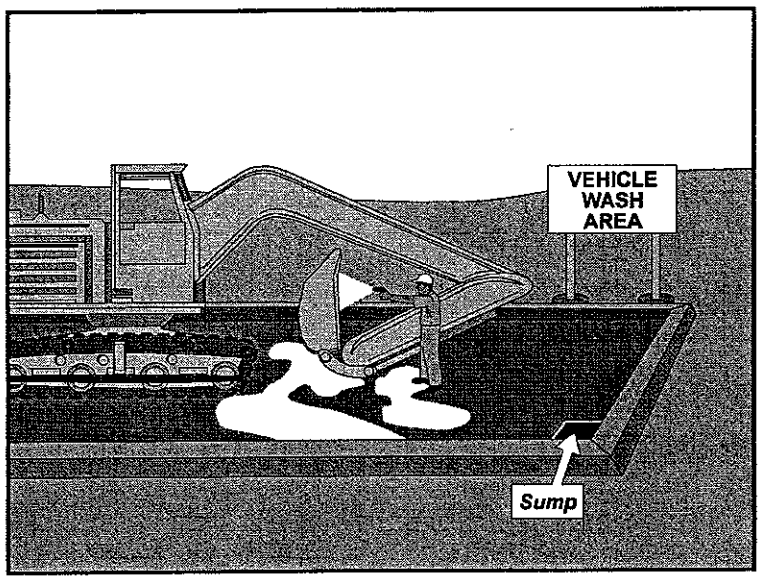
Maintenance and Inspection

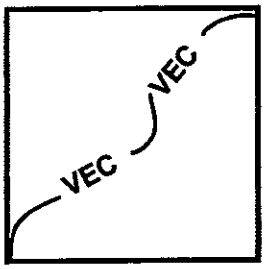
Inspect and maintain machinery regularly to minimize leaks and drips.

Ensure that employees and subcontractors are implementing appropriate measures during paving operations.

Vehicle and Equipment Cleaning

NS-8





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Procedures and practices used to minimize or eliminate the discharge of pollutants from vehicle and equipment cleaning operations to storm drain system or to watercourses.

Appropriate Applications

These procedures are applied on all construction sites where vehicle and equipment cleaning is performed.

Limitations

None.

Standards and Specifications

On-site vehicle and equipment washing is discouraged.

Cleaning of vehicles and equipment with soap, solvents or steam shall not occur on the project site unless the Resident Engineer (RE) has been notified in advance and the resulting wastes are fully contained and disposed of outside the highway right-of-way in conformance with the provisions in Section 7-1.13 of the Standard Specifications. Resulting wastes shall not be discharged or buried within the highway right-of-way.

Vehicle and equipment wash water shall be contained for percolation or evaporative drying away from storm drain inlets or watercourses and shall not be discharged within the highway right-of-way.

All vehicles/equipment that regularly enter and leave the construction site must be cleaned off-site.

When vehicle/equipment washing/cleaning must occur on-site, and the operation cannot be located within a structure or building equipped with appropriate disposal facilities, the outside cleaning area shall have the

following characteristics, and shall be arranged with the construction storm water coordinator:

- Located away from storm drain inlets, drainage facilities, or watercourses
- Paved with concrete or asphalt and bermed to contain wash waters and to prevent run-on and runoff
- Configured with a sump to allow collection and disposal of wash water
- Wash waters shall not be discharged to storm drains or watercourses
- Used only when necessary

When cleaning vehicles/equipment with water:

- Use as little water as possible. High pressure sprayers may use less water than a hose, and shall be considered.
- Use positive shutoff valve to minimize water usage.

Maintenance and Inspection

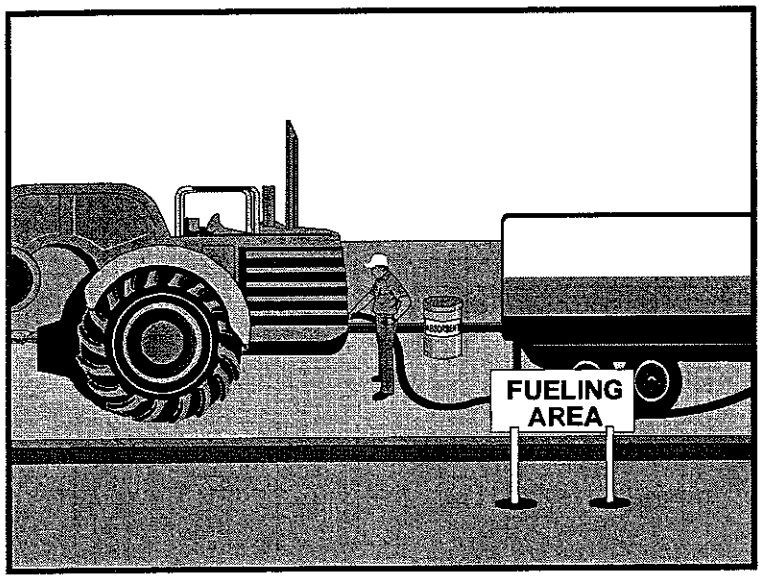
The control measure shall be inspected at a minimum of once a week.

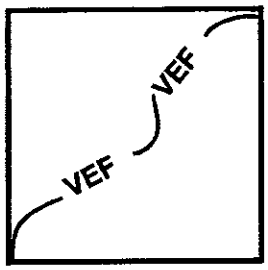
Monitor employees and subcontractors throughout the duration of the construction project to ensure appropriate practices are being implemented.

Inspect sump regularly and remove liquids and sediment as needed or as directed by the RE.

Vehicle and Equipment Fueling

NS-9





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Procedures and practices to minimize or eliminate the discharge of fuel spills and leaks into the storm drain system or to watercourses.

Appropriate Applications

These procedures are applied on all construction sites where vehicle and equipment fueling takes place.

Limitations

On-site vehicle and equipment fueling shall only be used where it's impractical to send vehicles and equipment off-site for fueling.

Standards and Specifications

When fueling must occur on-site, the contractor shall select and designate an area to be used, subject to approval of the Resident Engineer (RE).

Absorbent spill clean-up materials and spill kits shall be available in fueling areas and on fueling trucks and shall be disposed of properly after use.

Drip pans or absorbent pads shall be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.

Dedicated fueling areas shall be protected from storm water run-on and runoff, and shall be located at least 15 m from downstream drainage facilities and watercourses. Fueling must be performed on level-grade areas.

Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shut-off to control drips. Fueling operations shall not be left unattended.

Protect fueling areas with berms and/or dikes to prevent run-on, runoff, and to contain spills.

Use vapor recovery nozzles to help control drips as well as air pollution where required by Air Quality Management Districts (AQMD).

Fuel tanks shall not be "topped-off."

Vehicles and equipment shall be inspected on each day of use for leaks. Leaks shall be repaired immediately or problem vehicles or equipment shall be removed from the project site.

Absorbent materials shall be used on small spills instead of hosing down or burying techniques. The spent absorbent material shall be removed promptly and disposed of properly.

Federal, state, and local requirements shall be observed for any stationary above ground storage tanks.

Mobile fueling of construction equipment throughout the site shall be minimized. Whenever practical, equipment shall be transported to the designated fueling area.

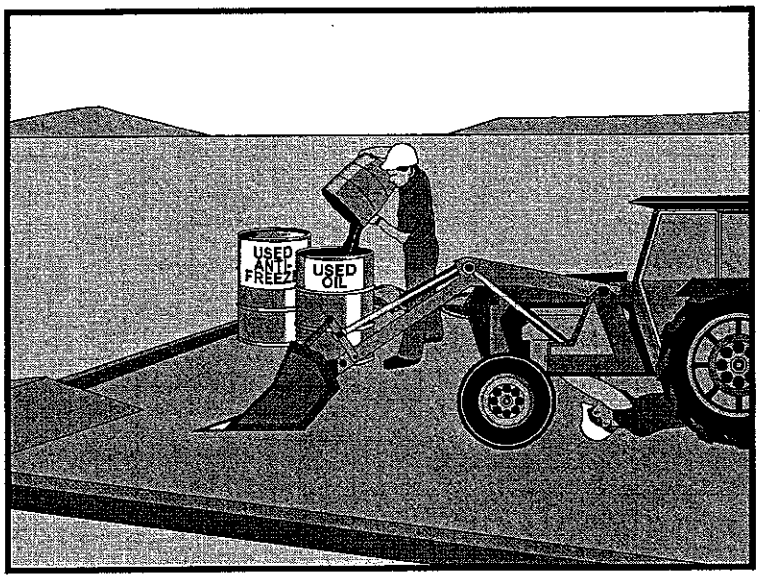
Maintenance and Inspection

Fueling areas and storage tanks shall be inspected on a regular basis.

Keep an ample supply of spill cleanup material on the site.

Immediately cleanup spills and properly dispose of contaminated soil and cleanup materials.

Vehicle and Equipment Maintenance NS-10



VEM

BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Procedures and practices to minimize or eliminate the discharge of pollutants to the storm drain system or to watercourses from vehicle and equipment maintenance procedures.

Appropriate Applications

These procedures are applied on all construction projects where an on-site yard area is necessary for storage and maintenance of heavy equipment and vehicles.

Limitations

None identified.

Standards and Specifications

Drip pans or absorbent pads shall be used during vehicle and equipment maintenance work that involves fluids, unless the maintenance work is performed over an impermeable surface in a dedicated maintenance area.

All fueling trucks and fueling areas are required to have spill kits and/or use other spill protection devices.

Dedicated maintenance areas shall be protected from storm water run-on and runoff, and shall be located at least 15 m from downstream drainage facilities and watercourses.

Drip Pans or plastic sheeting shall be placed under all vehicles and equipment placed on docks, barges, or other structures over water bodies when the vehicle or equipment is planned to be idle for more than one hour.

– Absorbent spill clean-up materials shall be available in maintenance areas and shall be disposed of properly after use. Substances used to coat asphalt transport trucks and asphalt spreading equipment shall be non-toxic. Drainage inlet structures and manholes shall be covered with filter fabric

when seal coat, tack coat , slurry seal, or fog seal is applied to adjacent surfaces. Seal coat, tack coat, slurry seal, or fog seal shall not be applied if rainfall or thunderstorms are predicted to occur during the application or curing period.

Use off-site maintenance facilities whenever practical.

For long-term projects, consider using portable tents or covers over maintenance areas.

Properly dispose of used oils, fluids, lubricants and spill cleanup materials.

Do not dump fuels and lubricants onto the ground

Do not place used oil in a dumpster or pour into a storm drain or watercourse.

Properly dispose of or recycle used batteries.

Do not bury used tires.

Repair leaks of fluids and oil immediately.

Provide spill containment dikes or secondary containment around stored oil and chemical drums.

Maintenance and Inspection

Maintain waste fluid containers in leak proof condition.

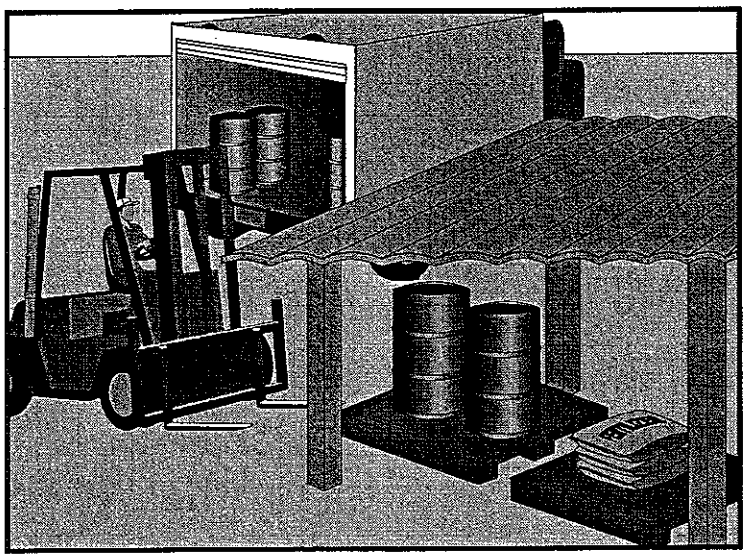
Vehicle and equipment maintenance areas shall be inspected regularly.

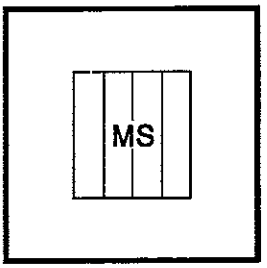
Vehicles and equipment shall be inspected on each day of use. Leaks shall be repaired immediately or the problem vehicle(s) or equipment shall be removed from the project site.

Inspect equipment for damaged hoses and leaky gaskets routinely. Repair or replace as needed.

Material Delivery and Storage

WM-1





BMP Objectives
- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Procedures and practices for the proper handling and storage of materials in a manner that minimizes or eliminates the discharge of these materials to the storm drain system or to watercourses.

Appropriate Applications

These procedures are implemented at all construction sites with delivery and storage of the following:

Soil

Pesticides and herbicides

Fertilizers

Detergents

Plaster

Petroleum products such as fuel, oil, and grease

Asphalt and concrete components

Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds

Concrete compounds

Other materials that may be detrimental if released to the environment

Limitations

Space limitation may preclude indoor storage.

Storage sheds must meet building & fire code requirements.

Standards and Specifications

General

Train employees and subcontractors on the proper material delivery and storage practices.

Temporary storage area shall be located away from vehicular traffic.

Material Safety Data Sheets (MSDS) shall be supplied to the Resident Engineer (RE) for all materials stored.

Material Storage Areas and Practices

Liquids, petroleum products, and substances listed in 40 CFR Parts 110, 117, or 302 shall be handled in conformance with the following provisions:

Storage, preparation, and mixing shall be accomplished in temporary containment facilities. Each temporary containment facility shall provide a spill containment volume equal to 1.5 times the volume of all containers therein and shall be impervious to the materials contained therein for a minimum contact time of 72 hours.

Sufficient separation shall be provided between stored containers to allow for spill cleanup and emergency response access.

Incompatible materials, such as chlorine and ammonia, shall not be stored in the same temporary containment facility.

To provide protection from wind and rain, throughout the rainy season, temporary containment facilities shall be covered during non-working days and prior to rain events.

Temporary containment facilities shall be maintained free of accumulated rainwater and spills.

Materials shall be stored in their original containers and the original product labels shall be maintained in place in a legible condition. Damaged or otherwise illegible labels shall be replaced immediately.

Liquid materials, petroleum products, and substances listed in 40 CFR Parts 110, 117 or 302 shall be stored in approved containers and drums shall not be overfilled. Containers shall be placed in temporary containment facilities for storage.

Bagged and boxed materials shall be stored on pallets and shall not be allowed to accumulate on the ground. To provide protection from wind and rain, throughout the rainy season, bagged and boxed materials shall be covered during non-working days and prior to rain events.

Stockpiles shall be protected in accordance with BMP WM-3, "Stockpile Management".

Minimize the material inventory stored on-site (e.g., only a few days supply).

Store materials indoors within existing structures or sheds when available.

Have proper storage instructions posted at all times in an open and conspicuous location.

Do not store hazardous chemicals, drums, or bagged materials directly on the ground. Place these items on a pallet and when possible, under cover in secondary containment.

Keep hazardous chemicals well labeled and in their original containers.

Keep ample supply of appropriate spill clean up material near storage areas.

Also see BMP WM-6, "Hazardous Waste Management", for storing of hazardous materials.

Material Delivery Practices

Keep an accurate, up-to-date inventory of material delivered and stored on-site.

Employees trained in emergency spill clean-up procedures shall be present when dangerous materials or liquid chemicals are unloaded.

Spill Clean-up

Contain and clean up any spill immediately.

If significant residual materials remain on the ground after construction is complete, properly remove and dispose any hazardous materials or contaminated soil.

See BMP WM-4, "Spill Prevention and Control", for spills of chemicals and/or hazardous materials.

Maintenance and Inspection

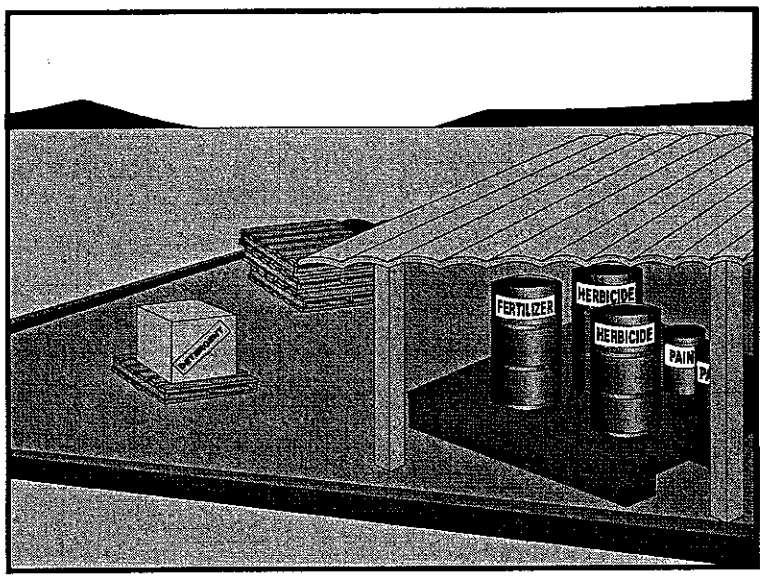
Storage areas shall be kept clean, well organized, and equipped with ample clean-up supplies as appropriate for the materials being stored.

Perimeter controls, containment structures, covers, and liners shall be repaired or replaced as needed to maintain proper function

Inspect storage areas before and after rainfall events, and at least weekly during other times.

Material Use

WM-2



MU

BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are procedures and practices for use of construction material in a manner that minimizes or eliminates the discharge of these materials to the storm drain system or to watercourses.

Appropriate Applications

This BMP applies to all construction projects. These procedures apply when the following materials are used or prepared on site:

Pesticides and herbicides

Fertilizers

Detergents

Plaster

Petroleum products such as fuel, oil, and grease

Asphalt and other concrete components

Hazardous chemicals such as acids, lime, glues, adhesives, paints, solvents, and curing compounds

Concrete compounds

Other materials that may be detrimental if released to the environment

Limitations

Safer alternative building and construction products may not be available or suitable in every instance.

Standards and Specifications

Material Safety Data Sheets (MSDS) shall be supplied to the Resident Engineer (RE) for all materials.

Latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths, when thoroughly dry and are no longer hazardous, may be disposed of with other construction debris.

Do not remove the original product label, it contains important safety and disposal information. Use the entire product before disposing of the container.

Mix paint indoors, or in a containment area. Never clean paintbrushes or rinse paint containers into a street, gutter, storm drain or watercourse. Dispose of any paint thinners, residue and sludge(s), that cannot be recycled, as hazardous waste.

For water-based paint, clean brushes to the extent practical, and rinse to a drain leading to a sanitary sewer where permitted, or into a concrete washout pit or temporary sediment trap. For oil-based paints, clean brushes to the extent practical and filter and reuse thinners and solvents.

Use recycled and less hazardous products when practical. Recycle residual paints, solvents, non-treated lumber, and other materials.

Use materials only where and when needed to complete the construction activity. Use safer alternative materials as much as possible. Reduce or eliminate use of hazardous materials on-site when practical.

Do not over-apply fertilizers and pesticides. Prepare only the amount needed. Strictly follow the recommended usage instructions. Apply surface dressings in smaller applications, as opposed to large applications, to allow time for it to work in and to avoid excess materials being carried off-site by runoff.

Application of herbicides and pesticides shall be performed by a licensed applicator.

Contractors are required to complete the "Report of Chemical Spray Forms" when spraying herbicides and pesticides.

Keep an ample supply of spill clean up material near use areas. Train employees in spill clean up procedures.

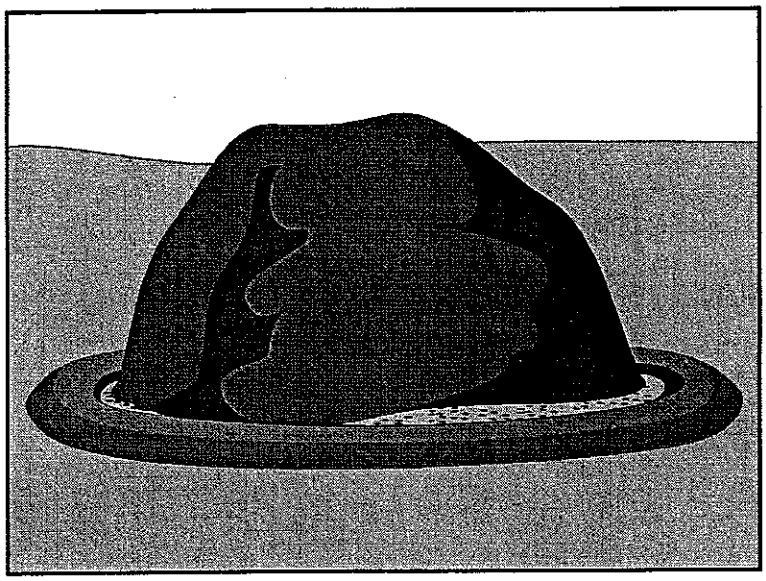
Avoid exposing applied materials to rainfall and runoff unless sufficient time has been allowed for them to dry.

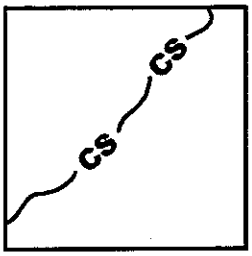
Maintenance and Inspections

Spot check employees and subcontractors monthly throughout the job to ensure appropriate practices are being employed.

Stockpile Management

WM-3





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Procedures and practices to reduce or eliminate pollution of storm water from stockpiles of soil, and paving materials such as portland cement concrete (PCC) rubble, asphalt concrete (AC), asphalt concrete rubble, aggregate base, aggregate subbase or pre-mixed aggregate and asphalt minder (so called "cold mix" asphalt).

Appropriate Applications

Implemented in all projects that stockpile soil and paving materials.

Limitations

None identified

Standards and Specifications

Protection of stockpiles is a year-round requirement.

Locate stockpiles away from concentrated flows of storm water, drainage courses, and inlets.

Protect all stockpiles from storm water run-on using a temporary perimeter sediment barrier such as berms, dikes, silt fences or sandbag barriers.

Implement wind erosion control practices as appropriate on all stockpiled material. For specific information see BMP WE-1, "Wind Erosion Control."

Stockpiles of contaminated soil shall be managed in accordance with BMP WM-7 "Contaminated Soil Management".

Bagged materials should be placed on pallets and under cover.

Protection of Non-Active Stockpiles

Non-active stockpiles of the identified materials shall be protected further as follows:

Soil stockpiles:

- During the rainy season, soil stockpiles shall be covered or protected with soil stabilization measures and a temporary perimeter sediment barrier at all times.
- During the non-rainy season, soil stockpiles shall be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

Stockpiles of portland cement concrete rubble, asphalt concrete, asphalt concrete rubble, aggregate base, or aggregate subbase:

- During the rainy season, the stockpiles shall be covered or protected with a temporary perimeter sediment barrier at all times
- During the non-rainy season, the stockpiles shall be covered or protected with a temporary perimeter sediment barrier prior to the onset of precipitation.

Stockpiles of "cold mix":

- During the rainy season, cold mix stockpiles shall be placed on and covered with plastic or comparable material at all times.
- During the non-rainy season, cold mix stockpiles shall be placed on and covered with plastic or comparable material prior to the onset of precipitation.

Protection of Active Stockpiles

Active stockpiles of the identified materials shall be protected further as follows:

All stockpiles shall be protected with a temporary linear sediment barrier prior to the onset of precipitation.

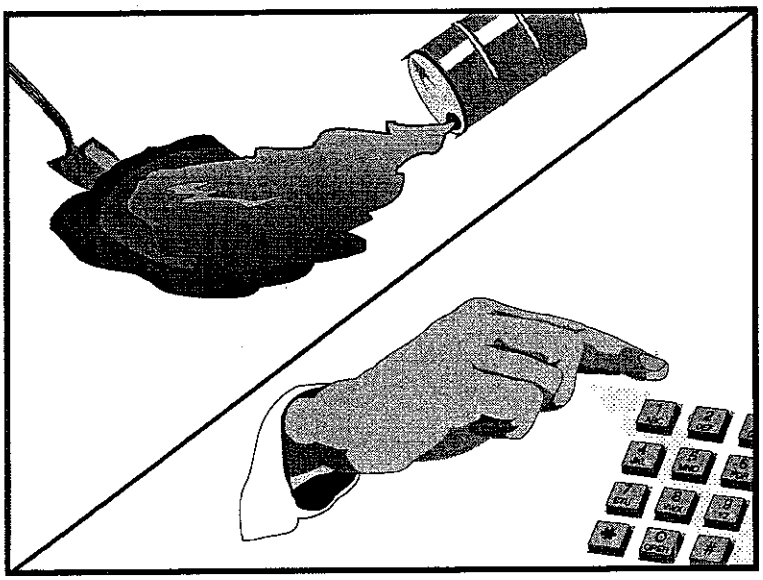
Stockpiles of "cold mix" shall be placed on and covered with plastic or comparable material prior to the onset of precipitation.

Maintenance and Inspections

Repair and/or replace perimeter controls and covers as needed, or as directed by the RE, to keep them functioning properly.

Spill Prevention and Control

WM-4



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are procedures and practices implemented to prevent and control spills in a manner that minimizes or prevents the discharge of spilled material to the drainage system or watercourses.

Appropriate Application

This best management practice (BMP) applies to all construction projects. Spill control procedures are implemented anytime chemicals and/or hazardous substances are stored. Substances may include, but are not limited to:

Soil stabilizers/binders

Dust Palliatives

Herbicides

Growth inhibitors

Fertilizers

Deicing/anti-icing chemicals

Fuels

Lubricants

Other petroleum distillates

To the extent that the work can be accomplished safely, spills of oil, petroleum products, substances listed under 40 CFR parts 110, 117, and 302, and sanitary and septic wastes shall be contained and cleaned up immediately.

Limitations

This BMP only applies to spills caused by the contractor.

Procedures and practices presented in this BMP are general. Contractor shall identify appropriate practices for the specific materials used or stored on-site.

Standards and Specifications

To the extent that it doesn't compromise clean up activities, spills shall be covered and protected from storm water run-on during rainfall.

Spills shall not be buried or washed with water.

Used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose shall be stored and disposed of in conformance with the provisions in these special provisions.

Water used for cleaning and decontamination shall not be allowed to enter storm drains or watercourses and shall be collected and disposed of in accordance with BMP WM-10, "Liquid Waste Management".

Water overflow or minor water spillage shall be contained and shall not be allowed to discharge into drainage facilities or watercourses.

Proper storage, clean-up and spill reporting instruction for hazardous materials stored or used on the project site shall be posted at all times in an open, conspicuous and accessible location.

Waste storage areas shall be kept clean, well organized and equipped with ample clean-up supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers and liners shall be repaired or replaced as needed to maintain proper function.

Education

Educate employees and subcontractors on what a "significant spill" is for each material they use, and what is the appropriate response for "significant" and "insignificant" spills.

Educate employees and subcontractors on potential dangers to humans and the environment from spills and leaks.

Hold regular meetings to discuss and reinforce appropriate disposal procedures (incorporate into regular safety meetings).

Establish a continuing education program to indoctrinate new employees.

The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce proper spill prevention and control measures.

Clean up and Storage Procedures

Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc. which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Remove the absorbent materials promptly and dispose of properly.
- The practice commonly followed for a minor spill is:
  1. Contain the spread of the spill.
  2. Recover spilled materials.
  3. Clean the contaminated area and/or properly dispose of contaminated materials.

Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.
- Clean up spills immediately:
  1. Notify the project foreman immediately. The foreman shall notify the Resident Engineer (RE).
  2. Contain spread of the spill.
  3. If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
  4. If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
  5. If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, the following steps shall be taken:

  1. Notify the RE immediately and follow up with a written report.
  2. Notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper county officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
  3. Notify the Governor's Office of Emergency Services Warning Center, (805) 852-7550.
  4. For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor shall notify the National Response Center at (800) 424-8802.
  5. Notification shall first be made by telephone and followed up with a written report.
  6. The services of a spills contractor or a Haz-Mat team shall be obtained immediately. Construction personnel shall not attempt to clean up until the appropriate and qualified staff have arrived at the job site.
  7. Other agencies which may need to be consulted include, but are not limited to, the Fire Department, the Public Works Department, the Coast Guard, the Highway Patrol, the City/County Police Department, Department of Toxic Substances, California Division of Oil and Gas, Cal/OSHA, etc.

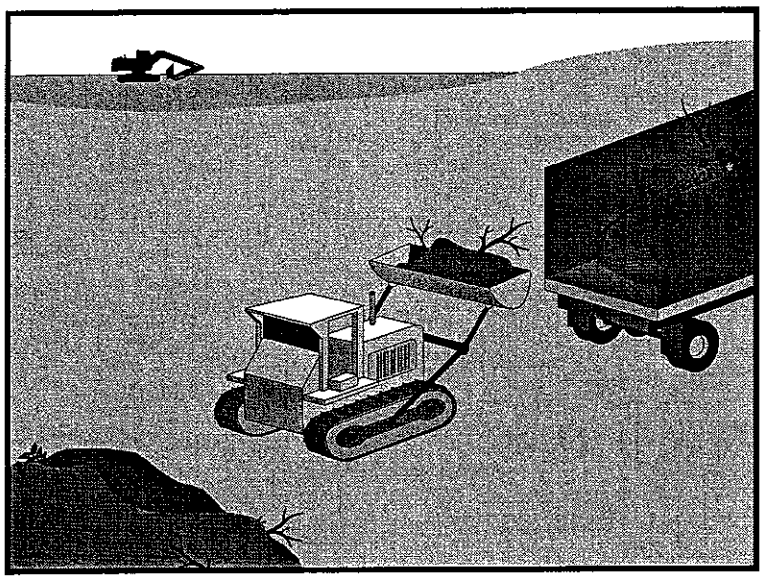
Maintenance and Inspection

Verify weekly that spill control clean up materials are located near material storage, unloading, and use areas.

Update spill prevention and control plans and stock appropriate clean-up materials whenever changes occur in the types of chemicals on site.

Solid Waste Management

WM-5



SWM

BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are procedures and practices to minimize or eliminate the discharge of pollutants to the drainage system or to watercourses as a result of the creation, stockpiling, and removal of construction site wastes.

Appropriate Applications

Solid waste management practices are implemented on all construction projects that generate solid wastes.

Solid wastes include but are not limited to:

Construction wastes including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials.

Highway planting wastes, including vegetative material, plant containers, and packaging materials.

Litter, including food containers, beverage cans, coffee cups, paper bags, plastic wrappers, and smoking materials, including litter generated by the public.

Limitations

Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season or in desert areas with low rainfall.

Standards and Specifications

Education

The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce proper solid waste procedures and practices.

Instruct employees and subcontractors on identification of solid waste and hazardous waste.

Educate employees and subcontractors on solid waste storage and disposal procedures.

Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

Require that employees and subcontractors follow solid waste handling and storage procedures.

Prohibit littering by employees, subcontractors, and visitors.

Wherever possible, minimize production of solid waste materials.

Collection, Storage, and Disposal

Littering on the project site shall be prohibited.

To prevent clogging of the storm drainage system litter and debris removal from drainage grates, trash racks, and ditch lines shall be a priority.

Trash receptacles shall be provided in the Contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.

Litter from work areas within the construction limits of the project site shall be collected and placed in water tight dumpsters at least weekly regardless of whether the litter was generated by the Contractor, the public, or others. Collected litter and debris shall not be placed in or next to drain inlets, storm water drainage systems or watercourses.

Dumpsters of sufficient size and number shall be provided to contain the solid waste generated by the project.

Full dumpsters shall be removed from the project site and the contents shall be disposed of outside the highway right of way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

Litter stored in collection areas and containers shall be handled and disposed of by trash hauling contractors.

Materials that are disposed of or temporarily stockpiled outside the highway right-of-way but are visible from the Highway, shall be in a neat and orderly fashion to the satisfaction of the Resident Engineer (RE).

Storm water run-on shall be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or

through the use of measures to elevate waste form site surfaces.

Solid waste storage areas shall be located at least 15m from drainage facilities and watercourses and shall not be located in areas prone to flooding or ponding.

Except during fair weather, construction and highway planting waste not stored in watertight dumpsters shall be protected from wind and rain by securely covering the waste with tarps or plastic sheeting or protected in conformance with the applicable Disturbed Soil Area protection.

Dumpster washout on the project site is not allowed.

Notify trash hauling contractors that only watertight dumpsters are acceptable for use on-site.

Plan for additional containers during the demolition phase of construction.

Plan for more frequent pickup during the demolition phase of construction.

Designate on-site waste storage areas and obtain approval of the RE.

Segregate potentially hazardous waste from non-hazardous construction site waste.

Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.

Dispose of non-hazardous waste in accordance with Standard Specification 7-1.13, Disposal of Material Outside the Highway right-of-way.

For disposal of hazardous waste, see BMP WM-6, "Hazardous Waste Management". Have hazardous waste hauled to an appropriate disposal and/or recycling facility.

Salvage or recycle useful vegetation debris, packaging and/or surplus building materials when practical. For example, trees and shrubs from land clearing can be used as a brush barrier, or converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled

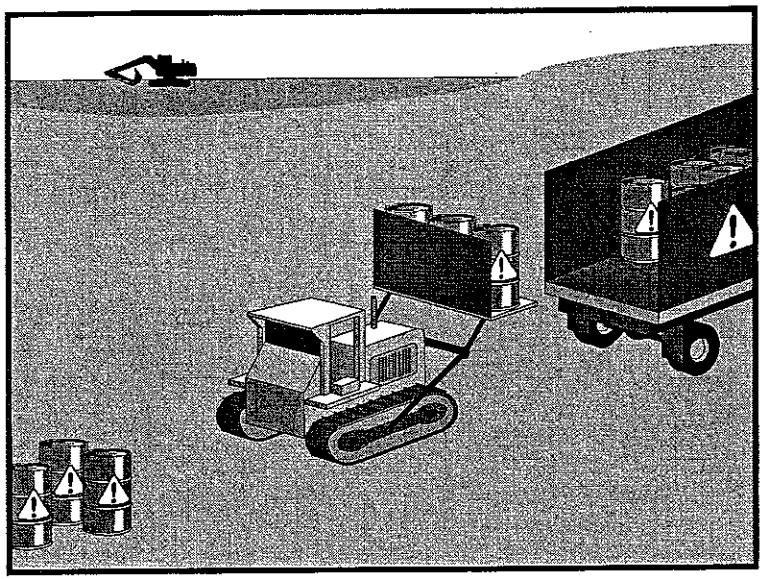
Maintenance and Inspection

The WPCM shall monitor on-site solid waste storage and disposal procedures.

Police site for litter and debris.

Hazardous Waste Management

WM-6



BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are procedures and practices to minimize or eliminate the discharge of pollutants from construction site hazardous waste to the storm drain system or to watercourses.

Appropriate Applications

This best management practice (BMP) applies to all construction projects.

Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products,
- Concrete Curing Compounds,
- Palliatives,
- Septic Wastes,
- Stains,
- Wood Preservatives,
- Asphalt Products,
- Pesticides,
- Acids,
- Paints,
- Solvents,
- Roofing Tar, or
- Any materials deemed a hazardous waste in California, Title 22 Division 4.5, or listed in 40 CFR Parts 110, 117, 261, or 302.

Limitations

Nothing in this BMP relieves the Contractor from responsibility for compliance with federal, state, and local laws regarding storage, handling, transportation, and disposal of hazardous wastes.

This BMP does not cover aerially deposited lead (ADL) soils. For ADL soils refer to BMP WM-7, Contaminated Soil Management, and the project Special Provisions.

Standards and Specifications

Education

Educate employees and subcontractors on hazardous waste storage and disposal procedures.

Educate employees and subcontractors on potential dangers to humans and the environment from hazardous wastes.

Instruct employees and subcontractors on safety procedures for common construction site hazardous wastes.

Instruct employees and subcontractors in identification of hazardous and solid waste.

Hold regular meetings to discuss and reinforce hazardous waste management procedures (incorporate into regular safety meetings).

The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce proper hazardous waste management procedures and practices.

Make sure that hazardous waste is collected, removed, and disposed of only at authorized disposal areas.

Storage Procedures

Wastes shall be stored in sealed containers constructed of a suitable material and shall be labeled as required by Title 22 CCR, Division 4.5 and 49 CFR Parts 172,173, 178, and 179.

All hazardous waste shall be stored, transported, and disposed as required in Title 22 CCR, Division 4.5 and 49 CFR 261-263.

Waste containers shall be stored in temporary containment facilities that shall comply with the following requirements:

- Temporary containment facility shall provide a spill containment volume equal to 1.5 times the volume of all containers.
- Temporary containment facility shall be impervious to the materials contained for a minimum contact time of 72 hours.
- Temporary containment facilities shall be maintained free of accumulated rainwater and spills.
- Sufficient separation shall be provided between stored containers to allow for spill cleanup and emergency response access.
- Incompatible materials, such as chlorine and ammonia, shall not be stored in the same temporary containment facility.

Throughout the rainy season, temporary containment facilities shall be covered during non-working days, prior to rain events.

Drums shall not be overfilled and wastes shall not be mixed.

Paint brushes and equipment for water and oil based paints shall be cleaned within a contained area and shall not be allowed to contaminate site soils, watercourses or drainage systems. Waste paints, thinners, solvents, residues, and sludges that cannot be recycled or reused shall be disposed of as hazardous waste When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths shall be disposed of as solid waste.

Ensure that adequate hazardous waste storage volume is available.

Ensure that hazardous waste collection containers are conveniently located.

Designate hazardous waste storage areas on site away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.

Minimize production or generation of hazardous materials and hazardous waste on the job site.

Use containment berms in fueling and maintenance areas and where the potential for spills is high.

Segregate potentially hazardous waste from non-hazardous construction site debris.

Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.

Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.

Place hazardous waste containers in secondary containment.

Do not allow potentially hazardous waste materials to accumulate on the ground.

Unless watertight, containers of dry waste shall be stored on pallets.

Do not mix wastes.

Disposal Procedures

Waste shall be disposed of outside the highway right-of-way within 90 days of being generated, or as directed by the Resident Engineer (RE).

To minimize on-site storage, full containers of waste shall be disposed of outside the highway right-of-way at least weekly. In no case shall hazardous waste storage exceed requirements in Title 22 CCR, section 66262.34.

Waste shall be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Waste Manifest forms. In no case shall hazardous waste storage exceed requirements in Title 22 CCR, section 66262.34.

A Caltrans certified laboratory shall sample waste to determine the appropriate disposal facility.

Make sure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for solid waste construction debris.

Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.

Recycle any useful material such as used oil or water-based paint when practical.

Attention is directed to "Hazardous Material", "Contaminated Material", and "Aerially Deposited Lead" of the contract documents regarding the handling and disposal of hazardous materials.

Maintenance and Inspection

The WPCM shall monitor on-site hazardous waste storage and disposal procedures.

Waste storage areas shall be kept clean, well organized, and equipped with ample clean-up supplies as appropriate for the materials being stored.

Storage areas shall be inspected in conformance with the provisions in the contract documents.

Perimeter controls, containment structures, covers, and liners shall be repaired or replaced as needed to maintain proper function.

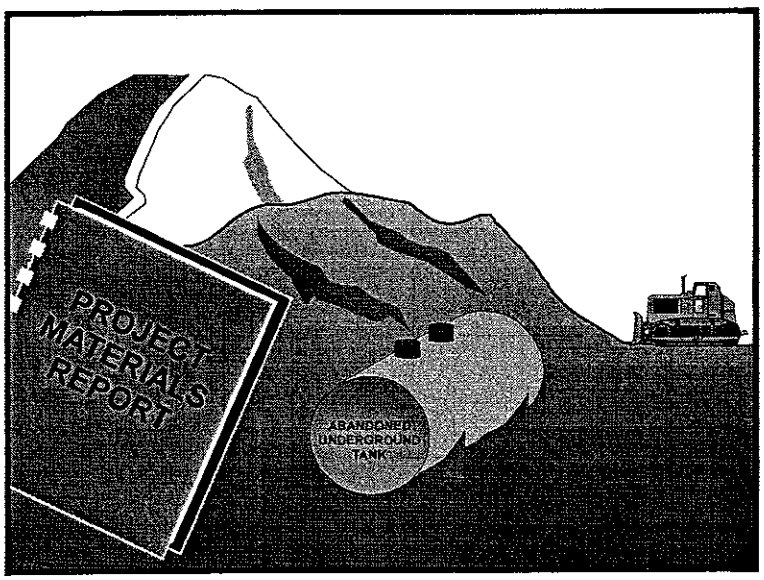
Hazardous spills shall be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.

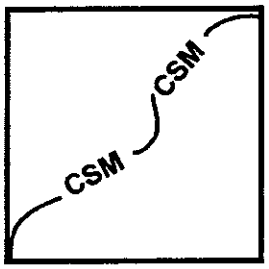
The National Response Center, at (800) 424-8802, shall be notified of spills of Federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302.

Copy of Bill of Laden and disposal receipts shall be provided to the RE.

Contaminated Soil Management

WM-7





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are procedures and practices to minimize or eliminate the discharges of pollutants to the drainage system or to watercourses from contaminated soil.

Appropriate Applications

Contaminated soil management is implemented on construction projects in highly urbanized or industrial areas where soil contamination may have occurred due to spills, illicit discharges, and leaks from underground storage tanks.

It may also apply to highway widening projects in older areas where median and shoulder soils may have been contaminated by aerially deposited lead (ADL).

Limitations

The procedures and practices presented in this best management practice (BMP) are general. The contractor shall identify appropriate practices and procedures for the specific contaminants known to exist or discovered on site.

Standards and Specifications

Identifying Contaminated Areas

Contaminated soils are often identified during project planning and development with known locations identified in the plans and specifications. The contractor shall review applicable reports and investigate appropriate call-outs in the plans and specifications.

The contractor may further identify contaminated soils by investigating:

- Past site uses and activities.
- Detected or undetected spills and leaks.

- Acid or alkaline solutions from exposed soil or rock formations high in acid or alkaline forming elements.
- Look for contaminated soil as evidenced by discoloration, odors, differences in soil properties, abandoned underground tanks or pipes, or buried debris. Test suspected soils at a certified laboratory.

Education

Prior to performing any excavation work at the locations containing material classified as hazardous, employees and subcontractors shall complete a safety training program which meets 29 CFR 1910.120 and 8 CCR 5192 covering the potential hazards as identified.

Educate employees and subcontractors in identification of contaminated soil and on contaminated soil handling and disposal procedures.

Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

Handling Procedures for Material with Aerially Deposited Lead (ADL)

Materials from areas designated as containing (ADL) may, if allowed by the contract special provisions, be excavated, transported, and used in the construction of embankments and/or backfill.

Excavation, transportation, and placement operations shall result in no visible dust.

Use caution to prevent spillage of lead containing material during transport.

Monitor the air quality during excavation of soils contaminated with lead.

Handling Procedures for Contaminated Soils

Test suspected soils at a Caltrans approved certified laboratory.

If the soil is contaminated, work with the local regulatory agencies to develop options for treatment and/or disposal.

Avoid temporary stockpiling of contaminated soils or hazardous material.

If temporary stockpiling is necessary:

(1) Cover the stockpile with plastic sheeting or tarps.

(2) Install a berm around the stockpile to prevent runoff from leaving the area.

(3) Do not stockpile in or near storm drains or watercourses.

Contaminated material and hazardous material on exteriors of transport vehicles shall be removed and placed either into the current transport vehicle or the excavation prior to the vehicle leaving the exclusion zone.

Monitor the air quality continuously during excavation operations at all locations containing hazardous material.

Procure all permits and licenses, pay all charges and fees, and give all notices necessary and incident to the due and lawful prosecution of the work, including registration for transporting vehicles carrying the contaminated material and the hazardous material.

Collect water from decontamination procedures and treat and/or dispose of it at an appropriate disposal site.

Collect non-reusable protective equipment, once used by any personnel, and dispose of at an appropriate disposal site.

Install temporary security fence to surround and secure the exclusion zone. Remove fencing when no longer needed.

Excavation, transport, and disposal of contaminated material and hazardous material shall be in accordance with the rules and regulations of the following agencies (the specifications of these agencies supersede the procedures outlined in this BMP):

- United States Department of Transportation (USDOT);
- United States Environmental Protection Agency (USEPA);
- California Environmental Protection Agency (CAL-EPA);
- California Division of Occupation Safety and Health Administration (CAL-OSHA); and
- Local regulatory agencies.

Procedures for Underground Storage Tank Removals

Prior to commencing tank removal operations, obtain the required underground storage tank removal permits and approval from the federal, state, and local agencies which have jurisdiction over such work.

Arrange to have tested, as directed by the Resident Engineer (RE), any liquid or sludge found in the underground tank prior to its removal to determine if it contains hazardous substances.

Following the tank removal, take soil samples beneath the excavated tank and perform analysis as required by the local agency representative(s).

The underground storage tank, any liquid and/or sludge found within the tank, and all contaminated substances and hazardous substances removed during the tank removal shall be transported to disposal facilities permitted to accept such waste.

Water Control

Take all necessary precautions and preventive measures to prevent the flow of water, including ground water, from mixing with hazardous substances or underground storage tank excavations. Such preventative measures may consist of, but are not limited to: berms, cofferdams, grout curtains, freeze walls, and seal course concrete or any combination thereof.

If water does enter an excavation and becomes contaminated, such water, when necessary to proceed with the work, shall be discharged to clean, closed top, watertight holding tanks, treated, and disposed of in accordance with federal, state, and local laws

Maintenance and Inspection

The Contractor's Water Pollution Control Manager and/or construction supervisor shall monitor on-site contaminated soil storage and disposal procedures.

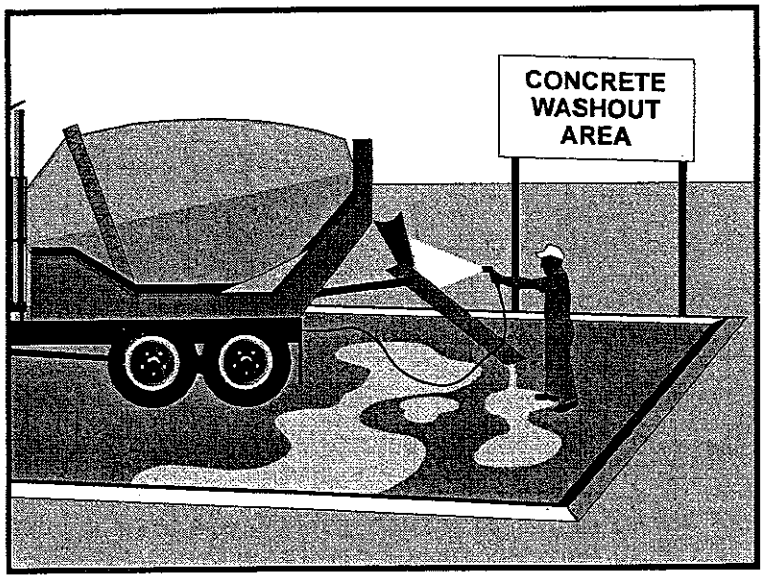
Monitor air quality continuously during excavation operations at all locations containing hazardous material.

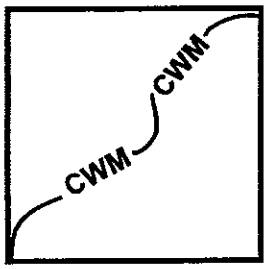
Coordinate contaminated soils and hazardous substances/waste management with the appropriate federal, state, and local agencies.

Inspect hazardous waste receptacles and areas regularly.

Concrete Waste Management

WM-8





BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

These are procedures and practices that are implemented to minimize or eliminate the discharge of concrete waste materials to the storm drain system or to watercourses.

Appropriate Applications

Concrete waste management practices are implemented on construction projects where concrete is used as a construction material or where concrete dust and debris result form demolition activities.

Where slurries containing portland cement concrete (PCC) or asphalt concrete (AC) are generated, such as from sawcutting, coring, grinding, grooving, and hydro-concrete demolition.

Where concrete trucks and other concrete-coated equipment are washed on site, when approved by the Resident Engineer (RE). See also NS-8, Vehicle and Equipment Cleaning.

Where mortar-mixing stations exist.

Limitations

None identified.

Standards and Specifications

Education

Educate employees, subcontractors, and suppliers on the concrete waste management techniques described herein.

The Contractor's Water Pollution Control Manager (WPCM) shall oversee and enforce concrete waste management procedures.

Concrete Slurry Wastes

PCC and AC waste shall not be allowed to enter storm drains or watercourses.

PCC and AC waste shall be collected and disposed of outside the highway right-of-way in conformance with section 7-1.13 of Standard Specifications or placed in a temporary concrete washout facility.

Disposal of hardened PCC and AC waste shall be in conformance with Section 15-3.02 of the Standard Specifications.

A sign shall be installed adjacent to each temporary concrete washout facility to inform concrete equipment operators to utilize the proper facilities.

Below grade concrete washout facilities are typical. Above grade facilities are used if excavation is not practical.

Do not allow slurry residue from wet coring or saw-cutting AC or PCC to enter storm drains or receiving waters by:

- Placing temporary berms or sandbags around coring or saw-cutting locations to capture and contain slurry runoff.
- Placing straw bales, sandbags, or gravel dams around inlets to prevent slurry from entering storm drains.

Vacuum slurry residue and dispose in a temporary pit (as described in *On-Site Temporary Concrete Washout Facility, Concrete Transit Truck Washout Procedures*, below) and allow slurry to dry. Dispose of dry slurry residue in accordance with BMP WM-5, "Solid Waste Management", or, for on-site disposal, in accordance with Standard Specification 15-3.02, Removal Methods.

Collect residue from grooving and grinding operations in accordance with Standard Specifications Section 42-1.02 and 42-2.02, "Construction."

On-site Temporary Concrete Washout Facility, Transit Truck Washout Procedures

Temporary concrete washout facilities shall be located a minimum of 15 m (50 ft) from storm drain inlets, open drainage facilities, and watercourses, unless determined unfeasible by the RE. Each facility shall be located away from construction traffic or access areas to prevent disturbance or tracking.

A sign shall be installed adjacent to each washout facility to inform concrete equipment operators to utilize the proper facilities. The sign shall be

installed as shown on the plans and in conformance with the provisions in Section 56-2, "Roadside Signs", of the Standard Specifications.

Temporary concrete washout facilities shall be constructed above grade or below grade at the option of the Contractor. Temporary concrete washout facilities shall be constructed and maintained in sufficient quantity and size to contain all liquid and concrete waste generated by washout operations.

Temporary washout facilities shall have a temporary pit or bermed areas of sufficient volume to completely contain all liquid and waste concrete materials generated during washout procedures.

Perform washout of concrete trucks in designated areas only.

Once concrete wastes are washed into the designated area and allowed to harden, the concrete shall be broken up, removed, and disposed of per BMP WM-5, "Solid Waste Management", and in conformance with the provisions in Section 15-3.02, "Removal Methods", of the Standard Specifications. Dispose of hardened concrete on a regular basis.

Temporary Concrete Washout Facility (Type Above Grade)

- Temporary concrete washout facility (type above grade) shall be constructed as shown on the plans, with a recommended minimum length and minimum width of 3m, but with sufficient quantity and volume to contain all liquid and concrete waste generated by washout operations. The length and width of a facility may be increased, at the Contractor's expense, upon approval of the RE.

- Straw bales, wood stakes, and sandbag materials shall conform to the provisions in BMP SC-9, "Straw Bale Barrier".

- Plastic lining material shall be a minimum of 60 mil polyethylene sheeting and shall be freeof holes, tears or other defects that compromise the impermeability of the material.

- Portable delineators shall conform to the provisions in Section 12-3.04, "Portable Delineators", of the Standard Specifications. The delineator bases shall be cemented to the pavement in the same manner as provided for cementing pavement markers to pavement in Section 85-1.06, "Placement", of the Standard Specifications. Portable delineators shall be applied only to a clean, dry surface.

Temporary Concrete Washout Facility (Type Below Grade)

- Temporary concrete washout facility (type below grade) shall be constructed as shown on the plans, with a recommended minimum

length and minimum width of 3m (10 ft). The quantity and volume shall be sufficient to contain all liquid and concrete waste generated by washout operations. The length and width of a facility may be increased, at the Contractor's expense, upon approval of the RE. Lath and flagging shall be commercial type.

Removal of Temporary Concrete Washout Facilities

When temporary concrete washout facilities are no longer required for the work, as determined by the RE, the hardened concrete shall be removed and disposed of in conformance with the provisions in Section 15-3.02 of the Standard Specifications. Materials used to construct temporary concrete washout facilities shall become the property of the Contractor, shall be removed from the site of the work, and shall be disposed of outside the highway right-of-way in conformance with the provisions in Section 7-1.13 of the Standard Specifications.

Holes, depressions or other ground disturbance caused by the removal of the temporary concrete washout facilities shall be backfilled and repaired in conformance with the provisions in Section 15-1.02, "Preservation of Property," of the Standard Specifications.

Maintenance and Inspection

The Contractor's Water Pollution Control Manager (WPCM) shall monitor on site concrete waste storage and disposal procedures at least weekly.

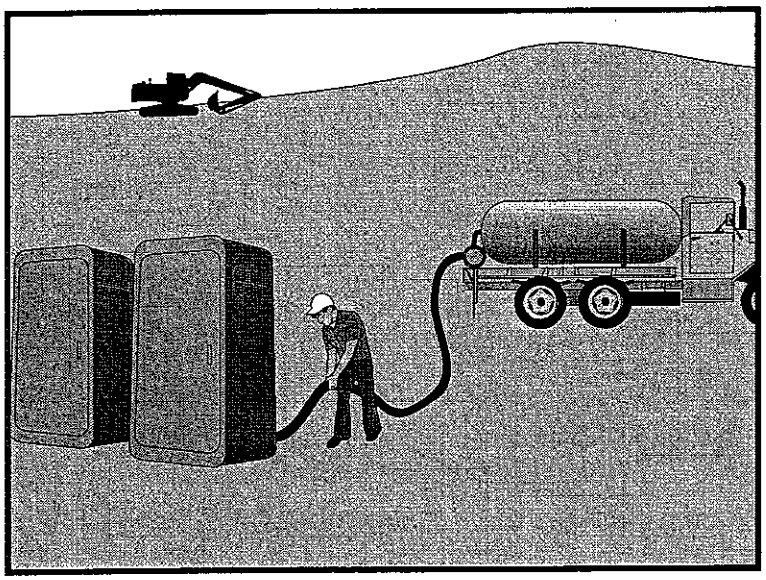
The WPCM shall monitor concrete working tasks, such as saw cutting, coring, grinding and grooving at least weekly to ensure proper methods are employed.

Temporary concrete washout facilities shall be maintained to provide adequate holding capacity with a minimum freeboard of 100mm for above grade facilities and 300mm for below grade facilities. Maintaining temporary concrete washout facilities shall include removing and disposing of hardened concrete and returning the facilities to a functional condition. Hardened concrete materials shall be removed and disposed of in conformance with the provisions in Section 15-3.02, "Removal Methods," of the Standard Specifications.

Existing facilities must be cleaned, or new facilities must be constructed and ready for use once the washout is 75% full.

Sanitary/Septic Waste Management

WM-9



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BMP Objectives

- Soil Stabilization
- Sediment Control
- Tracking Control
- Wind Erosion Control
- Non-Storm Water Management
- Materials and Waste Management

Definition and Purpose

Procedures and practices to minimize or eliminate the discharge of construction site sanitary/septic waste materials to the storm drain system or to watercourses.

Appropriate Applications

Sanitary/septic waste management practices are implemented on all construction sites that use temporary or portable sanitary/septic waste systems.

Limitations

Not applicable.

Standards and Specifications

Education

Educate employees, subcontractors, and suppliers on sanitary/septic waste storage and disposal procedures.

Educate employees, subcontractors, and suppliers of potential dangers to humans and the environment from sanitary/septic wastes.

Instruct employees, subcontractors, and suppliers in identification of sanitary/septic waste.

Hold regular meetings to discuss and reinforce disposal procedures (incorporate into regular safety meetings).

Establish a continuing education program to indoctrinate new employees.

Storage and Disposal Procedures

Temporary sanitary facilities shall be located away from drainage facilities, watercourses, and from traffic circulation. When subjected to high winds or risk of high winds, as determined by the Resident Engineer (RE), temporary

sanitary facilities shall be secured to prevent overturning.

Wastewater shall not be discharged or buried within the highway right-of-way.

Sanitary and septic systems that discharge directly into sanitary sewer systems, where permissible, shall comply with the local health agency, city, county, and sewer district requirements.

If using an on site disposal system, such as a septic system, comply with local health agency requirements.

Properly connect temporary sanitary facilities that discharge to the sanitary sewer system to avoid illicit discharges

Ensure that sanitary/septic facilities are maintained in good working order by a licensed service.

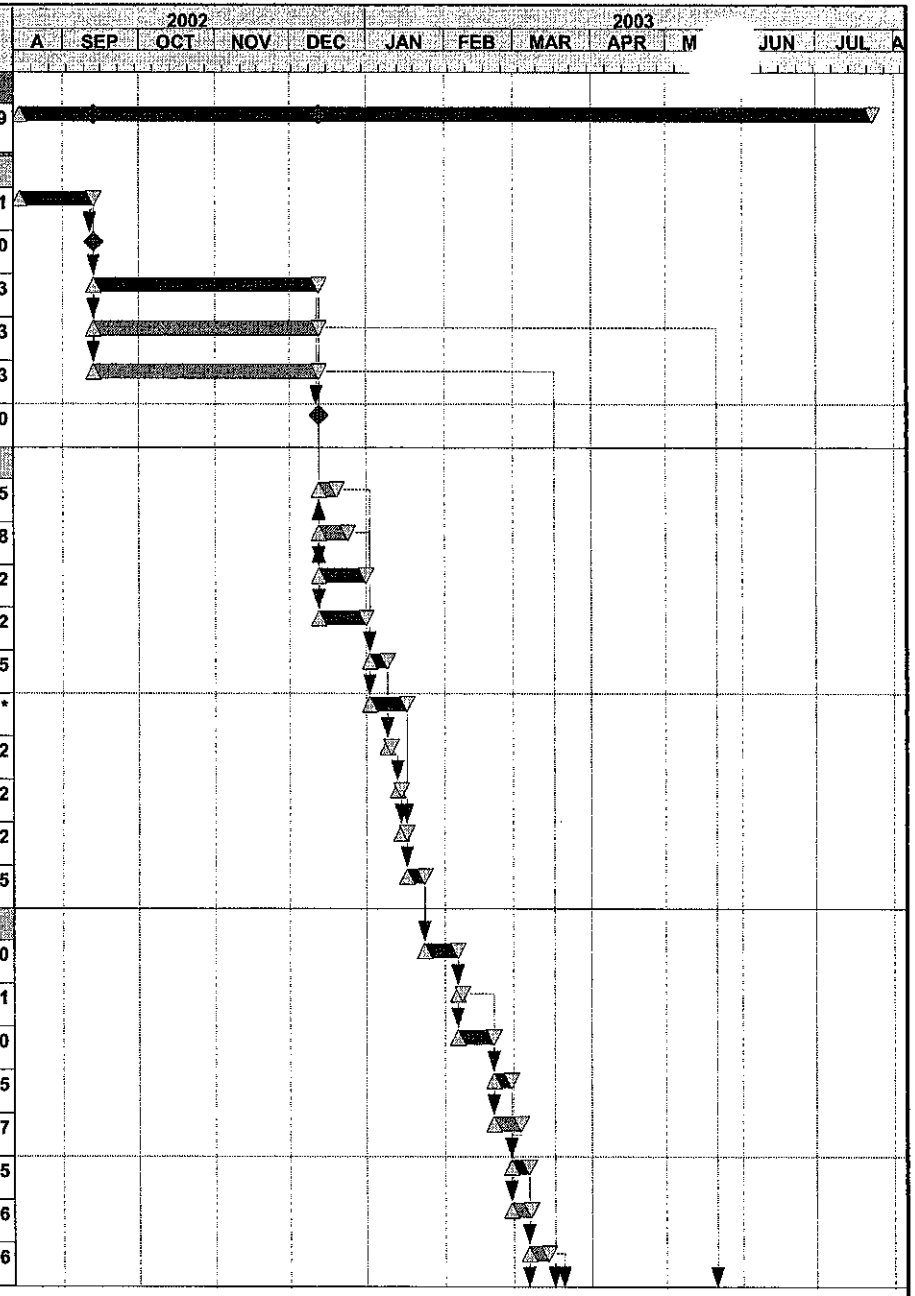
Use only reputable, licensed sanitary/septic waste haulers.

Maintenance and Inspection

The Contractor's Water Pollution Control Manager (WPCM) shall monitor on site sanitary/septic waste storage and disposal procedures at least weekly.

ATTACHMENT 3
SCHEDULE

Activity ID	Activity Description	Early Start	Ear' Fini.	Orig Dur
IR Site 10 Shore[illegible]ag Area				
Total		14AUG02	23JUL03	239
PRE-CONSTRUCTION ACTIVITIES				
A10001	DTSC Final Review, RAP	14AUG02*	12SEP02	21
A10002	NASNI PWO Site Approval Received (Stockpiling)		12SEP02	0
A10004	Public Comment Period, RAP	13SEP02	12DEC02	63
A10022	Import/Stockpile Rock Riprap	13SEP02	12DEC02	63
A10024	Import/Stockpile Clean Soil (Backfill/ET Cover)	13SEP02	12DEC02	63
A10005	NASNI PWO Site Approval Received (Constr)		12DEC02	0
SITE PREPARATION				
A10204	Conduct Geophysical / Utility Survey	13DEC02	19DEC02	5
A10202	Remove Chain-link & Gates / Install Temp Fence	13DEC02	24DEC02	8
A10201	Mobilize Personnel & Equipment	13DEC02	31DEC02	12
A10203	Setup Temporary Facilities	13DEC02	31DEC02	12
A10205	Clear & Grub Site (vegetation)	02JAN03	08JAN03	5
A10211	Remove / Dispose Debris - Offsite	02JAN03	16JAN03	11*
A10207	Remove Pipeline Foundation Structures	09JAN03	10JAN03	2
A10208	Install Bldg 380 Temporary Access Ramp	13JAN03	14JAN03	2
A10209	Demolish / Remove Bldg 380 Existing Access Ramp	15JAN03	16JAN03	2
A10210	Install Temporary Erosion Control Measures	17JAN03	23JAN03	5
EXCAVATE & CONSTRUCT CONTAINMENT SYSTEM				
A10300	Excavate WCA to 5' above MHHW	24JAN03	06FEB03	10
A10320	Confirmation Sampling / Analysis, WCA area	07FEB03	07FEB03	1
A10302	Excavate Northeast of Pier E	07FEB03	20FEB03	10
A10304	Excavate surrounding Foundations, Pier E	21FEB03	27FEB03	5
A10322	Confirmation Sampling / Analysis, NE Pier E	21FEB03	03MAR03	7
A10306	Excavate between Storm Drain & Pier E	28FEB03	06MAR03	5
A10324	Confirmation Sampling / Analysis, Foundations	28FEB03	07MAR03	6
A10326	Confirmation Sampling / Analysis, between	07MAR03	14MAR03	6



Start Date	01APR02	EFA2 - NU28	Sheet 1 of 2
Finish Date	23JUL03	IR site 10 Shoreline Slag Area	
Data Date	01APR02		
Run Date	09APR02 14:28	NAS North Island	

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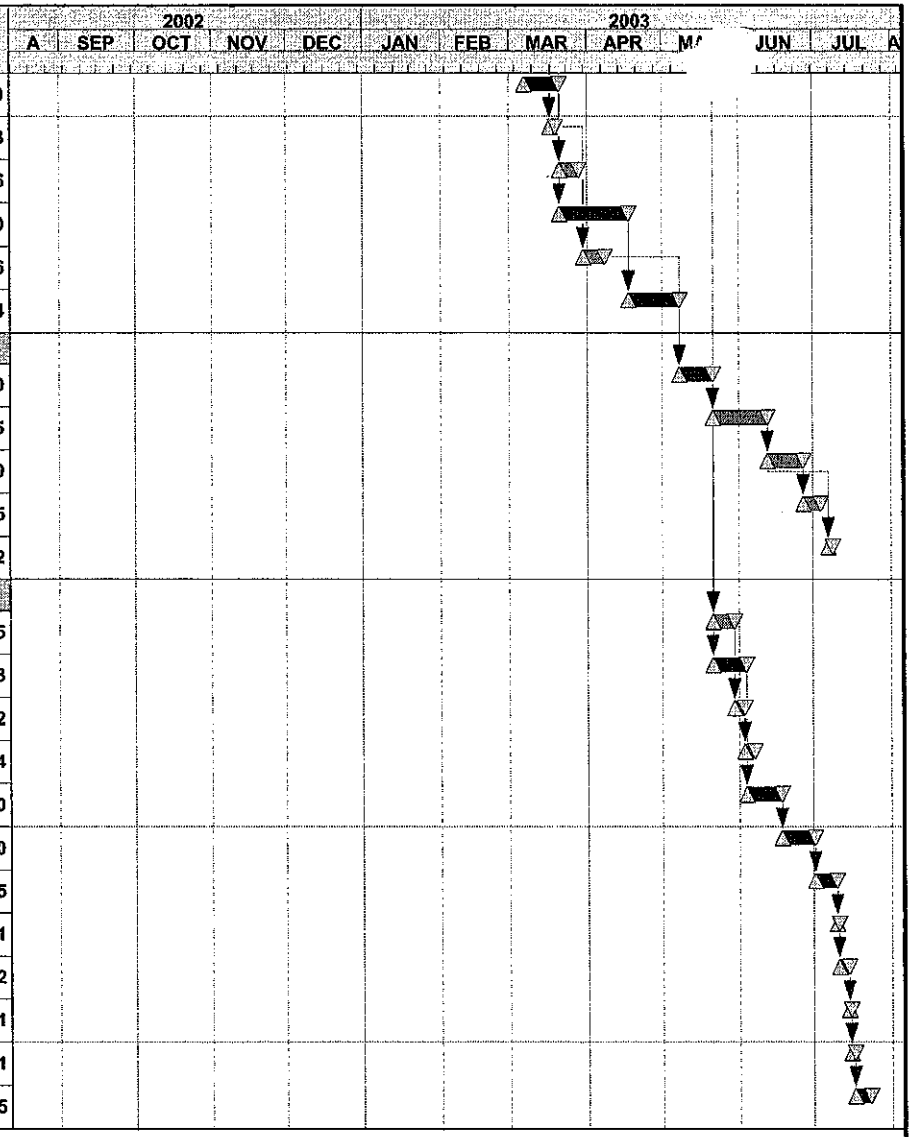
Activity ID	Activity Description	Early Start	Early Finish	Orig Dur
A10308	Excavate around / under Storm Drain	07MAR03	20MAR03	10
A10340	Backfill Clean Overburden (Drain & Pier E)	17MAR03	19MAR03	3
A10328	Confirmation Sampling / Analysis, Storm Drain	21MAR03	28MAR03	6
A10310	Excavate Southwest of Pier E	21MAR03	17APR03	20
A10342	Backfill around Storm Drain	31MAR03	07APR03	6
A10330	Confirmation Sampling / Analysis, SW Pier E	18APR03	07MAY03	14
CONSTRUCT ROCK REVETMENT				
A10401	Site Grading (rough & finish)	08MAY03	21MAY03	10
A10402	Construct Revetment	22MAY03	12JUN03	15
A10403	Place Cover on Waste Consolidation Area	13JUN03	26JUN03	10
A10404	Conduct Final Radiological Survey	27JUN03	03JUL03	5
A10405	Install & Calibrate Monitoring Devices	07JUL03	08JUL03	2
SITE RESTORATION				
A10502	Pour Concrete Driveway to Pier E	22MAY03	29MAY03	5
A10501	Install Groundwater Monitoring Wells, WCA	22MAY03	03JUN03	8
A10503	Replace Concrete behind Bldg 380	30MAY03	02JUN03	2
A10504	Construct Access Road, Bldg 380 A/C	03JUN03	06JUN03	4
A10505	Landscape Evapotranspiration Cover	04JUN03	17JUN03	10
A10506	Landscape Remainder of Site	18JUN03	01JUL03	10
A10507	Install Permanent Perimeter Fence / Gates	02JUL03	09JUL03	5
A10510	Conduct Preliminary Inspection with ROICC	10JUL03	10JUL03	1
A10511	Develop Punchlist	11JUL03	14JUL03	2
A10512	Complete Minor Improvements	15JUL03	15JUL03	1
A10513	Conduct Final Inspection	16JUL03	16JUL03	1
A10520	Demobilize Temporary Facilities & Equipment	17JUL03	23JUL03	5



Start Date	01APR02	EFA2 - NU28	Sheet 2 of 2
Finish Date	23JUL03	IR site 10	
Data Date	01APR02	Shoreline Slag Area	
Run Date	09APR02 14:28	NAS North Island	

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ATTACHMENT 4
INSPECTION CHECKLIST AND LOG

Construction Site Inspection Checklist

Inspected By: _____

Project: _____

Contractor: _____

Date: _____

Contractor's Inspector: _____

_____

Check "Yes" or "No" or "N/A" if not applicable

YES	NO	N/A		
_____	_____	_____	1.	Has there been an absence of rain since the last inspection?
_____	_____	_____	2.	Are all sandbags, straw bales, and silt fences in-place in accordance with the WPCP or SWPPP and are they functioning properly?
_____	_____	_____	3.	If present, are all significant erodible slopes protected from erosion through the implementation of acceptable soil stabilization practices?
_____	_____	_____	4	If present, are all sediment traps/basins functioning properly?
_____	_____	_____	5.	Are all material handling and storage areas reasonably clean and free of spills, leaks, or other deleterious materials?
_____	_____	_____	6.	Are all equipment storage and maintenance areas reasonably clean and free of spills, leaks, or any other deleterious materials?
_____	_____	_____	7.	Are all materials and equipment properly covered?
_____	_____	_____	8.	Are all discharge points reasonably free of any noticeable pollutant discharges?
_____	_____	_____	9.	Are all discharge points reasonably free of any significant erosion or sediment transport?
_____	_____	_____	10.	Are all BMPs identified on the WPCP or SWPPP installed in the proper location and according to the specifications for the plan?
_____	_____	_____	11.	Are all BMPs in good repair and maintained in functional order?

YES	NO	N/A		
_____	_____	_____	12.	Are all on-site traffic routes, parking, and storage of equipment and supplies restricted to areas designated in the WPCP or SWPPP for those uses?
_____	_____	_____	13.	Are all locations of temporary soil stockpiles or construction materials in approved areas?
_____	_____	_____	14.	Are all seeded or landscaped areas properly maintained?
_____	_____	_____	15.	Are sediment controls in place at discharge points from the site?
_____	_____	_____	16.	Are slopes free of significant erosion?
_____	_____	_____	17	Is sediment, debris, or mud being cleaned from public roads at intersections with site access roads?
_____	_____	_____	18.	Does the WPCP or SWPPP reflect current site conditions?

If you answered "no" to any of the above questions, describe any corrective action which must be taken to remedy the problem and when the corrective action is to be completed.

_____

_____

_____

_____

_____

INSPECTION LOG

Project Name: _____ Caltrans Contract Number: _____

Date	Inspector	Comments

APPENDIX F
TRAFFIC CONTROL PLAN

TRAFFIC CONTROL PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Prepared for:

U. S. Department of the Navy
Southwest Division
Naval Facilities Engineering Command
Environmental Division
1220 Pacific Highway
San Diego, California 92132-5190

Prepared by:

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Concord, California 94520-1120

TRAFFIC CONTROL PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
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Document Control Number 2740
Revision 0

July 8, 2002

Prepared by: _____ Date: 7/8/02
Holly Buschman
Project Engineer

Approved by: _____ Date: 7·8·02
Rich Wong
II Project Manager

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Figure 1 Truck Route Map

Acronyms and Abbreviations

Caltrans	State of California Department of Transportation
IR	Installation Restoration
MTC	Manual of Traffic Controls
NAS	Naval Air Station
TCP	Traffic Control Plan

1.0 Introduction

This Traffic Control Plan (TCP) describes the procedures for controlling traffic along Moffett Road during transportation of equipment and materials. This TCP has been developed to ensure that there is adequate consideration for the safety and convenience of motorists, pedestrians, and workers during construction.

Traffic control devices placed and maintained on all streets and highways in California are required by Section 21400 of the California Vehicle Code to conform with the Manual of Traffic Controls (MTC) published by the State of California Department of Transportation (Caltrans) (2000).

1.1 Traffic Volume

The majority of the traffic volume will be generated from the transportation of clean fill and riprap to Installation Restoration (IR) Site 10, the Shoreline Slag Area. Approximately 700 truckloads will be generated from these activities between August and December 2002. Maximum traffic speed along the transportation route is 30 miles per hour. The site is shown in Figure 1, "Truck Route Map." The transportation routes and traffic control measures are described in the following text. Overall transportation health and safety procedures are discussed in the Site Health and Safety Plan (Appendix A of the Removal Action Plan).

2.0 Traffic Control Measures

Section 5-01.5 of the MTC states fundamental principles for traffic control. The following are those principles most applicable to work at Naval Air Station (NAS) North Island:

- All traffic control devices shall conform to the specifications of the MTC.
- The goal of the design of traffic control procedures at construction and maintenance sites is to route traffic through these areas with road layouts and traffic control devices comparable to those for normal highway situations.
- Traffic movement should be inhibited as little as practical. Reduced speed zoning should be avoided as much as practical. Frequent and abrupt changes in road layouts, such as lane narrowing, dropped lanes, or main roadway transitions that require rapid maneuvers should be avoided.
- Flaggers should only be employed to control traffic when all other methods of traffic control are inadequate to warn and direct drivers or when traffic is heavy and interference with normal flow would be minimized.
- Modification of traffic controls or working conditions may be required to promote worker safety. Work sites should be carefully monitored under varying conditions of traffic volumes, light, and weather, to ensure that traffic control measures are operating effectively and that all devices used are clearly visible, clean, and in good repair. Work zone accident records should be analyzed periodically.
- All traffic control devices will be removed immediately when no longer needed, such as during hours when no transportation is scheduled.
- Traffic should be channeled by the use of pavement markings and signing, flexible posts, and other lightweight devices that will yield when hit by vehicles.

2.1 Construction Signs

Section 5-02 of the MTC states regulations for construction signs. The following list of regulations is most applicable to the work at NAS North Island.

- Warning signs in construction areas will have a black legend on an orange background. The use of standard orange flags or flashing yellow beacons in conjunction with signs is permitted, so long as they do not interfere with a clear view of the sign face.
- Signs will be placed in positions where they will convey their messages most effectively and placement must therefore be accommodated to highway design and alignment. Signs will be placed so the driver will have adequate time to respond. As a general rule, signs will be located on the right side of the road. Standards for

height and lateral clearance of roadside signs are shown in Section 5-05.2 of the MTC (Caltrans, 2000). These standards state that, for urban locations, a sign should be a minimum of 7 feet above the ground and a minimum of 6 feet off the shoulder of the road. Temporary signs mounted on barricades, or portable supports, may be lowered in height to the pavement elevation, however, higher mounting heights are desirable.

- Where open highway conditions prevail on the approach to the work site, advance warning signs should be placed at least 750 feet in advance of the condition or hazard. Where a series of advance warning signs are used, the warning sign nearest the work site should be placed at least 500 feet in advance with the additional signs at 500-foot minimum intervals. Signs will be required at NAS North Island at the approaches to the pullouts from both directions on Moffett. The most applicable sign is the "SLOW TRUCKS" sign (W51 of the MTC). Additionally, the pullout onto Moffett. may be highly trafficked at certain times each day, thereby requiring a flagger to slow and/or stop traffic, as trucks turn off of Moffett into Site 10. If this is the case, then the flagger sign (C9A of the MTC) will also be used.

If traffic control measures are required during hours of darkness, all construction signs used at night will be reflectorized with a material that has a smooth, sealed outer surface, or illuminated to show approximately the same shape and color day and night. Additional standards for illumination of signs are included in Section 5-02.2 in the MTC (Caltrans, 2000).

2.2 Lane Closures

Because the MTC states that the flow of traffic should be kept as close to normal as possible, cones should not be used for channelizing traffic unless absolutely necessary. However, if cones are used, the following principles apply.

- Channelizing devices warn and alert drivers of hazards created by construction activities in or near the traveled way and guide drivers past the hazards. Channelization devices should provide a smooth and gradual transition in moving traffic from one lane to another, onto a bypass or detour, or in reducing the width of the traveled way. They should be constructed so as not to inflict damage to a vehicle that inadvertently strikes them. The channelizing devices will be preceded by a system of warning devices (signs).
- The single most important element regarding channelization devices where pavement width is reduced is the taper. An inadequate taper will almost always produce undesirable traffic operations resulting in congestion and possibly accidents throughout the area. Tapers are described in Section 5-02.3 of the MTC (Caltrans, 2000).
- Channelization often remains in the same place for long periods of time. Some of the devices move from their original alignment due to being struck or moved because of construction activities. It is, therefore, necessary to patrol the

channelization at regular intervals to ensure that it is functioning properly as a traffic control device. For this project, traffic control devices, including signs, should be checked at the beginning of each shift and following heavy traffic periods ending at approximately 0930, 1330, and 1800. Replacement or shifting of the elements into the original alignment can best be done if the original positions of the elements had been indicated on the pavement by paint marks.

- As used in the MTC (Section 5-05.6), portable channelizing devices consist of tubular (portable delineator) or conical (traffic cones) shaped plastic devices, which should be at least 18 inches high. Cones, at least 28 inches high, and delineators, at least 36 inches high, will be used. Portable delineators will be either internally illuminated or reflectorized for use at night. Reflectors will be a minimum of two 3-inch bands placed a maximum of 2 inches from the top, with a maximum of 6 inches between the bands (Caltrans, 2000).
- The maximum spacing for channelization devices (cones or delineators) will be 25 feet.

If traffic control measures are required during hours of darkness, traffic cones used at night will be either internally illuminated or affixed with reflectorized sleeves. Sleeves for 28-inch cones will be at least 13 inches. Sleeves for smaller cones will be 7 inches. Reflectorized materials for the above devices will be white and maintained to be capable of clearly reflecting light under normal atmospheric conditions from a distance of 1,000 feet when illuminated by the upper beam of standard vehicle lights. Orange will be the predominant color of these devices. Drawings of applicable and nonapplicable devices are shown in Figure 5-10, Section 5-05.6 of the MTC (Caltrans, 2000).

2.3 Flaggers

A flagger may be used to control traffic where trucks turn off **Moffett into Site 10** based on the traffic analysis presented in Section 4.4.2. Regulations related to flagging are summarized below:

- Flaggers will be trained in the proper fundamentals of flagging traffic before being assigned to that duty. Flaggers are used at locations where it is necessary to change traffic controls frequently. The flagger must be clearly visible to approaching traffic for a distance sufficient to permit proper response by the motorist to flagging instructions and to permit traffic to reduce speed before entering the work site. The flagger must be protected by the use of warning signs and cones. All flaggers will be required to use orange vests, jackets, or shirts.
- **To Slow or Stop Traffic** — The STOP-SLOW paddle that will be used for flagging operations (C28A-B) is shown on Page 5-16 of the MTC. The paddle may

be either hand-held or supported by a staff. The following flagging procedures will be used (as illustrated in Figure 5-4, Section 5-04.6 of the MTC).

- **To Stop Traffic** — The flagger will face traffic and hold the STOP paddle in a vertical position at arm's length. For greater emphasis, the free arm may be raised with the palm toward approaching traffic.
- **When It Is Safe for Traffic to Proceed** — The flagger will stand parallel to the traffic movement, and with the SLOW paddle held in a vertical position, motion traffic ahead with the free arm.
- **Where It Is Desired to Alert or Slow Traffic** — The flagger will face traffic and hold the SLOW paddle in a vertical position at arm's length. For added emphasis, the flagger may slowly raise and lower the free hand with the palm down.

3.0 Reference

California Department of Transportation, 2000, *Manual of Traffic Controls*, January 3.

IR SITE 10

SHORELINE SLAG AREA

LEGEND

PROPOSED DELIVERY ROUTE

PROPOSED DELIVERY AND EXIT ROUTE

PROPOSED EXIT ROUTE

SAN DIEGO BAY

SAN DIEGO BAY

CITY OF CORONADO

GATE 2

GATE 5

GATE 8

MAIN GATE

BREAKERS BEACH

LEAST TERN NESTING AREA

TAXIWAY NO. 2 NORTH

TAXIWAY NO. 3

ROGERS ROAD

SHERMAN ROAD

TOW WAY

ALAMEDA BLVD.

FIRST STREET

SECOND STREET

THIRD STREET

FOURTH STREET

FIFTH STREET

SIXTH STREET

ORANGE AVE.

TO IMPERIAL BEACH

TO SAN DIEGO

GRAPHIC SCALE

0' 750' 1500' 3000'

(IN FEET)

IT FIELD OFFICE

(619) 437-6326

FAX (619) 437-6368

PACIFIC OCEAN

NAS NORTH ISLAND SAN DIEGO, CALIFORNIA

TRUCK ROUTES ESTABILISHED IN ACCORDANCE WITH CITY OF CORONADO RESOLUTION No. 6944

CONTRACT NAME: SWDIV			IT CORPORATION	IR SITE 10 SHORELINE SLAG AREA NAVAL AIR STATION, NORTH ISLAND SAN DIEGO, CALIFORNIA	
DRAWN BY: C. GERONIMO	DATE: 1/14/02			TRUCK ROUTE MAP TRAFFIC CONTROL PLAN (TCP)	
CHECKED BY: S. AUSTIN	DATE: 1/15/02				
APPROVED BY: H. BUSCHMAN	DATE: 1/15/02				
PROJECT MANAGER: R. WONG					
AUTOCAD FILE No.: 818724-B12					
SCALE: N.T.S.	SHEET: 1	OF: 1	DOCUMENT CONTROL No.: 2740	IT PROJECT No.: 818724	DRAWING No.: FIG. 1

APPENDIX G
WASTE MANAGEMENT PLAN

WASTE MANAGEMENT PLAN
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION NORTH ISLAND
SAN DIEGO, CALIFORNIA

Environmental Remedial Action
Contract Number N62474-98-D-2076
Contract Task Order 0028

Document Control Number 2740
Revision 0

July 8, 2002

Submitted to:

U.S. Department of the Navy
Southwest Division
Naval Facilities Engineering Command
Environmental Division
1220 Pacific Highway
San Diego, California 92132-5190

Submitted by:

IT Corporation
4005 Port Chicago Highway
Concord, California 94520-1120

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Attachment 1 Investigation-Derived Waste Management Plan for Naval Complex Coronado

1.0 Introduction

This Waste Management Plan describes procedures and documentation controls that IT Corporation will use in managing waste generated during the non-time critical removal action at Installation Restoration Site 10, the Shoreline Slag Area. Waste management will be implemented under the direction of the project's assigned Transportation and Disposal Coordinator in accordance with the Investigation-Derived Waste Management Plan prepared by the U.S. Department of the Navy for Naval Complex Coronado (see Attachment 1).

1.1 Types of Wastes

Waste streams expected to be generated during this project include liquid, personal protection equipment (PPE), and materials waste. Liquid waste will be produced from decontamination.

1.2 Accumulation of Wastes

Liquids produced by this project will be containerized and stored in properly labeled Department of Transportation-approved drums. The volume of liquid waste expected to occur from project activities is low. All containerized materials and waste will be properly labeled and stored. Stored containers will be inspected regularly to ensure they are properly identified and in working order. No wastes will be stored at any location in excess of the 90-day temporary holding time.

1.3 Waste Disposal Methods

Remediation-derived materials will be characterized to determine the appropriate method of disposal. Waste characterization sampling will be performed in accordance with requirements in the *San Diego County Site Assessment and Mitigation Manual* (County of San Diego, 2000). For each unit or batch of waste, samples will be collected and analyzed for known site contaminants as required for disposal.

After characterization and acceptance of waste characterization results, wastes will be transferred to Naval Air Station North Island Industrial Waste Treatment Plant or an appropriate off-site disposal facility. Waste will be transferred to the disposal facility utilizing the appropriate transport method and documentation (hazardous waste manifest, nonhazardous waste manifest, and/or bills of lading).

PPE, plastic sheeting, and nonhazardous debris will be disposed of at the Navy-owned Miramar Class III landfill. Material will be inspected for contamination prior to disposal in waste

containers. Contaminated PPE, plastic sheeting, and nonhazardous debris will be decontaminated prior to disposal or properly containerized, labeled, and transferred to an appropriate waste disposal facility.

2.0 References

County of San Diego, 2000, *San Diego County Site Assessment and Mitigation Manual*.

ATTACHMENT 1
INVESTIGATION-DERIVED WASTE MANAGEMENT PLAN FOR NAVAL COMPLEX CORONADO

INVESTIGATION-DERIVED WASTE MANAGEMENT PLAN FOR THE NAVAL COMPLEX CORONADO

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INVESTIGATION DERIVED WASTE MANAGEMENT PLAN
For the Naval Complex Coronado

1.0 PURPOSE

The purpose of this plan is to provide guidelines for sampling, containment, analysis, classification, handling, and disposal of investigation derived waste (IDW) generated during field investigations at the Naval Air Station, North Island (NASNI) and all tenant commands, Naval Amphibious Base, Coronado (NAB), Navy Auxiliary Landing Field, San Clemente Island (NALF, SCI), Navy Outlying Landing Field, Imperial Beach (NOLF), Naval Computer and Telecommunication Station, Imperial Beach (NCTS), and the Survival Evasion Resistance and Escape (SERE) Camp, Warner Springs. These activities are referred in this document as the Naval Complex Coronado. IDW generating activities covered under this plan include investigation and remediation activities at Installation Restoration (IR) sites, underground storage tanks (UST) sites, above ground storage tanks (AST) sites, and other contaminated sites.

Field investigation activities result in the generation of waste materials that may pose a risk to human health and the environment. The extent of that risk must be determined by the generator or contractor responsible for disposition of the material prior to further management of the waste. Throughout this plan, "contractor" refers to all persons performing remedial actions who may generate IDW including Navy contractors, Construction Battalion personnel, self-help personnel, and the Navy Public Works Center (PWC).

This Plan does not provide guidance for the management and disposal of radioactive IDW. Radioactive waste must be managed in accordance with requirements established by the Navy Nuclear Program or Radiological Affairs Support Organization (RASO).

Both liquid and solid wastes may be generated as a result of field investigation activities at the Naval Complex Coronado. IDW from the field activities may consist of the following:

- Used personal protective equipment and debris
- Decontamination wash water from cleaning, sampling, and other equipment
- Waste sediment from sediment sampling locations
- Development and purge water from monitoring wells
- Waste soil from UST/AST excavations and removals, and Comprehensive Environmental Response, Compensation and Liability Act/Resource Conservation and Recovery Act (CERCLA/RCRA) sites.
- Waste soil cuttings from borings and monitoring wells

The environmental laboratory will provide proper disposal for samples and excess sample material submitted for testing and analyses.

2.0 ROLES AND RESPONSIBILITIES

2 1 IDW Contractor

- Responsible for storing, characterizing, tracking, and initial handling of the IDW.

- Conducts weekly inspections of IDW containers and submits a copy of the inspection report to the Naval Complex Coronado Environmental Office, Naval Aviation Depot (NADEP) Environmental Office, or PWC Environmental Office, as appropriate.
- Prepares profiles for approval by the Navy Representative (Option 1 and 4)
- Provides copies of signed profiles to PWC (Option 1 and 4)

2.2 Navy Representative (may include Naval Complex Coronado, NADEP, or PWC)

- Reviews and signs profiles - If Naval Complex Coronado or Southwest Division, Naval Facilities Engineering Command (SWDIV) are the Project Leaders, Naval Complex Coronado reviews and signs profiles. If NADEP is the Project Leader, NADEP reviews and signs profiles. If PWC is the Project Leader or if other representatives contract for PWC's sampling and characterization services, PWC prepares and signs profiles.
- Provides guidance regarding disposal options.
- Inspects IDW generator sites.

2.3 PWC

- Picks up and disposes of IDW waste (Options 1, 2, and 3)
- Provides manifesting services (preparation of Uniform Hazardous Waste Manifests and Land Disposal Restriction Notifications) and provides inspections of containers, vehicles, and transporter.
- Develop profiles (Options 2 and 3)
- Characterize hazardous waste (Option 3)
- Provides for sampling and analytical services (Option 3)

2.4 Naval Complex Coronado Environmental Office

- Ensures all projects comply with Hazardous Waste (HW) statutes and regulations at Naval Complex Coronado.
- Receives weekly inspection reports.

2.5 Project Leader (SWDIV, PWC, Naval Complex Coronado Environmental, NADEP)

- Provide project management and technical support
- Provide for funding and account for expenditures

2.6 Resident Officer in Charge of Construction (ROICC)

- Coordinates physical activities performed by contractors.
- Performs compliance inspections at IDW contractor sites

3.0 PROCEDURES:

The handling and disposal methods for IDW generated at the Naval Complex Coronado are presented in four options. The desired option selected for a particular project will be negotiated within the project team and communicated to SWDIV Remedial Program Manager (RPM), Resident Officer In Charge of Construction (ROICC), PWC Remedial Project Leader, NADEP, or other project supervisor as applicable. Project managers must be aware that all waste must be disposed within 90 days, therefore, sufficient time must be allocated for containerization, labeling, sampling, profiling, and removal. Funding issues for activities using PWC services are addressed in Appendix C. The options are as follows:

- Option #1 — The IDW contractor profiles the IDW and PWC disposes the waste.
- Option #2 — The IDW contractor samples and PWC profiles and disposes the waste.
- Option #3 — PWC samples, profiles, and disposes of the IDW.
- Option #4 — The IDW contractor samples, profiles (Navy Representative signs), and disposes of the IDW (PWC provides manifesting services only).

Although the detailed steps will vary depending on which option is selected, the general procedures for processing IDW are as follows:

- The IDW is collected in containers, labeled, and inventoried.

- Samples of the IDW are collected and analyzed for characterization purposes. Additional sampling may be required if initial sampling was inconclusive.

- Profiles are developed and forwarded to the Navy Representative for approval. The approval authority is contingent upon the investigation site; if it is on a NADEP site, NADEP signs the profile; if it's on a PWC site or the investigation is conducted by PWC or if PWC prepares the profile, PWC signs the profile; all other sites, Naval Complex Coronado Environmental signs the profile).

- A hazardous or non-hazardous waste determination is made.

- The IDW is relabeled , Uniform Hazardous Waste Manifests and Land Disposal Restriction Notifications are prepared as necessary, and the IDW is removed for disposal.

The specific procedures presented for each option are as follows:

3.1 Option #1 (refer to Appendix E, Figure 1):

- The contractor collects and containerizes the IDW, initiates a container log, and labels the container (use a hazardous waste label listing contents and stating "Awaiting Analytical Results"). SEE APPENDIX D.
- The contractor submits copies of the container log to the Navy Representative SEE APPENDIX D.
- The contractor collects IDW samples and delivers them to the laboratory for testing.
- The contractor receives and interprets analytical results.
- If sufficient data are available from the analytical results to properly characterize the IDW, the contractor develops a profile and submits it to the Navy Representative for approval and signature.
- If additional testing is required to properly characterize the IDW, the contractor obtains and submits additional samples for analyses, interprets the results, and develops and submits a profile to the Navy Representative for approval.
- The Navy Representative approves the profile and the contractor and Navy Representative determine whether the IDW is a hazardous waste.
- If the IDW is not hazardous, the contractor arranges for disposal in accordance with guidance provided by the Navy Representative.
- If the IDW is hazardous, the contractor forwards a copy of the signed profile and the container log to PWC.
- The contractor contacts PWC and arranges for removal and disposal of the IDW.
- PWC prepares Uniform Hazardous Waste Manifests and Land Disposal Restriction Notifications, and removes the IDW prior to 90 days (PWC may transport the IDW to

the permitted Treatment Storage and Disposal Facility (TSDF) at Naval Complex Coronado).
- PWC provides copies of disposal documents as requested.

3.2 Option #2 (refer to Appendix E, Figure 2):

- Proceed as in bullets 1 through 3 in Option #1.
- The contractor receives analytical results and delivers them with the Container Log to PWC.
- PWC interprets the sampling results. If sufficient data are available from the analytical results to properly characterize the IDW, PWC develops and signs a profile.
- If additional testing is required to properly characterize the IDW, PWC notifies the contractor to obtain and submit additional samples for analyses.
- Following receipt of the sample results, PWC interprets the results, develops and signs a profile.
- After the profile is prepared and signed, PWC determines whether the IDW is a hazardous waste.
- If the IDW is not hazardous, PWC arranges for disposal in accordance with guidance provided by the Navy Representative.
- If the IDW is hazardous, the contractor contacts PWC for removal of the IDW.
- PWC prepares Uniform Hazardous Waste Manifests and Land Disposal Restriction Notifications, and removes the IDW prior to 90 days (PWC may transport the IDW to the permitted TSDF at Naval Complex Coronado).
- PWC provides copies of disposal documents as requested.

3.3 Option #3 (refer to Appendix E, Figure 3):

- The contractor collects and containerizes the IDW, initiates a container log, and labels the container (use a hazardous waste label listing contents and stating "Awaiting Analytical Results"). SEE APPENDIX D.
- The contractor submits copies of the container log to PWC and the Navy Representative.
- PWC collects the IDW samples and sends them to the laboratory for analyses.
- PWC receives and interprets the results.
- If sufficient data are available for the analytical results to properly characterize the IDW, PWC develops and signs the profile.
- If further testing is required to properly characterize the IDW, PWC obtains and submits additional samples for analyses, interprets results, develops and signs the profile.
- PWC determines whether the IDW is a Hazardous Waste.
- If the IDW is not hazardous, PWC disposes in accordance with guidance provided by the Navy Representative.
- If the IDW is hazardous, PWC contacts the contractor and arranges for removal.
- PWC prepares Uniform Hazardous Waste Manifests and Land Disposal Restriction Notifications, and removes the IDW prior to 90 days (PWC may transport the IDW to the permitted TSDF at NASNI).
- PWC provides copies of disposal documents as requested.

3.4 Option #4 (refer to Appendix E, Figure 4):

- The contractor collects and containerizes the IDW, initiates a container log, and labels the container (use a hazardous waste label listing contents and stating "Awaiting Analytical Results"). SEE APPENDIX D.
- The contractor submits copies of the container log to the Navy Representative.
- The contractor collects IDW samples and delivers them to the laboratory for testing.
- The contractor receives and interprets analytical results.
- If sufficient data are available from the analytical results to properly characterize the IDW, the contractor develops a profile and submits it to the Navy Representative for approval and signature.
- If additional testing is required to properly characterize the IDW, the contractor obtains and submits additional samples for analyses, interprets the results, develops and submits a profile to the Navy Representative for approval.
- The Navy Representative approves the profile and the contractor and Navy Representative determine whether the IDW is a hazardous waste.
- If the IDW is not hazardous, the contractor arranges for disposal in accordance with guidance provided by the Navy Representative.
- If the IDW is hazardous, the contractor forwards a copy of the profile signed by the Navy Representative and the container log to PWC for manifest preparation.
- The IDW contractor contacts a disposal company and arranges for removal and disposal of the IDW (The IDW contractor must receive approval from the Navy Representative prior to affecting disposal).
- PWC prepares Uniform Hazardous Waste Manifests and Land Disposal Restriction Notifications, and the generator ensures the IDW is removed prior to 90 days.
- PWC provides copies of disposal documents to the Navy Representative.

4.0 WASTE CHARACTERIZATION:

IDW may be characterized as any of the following (refer to Appendix A for more detailed regulatory guidance):

- RCRA hazardous waste - Fails 40 CFR 261 criteria for ignitability, corrosivity, reactivity, toxicity, or is a "listed" waste.
- Non-RCRA hazardous waste - Fails Title 22, CCR 66261 criteria for corrosivity, toxicity, carcinogenicity, or meets the definition of "Used Oil".
- Non-hazardous designated waste - Does not meet the Title 22 CCR 66261 criteria for a hazardous waste but contains constituents that have been determined to pose a threat to groundwater as described in Title 23, CCR, 2522.
- Non-hazardous, non-sewerable industrial wastewater - Does not meet the Title 22 CCR 66261 criteria for a hazardous waste but contains concentrations of constituents listed in the Industrial Users Discharge Permit in excess of established thresholds.
- Sewerable Industrial wastewater - Does not meet the 22 CCR 66261 criteria for a hazardous waste and meets sanitary sewer discharge requirements.
- Municipal solid waste - Does not meet the 22 CCR 66261 criteria for a hazardous waste and is suitable for disposal at a Class III landfill.
- The environmental samples collected as part of the field investigations may be used to characterize both the solid and liquid IDW waste streams.

5.0 HANDLING AND DISPOSAL PROCEDURES (Refer to Appendix D for examples of labels and inspection sheets)

5.1 HANDLING

IDW that are considered to be potentially hazardous after on-site screening and treatment will be placed in labeled approved United Nations (UN) drums, roll-offs, and/or tanks. These wastes will be stored at contractor's storage areas for a period of less than 90 days, unless specifically excluded by direction of the Navy Representative. Each container of waste will be labeled and will contain the following wording: "Awaiting Analytical Results" at the top of the label. Samples taken in order to characterize IDW must be processed and analytical results received within 30 days of original accumulation in order to allow sufficient time for profiling and removal for disposal. Records will be maintained to allow individual samples to be traced to specific drums. Liquid waste will be stored in approved 55-gallon containers and/or tanks. The liquid waste containment area will be bermed and lined to catch any potential leakage. The containment area will have a capacity equal to 10 percent of the total volume of the containers or 110 percent of the volume of the largest container, whichever is greater. Solid wastes will be stored in approved 55-gallon containers and/or roll-off bins. All containers for hazardous material must meet the UN Performance Oriented Packaging requirements. Solid wastes do not require secondary containment. All drums will be stored on pallets and kept closed during storage, except when they are being accessed for sampling or filling.

During the investigation, the contractor will perform weekly inspections of the storage area to check for compliance and to evaluate the current inventory. A copy of the weekly inspection checklist will be submitted to the Navy Representative on a weekly basis. The contractor will be responsible for assuring that the following requirements are met:

All personnel involved in the operations and handling of IDW are thoroughly familiar with proper waste handling techniques and emergency procedures.
Wastes are shipped for disposal through PWC within 90 days unless specifically excluded by Navy direction.
IDW containers are properly labeled. See APPENDIX D, HW Label. If IDW is awaiting analytical results, affix the words "Awaiting Analytical Results" on top of the label. The generator's name will be the name of the geographic location associated with the EPA Identification Number (e.g. NAS North Island, Naval Amphibious Base, etc.). CONTACT THE NAVY REPRESENTATIVE FOR PROPER LABELING REQUIREMENTS.
During storage, containers are properly managed and regularly inspected (IDW inspection reports will be maintained to certify this). The inspection checklist is provided in APPENDIX D.
Construction personnel have access to necessary spill control equipment.
Secondary containment is used that is capable of holding 10 percent of the total volume of the waste stored or 110 percent of the volume of the largest container, whichever is greater (for liquid waste only).

- Waste are properly segregated.
- Ignition sources are eliminated before storing ignitable waste in the site.
- Necessary documents (inspection reports, manifests, container labels) are maintained and in proper order.
- The site is secured, and only approved personnel have site access.

5.2 DISPOSAL

Following characterization, the waste in each container will be handled and disposed according to its classification, as described below. Additional sampling and analysis may be required to develop waste profiles for both hazardous and non-hazardous waste. California regulations relate waste classifications to classes of Waste Management Units. Designated waste must be disposed in Class II or Class I facilities. Non-hazardous solid waste must be disposed in Class III or higher class facilities. Petroleum hydrocarbon contaminated soils must be treated or disposed at facilities permitted to handle such waste. Inert waste may be disposed in unclassified disposal facilities according to individual permits.

5.2.1 NON-HAZARDOUS SOLID WASTE DISPOSAL OPTIONS:

In lieu of storage on-site, disposal options for non-hazardous soil and solid IDW include redeposition on-site (as inert waste), if permitted, or disposal off-site in a Class II (designated waste) or Class III management unit. Solid waste, such as PPE and plastic/paper trash generated during sampling operations, may be handled and disposed as non-hazardous trash depending on the concentrations and type of suspected contaminants. Notify SCE Environmental Division prior to disposal.

5.2.1.1 Designated Waste

Waste soil (including drill cuttings) and debris that are classified as designated waste shall be placed in proper containers and disposed via PWC or other appropriate contractors.

5.2.1.2 Inert Waste

Inert waste may be spread at the source, if permitted. If not, it may be disposed at a classified or unclassified disposal site according to existing permits.

5.2.1.3 Petroleum Hydrocarbon Contaminated Soil

Petroleum Hydrocarbon contaminated soil may be used in routine land applications if concentrations of TPH are below RWQCB levels (typically 1,000 mg/kg or less for diesel and 100 mg/kg for gasoline). Soil

contaminated with higher concentrations of TPH will either be treated on-site at the bioremediation facility (diesel and Jet Petroleum-5 [JP-5]) or taken off-site for treatment and/or disposal at a permitted facility.

5.2.1.4 Non-hazardous Liquid Waste

Liquid IDW with contaminant concentrations below regulatory levels for HW may be disposed by one of two methods: (1) Directly to the sanitary sewer if contaminant levels are below local sewer discharge limits (a batch discharge authorization must be obtained - contact Naval Complex Coronado Environmental Office at 545-1125 for information regarding the preparation of a City of San Diego, Industrial User's Batch Discharge Permit). (2) In the PWC Industrial and Oily Waste Treatment Plant, Naval Complex Coronado or other appropriate disposal facilities.

5.2.2 HAZARDOUS WASTE DISPOSAL OPTIONS:

All HW must be shipped from the accumulation site before the 90-day storage period ends. IDW contractors must have the waste properly containerized and labeled, and have appropriate documentation (profiles, laboratory analyses) available prior to or at the time of pick-up. Contact the PWC HW Dispatcher at 556-8002 to schedule HW removal services. PWC will provide the necessary shipping papers, Land Disposal Restriction Notifications, and HW Turn-In Records. A receipt will be given to the IDW contractor for the amount of HW picked-up. For HW transported to non-PWC disposal facilities, PWC will provide manifesting services in most cases. Contact the PWC Manifest Office at 556-8647 for detailed information.

5.2.3 RADIOACTIVE AND MIXED WASTE

Handling and disposal of radioactive and mixed waste (RCRA HW and radioactive waste) will be coordinated through the Navy Representative's Radiation Safety Officer. Off-site facilities permitted to accept radioactive and mixed waste will be identified by the Navy Representative or SWDIV RPM and transportation will be arranged for disposal of these wastes per their direction.

6.0 DOCUMENTATION

Each UN approved waste container will be numbered and labeled to indicate the contents, source, and nature of the waste. Labeling will consist of placing a durable adhesive label on the container. A tracking system containing information on drums, contents, and data collected will be maintained to assure 90-day storage control. The objective of the system is to provide the current status on the IDW and to facilitate appropriate waste characterization and disposal decisions.

Containers in which wastes are stored but not yet characterized will be labeled with a HW label with the words "Awaiting Analytical Results" as well as the name of the contractor, a point of contact, and a telephone number. Wastes characterized as HW will be labeled in accordance with state and federal requirements.

6.1 Waste Inventory

The generation and disposal of IDW will be tracked through an IDW Container Log (see Appendix D). The log will provide the following information:

- Site location
- Container number
- Container contents (e.g. water, soil, sludge, PPE)
- Sampling location
- Comments

If sampling is required to determine the hazardous classification of the IDW, the documentation and tracking protocols for these samples will consist of properly handling and recording the sample shipments using the selected laboratory's Chain-of-Custody form.

6.2 Waste Profile Sheets

The contractor using the characterization sampling results will prepare profile sheets. The profile sheet identifies and characterizes the waste being shipped on the manifest. The identification number on each waste container must be listed on the profile sheet. Laboratory analytical reports used for supporting documentation must also reference the waste containers being shipped (i.e. the container identification must be on the analytical report or the analysis number must be on the container label). The Naval Complex Coronado Environmental Office has the authorization to sign profile sheets. A representative from the NADEP Environmental Office will sign profiles for IDW generated during operations at NADEP. A PWC representative will sign profiles for IDW generated at PWC facilities or by PWC personnel or where PWC prepared the profiles.

Each container need not be separately analyzed. A composite sample of the waste may be analyzed or, if all of the waste is from the same site, a representative sample may be analyzed. Generic analyses of material from different locations may not be substituted on a profile sheet. The profile sheet is a summary of the analytical results and is used to characterize the waste being shipped on the manifest for transportation and treatment purposes, and to certify the validity of the information. Incomplete or unsubstantiated statements expose the signer to regulatory penalties.

6.3 Waste Manifests and Disposal

Once properly characterized and the profiles signed by the Navy Representative , the contractor will submit profiles to PWC for manifesting (HW only). Final disposition of the waste (within 90 days), can be arranged with PWC by calling 556-8002 or by a designated disposal contractor. A PWC Job Order Number (JON), good for labor and materials, is required in order to arrange for IDW disposal through PWC(see Appendix C_for information on obtaining a JON). The contractor should contact the Navy Representative or Navy Project Manager for guidance regarding funding issues with PWC.

Manifesting services for most locations can be obtained by calling the PWC Manifest Office at (619) 556-8647. PWC will prepare and sign the Uniform Hazardous Waste Manifest, Land Disposal Restriction Notification (if necessary) based on profiles/laboratory analyses of the waste being transported, and provide photocopies as requested. As part of the manifesting procedure, PWC manifesters will check driver's licenses, required certificates, endorsements, and will perform a vehicle/container/waste inspection prior to signing shipping papers.

APPENDIX A

REGULATORY CRITERIA

The following discussion presents an overview of the primary federal, state, and local regulatory requirements governing the management of IDW at the Naval Complex Coronado. Specific local agencies that have requirements relevant to IDW disposal include: the San Diego County Department of Environmental Health, Site Assessment and Mitigation Branch; the State of California Department of Toxic Substances Control (DTSC); the Regional Water Quality Control Board (RWQCB), San Diego Region; and the City of San Diego, Metropolitan Industrial Wastewater Program.

FEDERAL HAZARDOUS WASTE CRITERIA

Federal hazardous waste classifications are defined in Title 40, Code of Federal Regulations (CFR), Part 261. After a waste has met the definition of a solid waste, and is determined not to be an excluded waste, it is considered to be a hazardous waste if it is a "listed waste" as defined in the regulations or it possesses at least one of the hazardous characteristics listed in the regulations. These characteristics include ignitability, corrosivity, reactivity, and toxicity.

Listed waste definitions are process and industry specific, and are related to specified spent solvents, or off-specification and discarded chemicals. Definitions of listed waste are not likely to apply to the IDW generated during investigative activities at the Naval Complex Coronado. Additionally, the ignitability, corrosivity, and reactivity of the IDW are typically not of a significant concern. The primary characteristic of concern will typically be the toxicity of the IDW generated during the investigations.

The toxicity of a waste can normally be determined using the TCLP test. The TCLP is an extraction test to determine the presence and potential mobility of specified organic and inorganic contaminants present in a waste. Although the regulatory threshold standards apply strictly to contaminant concentrations in the TCLP extract, total contaminant concentrations (as measured by other methods) can be compared to the TCLP standards and used as a guideline to determine whether a waste warrants TCLP testing. Federal TCLP concentrations may be found in 40 CFR 261.24. Under federal regulations, for a waste to be considered hazardous due to toxicity, the contaminant concentrations in a TCLP extract must exceed the TCLP limits for the specific contaminant. Since these concentrations have been developed for characterization of an extract, they are presented in volume-based concentrations. These concentrations are appropriate for comparison with other volume-based concentrations such as analytical results of liquid sampling (containing < 0.5% filterable solids). However, direct comparison of TCLP concentrations with weight-based concentrations, such as analytical results of solid sampling, is not appropriate. A conservative comparison of weight-based constituent concentrations in solid samples (solids, slurries, oily and tarry materials, and sledges) with TCLP limits may eliminate

the need to perform the TCLP test. If the total analysis results (which uses nitric acid for digestion) from solids sampling are less than 20 times the TCLP limits, then the TCLP test (which uses the less aggressive acetic acid for extraction) is not required. Since the TCLP methodology prescribes a 20-times dilution during the extraction process, the comparison accounts for a 100-percent extraction from the solid. Thus, this modified comparison is conservative (given the different extraction efficiencies of the acids), and the TCLP criteria could not be exceeded.

CALIFORNIA HAZARDOUS WASTE CRITERIA

In California, the classification of waste is defined by two departments of the California Environmental Protection Agency (CAL-EPA), each with separate regulatory authority. The DTSC classifies waste as hazardous or non-hazardous based on its threat to public health. DTSC uses a classification system similar to that used by Federal EPA that defines listed hazardous waste and describes the hazardous characteristics that cause a waste to be classified as hazardous. State regulations that define the criteria for hazardous waste are specified in the California Code of Regulations (CCR), Title 22, Chapter 11, Sections 66261.21 through 66261.24.

The California Water Resource Control Board (WRCB), together with the nine RWQCBs, classify non-hazardous waste as "designated", non-hazardous solid", or "inert" based on the threat each waste poses to the beneficial use of groundwater and surface water. State regulations that define the different classifications of non-hazardous waste are found in the CCR, Title 23.

CHARACTERISTIC WASTE

In addition to the TCLP criteria for toxicity, the California regulations include an additional set of standards for classifying waste. To determine if the waste has a toxic characteristic under California regulations, waste samples must be analyzed for their total contaminant concentration and compared against the State of California Total Threshold Limit Concentration (TTLC) standards. If any contaminant concentration in the IDW exceeds the specific TTLC standard, the waste is considered hazardous.

If the contaminant concentrations in solid IDW do not exceed the TTLC standards but are more than ten times the California Soluble Threshold Limit Concentration (STLC) standards, the waste is required to undergo the California Waste Extraction Test (WET). The STLC values are presented on a volume basis (similar to TCLP concentrations); thus, a similar conservative comparison rationale is used both for STLC and TCLP. If the sampling results are between the TTLC and ten times the STLC, the WET test is performed to determine if the waste is hazardous under California regulations, however, the WET should only be performed for the constituents of concern. If the IDW WET test results exceed the STLC threshold, the waste is considered to be a California hazardous waste. Sampling results for liquids with less than 0.5% filterable solids are compared directly with the STLC concentrations to determine if the liquid IDW is a California hazardous waste. California STLC and TTLC limits are summarized in CCR, Title 22, Section 66261.24.

Since the California WET uses a lower extract-to-solid ratio (10:1) than the TCLP (20:1), it is generally considered to be more aggressive and, therefore, more conservative in determining the

toxicity characteristics of the waste. Thus, for solid waste disposal within California, TCLP testing may not be necessary. An IDW with WET results that do not exceed the STLC standards would not be expected to exceed the less-stringent TCLP limits.

CALIFORNIA NON-HAZARDOUS WASTE CRITERIA

The non-hazardous waste category of this plan includes both liquid and solid wastes.

Solid Waste

Several categories of non-hazardous solid waste are classified by the WRCB and RWQCB according to the regulations contained in CCR, Title 23 Subchapter 15, Discharges of Waste to Land. Under the regulations in Title 23, the RWQCB determines whether a non-hazardous solid waste is characterized as "designated", "non-hazardous solid", or "inert".

- Designated solid waste is defined by California regulations (23 CCR 2522 [a]) as; (1) "non-hazardous waste which consists of, or contains pollutants which, under ambient environmental conditions at the waste management unit, could be released at concentrations in excess of applicable waster quality objectives, or could cause degradation of eater of the State"; or (2) "hazardous waste which has been granted a variance from hazardous waste management requirements." A designated waste has the potential for producing a leachate that could pose a significant threat to water quality.
- Non-hazardous solid waste, more commonly referred to as "municipal solid waste" or "refuse", is characterized as having a significant proportion of degradable materials, but cannot contain designated or hazardous waste.
- Inert solid waste consists of non-hazardous, non-designated, non-putresible solid wastes. Such waste poses no significant hazard to waters of the State other than saltation. Paving fragments and non-degradable construction debris are examples of inert waste.

Liquid Waste

Liquid wastes discharged to the land are also classified under the regulations contained in CCR, Title 23, Subchapter 15. Dissolved concentrations of chemical constituents that threaten water quality may be prohibited by the RWQCB, San Diego Region. This prohibition is based on WRCB policies. The policy favors maintaining groundwater quality at existing levels that are more stringent than levels otherwise established by the state or RWQCB policies. The WRCB further defines the quality of groundwater aquifers with their policy on sources of drinking water. This policy establishes that all surface water and groundwater of the state are considered to be potentially suitable for municipal or domestic water supply.

Petroleum Hydrocarbon-Contaminated Soil

IDW consisting of soil contaminated with petroleum hydrocarbons is routinely generated during the investigation and remediation of petroleum product storage tanks. This soil would also include drill cuttings and mud generated during the installation of monitoring wells. Since the generation of such IDW could be an integral part of many environmental activities at the Naval Complex Coronado, the handling of this type of IDW is considered separately.

Guidelines for the disposal of petroleum hydrocarbon contaminated soils are based on the permit restrictions at available disposal or treatment facilities. In the event that soil is to be used for land applications in unpermitted areas, local regulatory agencies should be consulted prior to deposition of the soil.

A permitted bioremediation facility is in operation at Naval Complex Coronado and can provide an alternative to off-site disposal. The facility can only accept soils contaminated with JP-5 or diesel fuels and has a capacity of 5,000 cubic yards. Since there are a number of permit restrictions regarding this facility, contact PWC at 556-8002 for guidance.

APPENDIX B

ACRONYMS AND ABBREVIATIONS

AST	Above ground storage tanks
CAL-EPA	California Environmental Protection Agency
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response Compensation and Liabilities Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
DON	Department of the Navy
DOT	(U.S.) Department of Transportation
DTSC	State of California, Department of Toxic Substances Control
EPA	Environmental Protection Agency
IDW	Investigation Derived Waste
IR	Installation Restoration
IWTP	Industrial Waste Treatment Plant
LDR	Land Disposal Restriction
mg/kg	milligrams per kilogram
MEK	Methyl Ethyl Ketone
MSDS	Material Safety Data Sheet
NASNI	Naval Air Station, North Island
NAB	Naval Amphibious Base
NADEP	Naval Aviation Depot
NALF	Navy Auxiliary Landing Field
NCTS	Naval Computer and Telecommunication Station
NOLF	Navy Outlying Landing Field, Imperial Beach
PPE	Personal Protective Equipment
PWC	Public Works Center
RASO	Radiological Affairs Support Organization
RCRA	Resource Conservation and Recovery Act
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Program Manager
RWQCB	Regional Waster Quality Control Board
SCI	San Clemente Island
SERE	Survival Evasion Resistance and Escape
SOP	Standard Operating Procedure
STLC	Soluble Threshold Limit Concentration
SWDIV	Southwest Division Naval Facility Engineering Command
TCLP	Toxicity Characteristic Leaching Procedure
TFH	Total Fuel Hydrocarbons
TPH	Total Petroleum Hydrocarbons
TSDF	Treatment, Storage and Disposal Facility
TTLC	Total Threshold Limit Concentration
UN	United Nations
UST	Underground storage tank
WET	(California)Waste Extraction Test
WRCB	(California) Water Resource Control Board

APPENDIX C

PROCEDURES FOR ESTABLISHING FUNDING TO ESTABLISH PWC SERVICES

1. PWC services are available to all federal government activities and private contractors working under federal government contracts. Activities desiring to use PWC services must establish and fund an account with the PWC Comptroller's office. The procedure is as follows:

   a. For Department of the Navy activities: Provide a completed NAVCOMPT Form 2275 or a DD Form 1149 to the PWC Comptroller representative (Code 151B). This document can be sent by facsimile (FAX 619-556-2877), hand delivered to building 119, Naval Station San Diego, or sent by mail to:

   2730 McKean Street, Suite 1
   San Diego, CA 92136-5294
   ATTN: Code 151B

   b. For other Department of Defense activities: Provide a completed DD Form 448 (MIPR) in the same manner described above.

   c. For non-DOD activities: Call the PWC Comptroller representative (Ms. Joan Goldade) at (619) 556-2234/2235 for specific guidance.

   d. For contractors: Provide a letter of intent (on company letterhead) listing the required services and billing information, and a company check for three months of service. The check will be held as a deposit. Present the letter and check either in person or by mail to the location or address listed above.

2. Once the funding has been established, the PWC Comptroller will assign a Job Order Number which can be used by the various PWC shops to provide the required services.

APPENDIX D

FORMS

Investigation Derived Waste - Weekly Inspection Checklist

Hazardous and Non-Hazardous Waste Labels

Container Log

Hazardous Waste Profile Sheet

INVESTIGATION DERIVED WASTE
WEEKLY INSPECTION CHECKLIST

CONTRACTOR: _____ SITE/BLDG : _____

PROJECT NAME: _____

CONTRACTOR POC: _____ ROICC POC: _____

NO.	SUBJECT ITEM	YES	NO	N/A
1.0	**HAZARDOUS WASTE (HW) AND INVESTIGATION DERIVED WASTE (IDW) CONTAINERS**			
	a. HW labels properly filled out.			
	b. Container covers and bungs kept closed.			
	c. Container compatible with contents.			
	d. No leaks, puddles on drum heads.			
	e. Ignitable HW grounded.			
	f. Containers inspected weekly. Documentation kept on file.			
	g. Containers stored to prevent spills.			
	h. Accumulation date less than 90 days old.			
	i. Drill cuttings, waste sediments, development and purge water, decontamination wash water, and used PPE will be placed in UN shipping containers, tanks, or roll-off bins and will be stored on-site or assigned a staging area.			
	j. IDW containers are clearly marked to indicate source and contents.			
	k. Containers in which IDW are stored but not yet classified as HW will be labeled with a HW label; dated and contain the words "AWAITING ANALYTICAL RESULTS".			
	l. If non-hazardous, affix a "NON-HAZARDOUS WASTE" label.			
	m. IDW storage must have a secondary containment.			
	n. Waste analysis and profiles submitted to SCE Environmental Office for review prior to disposal of the IDW.			
2.0	**90-DAY ACCUMULATION SITE**			
	a. Secondary containment for liquids.			
	b. Signs (DANGER HW, NO SMOKING, POCs)			
	c. Spill kit available.			
	d. Communication (alarm, air horn)			
	e. Security fence around accumulation site.			
	f. Adequate aisle space between rows of containers.			
	g. Housekeeping (clean spills, debris, etc.)			
	h. Incompatible waste separated.			
	i. Ignitable HW grounded.			
	j. HW accumulation date < 90 days.			
	k. Site inspected weekly; documentation kept on site.			

NO.	SUBJECT ITEM	YES	NO	N/A
	l. Inspection results forwarded to SCE Environmental Division.			
	m. Training documentation on file.			
3.0	**SOIL PILES**			
	a. HW soil piles do not contain free liquids.			
	b. The HW pile is accumulated on an impermeable surface, such as high density polyethylene (HDPE).			
	c. Provide controls for windblown dispersion and precipitation run-off and run-on and complies with local storm water permit issued by the Regional Water Quality Control Board.			
	d. Accumulation site inspected weekly and after storms to ensure that controls for windblown dispersion and precipitation are functioning properly.			
	e. Weekly inspection documentation is forwarded to the Navy Representative.			

HAZARDOUS WASTE LABEL
(Not for use during transportation off-site)

HAZARDOUS WASTE

STATE AND FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.
IF FOUND, CONTACT THE BASE COMMAND DUTY OFFICER.

GENERATOR INFORMATION:
NAME: NAVY PUBLIC WORKS CENTER – BUILDING 343 NASNI
ADDRESS: 2730 MCKEAN STREET SUITE 1
CITY: SAN DIEGO STATE: CA ZIP: 92136
CONTENTS/COMPOSITION: INVESTIGATIVE DERIVED WASTE - WATER
CONTAMINATED WITH TRICHLOROETHYLENE AND GASOLINE

SAMPLE

PHYSICAL STATE: ☐ SOLID ☐ SEMI-SOLID ☐ LIQUID ☐ GAS
HAZARDOUS PROPERTIES:
☐ IGNITABLE ☐ CORROSIVE ☐ TOXIC ☐ REACTIVE

ACCUMULATION DATE:
31 SEPTEMBER 1997

LABELED BY:
DAVID E. JONES

NON-HAZARDOUS WASTE LABEL

NON-HAZARDOUS WASTE

OPTIONAL INFORMATION:

SHIPPER: NAVY PUBLIC WORKS CENTER BUILDING 343
ADDRESS: 2730 MCKEAN STREET SUITE 1
CITY: SAN DIEGO STATE: ZIP: 92136
CONTENTS: INVESTIGATIVE DERIVED WASTE – AWAITING ANALYTICAL RESULTS

SAMPLE

START ACCUMULATION DATE: 31 SEPT 1997

NON-HAZARDOUS WASTE

CONTAINER LOG

Page ____of ____

LOG NUMBER: _____

FIELD ACTIVITIES BEGAN: _____

FIELD ACTIVITIES ENDED: _____

Container No.	Container Contents (e.g. water, soil, sludge, PPE)	Sample Location (e.g. boring/well number)	Date container filled	Comments

HAZARDOUS WASTE PROFILE SHEET

PART I

A. GENERAL INFORMATION

WASTE PROFILE NO. _____

1. GENERATOR'S NAME

2. FACILITY ADDRESS

3. GENERATOR'S USEPA ID

5. ZIP CODE

4. GENERATOR'S STATE ID

6. TECHNICAL CONTACT

7. TITLE

PHONE

B

1. NAME OF WASTE: _____
2. USEPA OR STATE WASTE CODES: _____
3. PROCESS GENERATING THE WASTE: _____
4. PROJECTED ANNUAL VOLUME/UNITS: _____/_____ 5. MODE OF COLLECTION: _____
6. IS THIS WASTE A DIOXIN LISTED WASTE AS DEFINED IN 40 CFR 261.31 (e.g., F020, F021, F022, F023, F026, F027, OR F028)? YES NO
7. IS THIS WASTE RESTRICTED FROM LAND DISPOSAL (40 CFR 268)? YES NO
   HAS AN EXEMPTION BEEN GRANTED? YES NO
   DOES THE WASTE MEET APPLICABLE TREATMENT STANDARDS? YES NO REFERENCE STANDARDS: _____

PART II

1. MATERIAL CHARACTERIZATION

COLOR: _____
DENSITY: _____ BTU/LB: _____
TOTAL SOLIDS: _____ ASH CONTENT: _____
LAYERING: MULTILAYERED BILAYERED SINGLE PHASE

2. RCRA CHARACTERISTICS

PHYSICAL STATE: SOLID LIQUID SEMI-SOLID
GAS OTHER
TREATMENT GROUP: WASTEWATER NON-WASTEWATER

IGNITABLE (D001)
FLASHPOINT (F°): _____
HIGH TOC (> 10%)
LOW TOC (< 10%)

REACTIVE (D003)
WATER REACTIVE
CYANIDE REACTIVE
SULFIDE REACTIVE

CORROSIVE (D002)
Ph: _____
CORRODES STEEL

TOXICITY CHARACTERISTIC

3. CHEMICAL COMPOSITION (ppm or mg/L)

ANTIMONY _____ MOLYBDENUM _____
ARSENIC _____ NICKEL _____
BARIUM _____ SELENIUM _____
BERYLLIUM _____ SILVER _____
CADMIUM _____ THALLIUM _____
CHROMIUM _____ VANADIUM _____
COBALT _____ PHENOLICS _____
COPPER _____ TOTAL HALOGENS _____
LEAD _____ VOCs _____
MERCURY _____ PCBs _____

4. MATERIAL COMPOSITION

COMPONENT	CONCENTRATION	RANGE

TOTAL _____ 100%

5. SHIPPING INFORMATION

DOT HAZARDOUS MATERIAL? YES NO

PROPER SHIPPING NAME: _____

HAZARD CLASS: _____ UN/NA NO. _____
ADDITIONAL DESCRIPTION: _____

METHOD OF SHIPMENT: BULK DRUM OTHER: _____
CERCLA REPORTABLE QUANTITY (RQ): _____
EMERGENCY RESPONSE GUIDE PAGE: _____
SPECIAL HANDLING INFORMATION: _____

REMARKS: _____

6. GENERATOR CERTIFICATION - BASIS FOR INFORMATION
CHEMICAL ANALYSIS (ATTACH TEST RESULTS)
USER KNOWLEDGE (ATTACH SUPPORTING DOCUMENTS – Explain how and why these documents comply with RCRA requirements):

I, _____ HEREBY CERTIFY THAT ALL INFORMATION SUBMITTED IN THIS AND ALL ATTACHED DOCUMENTS IS, TO THE BEST OF MY KNOWLEDGE, AN ACCURATE REPRESENTATION OF THE WASTE. ALL KNOWN OR SUSPECTED HAZARDS HAVE BEEN DISCLOSED.

SIGNATURE OF GENERATOR'S REPRESENTATIVE

DATE

APPENDIX E

FIGURES

Figure 1 - IDW Handling and Disposal Procedures - Option #1 Flow Diagram

Figure 2 - IDW Handling and Disposal Procedures - Option #2 Flow Diagram

Figure 3 - IDW Handling and Disposal Procedures - Option #3 Flow Diagram

Figure 4 - IDW Handling and Disposal Procedures - Option #4 Flow Diagram

Figures are not available at this time.

APPENDIX H
BORROW SOURCE GEOTECHNICAL ANALYTICAL DATA

IT/EMCON
Geotechnical Laboratory
371 Rt. 17A Sterling Forest
Tuxedo, New York 10987
Ph:(845)351-5100 Fax:(845)351-5199

LETTER OF TRANSMITTAL

Date	Job No.
9-24-01	818724

Attention: Richard Morris/Holly Buschman

RE: Lab Testing

IR Site 10 - Shoreline Area

TO The IT Group, Inc.
1202 Kettner Blvd., Suite 3400
San Diego, CA 92101-3341

WE ARE SENDING YOU ATTACHED: [ ] Samples [X] Test results # 7433

COPIES	DATE	NO.	DESCRIPTION
2	9-24-01	2	Liquid and Plastic Limits Test Report (7 tests)
2	9-24-01	7	Grain Size Distribution Test Report
			Sample ID: Surface 01 through 07

THESE ARE TRANSMITTED as checked below:

[ ] For approval
[X] As requested
[ ] For review and comment
[ ] Approved as submitted
[ ] Returned for corrections
[ ]
[ ] Resubmit ___ copies for approval
[ ] Return ___ corrected prints

REMARKS If you have any questions, please call 845-351-5100.

COPY TO (2) copies SIGNED:

EM\NY-GL\TRANSLET\IRSite7433.xls

No. 7433

EMCON - GEOTECHNICAL LABORATORY PRICE SCHEDULE

TUXEDO, N.Y. 10987

Client IT San Diego.

Date 9-24-01

Project IR. Site 10.

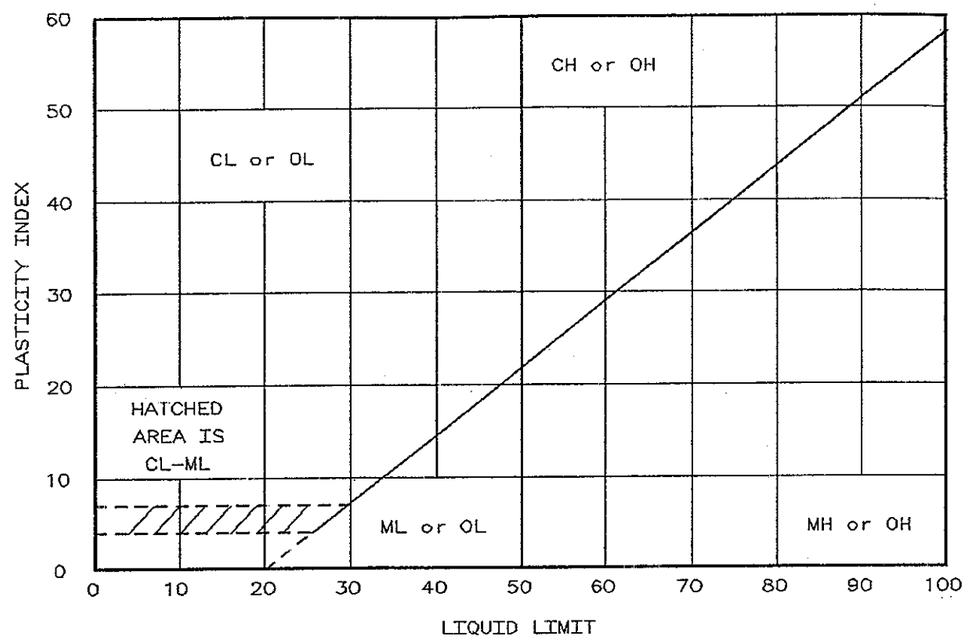
Project No. 818724

Code	Description of Test	Price per Test ($)	Test No.	Amount
A-1	Atterberg Limits, including sample preparation (ASTM D4318)	60		
A-2	1. Verification that material is Non-Plastic, including sample preparation	30	7	210
B-1	Compressive Strength, Unconfined, including Stress-Strain Curve (ASTM D2166)	60		
C-1	Consolidation 1. One Unload-Reload Cycle (ASTM D2435)	360		
C-2	2. Permeability Test at Specified Load Increments (during consolidation test)	150		
	Particle Size Analysis			
D-1	Washed Sieve Analysis (ASTM D422)	45		
D-2	Washed Sieve Analysis (sample over 5 lbs.) (ASTM D422)	55		
D-3	Hydrometer Analysis only (ASTM D422)	65		
D-4	Combined Sieve & Hydrometer Analysis (ASTM D422)	100	7	700
D-5	Material Passing #200 Sieve (ASTM D422)	30		
E-1	Moisture Content (ASTM D2216)	5		
	Moisture-Density Relations			
F-A	Standard Proctor, 4" Mold (ASTM D698)	140		
F-C	Standard Proctor, 6" Mold (ASTM D698)	160		
F-E	Modified Proctor, 4" Mold (ASTM D1557)	160		
F-G	Modified Proctor, 6" Mold (ASTM D1557)	175		
F-I	Compaction at Natural Moisture Content	45		
F-K	CBR: Compact (3) specimens at specified Dry Density and Moisture Content, soak (4) days - Measure Swell, test and plot Stress-Penetration Curve	570		
G-1	Organic Content, Loss-On Ignition (ASTM D2974)	50		
	Permeability Tests			
H-1	Permeability Test (ASTM D5084) (additional charges per hour if sample preparation is required)	225		
I-1	Permeability Test Remolded Sample (ASTM D5084/D2434) (additional charges if maximum density & opt. moisture are to be determined)	260		
I-2	Permeability Test Remolded Sample 4" sample(ASTM D5084)	275		
J-1	Permeability Test during Tri-Axial Test per Confining Pressure	150		
K-1	Photograph of Test Specimen	9.50		
L-1	Specific Gravity (ASTM D854)	35		
M-1	Tri-Axial Tests per Confining Pressure (ASTM D2850/D4767)	185		
M-2	Direct Shear per Normal Stress (ASTM D3080)	185		
M-3	Interface Friction Angle per normal stress HDPE, Geonet, Geotextile, etc. 4" x 4" sample (ASTM D3080)	125		
N-1	Opening Shelby Tubes (extrude)	20		
N-2	Logging Undisturbed Samples	15		
P-1	Unit Weight (Undisturbed Samples)	30		
P-2	Unit Weight (Disturbed Samples)	40		
Q-1	Visual Identification (per sample)	7		
R-1	Special Sample Preparation, testing not included (per hour)	55-65		
S-1	Torvane Shear Test	15		
J-1	Shrinkage Limits (ASTM D427)	55		
V-1	Leachate and Long-Term Permeability	Open		

Price per test samples delivered to the Lab

Total 910.00

LIQUID AND PLASTIC LIMITS TEST REPORT



	SAMPLE IDENTIFICATION	LL	PL	PI	-200	MATERIAL DESCRIPTION BURMISTER ☐ ASTM D 2487 ☒
●	SURFACE 01 SANDY LOAM, RIVER BOTTOM	NV	NP		35.0	SM, Silty sand
▲	SURFACE 02 70/30 AMENDED MIX	NV	NP		33.9	SM, Silty sand
■	SURFACE 03 70/30 AMENDED MIX	NV	NP		18.6	SM, Silty sand
◆	SURFACE 04 SCREENED TOPSOIL	NV	NP		28.8	SM, Silty sand
×	SURFACE 05 SANDY/SILTY LOAM	NV	NP		17.0	SM, Silty sand

NV - Non-Viscous NP - Non-Plastic

Project No.: 818724 Date: 9-24-01
Project: IR SITE 10

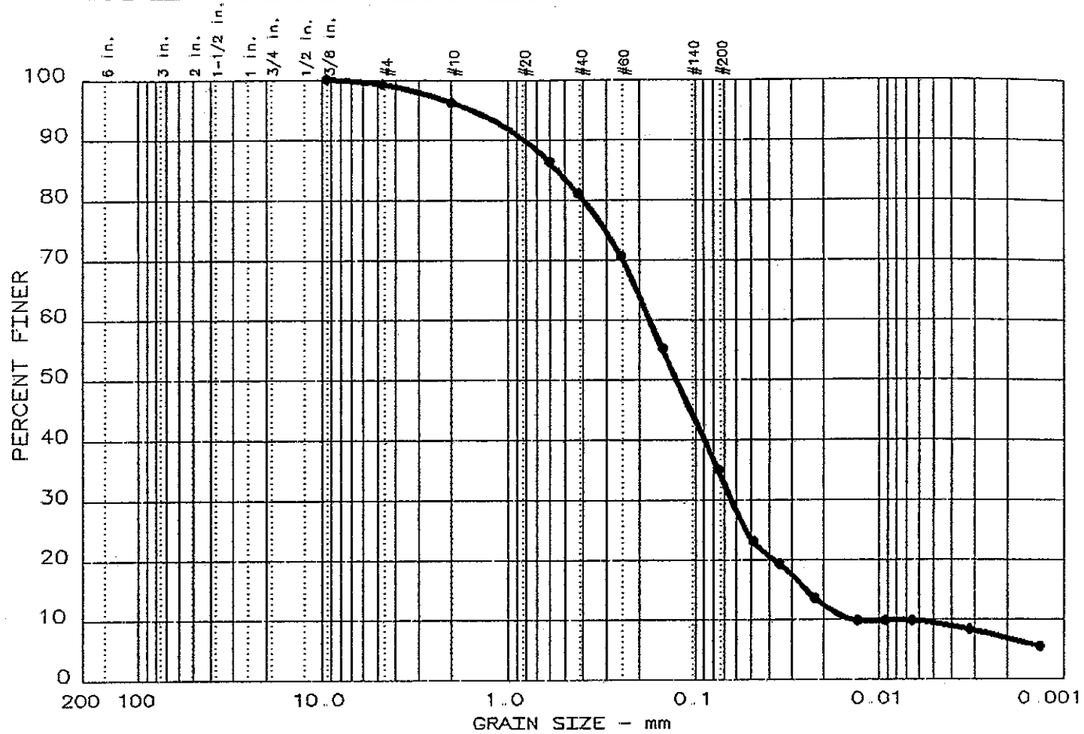
Client: IT SAN DIEGO
Location:

Performed by: M.S.
Entered by: L.B.
Checked by: R.S.A.
Remarks:

EMCON

Fig. No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.8	64.2	25.6	9.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.543	0.175	0.125	0.0635	0.0247	0.0141	1.64	12.4

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

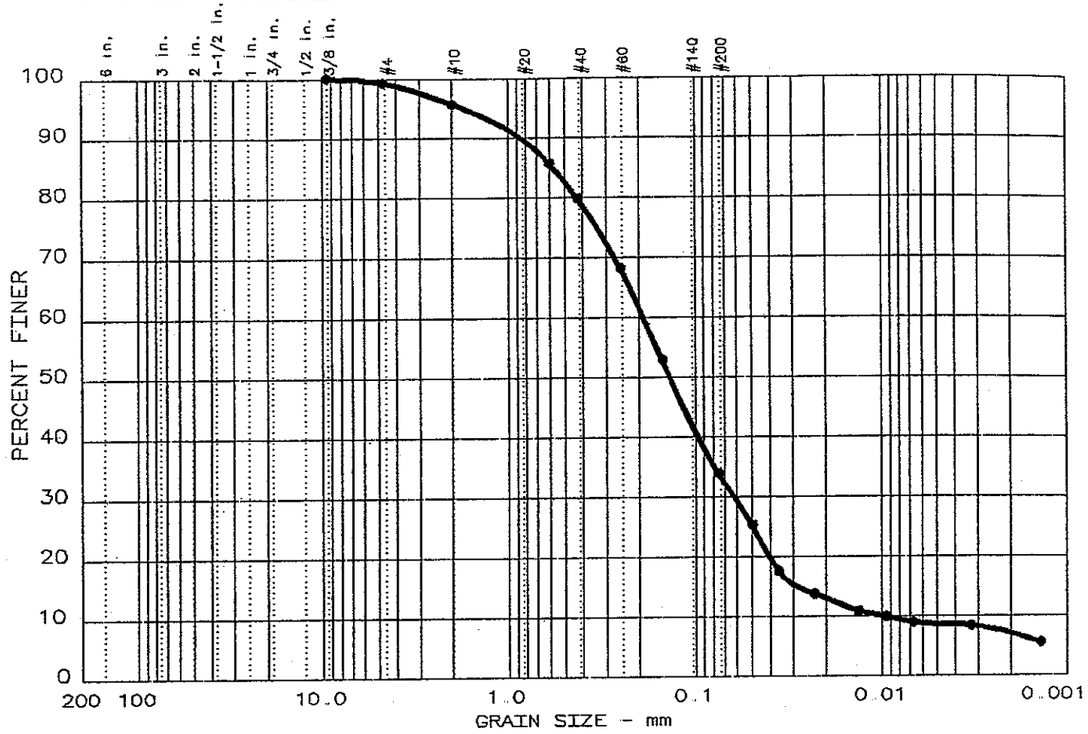
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 01 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 6.0%
TRACE ORGANIC MATERIAL

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	0.0	0.0	0.0	0.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●										

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

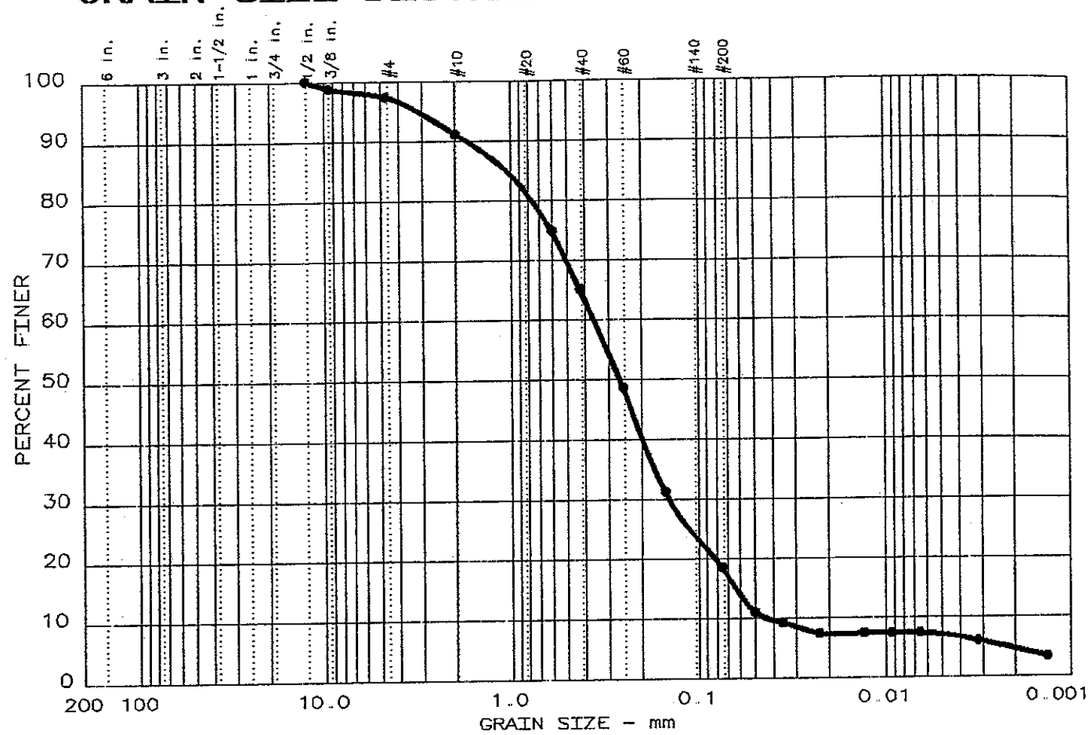
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 02 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 11.2%
TRACE ROOTS,WOOD,LEAVES

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	2.7	78.7	11.5	7.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.05	0.358	0.259	0.142	0.0629	0.0445	1.27	8.0

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

Project No.: 818724
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 03

Date: 9-24-01

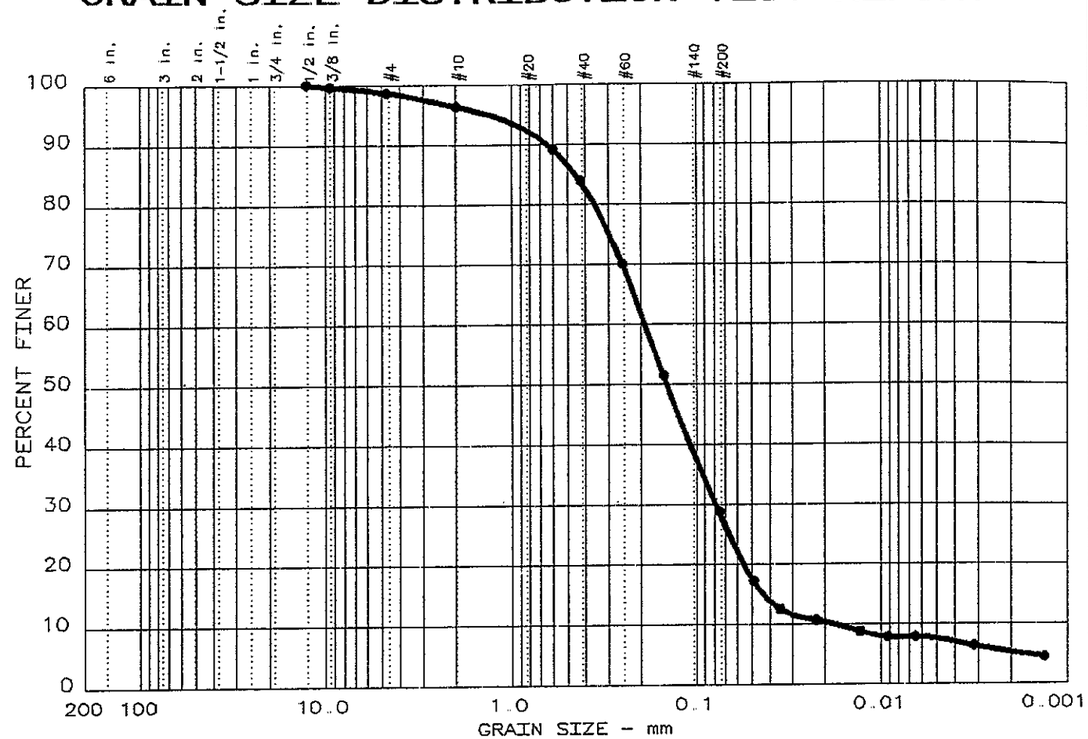
Sample No.:

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 5.8%
TRACE ORGANIC MATERIAL

EMCON

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	1.4	69.8	21.3	7.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.447	0.188	0.144	0.0780	0.0434	0.0177	1.83	10.7

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

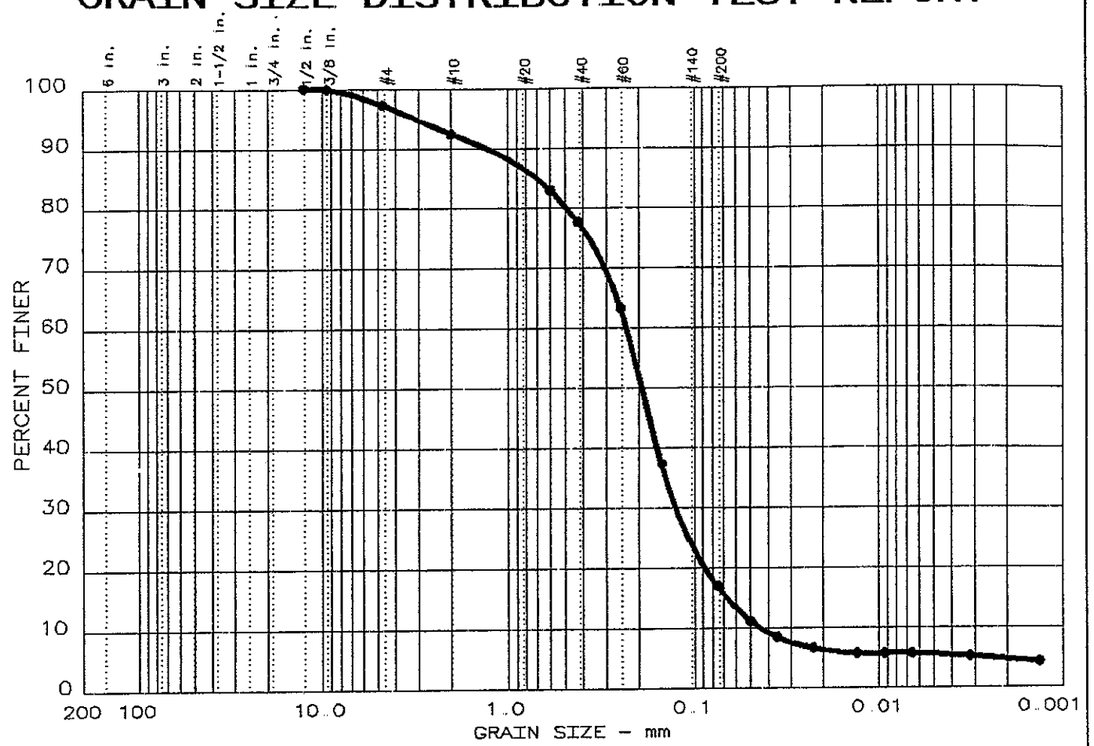
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 04 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 7.6%
TRACE ORGANIC MATERIAL

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	2.8	80.2	11.4	5.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.708	0.232	0.192	0.125	0.0665	0.0444	1.52	5.2

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

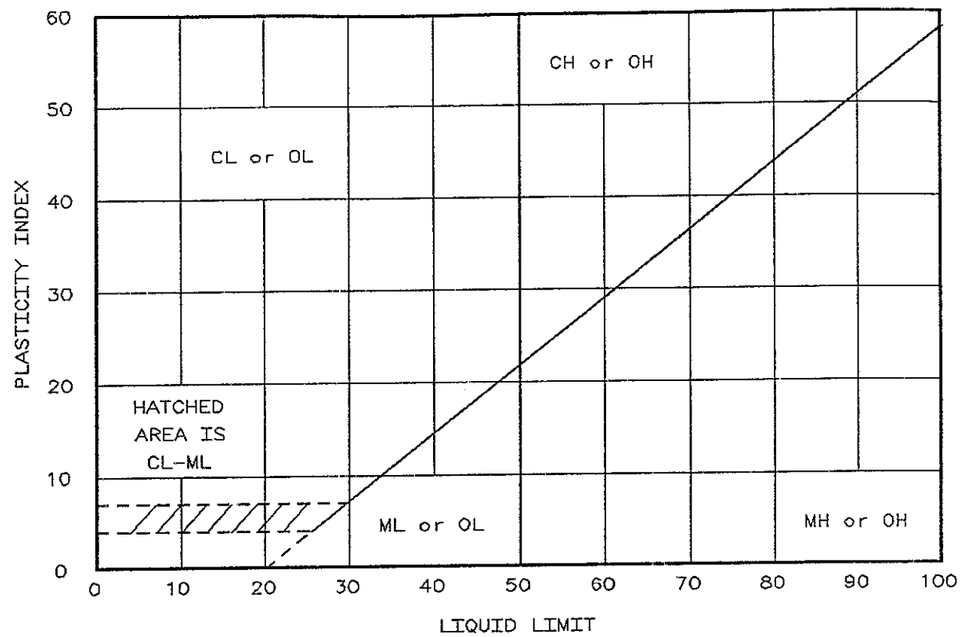
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 05 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 9.9%
TRACE ORGANIC MATERIAL

Fig. No.: EM NY-GL

LIQUID AND PLASTIC LIMITS TEST REPORT



	SAMPLE IDENTIFICATION	LL	PL	PI	-200	MATERIAL DESCRIPTION BURMISTER ☐ASTM D 2487 ☒
●	SURFACE 06 AMENDED MIX	NV	NP		30.9	SM, Silty sand
▲	SURFACE 07 TOPSOIL ONLY	NV	NP		34.2	SM, Silty sand

NV - Non-Viscous NP - Non-Plastic

Project No.: 818724 Date: 9-24-01
Project: IR SITE 10

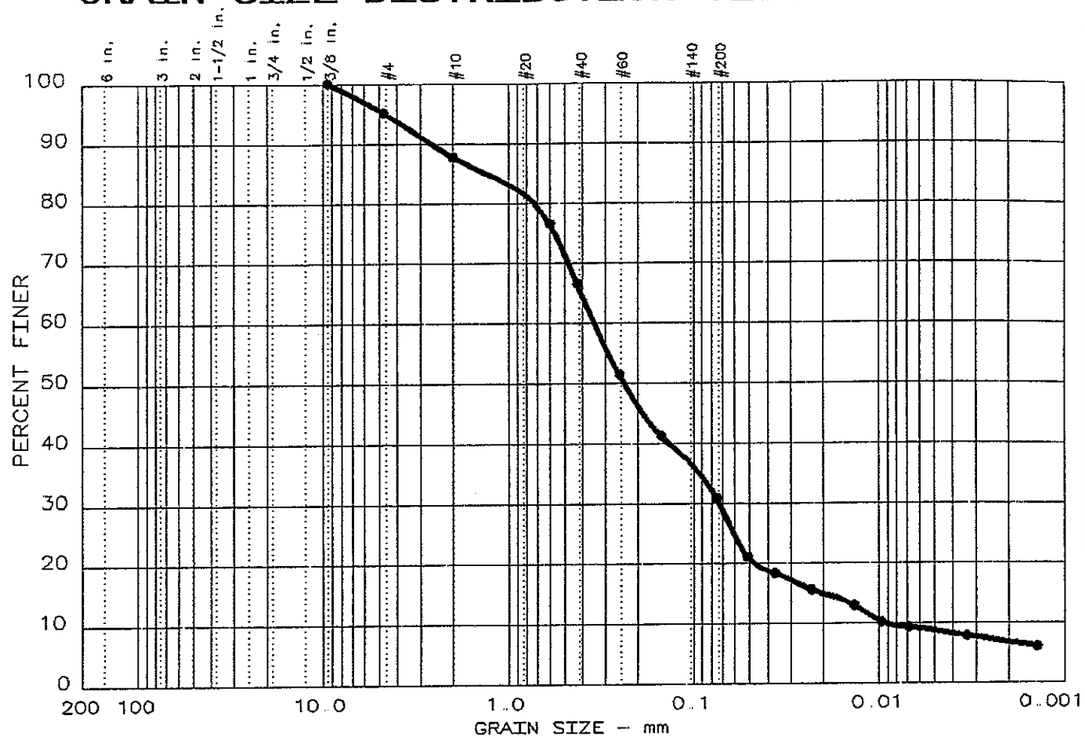
Client: IT SAN DIEGO
Location:

Performed by: M.S.
Entered by: L.B.
Checked by: R.S.A.
Remarks:

EMCON

Fig. No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	4.9	64.2	22.1	8.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.33	0.343	0.234	0.0724	0.0204	0.0093	1.64	36.7

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

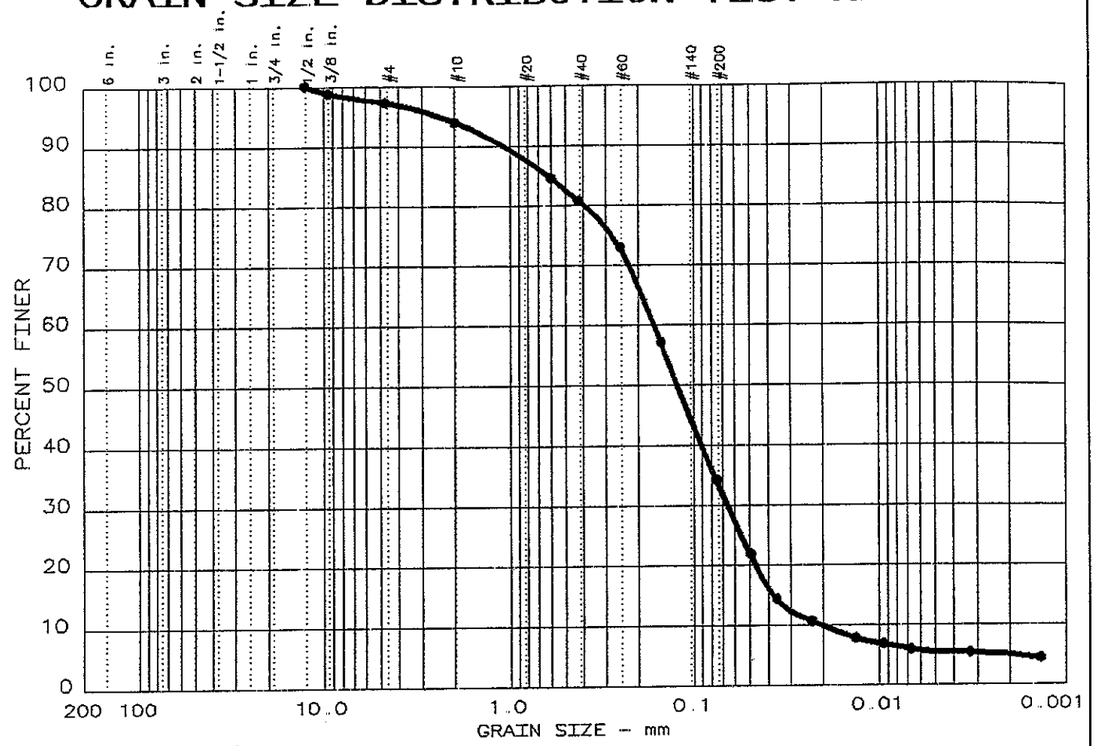
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 06 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 23.6%
ROOTS,LEAVS,ORGANIC MTRL

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	2.8	63.0	28.7	5.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.631	0.163	0.122	0.0654	0.0372	0.0204	1.28	8.0

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 07 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 10.3%
ROOTS,LEAVS,ORGANIC MTRL

Fig. No.: EM NY-GL

IT/EMCON
Geotechnical Laboratory
371 Rt. 17A Sterling Forest
Tuxedo, New York 10987
Ph:(845)351-5100 Fax:(845)351-5199

LETTER OF TRANSMITTAL

Date	Job No.
9-24-01	818724

Attention: Richard Morris/Holly Buschman

RE: Lab Testing

IR Site 10 - Shoreline Area

TO The IT Group, Inc.
1202 Kettner Blvd., Suite 3400
San Diego, CA 92101-3341

WE ARE SENDING YOU ATTACHED: [ ] Samples [X] Test results # 7433

COPIES	DATE	NO.	DESCRIPTION
2	9-24-01	2	Liquid and Plastic Limits Test Report (7 tests)
2	9-24-01	7	Grain Size Distribution Test Report
			Sample ID: Surface 01 through 07

THESE ARE TRANSMITTED as checked below:

[ ] For approval
[X] As requested
[ ] For review and comment
[ ] Approved as submitted
[ ] Returned for corrections
[ ] Resubmit ___ copies for approval
[ ] Return ___ corrected prints

REMARKS If you have any questions, please call 845-351-5100.

COPY TO (2) copies SIGNED: Ahmed

EM\NY-GL\TRANSLET\IRSite7433.xls

No. 7433

EMCON - GEOTECHNICAL LABORATORY PRICE SCHEDULE

TUXEDO, N.Y. 10987

Client IT San Diego

Date 9.24.01

Project IR. Site 10

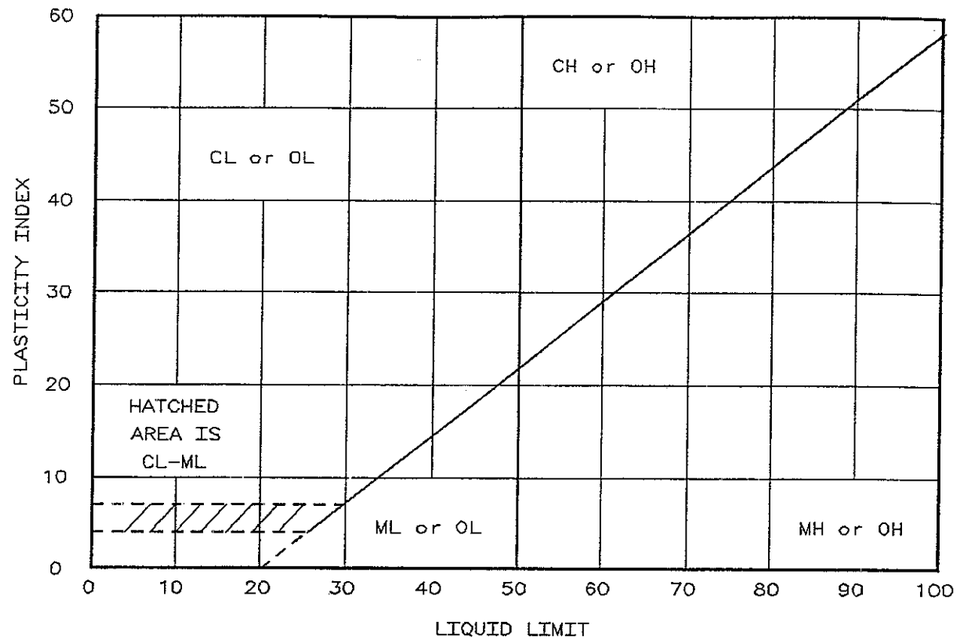
Project No. 818724

Code	Description of Test	Price per Test ($)	Test No.	Amount
A-1	Atterberg Limits, including sample preparation (ASTM D4318)	60		
A-2	1. Verification that material is Non-Plastic, including sample preparation	30	7	210
B-1	Compressive Strength, Unconfined, including Stress-Strain Curve (ASTM D2166)	60		
C-1	Consolidation 1. One Unload-Reload Cycle (ASTM D2435)	360		
C-2	2. Permeability Test at Specified Load Increments (during consolidation test)	150		
	Particle Size Analysis			
D-1	Washed Sieve Analysis (ASTM D422)	45		
D-2	Washed Sieve Analysis (sample over 5 lbs.) (ASTM D422)	55		
D-3	Hydrometer Analysis only (ASTM D422)	65		
D-4	Combined Sieve & Hydrometer Analysis (ASTM D422)	100	7	700
D-5	Material Passing #200 Sieve (ASTM D422)	30		
E-1	Moisture Content (ASTM D2216)	5		
	Moisture-Density Relations			
F-A	Standard Proctor, 4" Mold (ASTM D698)	140		
F-C	Standard Proctor, 6" Mold (ASTM D698)	160		
F-E	Modified Proctor, 4" Mold (ASTM D1557)	160		
F-G	Modified Proctor, 6" Mold (ASTM D1557)	175		
F-I	Compaction at Natural Moisture Content	45		
F-K	CBR: Compact (3) specimens at specified Dry Density and Moisture Content, soak (4) days - Measure Swell; test and plot Stress-Penetration Curve	570		
G-1	Organic Content, Loss-On Ignition (ASTM D2974)	50		
	Permeability Tests			
H-1	Permeability Test (ASTM D5084) (additional charges per hour if sample preparation is required)	225		
I-1	Permeability Test Remolded Sample (ASTM D5084/D2434) (additional charges if maximum density & opt. moisture are to be determined)	260		
I-2	Permeability Test Remolded Sample 4" sample(ASTM D5084)	275		
J-1	Permeability Test during Tri-Axial Test per Confining Pressure	150		
K-1	Photograph of Test Specimen	9.50		
L-1	Specific Gravity (ASTM D854)	35		
M-1	Tri-Axial Tests per Confining Pressure (ASTM D2850/D4767)	185		
M-2	Direct Shear per Normal Stress (ASTM D3080)	185		
M-3	Interface Friction Angle per normal stress HDPE, Geonet, Geotextile, etc. 4" x 4" sample (ASTM D3080)	125		
N-1	Opening Shelby Tubes (extrude)	20		
N-2	Logging Undisturbed Samples	15		
P-1	Unit Weight (Undisturbed Samples)	30		
P-2	Unit Weight (Disturbed Samples)	40		
Q-1	Visual Identification (per sample)	7		
R-1	Special Sample Preparation, testing not included (per hour)	55-65		
S-1	Torvane Shear Test	15		
U-1	Shrinkage Limits (ASTM D427)	55		
V-1	Leachate and Long-Term Permeability	Open		

Price per test samples delivered to the Lab

Total 910.00

LIQUID AND PLASTIC LIMITS TEST REPORT



	SAMPLE IDENTIFICATION	LL	PL	PI	-200	MATERIAL DESCRIPTION BURMISTER ☐ASTM D 2487 ☒
●	SURFACE 01 SANDY LOAM, RIVER BOTTOM	NV	NP		35.0	SM, Silty sand
▲	SURFACE 02 70/30 AMENDED MIX	NV	NP		33.9	SM, Silty sand
■	SURFACE 03 70/30 AMENDED MIX	NV	NP		18.6	SM, Silty sand
◆	SURFACE 04 SCREENED TOPSOIL	NV	NP		28.8	SM, Silty sand
×	SURFACE 05 SANDY/SILTY LOAM	NV	NP		17.0	SM, Silty sand

NV - Non-Viscous NP - Non-Plastic

Project No.: 818724 Date: 9-24-01
Project: IR SITE 10

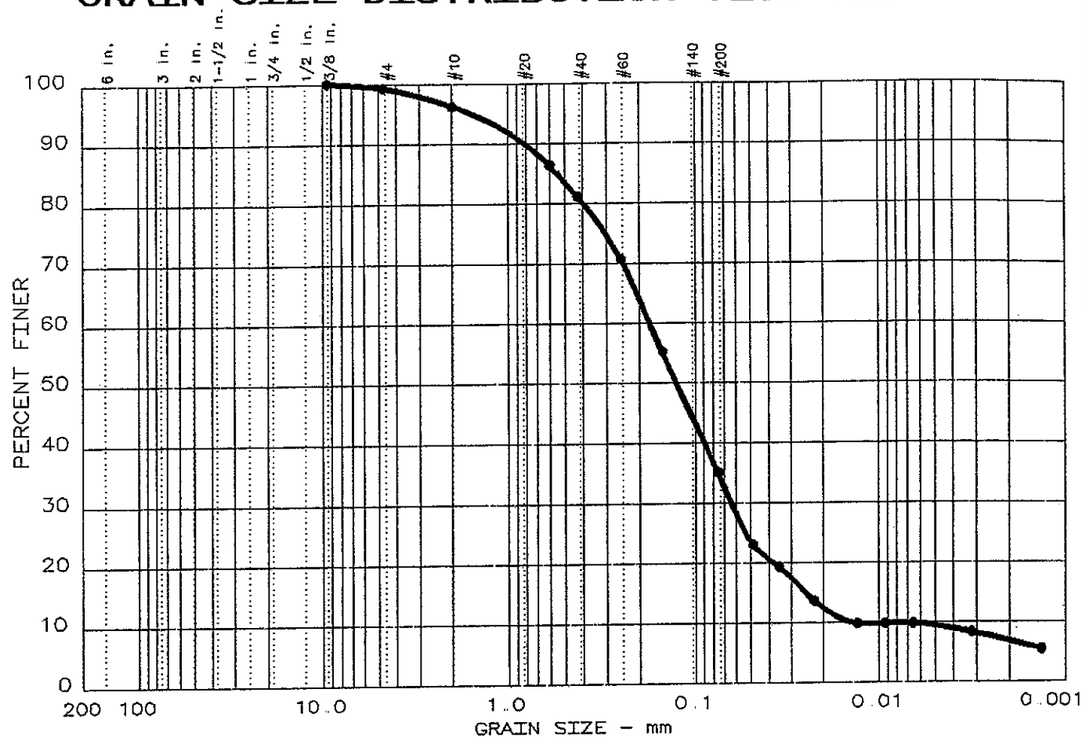
Client: IT SAN DIEGO
Location:

Performed by: M.S.
Entered by: L.B.
Checked by: R.S.A.
Remarks:

EMCON

Fig. No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	1	0.0	0.8	64.2	25.6	9.4

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.543	0.175	0.125	0.0635	0.0247	0.0141	1.64	12.4

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

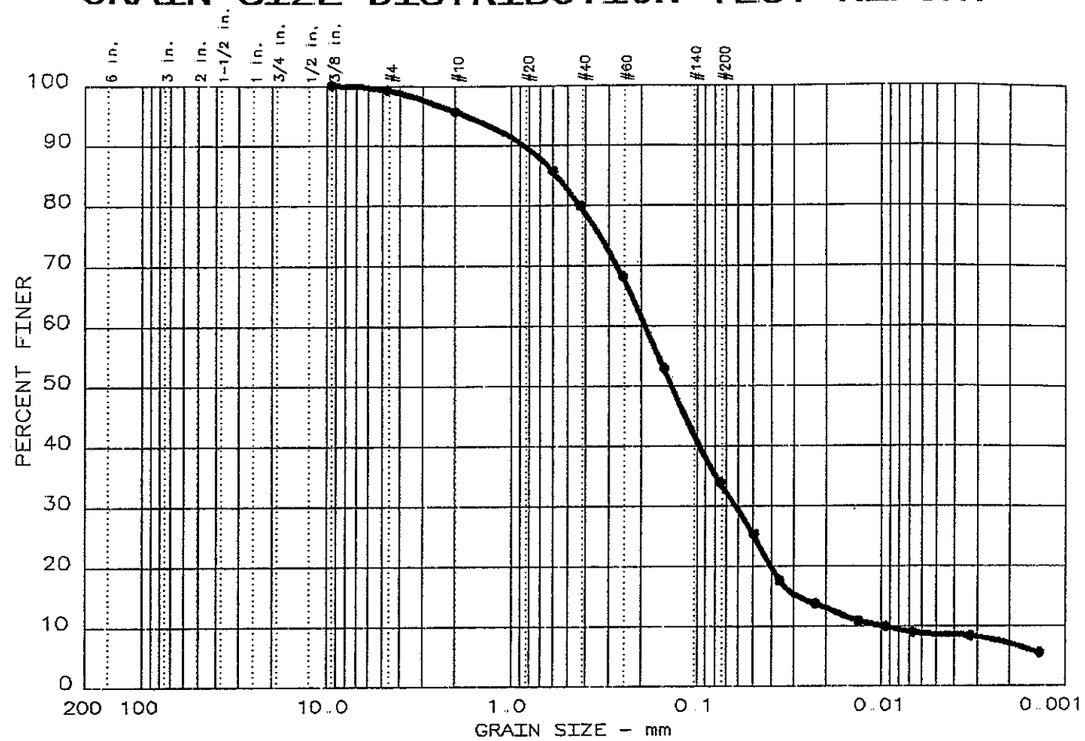
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 01 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 6.0%
TRACE ORGANIC MATERIAL

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	2	0.0	0.0	0.0	0.0	

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●										

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

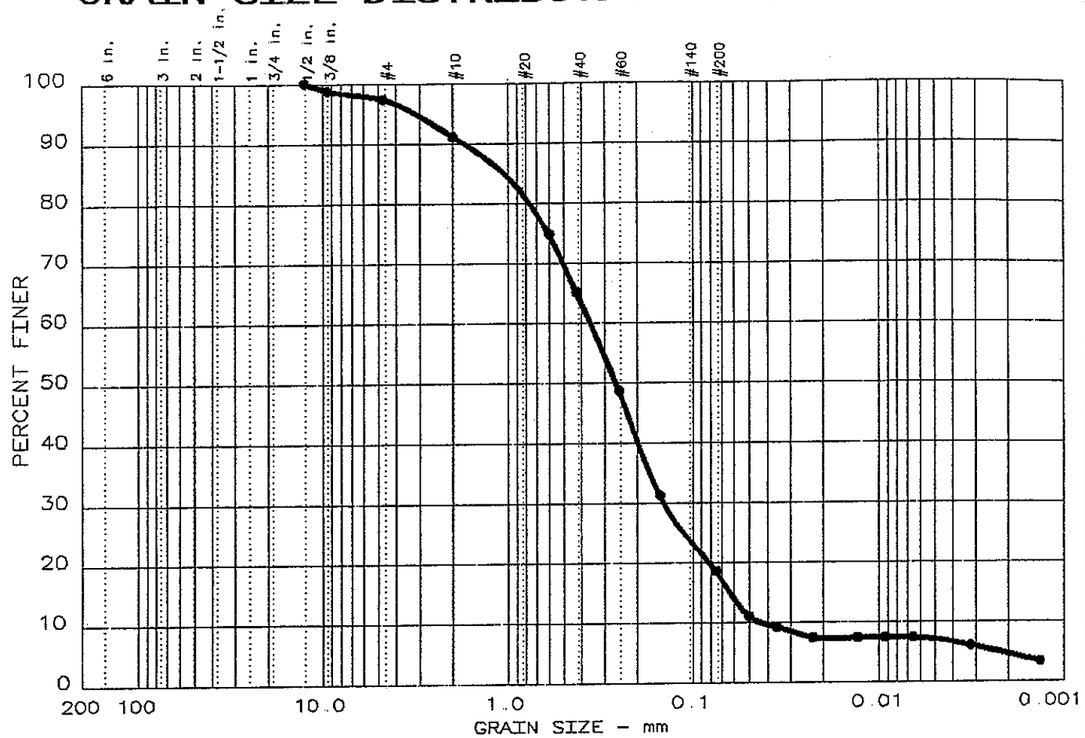
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 02 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R S.A.
Remarks:
MOISTURE CONTENT = 11.2%
TRACE ROOTS,WOOD,LEAVES

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	3	0.0	2.7	78.7	11.5	7.1

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.05	0.358	0.259	0.142	0.0629	0.0445	1.27	8.0

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

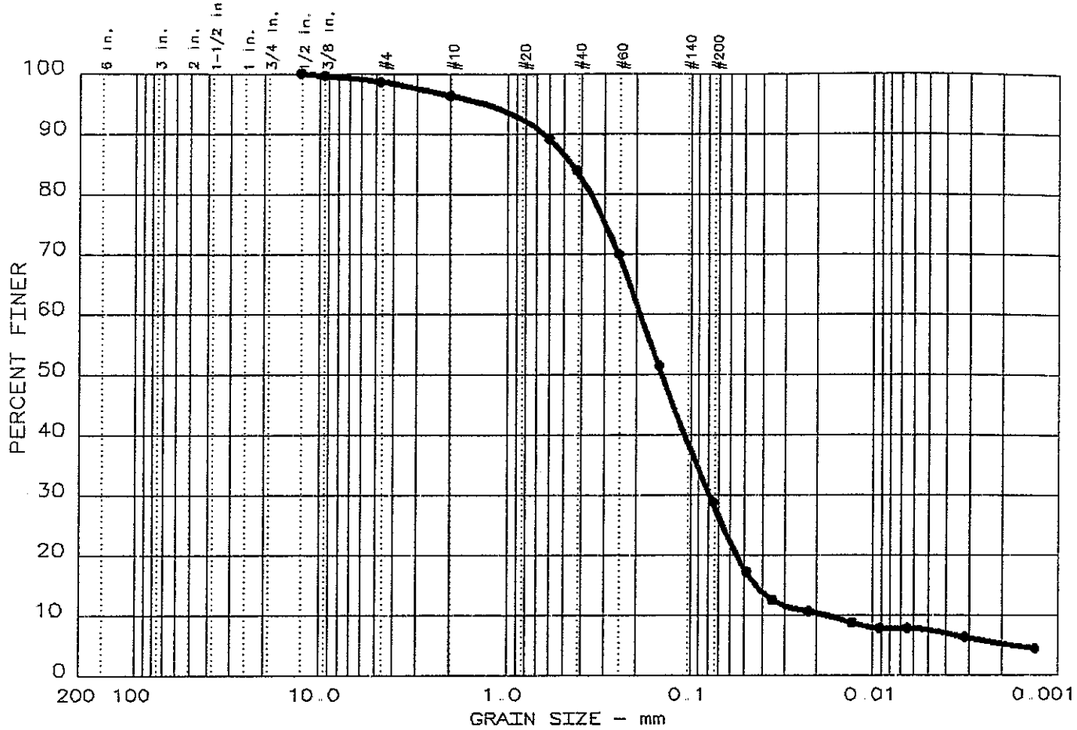
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 03 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 5.8%
TRACE ORGANIC MATERIAL

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	4	0.0	1.4	69.8	21.3	7.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.447	0.188	0.144	0.0780	0.0434	0.0177	1.83	10.7

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

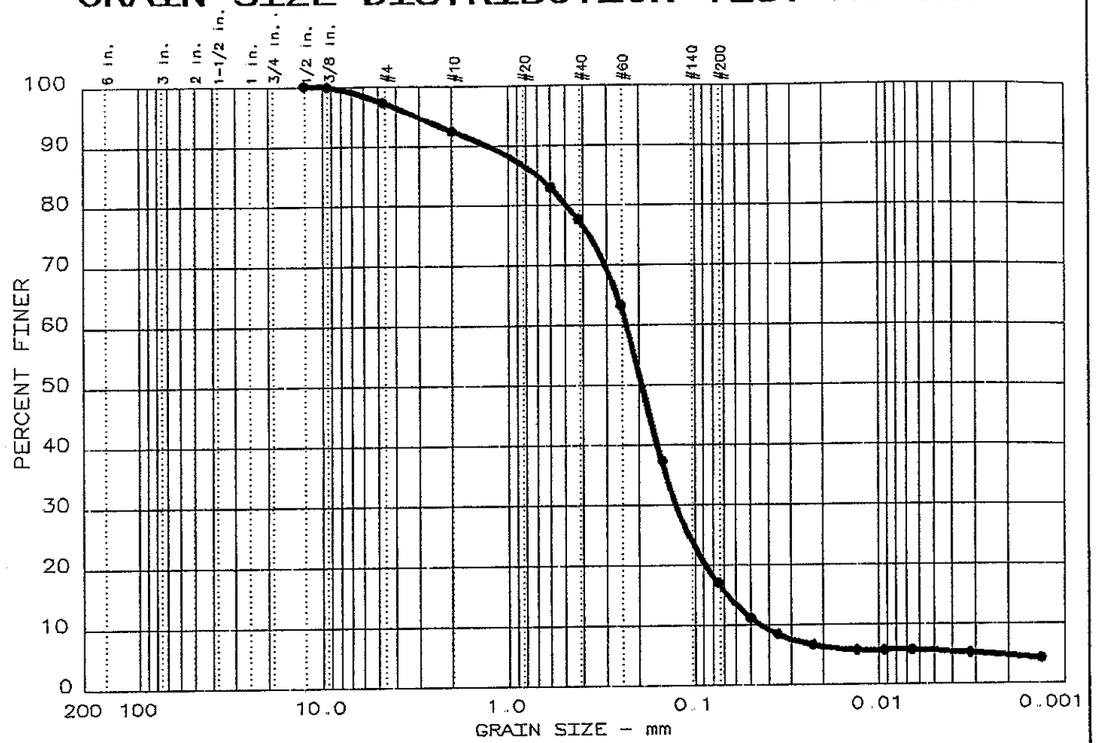
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 04 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 7.6%
TRACE ORGANIC MATERIAL

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	5	0.0	2.8	80.2	11.4	5.6

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.708	0.232	0.192	0.125	0.0665	0.0444	1.52	5.2

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

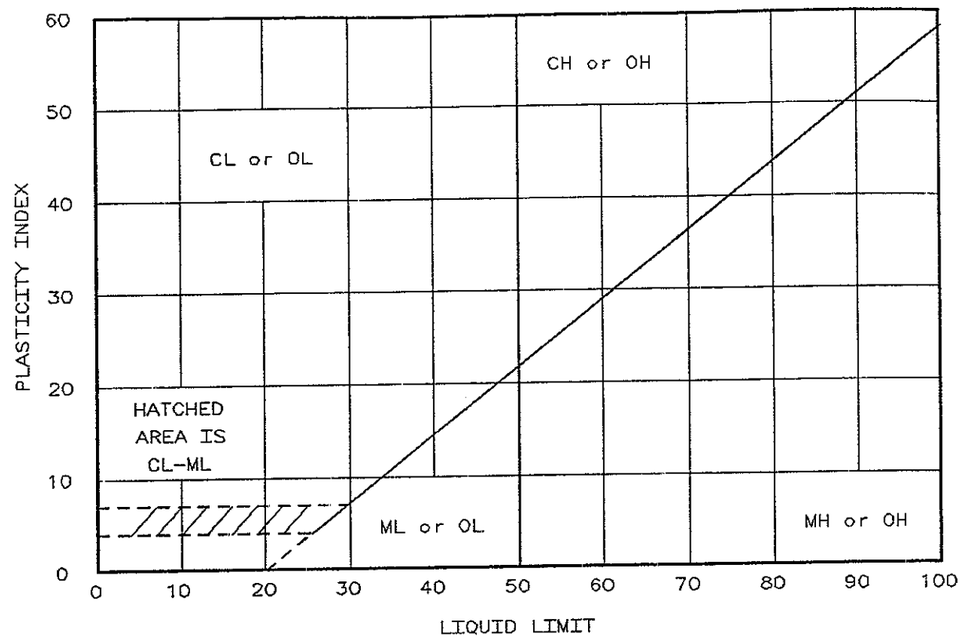
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 05 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 9.9%
TRACE ORGANIC MATERIAL

Fig. No.: EM NY-GL

LIQUID AND PLASTIC LIMITS TEST REPORT



	SAMPLE IDENTIFICATION	LL	PL	PI	-200	MATERIAL DESCRIPTION BURMISTER ☐ASTM D 2487 ☒
●	SURFACE 06 AMENDED MIX	NV	NP		30.9	SM, Silty sand
▲	SURFACE 07 TOPSOIL ONLY	NV	NP		34.2	SM, Silty sand

NV - Non-Viscous NP - Non-Plastic

Project No.: 818724 Date: 9-24-01
Project: IR SITE 10

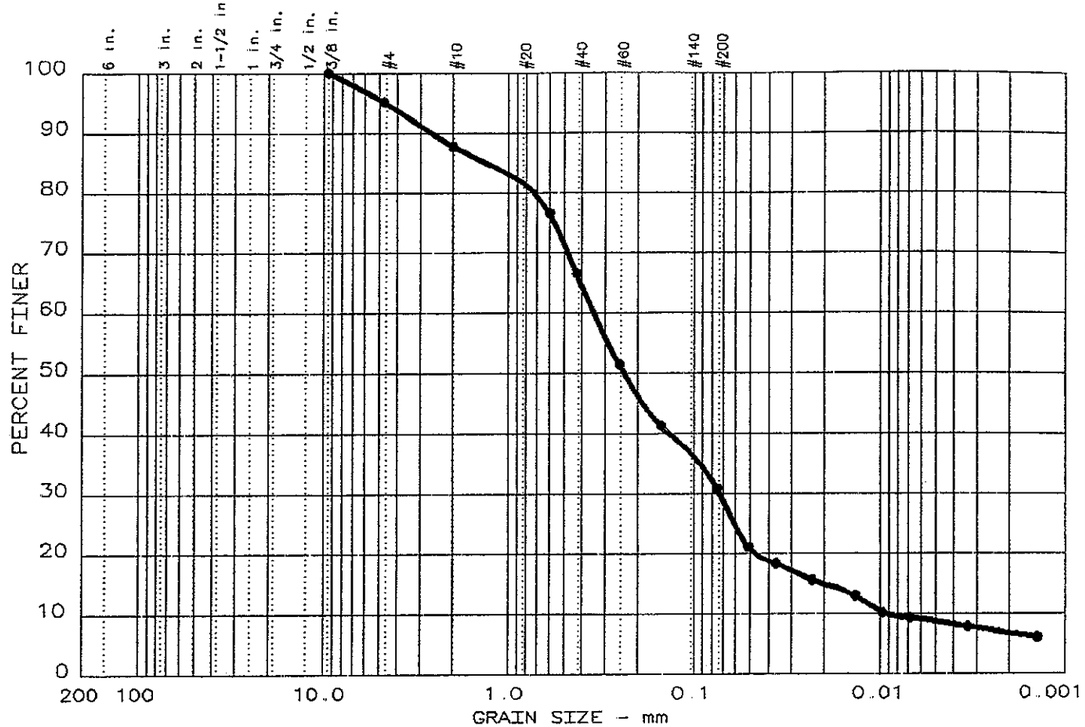
Client: IT SAN DIEGO
Location:

Performed by: M.S.
Entered by: L.B.
Checked by: R.S.A.
Remarks:

EMCON

Fig. No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	6	0.0	4.9	64.2	22.1	8.8

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			1.33	0.343	0.234	0.0724	0.0204	0.0093	1.64	36.7

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

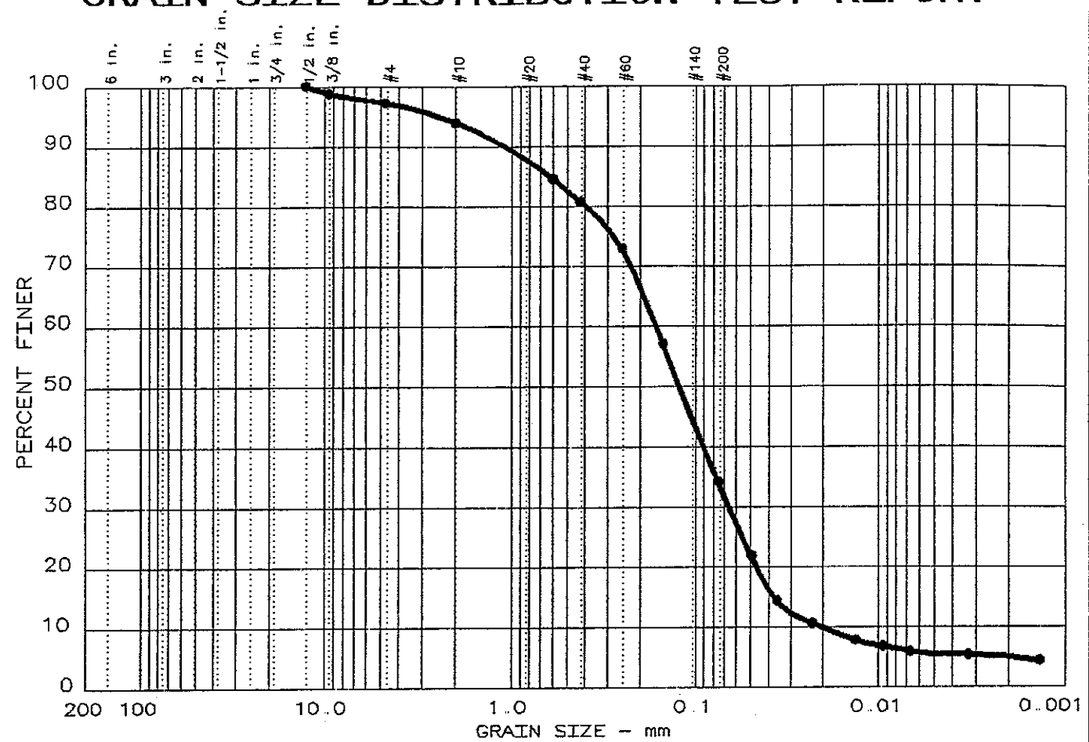
Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 06 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 23.6%
ROOTS, LEAVS, ORGANIC MTRL

Fig. No.: EM NY-GL

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	7	0.0	2.8	63.0	28.7	5.5

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.631	0.163	0.122	0.0654	0.0372	0.0204	1.28	8.0

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Dark Brown Silty sand	SM		A-2-4(0)

Project No.: 818724 Date: 9-24-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 07 Sample No.:

EMCON

Performed by: L.B.
Entered by: L.B.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 10.3%
ROOTS,LEAVS,ORGANIC MTRL

Fig. No.: EM NY-GL

IT/EMCON
Geotechnical Laboratory
371 Rt. 17A Sterling Forest
Tuxedo, New York 10987
Ph:(845)351-5100 Fax:(845)351-5199

LETTER OF TRANSMITTAL

Date	Job No.
9-24-01	818724

Attention: Richard Morris/Holly Buschman

RE: Lab Testing

IR Site 10 - Shoreline Area

TO The IT Group, Inc.
1202 Kettner Blvd., Suite 3400
San Diego, CA 92101-3341

WE ARE SENDING YOU ATTACHED: [ ] Samples [X] Test results # 7433

COPIES	DATE	NO.	DESCRIPTION
2	9-24-01	2	Liquid and Plastic Limits Test Report (7 tests)
2	9-24-01	7	Grain Size Distribution Test Report
			Sample ID: Surface 01 through 07
2	9-27-01	1	Liquid and Plastic Limits Test Report Surface 08
2	9-27-01	1	Grain Size Distribution Test Report Surface 08

THESE ARE TRANSMITTED as checked below:

[ ] For approval
[X] As requested
[ ] For review and comment
[ ] Approved as submitted
[ ] Returned for corrections
[X] Revised/Supplement
[ ] Resubmit ___ copies for approval
[ ] Return ___ corrected prints

REMARKS Enclosed please find test results of sample identified as 08 and revised Billing Sheet to include the cost of additional testing requested.

If you have any questions, please call 845-351-5100.

COPY TO (2) copies SIGNED: Ahmed

EM\NY-GL\TRANSLET\IRSite7433.xls

No. 7433

EMCON - GEOTECHNICAL LABORATORY PRICE SCHEDULE
TUXEDO, N.Y. 10987

Client IT San Diego.

Date 9-24-01

Project IR. Site 10

Project No. 818724

Code	Description of Test	Price per Test ($)	Test No.	Amount	
A-1	Atterberg Limits, including sample preparation (ASTM D4318)	60			
A-2	1. Verification that material is Non-Plastic, including sample preparation	30	~~87~~	~~210~~	2340
B-1	Compressive Strength, Unconfined, including Stress-Strain Curve (ASTM D2166)	60			
C-1	Consolidation 1. One Unload-Reload Cycle (ASTM D2435)	360			
C-2	2. Permeability Test at Specified Load Increments (during consolidation test)	150			
	Particle Size Analysis				
D-1	Washed Sieve Analysis (ASTM D422)	45			
D-2	Washed Sieve Analysis (sample over 5 lbs.) (ASTM D422)	55			
D-3	Hydrometer Analysis only (ASTM D422)	65			
D-4	Combined Sieve & Hydrometer Analysis (ASTM D422)	100	~~87~~	~~700~~	800
D-5	Material Passing #200 Sieve (ASTM D422)	30			
E-1	Moisture Content (ASTM D2216)	5			
	Moisture-Density Relations				
F-A	Standard Proctor, 4" Mold (ASTM D698)	140			
F-C	Standard Proctor, 6" Mold (ASTM D698)	160			
F-E	Modified Proctor, 4" Mold (ASTM D1557)	160			
F-G	Modified Proctor, 6" Mold (ASTM D1557)	175			
F-I	Compaction at Natural Moisture Content	45			
F-K	CBR: Compact (3) specimens at specified Dry Density and Moisture Content, soak (4) days - Measure Swell, test and plot Stress-Penetration Curve	570			
G-1	Organic Content, Loss-On Ignition (ASTM D2974)	50			
	Permeability Tests				
H-1	Permeability Test (ASTM D5084) (additional charges per hour if sample preparation is required)	225			
I-1	Permeability Test Remolded Sample (ASTM D5084/D2434) (additional charges if maximum density & opt. moisture are to be determined)	260			
I-2	Permeability Test Remolded Sample 4" sample(ASTM D5084)	275			
J-1	Permeability Test during Tri-Axial Test per Confining Pressure	150			
K-1	Photograph of Test Specimen	9.50			
L-1	Specific Gravity (ASTM D854)	35			
M-1	Tri-Axial Tests per Confining Pressure (ASTM D2850/D4767)	185			
M-2	Direct Shear per Normal Stress (ASTM D3080)	185			
M-3	Interface Friction Angle per normal stress HDPE, Geonet, Geotextile, etc. 4" x 4" sample (ASTM D3080)	125			
N-1	Opening Shelby Tubes (extrude)	20			
N-2	Logging Undisturbed Samples	15			
P-1	Unit Weight (Undisturbed Samples)	30			
P-2	Unit Weight (Disturbed Samples)	40			
Q-1	Visual Identification (per sample)	7			
R-1	Special Sample Preparation, testing not included (per hour)	55-65			
S-1	Torvane Shear Test	15			
U-1	Shrinkage Limits (ASTM D427)	55			
V-1	Leachate and Long-Term Permeability	Open			

Price per test samples delivered to the Lab

Total 410.00

1040

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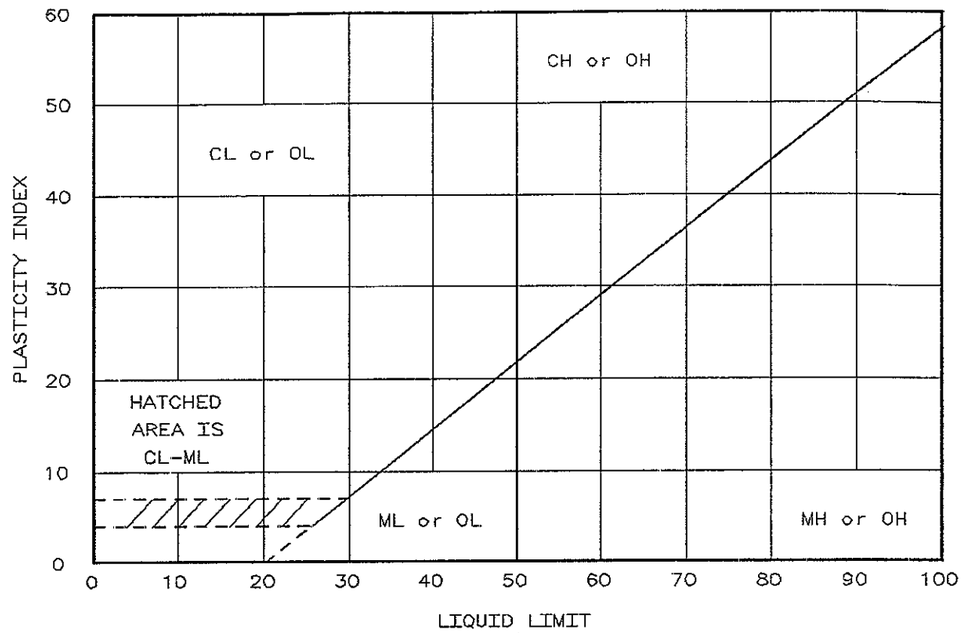
LIQUID AND PLASTIC LIMITS TEST REPORT



SAMPLE IDENTIFICATION	LL	PL	PI	-200	MATERIAL DESCRIPTION BURMISTER ☐ASTM D 2487 ☒
● SURFACE 08 SOURVE: MIRAMAR LANDFILL	NV	NP		22.0	SM, Silty sand

NV - Non-Viscous NP - Non-Plastic

Project No.: 818724 Date: 9-27-01
Project: IR SITE 10

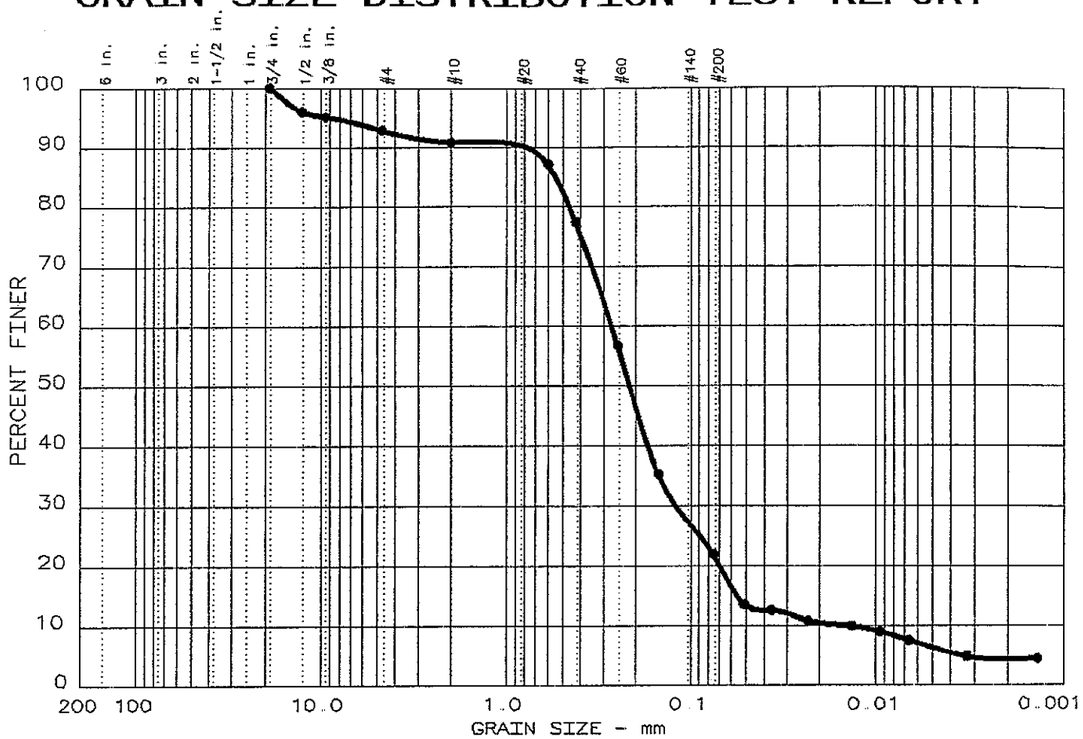
Client: IT SAN DIEGO
Location:

Performed by: M.S.
Entered by: K.H.
Checked by: R.S.A.
Remarks:

EMCON

Fig. No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	7.2	70.8	15.7	6.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.543	0.269	0.216	0.120	0.0560	0.0142	3.76	18.9

MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Brownish Yellow Silty sand	SM		A-2-4(0)

Project No.: 818724 Date: 9-27-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 08 Sample No.:

EMCON

Performed by: M.S.
Entered by: K.H.
Checked by: R S.A
Remarks:
MOISTURE CONTENT = 6.5%
SOURCE: MIRAMAR LNDFILL

Fig. No.: EM NY-GL

IT/EMCON
Geotechnical Laboratory
371 Rt. 17A Sterling Forest
Tuxedo, New York 10987
Ph:(845)351-5100 Fax:(845)351-5199

LETTER OF TRANSMITTAL

Date	Job No.
9-24-01	818724

Attention: Richard Morris/Holly Buschman

RE: Lab Testing

IR Site 10 - Shoreline Area

TO The IT Group, Inc.
1202 Kettner Blvd., Suite 3400
San Diego, CA 92101-3341

WE ARE SENDING YOU ATTACHED: [ ] Samples [X] Test results # 7433

COPIES	DATE	NO.	DESCRIPTION
2	9-24-01	2	Liquid and Plastic Limits Test Report (7 tests)
2	9-24-01	7	Grain Size Distribution Test Report
			Sample ID: Surface 01 through 07
2	9-27-01	1	Liquid and Plastic Limits Test Report Surface 08
2	9-27-01	1	Grain Size Distribution Test Report Surface 08

THESE ARE TRANSMITTED as checked below:

[ ] For approval
[X] As requested
[ ] For review and comment
[ ] Approved as submitted
[ ] Returned for corrections
[X] Revised/Supplement
[ ] Resubmit ___ copies for approval
[ ] Return ___ corrected prints

REMARKS Enclosed please find test results of sample identified as 08 and revised Billing Sheet to include the cost of additional testing requested.

If you have any questions, please call 845-351-5100.

COPY TO (2) copies SIGNED: Rahmed

EM\NY-GL\TRANSLET\IRSite7433 xls

No. 7433

EMCON - GEOTECHNICAL LABORATORY PRICE SCHEDULE
TUXEDO, N.Y. 10987

Client IT San Diego.

Date 9.24.01

Project IR. Site 10

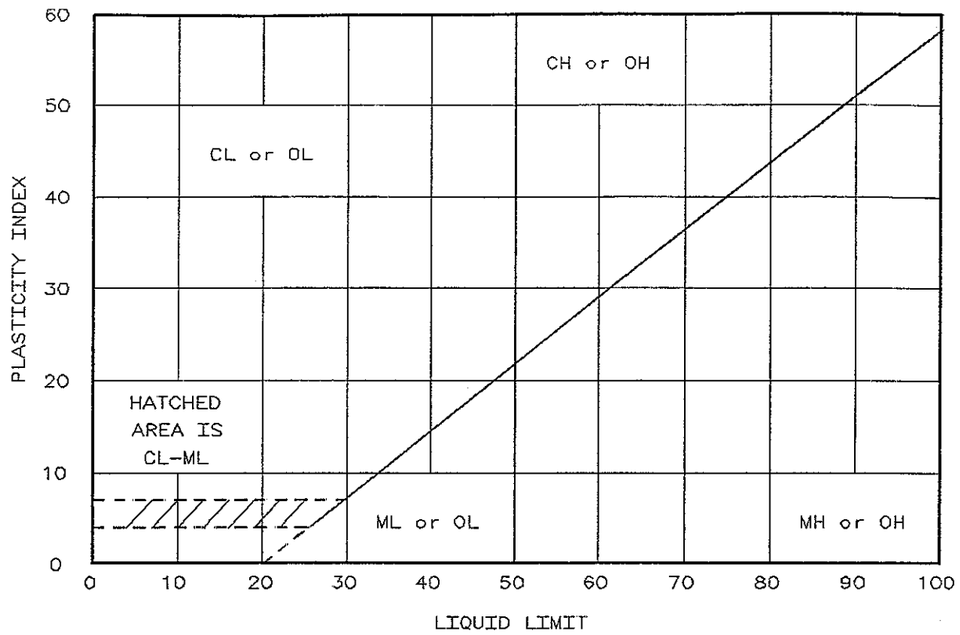
Project No. 818724

Code	Description of Test	Price per Test ($)	Test No.	Amount
A-1	Atterberg Limits, including sample preparation (ASTM D4318)	60		
A-2	1. Verification that material is Non-Plastic, including sample preparation	30	~~87~~	~~240~~ 240
B-1	Compressive Strength, Unconfined, including Stress-Strain Curve (ASTM D2166)	60		
C-1	Consolidation 1. One Unload-Reload Cycle (ASTM D2435)	360		
C-2	2. Permeability Test at Specified Load Increments (during consolidation test)	150		
	Particle Size Analysis			
D-1	Washed Sieve Analysis (ASTM D422)	45		
D-2	Washed Sieve Analysis (sample over 5 lbs.) (ASTM D422)	55		
D-3	Hydrometer Analysis only (ASTM D422)	65		
D-4	Combined Sieve & Hydrometer Analysis (ASTM D422)	100	~~87~~	~~700~~ 800
D-5	Material Passing #200 Sieve (ASTM D422)	30		
E-1	Moisture Content (ASTM D2216)	5		
	Moisture-Density Relations			
F-A	Standard Proctor, 4" Mold (ASTM D698)	140		
F-C	Standard Proctor, 6" Mold (ASTM D698)	160		
F-E	Modified Proctor, 4" Mold (ASTM D1557)	160		
F-G	Modified Proctor, 6" Mold (ASTM D1557)	175		
F-I	Compaction at Natural Moisture Content	45		
F-K	CBR: Compact (3) specimens at specified Dry Density and Moisture Content, soak (4) days - Measure Swell, test and plot Stress-Penetration Curve	570		
G-1	Organic Content, Loss-On Ignition (ASTM D2974)	50		
	Permeability Tests			
H-1	Permeability Test (ASTM D5084) (additional charges per hour if sample preparation is required)	225		
I-1	Permeability Test Remolded Sample (ASTM D5084/D2434) (additional charges if maximum density & opt. moisture are to be determined)	260		
I-2	Permeability Test Remolded Sample 4" sample(ASTM D5084)	275		
J-1	Permeability Test during Tri-Axial Test per Confining Pressure	150		
K-1	Photograph of Test Specimen	9.50		
L-1	Specific Gravity (ASTM D854)	35		
M-1	Tri-Axial Tests per Confining Pressure (ASTM D2850/D4767)	185		
M-2	Direct Shear per Normal Stress (ASTM D3080)	185		
M-3	Interface Friction Angle per normal stress HDPE, Geonet, Geotextile, etc. 4" x 4" sample (ASTM D3080)	125		
N-1	Opening Shelby Tubes (extrude)	20		
N-2	Logging Undisturbed Samples	15		
P-1	Unit Weight (Undisturbed Samples)	30		
P-2	Unit Weight (Disturbed Samples)	40		
Q-1	Visual Identification (per sample)	7		
R-1	Special Sample Preparation, testing not included (per hour)	55-65		
S-1	Torvane Shear Test	15		
U-1	Shrinkage Limits (ASTM D427)	55		
V-1	Leachate and Long-Term Permeability	Open		

Price per test samples delivered to the Lab

Total ~~910.00~~ 1040

LIQUID AND PLASTIC LIMITS TEST REPORT



SAMPLE IDENTIFICATION	LL	PL	PI	-200	MATERIAL DESCRIPTION BURMISTER ☐ASTM D 2487 ☒
● SURFACE 08 SOURVE: MIRAMAR LANDFILL	NV	NP		22.0	SM, Silty sand

NV - Non-Viscous NP - Non-Plastic

Project No.: 818724 Date: 9-27-01
Project: IR SITE 10

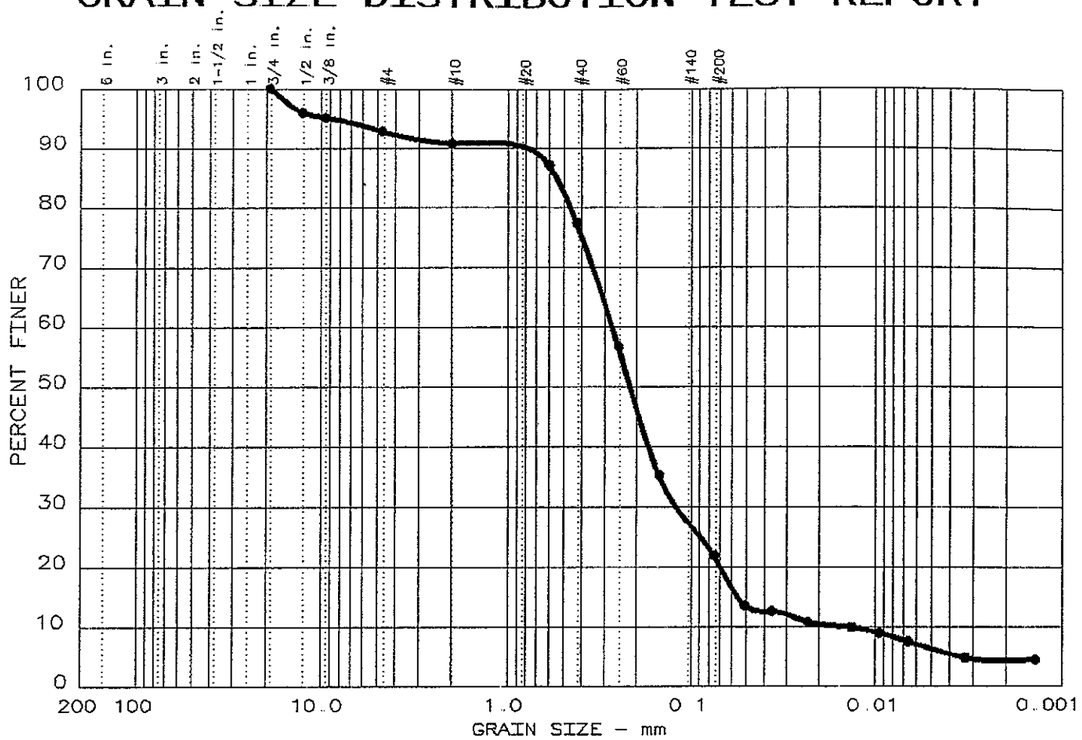
Client: IT SAN DIEGO
Location:

Performed by: M.S.
Entered by: K.H.
Checked by: R.S.A.
Remarks:

EMCON

Fig. No. _____

GRAIN SIZE DISTRIBUTION TEST REPORT



	Test	% +3"	% GRAVEL	% SAND	% SILT	% CLAY
●	15	0.0	7.2	70.8	15.7	6.3

	LL	PI	D_{85}	D_{60}	D_{50}	D_{30}	D_{15}	D_{10}	C_c	C_u
●			0.543	0.269	0.216	0.120	0.0560	0.0142	3.76	18.9

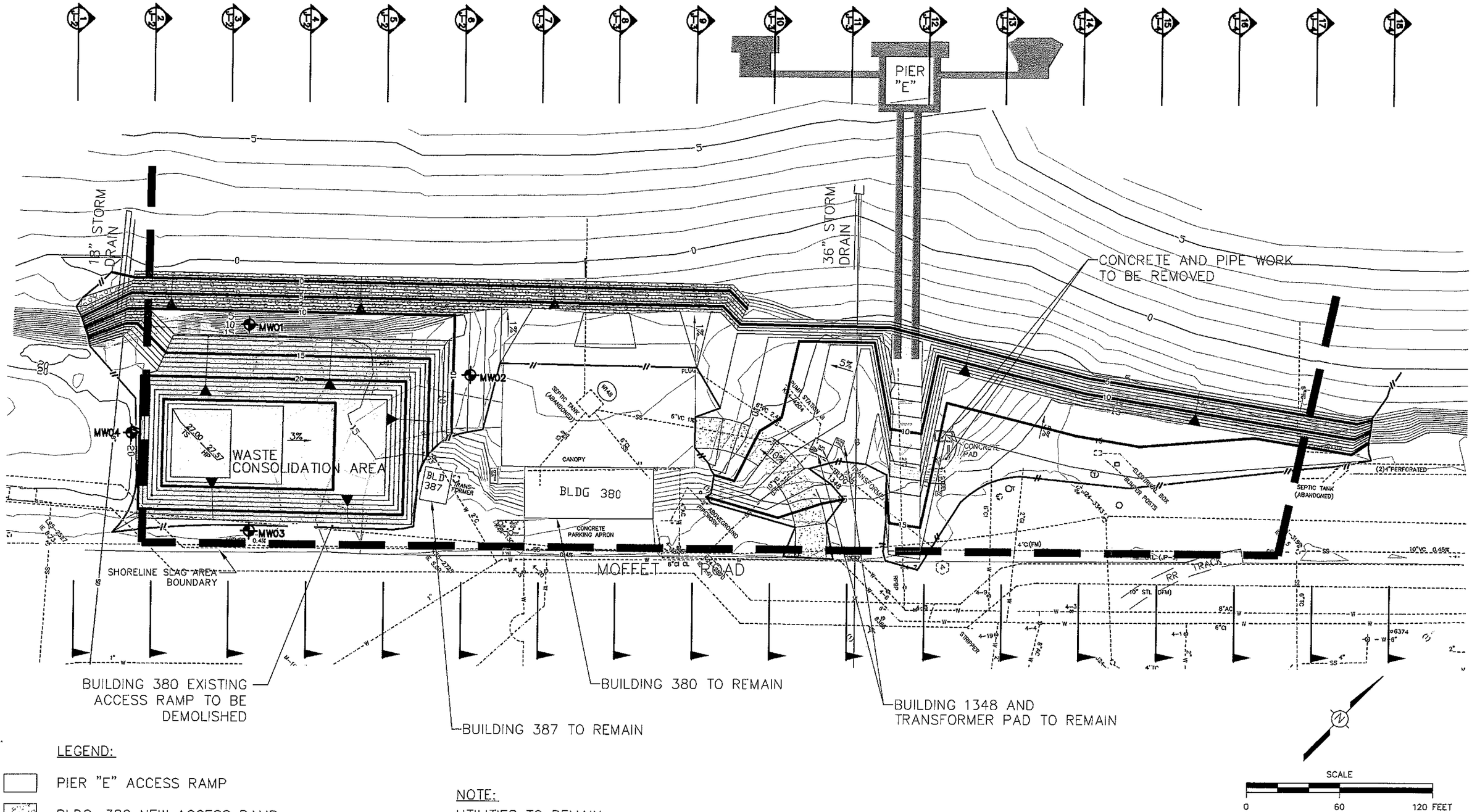
MATERIAL DESCRIPTION	ASTM	BURMISTER	AASHTO
● Brownish Yellow Silty sand	SM		A-2-4(0)

Project No.: 818724 Date: 9-27-01
Project: IR SITE 10
Client: IT SAN DIEGO
● Sample: SURFACE 08 Sample No.:

EMCON

Performed by: M.S.
Entered by: K.H.
Checked by: R.S.A.
Remarks:
MOISTURE CONTENT = 6.5%
SOURCE: MIRAMAR LNDFILL
Fig. No.: EM NY-GL

APPENDIX I
WCA DESIGN CONTINGENCY PLAN



LEGEND:

- PIER "E" ACCESS RAMP
- BLDG 380 NEW ACCESS RAMP
- E T COVER OVER CONSOLIDATED WASTE
- ROCK REVETMENT
- MW03 LOCATION OF GROUNDWATER MONITORING WELLS

NOTE:
UTILITIES TO REMAIN

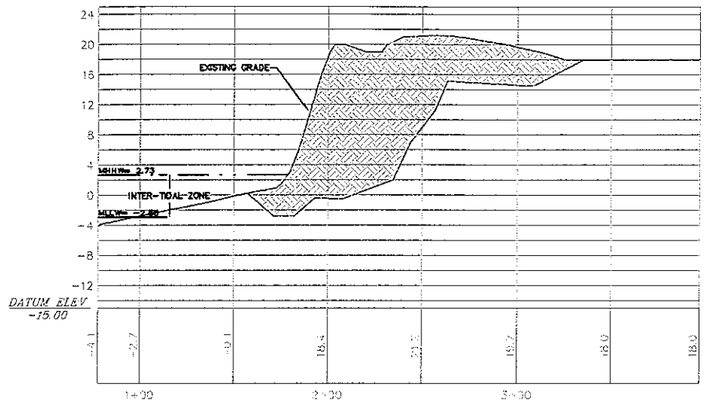
REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

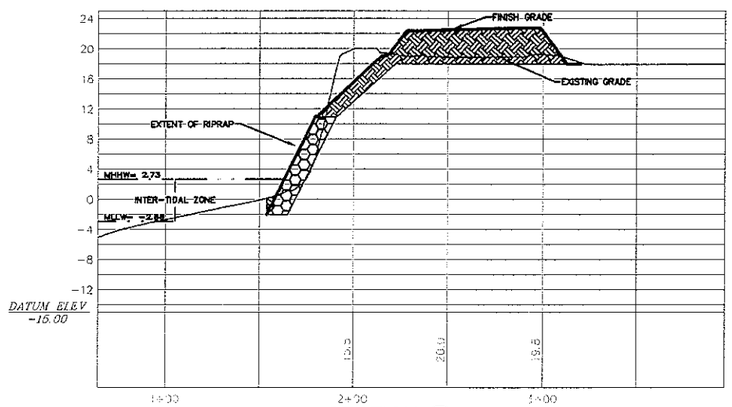
NAVY PUBLIC WORKS CENTER UNDERGROUND UTILITY INFORMATION (BECHTEL 1999a)

REVISIONS			
REV. No.	DESCRIPTION	DATE	APPROVED

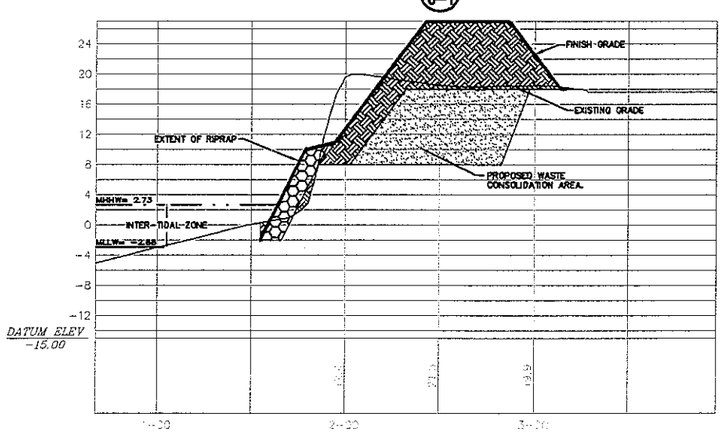
SWDIV	IT CORPORATION	IR SITE 10 SHORELINE SLAG AREA NAVAL AIR STATION, NORTH ISLAND SAN DIEGO CALIFORNIA
DRAWN BY S. AUSTIN DATE 3/18/02		
CHK'D BY R. MORRIS DATE 3/18/02		
APP'D BY H. BUSCHMAN DATE 3/18/02		SITE RECONSTRUCTION CONTINGENCY PLAN REMOVAL ACTION PLAN (RAP)
PROJECT MANAGER R. WONG		
AUTOCAD FILE No. 818724-B24		
SCALE AS NOTED / SHEET — / OF —	IT PROJECT No. 818724	DRAWING No. FIGURE 1 / REVISION —



SECTION 1 / J-1



SECTION 2 / J-1



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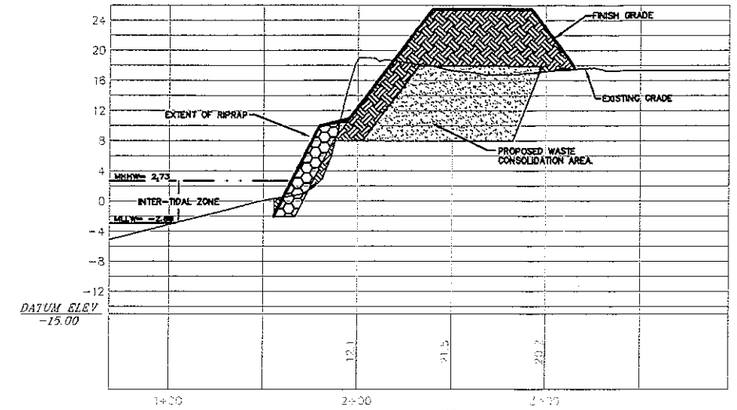
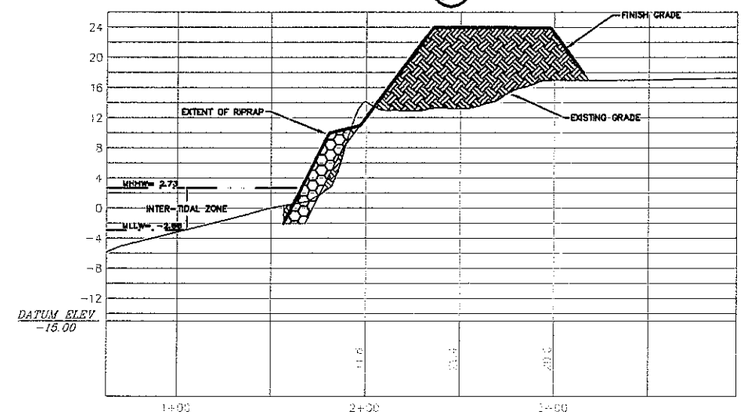
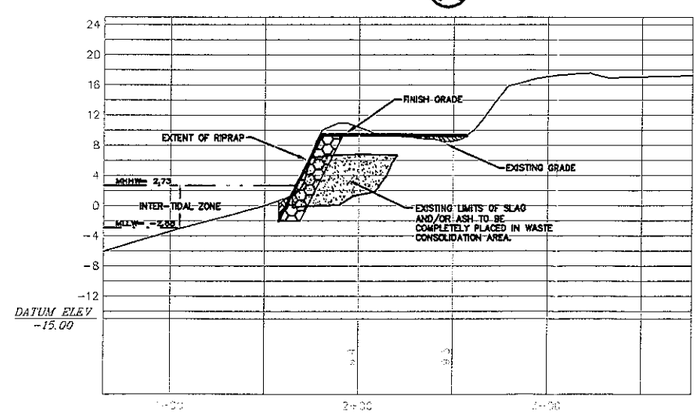


SECTION 4 / J-1



SECTION 5 / J-1



SECTION 6 / J-1

HORIZONTAL SCALE

0 80 160 FEET

VERTICAL SCALE

0 20 40 FEET

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC. (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

NAVY PUBLIC WORKS CENTER UNDERGROUND UTILITY INFORMATION (BECHTEL. 1999a)

REVISIONS

REV. No.	DESCRIPTION	DATE	APPROVED

SWDIV

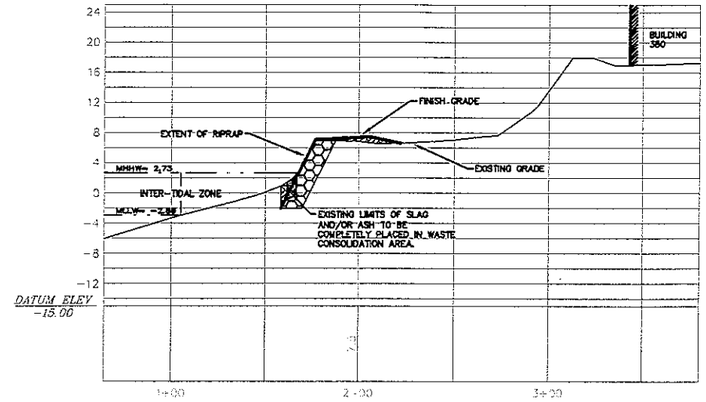
IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

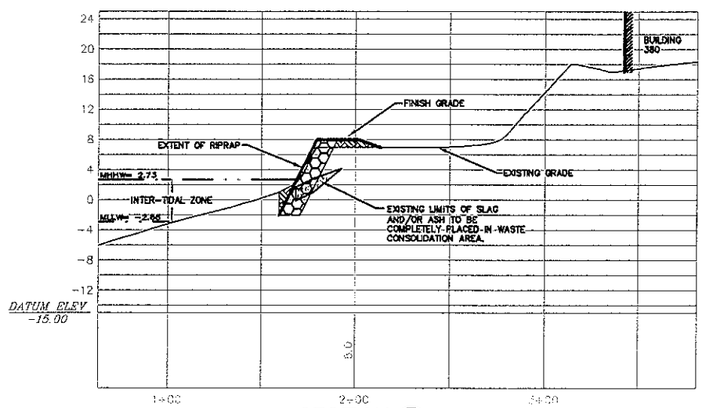
DRAWN BY S. AUSTIN	DATE 3/18/02	
CHK'D BY R. MORRIS	DATE 3/18/02	
APP'D BY H. BUSCHMAN	DATE 3/18/02	
PROJECT MANAGER R. WONG		
AUTOCAD FILE No. 818724-B24		

SECTIONS 1 TO 6
SITE RECONSTRUCTION
REMOVAL ACTION PLAN (RAP)

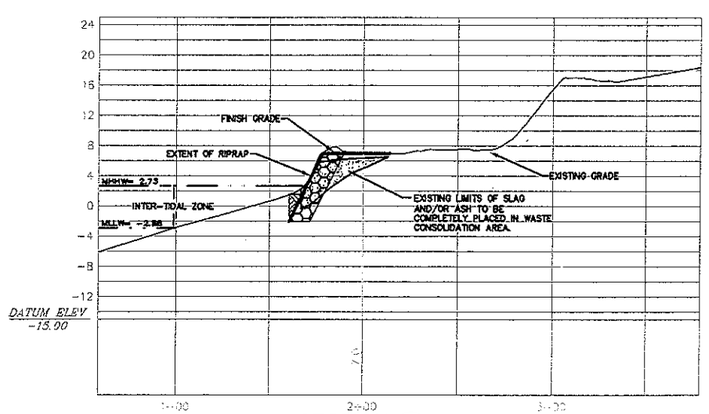
SCALE	SHEET	OF	IT PROJECT No.	DRAWING No.	REVISION
AS NOTED	–	–	818724	FIGURE 2	–



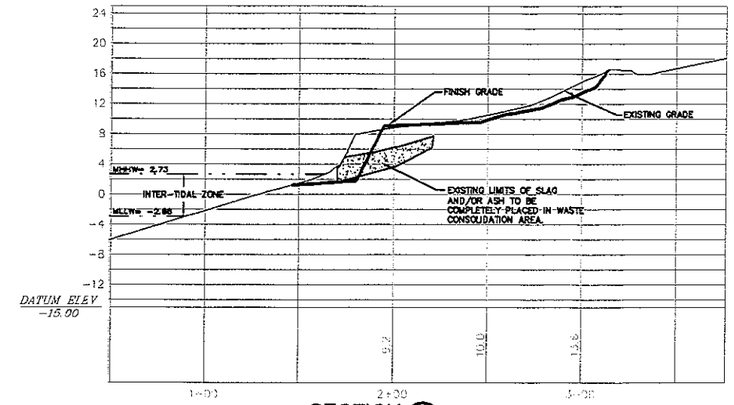
SECTION 7 / J-1



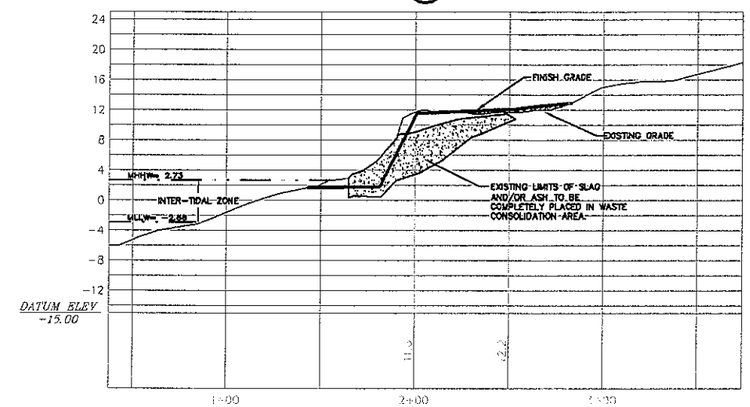
SECTION 8 / J-1



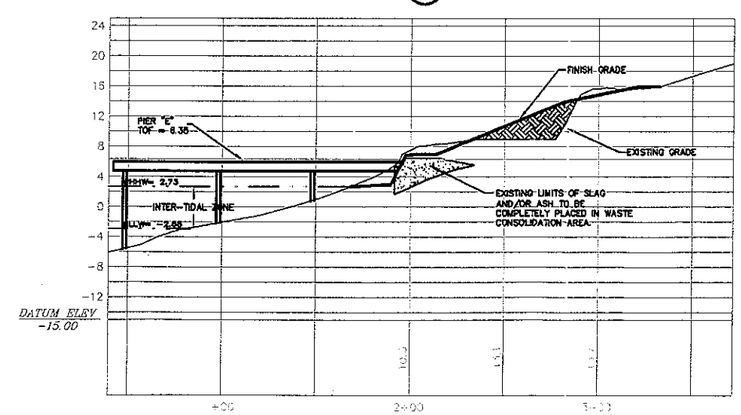
SECTION 9 / J-1



SECTION 10 / J-1



SECTION 11 / J-1



SECTION 12 / J-1

HORIZONTAL SCALE

0 80 160 FEET

VERTICAL SCALE

0 20 40 FEET

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

NAVY PUBLIC WORKS CENTER UNDERGROUND UTILITY INFORMATION (BECHTEL. 1999c)

REVISIONS

REV. No.	DESCRIPTION	DATE	APPROVED

SWDIV

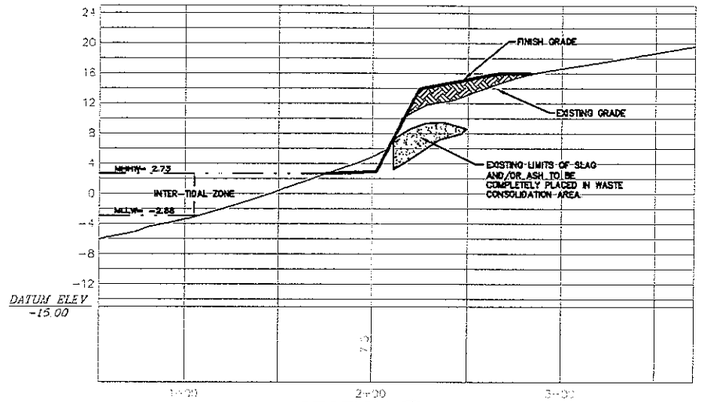
DRAWN BY S. AUSTIN	DATE 3/18/02	
CHK'D BY R. MORRIS	DATE 3/18/02	
APP'D BY H. BUSCHMAN	DATE 3/18/02	
PROJECT MANAGER R. WONG	DATE	
AUTOCAD FILE No. 818724-B24		
SCALE AS NOTED	SHEET –	OF –

IT CORPORATION

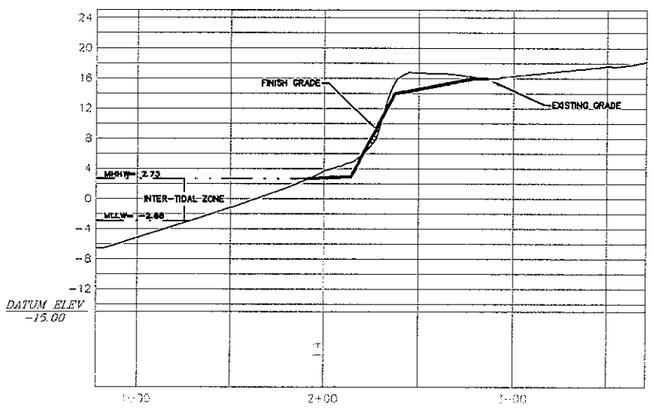
IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SECTIONS 7 TO 12
SITE RECONSTRUCTION
REMOVAL ACTION PLAN (RAP)

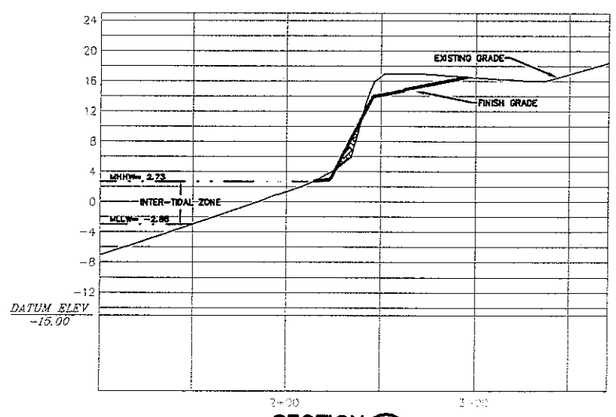
IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 3	–



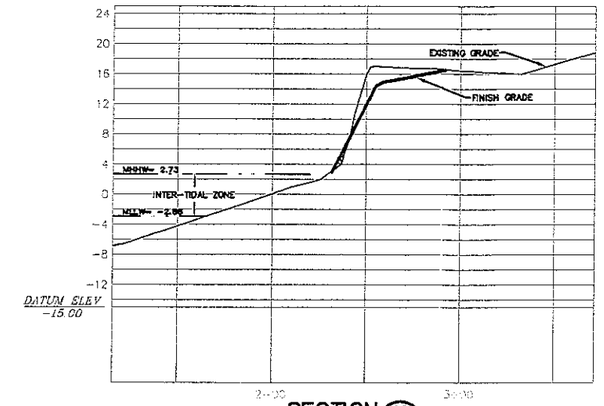
SECTION 13 J-1



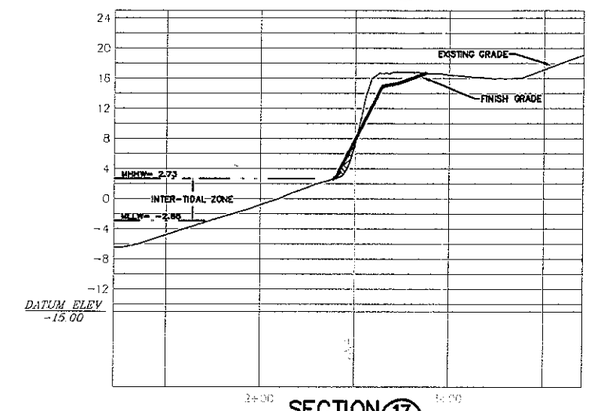
SECTION 14 J-1



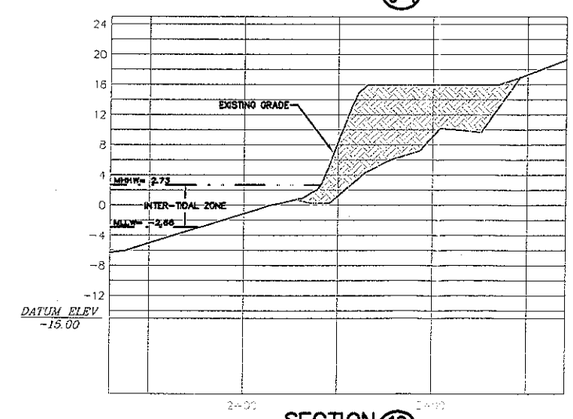
SECTION 15 J-1



SECTION 16 J-1



SECTION 17 J-1



SECTION 18 J-1

HORIZONTAL SCALE

0 80 160 FEET

VERTICAL SCALE

0 20 40 FEET

REFERENCES:

TOPOGRAPHIC SURVEY CONTROL BY ADVANCED SURVEY TECHNOLOGIES, INC. (JULY 1999); MEAN SEA LEVEL (MSL) DATUM

NAVY PUBLIC WORKS CENTER UNDERGROUND UTILITY INFORMATION (SECHTEL 1999a)

REVISIONS

REV. No.	DESCRIPTION	DATE	APPROVED

SWDIV

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CHK'D BY R. MORRIS	DATE 3/18/02	
APP'D BY H. BUSCHMAN	DATE 3/18/02	
PROJECT MANAGER R. WONG		
AUTOCAD FILE No. 818724-B24		
SCALE AS NOTED	SHEET –	OF –

IT CORPORATION

IR SITE 10 SHORELINE SLAG AREA
NAVAL AIR STATION, NORTH ISLAND
SAN DIEGO, CALIFORNIA

SECTIONS 13 TO 18
SITE RECONSTRUCTION
REMOVAL ACTION PLAN (RAP)

IT PROJECT No.	DRAWING No.	REVISION
818724	FIGURE 4	–

APPENDIX J
ROCK REVETMENT DESIGN CALCULATIONS

IT CORPORATION
A Member of The IT Group

Project:	NAS North Island IR Site 10 - CTO 28				
Project Number:	818724	*WBS Code:*	33010395	*Date:*	January-02

Calculation Cover Sheet

Calculation Title:	IR Site 10 Rock Revetment - Downsize Calculations	*Number:*	2

Description:

Design of armor stone and underlayer stone needed for shoreline bluff rock revetment

References:

see attached sheets

Remarks:

Calculated by: Holly [illegible] — *Signature* — 7/8/02 *Date*

Checked by: Richard A. Morris — *Signature* — 7/8/02 *Date*

Approved by: Richard J. Wong — *Signature* — 7.8.02 *Date*

Revisions

	Revised:	*Checked:*	*Approved:*
	Date:	*Date:*	*Date:*
	Revised:	*Checked:*	*Approved:*
	Date:	*Date:*	*Date:*
	Revised:	*Checked:*	*Approved:*
	Date:	*Date:*	*Date:*

CALCULATION SHEET

IT CORPORATION
Member of The IT Group

Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Armor Stone Sizing (graded rip rap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 10/08/01 *Checked:* *Date:*	*Calculation No.:*	2 - 1

Problem Statement:

Determine appropriate size and thickness of armor stone (graded rip rap) layer for rock revetment proposed as bluff cover in shoreline slag area removal action plan (RAP)

Assumptions:

1. design wave height (H) is 3 feet, see reference 1
2. per ASTM C127 specific weight of armor stone (w_r) is at least 162 lb/ft^3
3. stability coefficient (K_{RR}) is 2 2 (unitless), see reference 2
4. specific weight of salt water (w_w) is 64.0 lb/ft^3 see reference 2
5. revetment wall gradient is 1:2 cotθ = 2
6. layer coefficient (k_Δ) is 1.00 (unitless), see reference 2
7. thickness of rip rap is one layer
8. placement of rip rap is random

Find:

1. Required individual armor unit weight (W_{50}) (using Hudson armor unit stability equation reference 2)

Calculation:

$$W_{50} = \frac{w_r H^3}{K_{RR}(w_r/w_w - 1)^3 \cot\theta}$$

Where:

W_{50} = required individual armor unit weight	
w_r = specific weight of armor unit =	162 lb/ft^3
H = design wave height =	3 ft
K_{RR} = stability coefficient =	2 2 (unitless)
w_w = specific weight of salt water =	64 lb/ft^3
cotθ where θ = slope of structure (from the horizontal) =	2

W_{50} = 277 lbs

Stones within the cover layer can range from $4.0W_{50}$ to $0.125W_{50}$ (reference 2) so the acceptable range of stone size is:

W_{max} = 1108 lbs (maximum weight acceptable)

W_{min} = 35 lbs (minimum weight acceptable)

At least 50 percent of the stones should be heavier than W_{50} (reference 2)

CALCULATION SHEET

IT CORPORATION
Member of The IT Group

Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Armor Stone Sizing (graded rip rap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 10/08/01 *Checked:* *Date:*	*Calculation No.:*	2 - 1

Find:

2. Required armor average layer thickness (r) (using equation 7-123 and 7-124 reference 2)

Calculation:

Equation 7-123

$$r = 2.0(W_{50}/w_r)^{1/3}$$

Where:

r = average thickness of armor stone layer

W_{50} = required individual armor unit weight = 277 lbs

w_r = specific weight of armor unit = 162 lb/ft^3

r= 2.4 ft

Equation 7-124

$$r = 1.25(W_{max}/w_r)^{1/3}$$

Where:

r = average thickness of armor stone layer

w_r = specific weight of armor unit = 162 lb/ft^3

w_{max} = maximum acceptable weight of rip rap = 1108 lbs

r= 2.4 ft

Armor layer thickness should be the greater of the thicknesses generated from equations 7-123 and 7-124 (reference 2)

References:

1. Alcorn, Allen Engineer (Moffat Nichol & Ferver Engineers) San Diego, CA. Personal Interview. 22 Jan 2002
2. US Army Corps of Engineers *Shore Protection Manual, volumes 1 and 2* 1984

CALCULATION SHEET

IT CORPORATION
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Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Underlayer Sizing (graded riprap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 01/23/02 *Checked:* *Date:*	*Calculation No.:*	2 - 2

Problem Statement:

Determine if underlayer rock is needed and if so, appropriate size and thickness of underlayer stone (graded riprap) layer for rock revetment proposed as bluff cover in shoreline slag area removal action plan (RAP)

Assumptions:

1. Weight of 50% size in gradation (W_{50}) of armor stone (graded riprap) is 277 lbs (see Calculation 1 attached)
2. Average dimension of 50% size in gradation (W_{50}) of armor stone (graded riprap) is 15.5 inches (see Calculation 2-3, attached)
3. Size of coarsest 85% of riprap [$D_{85(cover)}$] is 20 inches (see Calculation 2-3, attached)
4. Diameter exceeded by the coarsest 15 percent of soil underlying revetment [$D_{85(under)}$] is 6mm (0 236in) reference 3 (using data from CPT 2)
5. Average dimension of maximum acceptable stone size in gradation (W_{max}) of armor stone (graded riprap) is 24.5 inches (see Calculation 2-3 attached)

Find:

1. Determine whether underlayer is needed for riprap

Calculation:

If $D_{15(cover)} \leq 5D_{85(under)}$ underlayer is not required (reference 1)

Underlayer is needed for riprap because $D_{15(cover)} \geq 5D_{85(under)}$

Find:

2. Required individual understone (underlayer beneath armor stone) unit weight (W_u)

Calculation:

$$W_u = \frac{W_{50}}{20} \quad \text{(reference 2)}$$

Where:

W_{50} = required individual armor unit weight = 276 88 lbs

W_u= 14 lbs

Find:

3. Thickness of underlayer

Calculation:

$$T_u \geq 2*W_{50d} \quad \text{(reference 2)}$$

Where:

W_{50d} = average dimension of W_{50} armor stone = 15 5 inches

$T_u \geq$ 31 inches

CALCULATION SHEET

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Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Underlayer Sizing (graded riprap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 01/23/02 *Checked:* *Date:*	*Calculation No.:*	2 - 2

Find:

4. Check that maximum quarrystone weight will fit into the minimum underlayer thickness (T_u)

Calculation:

$T_u \geq W_{maxd}$ (reference 2)

Where:

T_u = 31 inches

W_{maxd} = 24 5 inches

Maximum quarrystone weight will fit into the minimum underlayer thickness

Find:

5. Underlayer thickness for graded riprap should be >1 25 times the dimension of W_{max} (W_{maxd}). reference 2

Calculation:

$T_u > 1.25W_{maxd}$ (reference 2)

Where:

T_u = 31 inches

W_{maxd} = 24 5 inches

Underlayer will accommodate full range of gradation with adequate thickness for stone under maximum weight armor

References:

1. US Army Corps of Engineers *Shore Protection Manual, volumes 1 and 2*. 1984.
2. US Army Engineer Waterways Experiment Station. Coastal Engineering Research Center. 1985. "Riprap Revetment Design." CETN-III-1 Vicksburg, MI.
3. IT Corporation. *IR Site 10 Shoreline Slag Area - Engineering Estimate and Cost Analysis (EE/CA)*. November. 2001

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CALCULATION SHEET

Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Dimension Calculation (riprap)	*WBS Code:*	33010395
Prepared By: HAB	*Date:* 01/23/02 *Checked:*	*Date:*	*Calculation No.:* 2 - 3

Problem Statement:

Convert mass of riprap into size of riprap and determine diameter exceeded by the coarsest 85 percent of the riprap [$D_{15(cover)}$]

Assumptions:

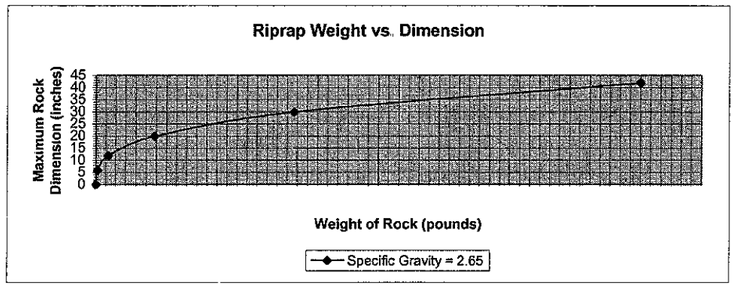
1 Specific gravity of stone is 2 65
2 Average of Cube and Sphere data used to plot stone sizing curve (reference 1)
3 Size of riprap is R-700, per ASTM Standard referenced In reference 1 below
4. Weight of maximum acceptable stone size in gradation (W_{max}) of armor stone (graded riprap) is 1108 lbs (see Calculation 1, attached)
5. Weight of minimum acceptable stone size in gradation (W_{min}) of armor stone (graded riprap) is 35 lbs (see Calculation 1, attached)
6 Weight of 50% size in gradation (W_{50}) of armor stone (graded riprap) is 277 lbs (see Calculation 1 attached)

Find:

1 Graph relating riprap weight to riprap size

Calculation:

Max Dimension (in)	Weight of riprap (pounds)
42	5401
30	1968
20	583
12	126
6	16
0	0



nd:

Dimension of the coarsest 85% of riprap [($D_{85(cover)}$]

Calculation:

Using Figure 1 (Gradation limits for Riprap R-700) in reference 1

$D_{85(cover)}$ = 600lbs

Using Graph above

$D_{85(cover)}$ = 20 inches

Find:

3 Dimension of W_{max}

Calculation:

Using Graph above

W_{max} = 24 5 inches

Find:

4 Dimension of W_{min}

Calculation:

Using Graph above

W_{min} = 7 5 inches

Find:

5 Dimension of W_{50}

Calculation:

Using Graph above

W_{50} = 15 5 inches

References:

1 American Standard for Testing of Materials (ASTM) Standard D6092-97[E1] 'Standard Practice for Specifying Standard Sizes of Stone for Erosion Control'

CALCULATION SHEET

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Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Toe Protection (graded rip rap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 01/23/02 *Checked:* *Date:*	*Calculation No.:*	2 - 4

Problem Statement:

Determine appropriate depth of toe protection

Assumptions:

1. design wave height (H) is 3 feet, see reference 1
2. per ASTM C127 specific weight of armor stone (w_r) is at least 162 lb/ft^3
3. gradation of armor stone used for revetment toe is same as that of armor stone layer above grade on bluff cover portion of revetment
4. site has low-to-moderate scour potential
5. revetment wall gradient is 1:2

Find:

1. Required vertical depth (a) of toe below ground surface at bottom of bluff

Calculation:

$$H \leq a \leq 1.5H$$

(reference 2)

Where:

H = design wave height = 3 ft

Depth of toe (a) must be between 3ft and 4.5ft below ground surface at the bottom of the revetment

and:

2. Toe configuration (see design II of figure 2-4 in reference 2 for schematic)

Calculation:

If depth of toe is 4 feet vertical depth and angle of revetment slope is 26.6 deg from horizontal, then

horizontal area impacted by toe of revetment (x) is:

$$\tan(63.4\text{deg}) = x/4'$$
$$x = 8 \text{ ft}$$

and length (L) of revetment extending from ground surface submerged to a depth of 4 feet at the endpoint is:

$$L^2 = a^2 + x^2$$
$$L = 9 \text{ ft}$$

per reference 2, thickness of toe section (armor layer and underlayer) should be twice that of revetment wall above on slope

References:

1. Alcorn Allen Engineer (Moffat, Nichol & Ferver Engineers) San Diego CA. Personal Interview. 22 Jan. 2002.
2. US Army Corps of Engineers. *Design of Coastal Revetments, Seawalls, and Bulkheads, Engineer Manual (EM 1110-2-1614)* 1995

CALCULATION SHEET

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Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Toe Protection (graded rip rap)	*WBS Code:*	33010395
Prepared By: HAB	*Date:* 01/23/02 *Checked:* *Date:*	*Calculation No.:*	2 - 5

Problem Statement:

Determine quantity of armor stone and underlayer stone needed

Assumptions:

1. revetment wall is 25 feet in height from submerged toe to top of wall
2. revetment wall is 750 feet long along shoreline bluff
3. thickness of underlayer is 31 inches (see calculation 2 - 2 attached)
4. thickness of armor stone is 24 inches (see calculation 2 - 1 attached)
5. weight of riprap is 3 150 lb/yd^3 (reference 3)

Find:

1. quantity of underlayer stone needed (ft^3)

Calculation:

$q_r = l(w)h$

where

l = 720 ft

w= 25 ft

h= 2 6 ft

q_r= 46440 ft^3

Find:

2. quantity of armor stone needed (ft^3)

Calculation:

$q_r = l(w)h$

where

l = 720 ft

w= 25 ft

h= 2 0 ft

q_r= 36000 ft^3

Find:

3. quantity of underlayer stone needed (lb)

Calculation:

$q_w = q_r(w_r)$

where

w_r = 3160 lb/yd^3

q_w= 5435200 lb

2718 tons

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CALCULATION SHEET

Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Toe Protection (graded rip rap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 01/23/02 *Checked:* *Date:*	*Calculation No.:*	2 - 5

Find:

4. quantity of armor stone needed (lb)

Calculation:

$q_w = q_f(w_r)$

where

$w_r =$ 3160 lb/yd^3

$q_w =$ 4213333 3 lb

2107 tons

References:

1. Alcorn Allen, Engineer (Moffat, Nichol & Ferver Engineers), San Diego, CA. Personal Interview 3 Oct 2001
2. US Army Corps of Engineers *Design of Coastal Revetments, Seawalls, and Bulkheads, Engineer Manual (EM 1110-2-1614)* 1995
3. Church, Horace K. *Excavation Planning Reference Guide.* 1988.

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CALCULATION SHEET

Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Wave Runup (graded rip rap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 03/13/02 *Checked:* *Date:*	*Calculation No.:*	2 - 6

Problem Statement:

Determine the vertical height above the still water level (swl) to which water from an incident wave will run up the face of the revetement

Assumptions:

1. regular (monochromatic) waves
2. shallow-water wave height (H) is 3 feet (reference 1)
3. design wave period (T) is 5 seconds
4. design depth (d_o) at revetment toe (highest tide) is 6 91 feet
5. swl is equal to mean higher high water (MHHW) which is 2 73 feet
6. water depth (d) (bed to SWL) is 2 73 feet
7. impermeable structure/smooth slope (2:1 H:V)

Find:

1. height above swl to which structure must be built to prevent overtopping by design wave (reference 1)

Calculation:

convert shallow water wave height (H) to equivalent deep water value (H_o)

$$d/L_o = (2\pi d)/(gT^2)$$

d = 2.73 ft
g = 32.1 ft/s^2
T = 5 s

d/Lo = 0 0214

CALCULATION SHEET

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Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Wave Runup (graded rip rap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 03/13/02 *Checked:* *Date:*	*Calculation No.:*	2 - 6

from table C_1 Appendix C for d/Lo = 0.0214 H/H_o = 1 205

$H'_o = H/1\ 205$

H = 3 feet

H'_o = 2.49 feet

to determine runup calculate:

H'_o/gT^2

H'_o/gT^2 = 0 0031

and using the depth at the structure toe:

d_s/H'_o

d_s = 6.91 feet

d_s/H'_o = 2 78

Interpolating between Figures 7-11 and 7-12 for a 2:1 (H:V) slope produces

Figure 7-11: d_s/H'_o = 2 R/H'_o = 2 85

Figure 7-12: d_s/H'_o > 3 R/H'_o = 2 15

so, for d_s/H'_o = 2 78 ;R/H'_o = 2 31

Runup (R) (uncorrected for scale effects)

$R = H'_o * 2.31$

R = 5.744 feet

Correct for scale effects using scale correction factor (k) from Figure 7-13

$R_{corr} = k*R$

k = 1.136

R_{corr} = 6 53 feet

CALCULATION SHEET

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Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Wave Runup (graded rip rap)	*WBS Code:*	33010395
Prepared By:	HAB *Date:* 03/13/02 *Checked:* *Date:*	*Calculation No.:*	2 - 6

Find:

2. height above swl to which *riprap* structure must be built to prevent overtopping by design wave (reference 1)

Calculation:

find the percent reduction in runup resulting from adding riprap to the 2:1 (H:V) slope

$[R/H'_o]_{smooth} = 2\ 31$

Using Figure 7-19 and the H_o/gT^2 value of 0 0031 obtain R/H'_o value for riprap

$R/H'_o =$ 1 6

The reduction in runup is therefore:

$$\frac{[R/H'_o]_{riprap}}{[R/H'_o]_{smooth}} = \text{runup reduction (rr)}$$

rr = 0 693

Runup on a riprap slope is then:

$R_{riprap} = R_{smooth} \cdot rr$

$R_{riprap} =$ 3 98 feet so revetment must be ~ 4feet (vertical) over MHHW

References:

1 Alcorn, Allen, Engineer (Moffat Nichol & Ferver Engineers), San Diego, CA. Personal Interview 3 Oct 2001

1 US Army Corps of Engineers. *Shore Protection Manual, volumes 1 and 2* 1984.

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CALCULATION SHEET

Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Rock Revetment Design - Filter Fabric Selection (graded rip rap)	*WBS Code:*	33010395
Prepared By: HAB	*Date:* 03/25/02 *Checked:* *Date:*	*Calculation No.:*	2 - 7

Problem Statement:

Determine appropriate filter cloth to underly rock revetment

Assumptions:

1 Diameter exceeded by the coarsest 15 percent of soil underlying revetment $[D_{85(under)}]$ is 6mm (0 236in) reference 1 (using data from CPT 2)
2 Equivalent opening size (EOS) is 70 (212 µm)

Find:

1. whether EOS of 70 will be adequate (reference 2)

Calculation:

$$\text{EOS sieve}/d_{85\ soil} \leq 1$$

EOS = 212 µm
$d_{85\ soil}$ = 6 mm

0 0035333 ≤ 1 therefore EOS of 70 will be adequate

References:

1 IT Corporation *IR Site 10 Shoreline Slag Area - Engineering Estimate and Cost Analysis (EE/CA)* November 2001
2 US Army Corps of Engineers *Design of Coastal Revetments, Seawalls, and Bulkheads, Engineer Manual (EM 1110-2-1614)* 1995

APPENDIX K
MONOFILL ET COVER PROFILE THICKNESS CALCULATION

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Sheet 1 of ____

Project:	NAS North Island IR Site 10 - CTO 28				
Project Number:	818724	*WBS Code:*	33010395	*Date:*	January-02

Calculation Cover Sheet

Calculation Title:	IR Site 10 Soil Cover Depth	*Number:*	1

Description:

Estimate appropriate depth of soil cover to maximize evapotranspiration of surface water which infiltrates cover

References:

see attached sheets

Remarks:

Calculated by: Holly Bo[illegible] — *Signature* — 7/8/02 *Date*

Checked by: Richard N. Morris — *Signature* — 7/8/02 *Date*

Approved by: Richard J. Wong — *Signature* — 7.8.02 *Date*

Revisions

	Revised:	*Checked:*	*Approved:*
	Date:	*Date:*	*Date:*
	Revised:	*Checked:*	*Approved:*
	Date:	*Date:*	*Date:*
	Revised:	*Checked:*	*Approved:*
	Date:	*Date:*	*Date:*

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CALCULATION SHEET

Sheet 1 of 1

Project Title:	IR Site 10 - Shoreline Slag Area	*Project No.:*	818724
Description:	Soil Cover Depth Approximation	*WBS Code:*	33010395
Prepared By: HAB	*Date:* 01/30/02 *Checked:*	*Date:*	*Calculation No.:* 1 - 1

Problem Statement:

Roughly approximate the appropriate thickness of the soil cover so it functions similar to an evapotranspiration cover

Given:

1. Soil is medium-textured loam
2. Effective storage capacity of soil is 15% by volume (150 mm/meter soil) (reference 1)
3. Maximum historical monthly precipitation is 9 26 inches (reference 2) which occurred in December 1921

Find:

1 Cover soil profile depth, C
2.

Calculation:

s = storage capacity = 150 mm/meter soil

m = maximum historical monthly precipitation = 9 26 inches = 235 20 mm

C = m/s

C = 1.57 meters = 5 14 feet

References:

1. Anderson, Jay E *Soil-Plant Cover Systems for Final Closure of Solid Waste Landfills in Arid Regions* Idaho State University, Pocatello Idaho.
2. http://wrcl sage dri edu/cgi-bin/cliMAIN pi?casand

APPENDIX L
RESPONSE TO COMMENTS

Reserved for future regulatory and public comments.