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Final

Preliminary Assessment/Site Inspection Report 12 Consent Order Sites and 8 PI/PAOC Sites

Former Vieques Naval Training Range
Vieques, Puerto Rico

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Acronyms and Abbreviations

amsl	above mean sea level
AOC	Area of Concern
AST	aboveground fuel storage tank
AVGAS	aviation gasoline
bls	below land surface
BTEX	benzene, ethylbenzene, toluene, and xylenes
CCP	Comprehensive Conservation Plan
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
CLEAN	Comprehensive Long-term Environmental Action—Navy
cm	centimeter
COPC	constituent of potential concern
CSM	conceptual site model
DAF	dilution attenuation factor
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DO	dissolved oxygen
DoD	Department of Defense
DOI	Department of the Interior
DRO	diesel range organics
EBS	Environmental Baseline Survey
ECA	Eastern Conservation Area
ELCR	excess lifetime cancer risk
EM	electromagnetic
EMA	Eastern Maneuver Area
EPA	United States Environmental Protection Agency
EPC	exposure point concentration
ESA	ecological screening evaluation
FID	flame ionization detector
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
ft	foot or feet
ft^2	square feet
gpd	gallons per day
gpm	gallons per minute
GPS	global positioning system
GRO	Gasoline Range Organics

HHRA	Human Health Risk Assessment
HQ	hazard quotient
IAS	Initial Assessment Study
IDW	investigation-derived waste
IR	Installation Restoration
LAW	light anti-craft weapon
LCS	Laboratory Confirmation Sample
lf	linear feet
LIA	Live Impact Area
µg/kg	micrograms per kilogram
MCL	maximum contaminant level
MEC	munitions and explosives of concern
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mm	millimeter
MOGAS	unleaded gasoline
MOU	Memorandum of Understanding
MRL	minimal risk level
NAPR	Naval Activity Puerto Rico
NASD	Naval Ammunition Support Detachment
NCEA	National Center for Environmental Assessment
NFA	no further action
NGVD	National Geodectic Vertical Datum of 1929
NPL	National Priorities List
NSRR	Naval Station Roosevelt Roads
OB/OD	open burning/open detonation
OP	observation post
ORO	oil range organics
OVA	organic vapor analyzer
OVM	organic vapor meter
PA	Preliminary Assessment
PA/SI	Preliminary Assessment/Site Inspection
PAOC	potential area of concern
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
pg	pictogram
PID	Photoionization detector
POL	petroleum, oil, and lubricant
ppt	parts per trillion
PR	Preliminary Review
PRASA	Puerto Rico Aqueduct and Sewer Authority
PREQB	Puerto Rico Environmental Quality Board
PRG	preliminary remediation goal

PVC	polyvinyl chloride
QA/QC	quality assurance/quality control
QAPP	Quality Assurance Project Plan
RCRA	Resource Conservation and Recovery Act
RFA	RCRA Facility Assessment
RFI	RCRA Facility Investigation
RI	Remedial Investigation
RTK	Real-Time Kinematic
SIA	Surface Impact Area
SOP	standard operating procedures
SSL	soil screening level
SVOC	semivolatile organic compound
SWMU	Solid Waste Management Unit
TCDD	2,3,7,8-tetrachlorodibenzo-*p*-dioxin
TCLP	toxicity characteristic leaching procedure
TCE	trichloroethene
TEQ	toxicity equivalence
TOC	top of casing
TPH	total petroleum hydrocarbon
USCS	Unified Soil Classification System
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UST	underground storage tank
UTL	upper tolerance limits
UTM	universal transverse mercator
UXO	unexploded ordnance
VNTR	Vieques Naval Training Range
VOC	volatile organic compound
VSI	Visual Site Inspection
WGS84	World Grid System of 1984

Executive Summary

This report summarizes the results, evaluation, conclusions, and recommendations of the Preliminary Assessment/Site Inspection (PA/SI) conducted for 20 sites within the former Vieques Naval Training Range (VNTR). Each of the 20 sites is shown in Figure ES-1. The 20 sites comprise 12 sites identified in the Resource Conservation and Recovery Act (RCRA) Consent Order (issued in January 2000), two photo-identified (PI) sites, and six potential areas of concern (PAOCs). The two PI sites and six PAOC sites were among a number of additional sites identified through historical records review in support of the Phase I RCRA Facility Investigation (RFI) conducted in accordance with the Consent Order.

The data compiled for the 12 Consent Order sites were gathered during field events conducted in 2000, 2002, 2003, and 2004, as documented in the *Final Site-Specific Work Plan for the Atlantic Fleet Weapons Training Facility, Vieques Island, Puerto Rico* (CH2M HILL, 2003b). The data compiled for the two PI sites and six PAOC sites were gathered during field events conducted in 2005 and 2006, as documented in the *Final Preliminary Assessment/Site Inspection Work Plan for Eight PI/PAOC Sites, Former Vieques Naval Training Range (VNTR), Vieques Island, Puerto Rico* (CH2M HILL, 2006). These various data gathering investigations are collectively referred to as the PA/SI for the 20 sites because in March 2005, Vieques was placed on the National Priorities List (NPL), which required all subsequent environmental restoration activities for Navy Installation Restoration (IR) sites on Vieques to be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unless and until removed from CERCLA authority.

Although "PA/SI" is CERCLA terminology and "Phase I RFI" is RCRA terminology, the objective of each is essentially the same, which is "release assessment." More specifically, stated in accordance with the appropriate CERCLA authority, the objectives of this PA/SI were to:

- To determine whether a release of hazardous waste or hazardous constituents has occurred at each of the 12 Consent Order sites and 8 PI/PAOC sites from past CERCLA-related activities at the sites.
- To determine whether a suspected release warrants further action for those sites where a release attributed to CERCLA-related activities is suspected (based on historical information, constituent-specific information, comparison of the detected concentrations to background levels and screening values, and, where warranted, evaluation of the screening value exceedances).

A "CERCLA-related release" is a release of hazardous substances, pollutants, and contaminants eligible for CERCLA response as defined in CERCLA Sections 101(14) and 101(33). In other words, a "CERCLA-related release" is where past site-specific activities resulted in spilling, leaking, disposing, or similar discharging of hazardous substances, pollutants, or contaminants that are subject to CERCLA regulation into the environment.

To determine whether a CERCLA-related release occurred at each of the 20 sites and whether any release warrants further action, samples of environmental media (primarily soil and, where warranted, groundwater) were collected for evaluation. The data were evaluated via the 6-step decision analysis process displayed in Figure ES-2. The figure shows that the first evaluation of the data collected is the "release assessment" (i.e., Step 2). That is, where inorganics above background or where any other constituents (i.e., non-inorganics) were detected, a potential release is suspected. It is important to note that identifying a "suspected release" does not necessarily mean a CERCLA-related release occurred. Nor does it mean that even if a release occurred that the release warrants further action. Additional evaluation, such as historical site information consideration and comparison of site-specific data to regulatory screening criteria, is then used to refine the understanding of the "suspected release." This additional evaluation is the subject of the remaining decision analysis steps. These remaining steps consider such information as CERCLA-eligibility of the constituents identified; presence of exposure pathways; and conservative and, where warranted, more realistic risk-based and other screening values published by regulatory agencies. The additional evaluation also includes a holistic consideration of site-specific information (e.g., historical information, media data, etc.) to make a determination of whether the potential source area at each site was sufficiently characterized.

The outcome of the 6-step decision analysis process is a conclusion of whether a CERCLA-related release likely occurred and, if so, whether the suspected release warrants further action. If no CERCLA-related release is suspected, or if the data suggest a release does not warrant further action, then preparation of a no further action decision document is recommended. If a CERCLA-related release is suspected that warrants further action, recommendation for the further action is made. Potential further action based on the 6-step decision analysis includes additional data collection via an expanded SI or limited removal of the contaminated media and evaluation of resulting site conditions.

For each of the 20 sites included in this PA/SI, the site history; data collection activities; results of the data evaluation, including the 6-step decision analysis; and recommendations are summarized in Table ES-1. As shown in the table, the following is recommended for each of the sites:

Expanded SI

- SWMU 1
- SWMU 2
- SWMU 6/7
- SWMU 10
- AOC G
- PI-4
- PAOC L

Contaminated Soil Removal and Confirmatory Soil Sampling

- AOC A

Drum Removal and Confirmatory Soil Sampling

- PI-7

No Further Action (Preparation of a No Further Action Decision Document)

- SWMU 4 (pending evaluation of regional groundwater data)
- SWMU 5
- SWMU 8
- SWMU 12
- AOC F
- PAOC J (pending evaluation of regional groundwater data)
- PAOC K (pending evaluation of regional groundwater data)
- PAOC N (pending confirmation of no underground fuel pipeline to PAOC S)
- PAOC S (pending confirmation of no underground fuel pipeline from PAOC N)
- PAOC U

Resumen Ejecutivo

Este reporte presenta los resultados, evaluaciones, conclusiones y recomendaciones de la Evaluación Preliminar/Inspección del Sitio (PA/SI, por sus siglas en inglés) realizadas para 20 sitios dentro del Antiguo Campo de Entrenamiento Naval de Vieques (VNTR, por sus siglas en inglés). Cada uno de los 20 sitios se muestra en la Figura ES-1. Los 20 sitios abarcando los 12 sitios identificados bajo la Orden de Consentimiento de la Ley de Conservación y Recuperación de Recursos (RCRA, por sus siglas en inglés) (emitida en enero 2000), dos sitios identificados con fotografías (PI, por sus siglas en inglés), y seis áreas de preocupación potenciales (PAOC, por sus siglas en inglés). Los dos sitios identificados con fotografías y los seis sitios PAOC se encontraban entre un número de sitios adicionales identificados a través de la revisión de archivos históricos en apoyo a la Investigación de Facilidades (RFI, por sus siglas en inglés) RCRA Fase I realizada de acuerdo con la Orden de Consentimiento.

Los datos recopilados para los 12 sitios de la Orden de Consentimiento se obtuvieron durante los eventos de campo llevados a cabo en el 2000, 2002, 2003, y 2004, según documentado en el "*Final Site-Specific Work Plan for the Atlantic Fleet Weapons Training Facility, Vieques Island, Puerto Rico*" (CH2M HILL, 2003b). Los datos recopilados para los dos sitios PI y seis sitios PAOC fueron obtenidos durante los eventos de campo llevados a cabo en el 2005 y 2006, según documentado en el "*Final Preliminary Assessment/Site Inspection Work Plan for Eight PI/PAOC Sites, Former Vieques Naval Training Range (VNTR), Vieques Island, Puerto Rico*" (CH2M HILL, 2006). Estos datos variados obtenidos durante las investigaciones se mencionan colectivamente como PA/SI para los 20 sitios debido a que en marzo del 2005, Vieques fue colocado en la Lista de Prioridades Nacionales (NPL, por sus siglas en inglés), lo cual requiere que todas las actividades subsecuentes de restauración ambiental para los sitios de Restauración de Instalaciones (IR, por sus siglas en inglés) en Vieques sean llevadas a cabo bajo la Ley de Respuesta Ambiental, Responsabilidad y Compensación Comprensiva (CERCLA, por sus siglas en inglés) a menos que, y hasta que sean removidos de la autoridad de CERCLA.

Aun cuando "PA/SI" es terminología de CERCLA y "RFI Fase I" es terminología RCRA, el objetivo de cada una es esencialmente el mismo: "evaluación de escapes." Más específicamente, declarado de acuerdo con la autoridad adecuada CERCLA, los objetivos de éste fueron:

- Para determinar si un escape de residuos peligrosos o componentes peligrosos ocurrieron en cada uno de los 12 sitios de la Orden de Consentimiento y 8 sitios PI/PAOC relacionadas a actividades pasadas en estos sitios CERCLA.

Note: This summary is presented in English and Spanish for the convenience of the reader. Every effort has been made for the translations to be as accurate as reasonably possible. However, readers should be aware that the English version of the text is the official version.

Nota: Este resumen se presenta en inglés y en español para la conveniencia del lector. Se han hecho todos los esfuerzos para que la traducción sea precisa en lo más razonablemente posible. Sin embargo, los lectores deben estar al tanto que el texto en inglés es la versión oficial.

- Para determinar si un escape sospechoso requiere acción adicional para aquellos sitios donde se sospecha de un escape atribuible a actividades relacionadas a CERCLA (en base a información histórica, información específica de componentes, comparación de concentraciones detectadas a niveles de trasfondo y valores de clasificación y donde justificado, evaluación de excedentes de clasificación.

Un "escape relacionado a CERCLA" es un escape de sustancias peligrosas, y contaminantes elegibles para respuestas CERCLA según se define en las Secciones CERCLA 101(14) y 101(33). En otras palabras, un "escape relacionado a CERCLA" es donde actividades pasadas en un sitio específico resultaron en derrames, filtraciones, desechos , o descargas de sustancias peligrosas similares o contaminantes sujetos a las regulaciones ambientales de CERCLA.

Para determinar si un escape relacionado a CERCLA ocurrió en cada uno de estos 20 sitios y si algún escape justifica mas acción, se recolectaron para evaluación muestras del medio ambiental (primariamente suelos, y donde se justifique, aguas subterráneas). Los datos fueron evaluados a través del proceso de análisis de decisión de seis pasos mostrados en la Figura ES-2. La figura muestra que la primera evaluación de los datos recolectados es la "evaluación de escape" (ej., Paso 2). Esto es, donde inorgánicos sobre el trasfondo o donde cualquier otro componente (ej., no - inorgánicos) fueron detectados, se sospecha de un escape potencial. Es importante notar que identificar una "sospecha de escape" no significa necesariamente que ocurrió un escape relacionado a CERCLA. Tampoco significa que aun si hubiese ocurrido un escape, el escape justifique más acción. Evaluaciones adicionales, tales como consideración de información histórica del sitio y comparaciones de datos específicos del sitio a los criterios de clasificación reguladora son utilizadas para refinar el entendimiento de las "sospechas de escape." Esta evaluación adicional es el tema de los pasos restantes del análisis de decisión. Esos pasos restantes consideran información tales como elegibilidad de los componentes de CERCLA identificados; presencia de vías de exposición; y conservadores, donde se justifique, otros valores de clasificación basados en riesgo más realistas publicados por las agencias reguladoras. La evaluación adicional también incluye una consideración integral de la información de un sitio específico (por ejemplo., información histórica, datos del medio, etc.) para tomar una determinación sobre si la posible fuente del área fue suficientemente caracterizada en cada sitio.

El resultado del proceso de análisis de decisión de seis pasos es una conclusión de si un escape relacionado a CERCLA probablemente haya ocurrido y, de ser así, si el escape sospechoso justifica acción adicional. Si no se sospecha de un escape relacionado a CERCLA, o si los datos sugieren que el escape no justifica acción adicional, entonces se recomienda la preparación de un documento de ninguna acción adicional. Si se sospecha de un escape relacionado a CERCLA que justifique acción adicional, se hace una recomendación para acción adicional. Una acción posible y adicional basada en el proceso de análisis de decisión de seis pasos incluye recolección de datos adicionales a través de un SI extendido ampliado o remoción limitada de los medios contaminados y una evaluación de las condiciones permanecientes en el sitio.

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En la Tabla ES-1 se resumen para cada uno de los 20 sitios incluidos en este PA/SI, la historia del sitio; actividades de recolección de datos, resultados de la evaluación de datos, incluyendo los seis pasos de análisis de decisión; y recomendaciones. Según se muestra en la tabla, se recomienda lo siguiente para cada uno de estos sitios:

SI Extendido

- SWMU 1
- SWMU 2
- SWMU 6/7
- SWMU 10
- AOC G
- PI-4
- PAOC L

Remoción de Suelos Contaminados y Muestras de Suelos Confirmadas

- AOC A

Remoción de Envases y Muestras de Suelos Confirmadas

- PI-7

Ninguna Acción Adicional (Preparación de un Documento de Ninguna Acción Adicional)

- SWMU 4 (evaluación pendiente de datos de aguas subterráneas regionales)
- SWMU 5
- SWMU 8
- SWMU 12
- AOC F
- PAOC J (evaluación pendiente de datos de aguas subterráneas regionales)
- PAOC K (evaluación pendiente de datos de aguas subterráneas regionales)
- PAOC N (confirmación pendiente de ninguna tubería de combustible subterránea hacia PAOC S)
- PAOC S (confirmación pendiente de ninguna tubería de combustible subterránea proveniente de PAOC N)
- PAOC U

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TABLE ES-1
Summary of Conclusions and Recommendations
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

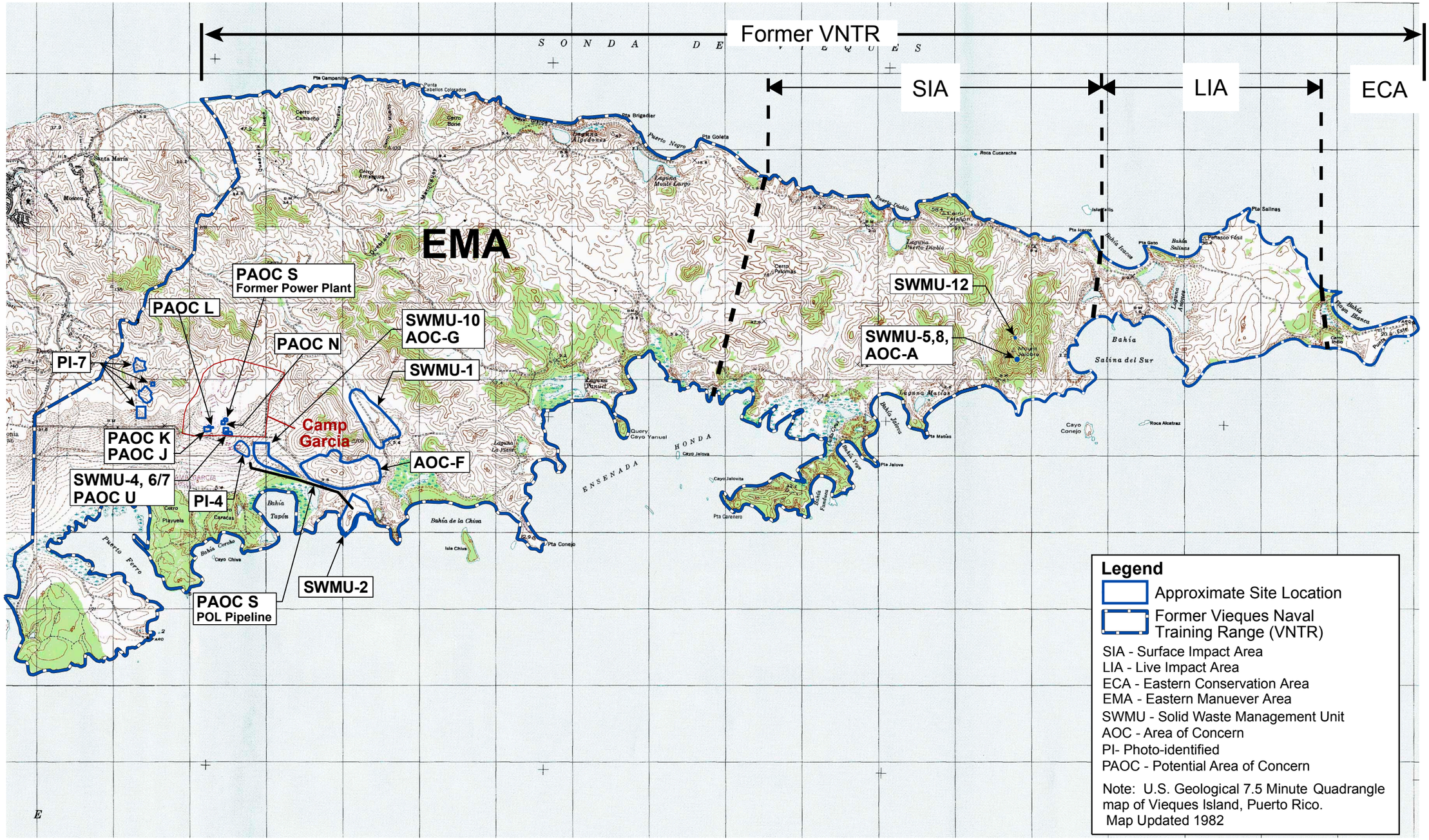
Site Name	Site Description	Site History	Potential Source(s)	Potential Release Mechanism(s)	Site-specific Data Collected	Results of 7-step Decision Analysis	Conclusions	Recommendations
SWMU 1	Camp Garcia Landfill	Unlined landfill reportedly used for trench disposal of municipal (non-hazardous) waste from 1954 to 1978	Buried waste	Leaching of constituents from waste into soil, groundwater, and/or ephemeral stream	Geophysical survey of landfill extent; 50 surface soil samples of landfill cover material; 4 downgradient monitoring wells; 1 upgradient (background) monitoring well	Data do not indicate a release has occurred to surface soil or groundwater; however, potential source area not sufficiently characterized.	Uncertainty regarding landfill boundary, nature of landfilled material, and condition of subsurface soil, groundwater, and ephemeral stream warrants additional evaluation.	1. Perform additional geophysics to complete landfill boundary delineation. 2. Excavate 20 test pits to characterize the waste. 3. Collect soil samples within and immediately below the waste in each pit to determine if releases to soil have occurred. 4. Install 4 monitoring wells to characterize groundwater within landfill boundary. 5. Resample existing wells to confirm previous findings. 6. Collect 4 ephemeral stream samples to determine if releases to ephemeral stream have occurred.
SWMU 2	Fuels Off-loading	Fuel offloaded from barges, pumped to series of above-ground storage tanks (ASTs)	Fuel transfer operations and ASTs	Leaks or spills to ground surface	8 surface soil samples and 2 subsurface soil samples around fuel offloading area and in vicinity of some tanks	Data suggest potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk; however, potential source area not sufficiently characterized.	Spatial coverage of existing samples is not adequate to conclude no further action. Samples collected around four of eight historical tank locations.	Use slide hammer to collect surface soil and subsurface soil samples at all eight historical tank locations, the fuel offloading area and the former fuel transfer pipeline (if its location can be acertained) and screen visually and with vapor monitor. If residual soil contamination is observed (visually or with a PID) during the soil borings, the need for and location of wells will be discussed with the regulatory agencies and installed during the mobilization.
SWMU 4	Bldg. 303 Waste Areas	Storage sheds for spent batteries, waste rags, absorbent material, and grease; catch basin for hydraulic oil and cleaning/degreasing	Materials stored in sheds; catch basin	Leaks or spills to ground surface	12 surface soil samples and 1 subsurface soil sample around all potential source areas	Data suggest potential source area was sufficiently characterized.	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending evaluation of regional groundwater data to ensure no release attributable to SWMU 4
SWMU 5	Spent Battery Accumulation Area	Area where spent batteries and battery acid at OP-1 were temporarily staged	Batteries and battery acid	Leaks to ground surface or concrete surface with runoff to ground surface	4 surface soil samples adjacent to concrete pad in area where battery staging was done	Data suggest potential source area was sufficiently characterized.	Release has not occurred or potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document
SWMU 6/7	Waste Oil and Paint Accumulation Areas	Concrete pad and caged area used to stage waste oil in 55-gallon drums and paint in small containers	Drums and small containers of waste oil and paint	Leaks or spills to concrete surface; runoff to ground surface	10 surface soil samples around entire perimeter of concrete pad	Data suggest potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk; however, potential source area not sufficiently characterized.	Due to the nature of VOCs, which were detected in surface soil, subsurface soil sampling is warranted. In addition, 7 years have elapsed since sampling, so re-evaluation of VOCs in surface soil is warranted.	Collect 10 co-located surface soil and subsurface soil samples to confirm previous results (surface soil) and characterize subsurface soil.
SWMU 8	Waste Oil Accumulation Area	Area where waste lubricants and oil at OP-1 were temporarily staged	Drums of waste lubricants and oil	Leaks or spills to ground surface or concrete surface with runoff to ground surface	5 surface soil samples adjacent to concrete pad in area where drum staging was done	Data suggest potential source area was sufficiently characterized.	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document
SWMU 10	Sewage Treatment Lagoons	Four historically unlined lagoons for Camp Garcia sanitary sewage treatment from 1950s to 2000 (lined in 1974); treated effluent discharged to land and/or sea until 1974; no discharge after 1974	Sewage treatment lagoons	Discharge to ground surface; leaching from lagoons into soil and/or groundwater	20 co-located surface soil and subsurface soil samples within lagoons; 5 monitoring wells (4 within and 1 outside lagoons)	Data suggest potential source area was sufficiently characterized and that constituent levels (other than thallium) do not pose unacceptable human health or ecological risk.	Uncertainty in thallium concentrations in soil and groundwater that warrants confirmation sampling.	Collect 2 co-located surface soil and subsurface soil samples in each lagoon (8 co-located sample locations total) and resample existing monitoring wells to re-assess thallium concentrations.
SWMU 12	Solid Waste Collection Area	Area where domestic solid waste (i.e., trash) from OP-1 were temporarily staged	Staged domestic solid waste (trash)	Leaks or spills to ground surface	5 surface soil samples within staging area	Data suggest potential source area was sufficiently characterized.	Material was domestic, staged in containers, and no evidence of release.	No further action; prepare no further action decision document
AOC A	Diesel Fuel Fill Pipe Area	15,000-gallon diesel fuel underground storage tank (UST) at OP-1; first one removed in 1997; second removed in 2003	UST and associated piping	Leaks or spills to ground surface and to subsurface soil	10 confirmatory subsurface soil samples around and beneath UST and associated piping following removal	Data suggest potential source area was sufficiently characterized, but TPH levels in soil below removed piping above PREQB corrective action criterion.	Additional soil removal is warranted to reduce TPH levels to below corrective action criterion.	Perform additional soil excavation beneath former piping and collect confirmatory soil samples.

TABLE ES-1
Summary of Conclusions and Recommendations
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site Name	Site Description	Site History	Potential Source(s)	Potential Release Mechanism(s)	Site-specific Data Collected	Results of 7-step Decision Analysis	Conclusions	Recommendations
AOC F	Rock Quarry	Source of gravel for road construction and other projects	None likely; trash observed in one area of quarry during 1995 site visit	None likely; leaking from trash to ground surface assumed for purposes of evaluation	5 surface soil samples around area where trash was observed; 42 composite crushed rock samples from quarried material	Data suggest potential source area was sufficiently characterized.	No release likely occurred.	No further action; prepare no further action decision document
AOC G	Pump Station and Chlorination Building	Building used for chlorination and pumping of sewage being treated in lagoons (SWMU 10)	Chlorine contact chamber; piping	Spills or leaks from chlorine contact chamber and/or associated piping to ground surface; spills or other discharge of pump maintenance fluids outside building	5 surface soil samples around building and chlorine contact chamber	Data suggest potential source area associated with SWMU 10 wastewater management was sufficiently characterized; potential source area associated with pump maintenance fluids not characterized.	No release associated with wastewater likely occurred or any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	Collect two co-located surface/subsurface soil samples adjacent to building door to determine if releases of pump maintenance fluids occurred
PI-4	Former Helicopter Maintenance Area, Trenched Area, Disturbed Areas, and Bermed Areas used for Fuel Bladder Storage	Helicopter maintenance area; barracks and mess; trenches that may have been associated with sanitary leach field; bermed area used for fuel bladder storage	Helicopter maintenance activities; unknown activities associated with trenches and disturbed areas; fuel bladders	Spills or leaks to ground surface; release to subsurface soil and/or groundwater from trenches	2 surface soil samples and 2 co-located surface soil and subsurface soil samples within bermed area; 5 co-located surface soil and subsurface soil samples at former helicopter maintenance building; 6 co-located surface soil and subsurface soil samples within the trenched area and nearby disturbed area; 2 co-located surface soil and subsurface soil samples within disturbed area south of helicopter maintenance area; 5 monitoring wells across the site	Data suggest soil within potential source areas was sufficiently characterized; however, groundwater within trenched area not sufficiently characterized.	Low levels of VOCs detected in groundwater, but not in soil warrant additional groundwater characterization to confirm groundwater contamination is not at unacceptable levels.	Collect a synoptic round of water levels to confirm direction of groundwater flow. Based on these findings, install two monitoring wells, one approximately 200 feet upgradient of the well with the single MCL exceedance, and the other approximately 200 feet downgradient of the same well. Collect a round of groundwater samples from the newly installed wells and all existing wells.
PI-7	Former Quarry, Tar Drum Disposal Area, Radar Communication Area	Three physically separate areas - former radar communication facility to the north; defunct rock quarry in the central area; and an area where drums containing tar residues were observed	Former radar communication facilities; drums in quarry and area to the south	Spills or leaks to the ground surface	3 co-located surface soil and subsurface soil samples around debris observed at the former radar communication facility location; 5 co-located surface soil and subsurface soil samples, 6 additional surface soil samples, and 1 monitoring well around drums and debris within the former quarry; 10 co-located surface and subsurface soil samples, 2 additional surface soil samples, and 2 monitoring wells around drums and debris in the tar drum disposal area	Data suggest potential source areas were sufficiently characterized	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk. However, drums may represent a potential future source of contamination.	Remove drums and contaminated soil (if present) and collect confirmatory soil sample(s) beneath the areas of drum and soil removal.
PAOC J	Former Vehicle Maintenance Area	Vehicle maintenance; facility demolished prior to 1980	Vehicle maintenance operations	Spills or leaks to ground surface	6 co-located surface soil and subsurface soil samples across former vehicle maintenance area	Data suggest potential source area was sufficiently sampled	No release likely occurred or any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending evaluation of regional groundwater data to ensure no release attributable to PAOC J
PAOC K	Former Wash Rack	Vehicle washing on a rack; facility demolished prior to 1980	Vehicle washing operations	Runoff of vehicle wash fluids to ground surface	5 co-located surface soil and subsurface soil samples at former wash rack location	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending evaluation of regional groundwater data to ensure no release attributable to PAOC K
PAOC L	Former Paint and Transformer Storage Area	Small, single room concrete block building used for storage of paints and transformers	Containers of paints; transformers	Spills or leaks onto concrete floor and tracked outside; spills or leaks outside building	4 co-located surface soil and subsurface soil samples and 1 monitoring well around building	Data suggest a release of pesticides may have occurred. Subsurface soil sufficiently characterized, but surface soil in potential source area not sufficiently characterized.	Additional soil sampling is warranted to sufficiently characterize the suspected release area. Another groundwater sample is warranted to confirm initial results.	Collect additional surface soil samples to evaluate extent of pesticides in suspected source area. Evaluate the data to determine if limited removal or expanded investigation is warranted. Collect second groundwater sample to confirm initial sample results.

TABLE ES-1
Summary of Conclusions and Recommendations
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

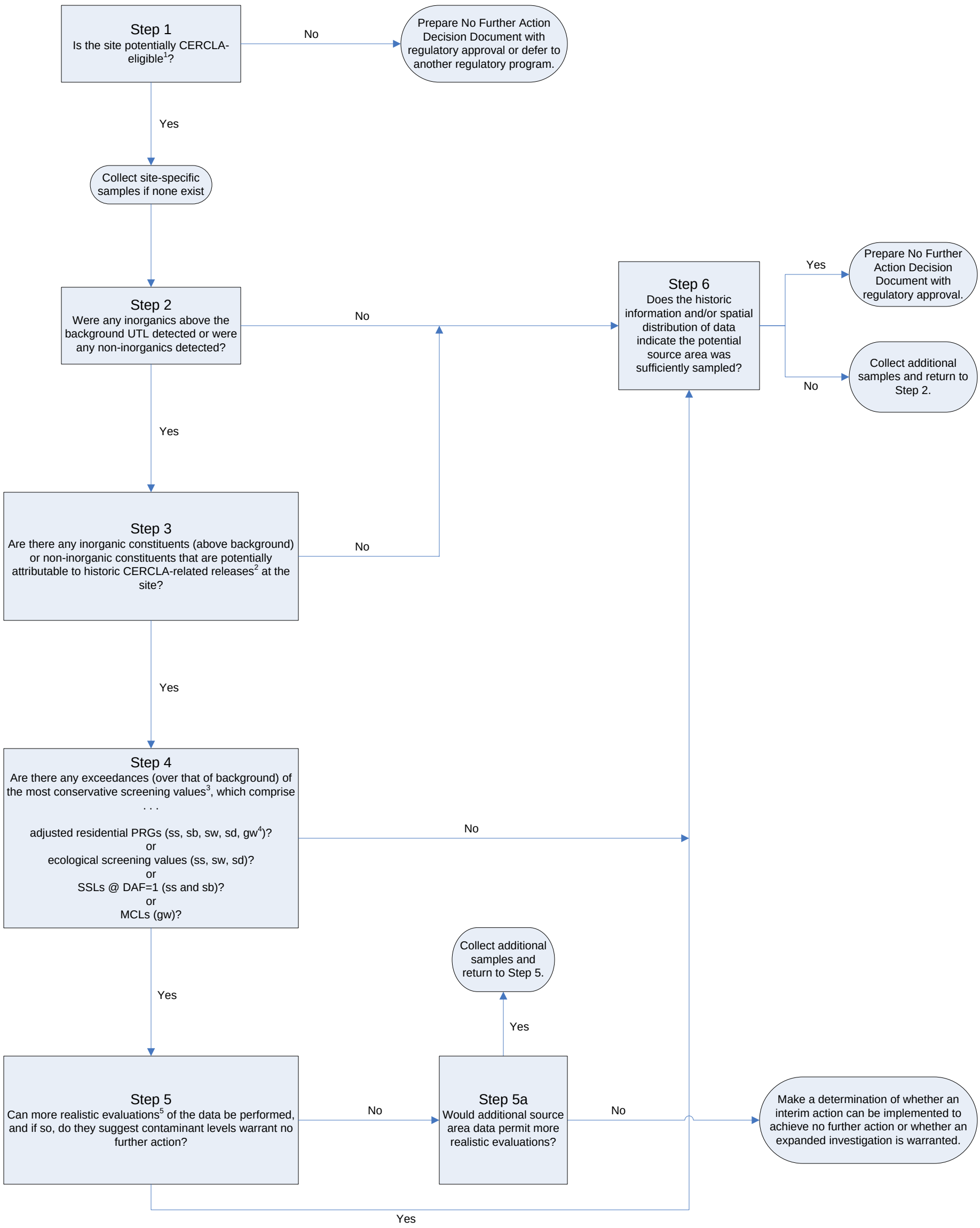
Site Name	Site Description	Site History	Potential Source(s)	Potential Release Mechanism(s)	Site-specific Data Collected	Results of 7-step Decision Analysis	Conclusions	Recommendations
PAOC N	Former Fuel Farm and Filling Station	3 ASTs present from 1985 through 1992; two-compartment AST (gas and diesel) installed in 2000	ASTs	Spills or leaks onto ground surface	3 co-located surface soil and subsurface soil samples around the former ASTs; 1 co-located surface soil and subsurface soil sample and 1 monitoring well at the former fuel building location	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending confirmation no underground pipeline to the PAOC S powerplant exists.
PAOC S	Former POL Pipeline and Power Plant	Two physically separate areas - underground fuel transfer pipeline from SWMU 2 to airfield (removed in 1984); former power plant in Camp Garcia	Former pipeline; power plant operations	Spills or leaks to ground surface; release also to subsurface from pipeline	14 co-located surface soil and subsurface soil samples along former pipeline; 2 surface soil samples between pipeline and saltflat; 5 co-located surface soil and subsurface soil samples and 1 monitoring well at the former power plant location	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending confirmation no underground pipeline from PAOC N exists.
PAOC U	Vehicle Maintenance Area	Vehicle maintenance; public works contractor storage shed; mechanics shop	Vehicle maintenance operations; materials storage	Spills or leaks to ground surface	4 surface soil samples, 9 co-located surface soil and subsurface soil samples, 1 monitoring well across vehicle maintenance area	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document



0 2,500 5,000 10,000 15,000 20,000
Feet

CH2MHILL

Figure ES-1
Former VNTR Site Location Map
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



[1] Determination of CERCLA eligibility is described in Section 1.1

[2] CERCLA-related releases are defined in Section 1.1

[3] For UST sites, PREQB UST Corrective Action Criteria are also included in the evaluation

[4] ss = surface soil; sb = subsurface soil; sw = surface water; sd = sediment; gw = groundwater

[5] Examples of the types of more realistic evaluations that may be performed are described in Section 1.1.2

Figure ES-2
PA/SI Evaluation Decision Tree
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 1

Introduction

This report summarizes the Preliminary Assessment/Site Inspection (PA/SI) conducted for 20 sites within the former Vieques Naval Training Range (VNTR). Twelve of the sites were identified in the Resource Conservation and Recovery Act (RCRA) Consent Order (RCRA-02-99-7301) between the United States (U.S.) Environmental Protection Agency (EPA) and the U.S. Navy (Navy), issued January 20, 2000. The remaining eight sites were photo-identified (PI) or otherwise determined to be a potential area of concern (PAOC). The 8 PI/PAOC sites were recommended for investigation in the *Draft Phase I RCRA Facility Investigation Report, Former Atlantic Fleet Weapons Training Facility, Vieques Island, Puerto Rico* Report (CH2M HILL, 2004), hereafter referred to as the Draft Phase I RFI Report. This PA/SI Report was prepared by CH2M HILL under Navy Contract N62470-02-D-3052, Navy Comprehensive Long-term Environmental Action—Navy (CLEAN III).

In accordance with the Consent Order, a Phase I RCRA Facility Investigation (RFI) at the 12 sites was implemented in January/February 2004 in accordance with the *Master Work Plan for the Atlantic Fleet Weapons Training Facility, Vieques, Puerto Rico* (CH2M HILL, 2003a) and the *Final Site-Specific Work Plan for the Atlantic Fleet Weapons Training Facility, Vieques Island, Puerto Rico* (CH2M HILL, 2003b), hereafter referred to as the Phase I RFI Work Plan, both of which were approved by EPA Region II. The Draft Phase I RFI Report was issued in June 2004. The PA/SI for the 8 PI/PAOC sites was conducted in accordance with the *Final Preliminary Assessment/Site Inspection Work Plan for Eight PI/PAOC Sites, Former Vieques Naval Training Range (VNTR), Vieques Island, Puerto Rico* (CH2M HILL, 2006).

On March 14, 2005, Vieques was placed on the National Priorities List (NPL), which required all subsequent environmental restoration activities for Navy Installation Restoration (IR) sites on Vieques be conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) unless and until removed from CERCLA authority. Because the objectives of a Phase I RFI are generally synonymous with a PA/SI, the Draft Phase I RFI Report is being resubmitted as a Draft PA/SI Report, and the RFI is also referred to as the 2004 PA/SI throughout this report, unless specifically referring to the Draft RFI Report. In addition to conforming to CERCLA terminology, there are several other reasons for resubmitting the report as draft. Because these reasons result in substantial changes made to the Draft Phase I RFI Report, this PA/SI Report represents an entirely new data evaluation and report submittal, not simply an update of the Draft Phase I RFI Report. In addition to the sites now being under CERCLA authority, the major reasons for the new evaluation are:

- Site-specific data have been re-screened against the most up-to-date regulatory screening values, as documented in the Master Quality Assurance Project Plan (QAPP) (CH2M HILL, 2007a), hereafter referred to as the Master QAPP. Since the Master QAPP was submitted, several screening values have been updated, so they have been substituted for the screening values provided in the Master QAPP. Table 1-1 provides a list of the updated screening values used for data screening in this PA/SI Report.

- This PA/SI Report also eliminates the section from the Draft Phase I RFI Report that summarized the historical data assessment and recommendations for all PI/PAOC sites because they were not the focus of the RFI Report. Instead, eight of the PI/PAOC sites recommended for further investigation in the Draft Phase I RFI Report were investigated via a PA/SI, and the results are included in this PA/SI Report.
- When the Draft Phase I RFI Report was submitted, the background soil inorganics investigation had not been conducted, which prevented comparison of site-specific soil inorganic concentrations to those of background soil. The background soil inorganics investigation has since been completed, the results of which are documented in the *Final East Vieques Background Soil Inorganics Investigation Report, Former Vieques Naval Training Range, Vieques Island, Puerto Rico* (CH2M HILL, 2007b). This PA/SI Report therefore includes the background soil inorganics comparison that was not in the Draft Phase I RFI Report. It is noted here that "inorganics" and "metals" are used interchangeably throughout this PA/SI Report, and are identified here as being synonymous.

  It is important to note that the thallium analysis done for the 12 Consent Order sites utilized a method that, although standard at the time, tended to provide falsely elevated results. Conversely, the thallium analysis done for the background soil inorganics investigation and the 8 PI/PAOC sites investigation utilized a newer method that did not have this limitation. Comparison of thallium data collected at the 12 Consent Order sites versus the 8 PI/PAOC sites demonstrates the improvement in the analytical methodology, especially for sites where samples were analyzed for thallium using both methods (i.e., PI-7 and PAOC U). The thallium results from the newer analytical method tend to be lower than those from the older method. This, therefore, is taken into consideration when comparing the thallium data for the 12 Consent Order sites (analyzed using the older method) to the background thallium data (analyzed using the newer method).
- This report also establishes a decision analysis framework by which determinations can be made whether CERCLA-related releases have occurred and whether those releases warrant additional evaluation. This framework is described in Section 1.1.

Figure 1-1 shows the geographic location of Vieques, including the former Naval Ammunition Support Detachment (NASD) and former VNTR, in relation to mainland Puerto Rico and the surrounding islands. The 12 Consent Order sites comprise nine Solid Waste Management Units (SWMUs) and three Areas of Concern (AOCs) located in the Eastern Maneuver Area (EMA) and the Surface Impact Area (SIA), which are subdivisions of the former VNTR. The 8 PI/PAOC sites comprise two PI sites and six PAOC sites, which are all located within the former EMA. The locations of the 12 Consent Order and 8 PI/PAOC sites are shown on Figure 1-2.

The 12 Consent Order sites included in the PA/SI Report are (general location of each site noted in parentheses):

- **SWMU 1—**Camp García Landfill (EMA)
- **SWMU 2—**Fuels Off-loading Site (EMA)

- **SWMU 4—**Waste Areas of Building 303 (Camp García, EMA)
- **SWMU 5—**Spent Battery Accumulation Area (Observation Post [OP]-1, SIA)
- **SWMU 6—**Waste Oil and Paint Accumulation Area (outside Building 303, Camp García, EMA)
- **SWMU 7—**Waste Oil Accumulation Area (outside Building 303, Camp García, EMA)
- **SWMU 8—**Waste Oil Accumulation Area (OP-1, SIA)
- **SWMU 10—**Sewage Treatment Lagoons (EMA)
- **SWMU 12—**Solid Waste Collection Unit Area (OP-1, SIA)
- **AOC A—**Diesel Fuel Fill Pipe Area (OP-1, SIA)
- **AOC F—**Rock Quarry (EMA)
- **AOC G—**Chlorination Building at Sewage Lagoons (EMA)

The 8 PI/PAOC sites included in this PA/SI Report are (general location of each site noted in parentheses):

- **PI 4—**Former helicopter maintenance area, trenched area, and bermed areas used for fuel bladder storage (northeast corner of former runway, EMA)
- **PI 7—**Former quarry, tar drum disposal area, and radar communications area (northwest of Camp Garcia, EMA)
- **PAOC J—**Former vehicle maintenance area (Camp Garcia, EMA)
- **PAOC K—**Former wash rack (Camp Garcia, EMA)
- **PAOC L—**Former paint and transformer storage area (Camp Garcia, EMA)
- **PAOC N—**Former fuel farm and filling station (Camp Garcia, EMA)
- **PAOC S—**Former petroleum, oils, and lubricants (POL) pipeline and power plant (east of former runway and power plant in Camp Garcia, EMA)
- **PAOC U—**Vehicle maintenance area (Camp Garcia, EMA)

Because of the high density of sites around the Camp Garcia area, Figure 1-3 shows the sites located in the EMA at a larger scale.

1.1 Objectives and Decision Analysis of the PA/SI

The following are the objectives of the PA/SI:

- To determine whether a release of hazardous waste or hazardous constituents has occurred at each of the 12 Consent Order sites and 8 PI/PAOC sites from past CERCLA-related activities at the sites

- To determine whether a suspected release warrants further action for those sites where a release attributed to CERCLA-related activities is suspected (based on historical information, constituent-specific information, comparison of the detected concentrations to background levels and screening values, and, where warranted, evaluation of the screening value exceedances)

To achieve the above objectives, a series of evaluations were conducted using the historical information and sample data for each site. The series of evaluations is depicted in the PA/SI decision analysis tree (Figure 1-4). This evaluation process is summarized as follows:

Step 1—Determination of Potential CERCLA Eligibility

In order to have a standard evaluation process for all Vieques sites, the first step in the decision analysis is to determine if a site is potentially CERCLA-eligible. This determination is referred to as the preliminary assessment (PA) and, for Vieques sites, it is made in general accordance with EPA guidance (EPA, 1991, 1999a, 1999b). This guidance lists several criteria that must be met in order for a site to be eligible for evaluation under CERCLA. For Vieques sites, in part because not all sites have existing analytical data, the specific criterion evaluated in this step is:

> *"Do available file information and site reconnaissance confidently rule out the presence of CERCLA hazardous substances at the site?"*
> (EPA, 1991)

Information evaluated in Step 1 includes historical records, aerial photographs, site visit observations, and interview records. Step 1 does not include evaluation of site-specific analytical data, which is performed in Step 2 if the site is determined to be potentially CERCLA eligible.

If the site is determined in this step to be CERCLA-eligible; that is, if it is reasonable to assume CERCLA hazardous substances may have been released at the site, the decision analysis proceeds to Step 2, where site-specific analytical data are evaluated, if available. If no site-specific analytical data have been collected, they are collected before proceeding to Step 2. If the site is determined not to be CERCLA-eligible, then it is proposed for no further action (NFA) (via a NFA decision document) or deferred to another regulatory program, if applicable.

Because the PA performed for the 20 sites included in this PA/SI Report determined that sampling as part of an SI was warranted and those samples were collected, it is assumed that these sites are potentially CERCLA eligible and, thus, their evaluation continues to Step 2. However, it is important to note that even if a site is determined to be potentially CERCLA eligible in Step 1, the site may ultimately be determined not to be CERCLA eligible, based on other EPA guidance criteria. For example, some hazardous substances (e.g., normal application of pesticides) are regulated under a statutory exclusion (EPA, 1991) and are thus not CERCLA-eligible.

Step 2—Release Assessment

The purpose of this step is to determine if there has been a potential CERCLA-related release at a particular site. A "CERCLA-related release" is a release of hazardous substances,

pollutants, and contaminants eligible for CERCLA response as defined in CERCLA Sections 101(14) and 101(33).

A potential release is suspected if any inorganic constituents inconsistent with background concentrations are detected or if any non-inorganic constituents are detected. To help determine whether site-specific inorganic concentrations are inconsistent with background inorganic concentrations, at a minimum, discrete sample concentrations will be compared to the background upper tolerance limits (UTLs) for individual inorganics. It is important to note, however, that the conclusion of whether inorganics concentrations present at a particular site are the result of a release or likely attributable to background may not be based solely on the background UTL comparisons. In fact, including other information in this evaluation may increase the confidence upon which the conclusion is drawn. Given that the ultimate goal is to ensure releases are identified and appropriately addressed, the more information available upon which to make the assessment, the higher the degree of confidence in the assessment. Depending on site-specific circumstances, other information may include a consideration of the magnitude of concentrations exceeding the UTLs as well as conclusions from other statistical comparisons (e.g., quantile, slippage, and central tendency comparisons, which are also referred to as population-to-population comparisons). Comparison of site data to outliers from the background dataset is further discussed at the end of Section 1.1.2. Additional information may also include historical knowledge of constituents potentially released during past site activities. The appropriateness of including such additional information will be made on a site-specific basis and be justified in the associated data evaluation text.

It is important here to emphasize the distinction between the use of background in a "release assessment" versus a "risk assessment." In the PA/SI phase, one of the primary objectives is to determine whether a release has occurred, such that the need for further action can be appropriately assessed. Therefore, it is critical that background be considered upon initial evaluation of site-specific data. In other words, whether a potential release occurred can be determined only if site-specific data are evaluated relative to background (i.e., for inorganics). On the other hand, when a risk assessment is performed, such as during a remedial investigation (RI), a release has already been determined to have occurred and the risk assessment is performed to evaluate the potential risks based on the nature and extent of the contaminant release. In that circumstance, background is considered only after the potential risks posed by all constituents of potential concern (COPCs) are evaluated, in accordance with EPA policy.

It is also important to note that identifying a "suspected release" does not necessarily mean a CERCLA-related release has occurred. Nor does it mean that even if a release has occurred that the release warrants further action. Additional evaluation, such as historical site information consideration and comparison of site-specific data to screening criteria, is used to refine the understanding of the "suspected release." This additional evaluation is the subject of the remaining decision analysis steps, as described below. If a release is not suspected, a determination is made whether the suspected source area was sufficiently sampled (see Step 6 below). If so, preparation of a NFA decision document is recommended; if not, collection of additional samples is recommended.

Step 3—Determination of Whether a Suspected Release is Potentially CERCLA-related

For any inorganic constituent inconsistent with background or for any detected non-inorganic constituent, historical site-specific information, as well as constituent-specific information, is considered to help determine whether the constituent's presence is potentially from a CERCLA-related release. In other words, some constituents may be present because of something other than a CERCLA-related release and are, therefore, not subject to CERCLA regulation. Examples of constituents that may be detected at sites but not be CERCLA-related are discussed in Section 1.1.1. If constituents are detected that are determined not to be CERCLA-related, they may be addressed under other regulatory programs, as applicable.

Step 4—Comparison to Conservative Screening Values

If a CERCLA-related release is suspected, site-specific data (that exceed background) are compared to the most conservative screening values, which comprise (as applicable):

- Adjusted residential PRGs
- Ecological screening values
- Soil screening levels (SSLs) at a dilution attenuation factor (DAF) of 1 (meaning there is no dilution attenuation at all; the concentration at the receptor point is the same as that in the soil leachate)
- Federal Maximum Contaminant Levels (MCLs)

For the PA/SI, it is appropriate to compare only those site-specific concentrations above background to risk-based screening criteria because the objective of the PA/SI is to not only determine whether a CERCLA-related release has occurred, but also to assess if the release warrants further action. Background, therefore, must be considered as part of this process. For the purposes of this PA/SI Report, the background soil inorganics used for comparison are those contained in the *East Vieques Background Soil Inorganics Investigation Report, Former Vieques Naval Training Range, Vieques Island, Puerto Rico* (CH2M HILL, 2007b). Generation of this background dataset and associated comparisons made were consistent with the *Guidance for Comparing Background and Chemical Concentrations in Soil for CERCLA Sites* (EPA, 2002a).

On a site-specific basis, other screening criteria are used for data comparison. For underground storage tank (UST) sites, screening criteria provided in the *Underground Storage Tank Control Regulation* (PREQB, 2002) are used for comparison.

Step 5—Evaluation of Exceedances Using More Realistic Assumptions

For the most conservative screening value exceedances that are likely attributable to an historic CERCLA-related release, an evaluation of the data using more realistic assumptions, if possible, is done. This more realistic evaluation is performed to help ensure appropriate perspective is considered regarding the release such that informed decisions on the need for further action can be made. Examples of more realistic evaluations are described in Section 1.1.2.

If it is not possible to perform more realistic evaluations based on existing data, but additional data may facilitate more realistic evaluations (Step 5a), the additional data collection is proposed and the process returns to Step 5 following their collection. If a more realistic evaluation can be performed, but the results of the more realistic evaluation suggests contaminant levels warrant further action, a determination is made whether an interim action can be implemented to address the contamination or whether an expanded investigation is warranted. While determining the appropriateness of an interim action (versus expanded investigation) will ultimately depend on site-specific conditions, the ultimate goal is to maximize the efficiency and cost-effectiveness of resources in ensuring protectiveness at each site. Factors that may be included in such a determination include type of contamination, media impacted, area of contamination, cost/time of additional investigation versus cost/time of interim action, and logistical considerations of implementing an interim action. For example, if the results of PA/SI sampling and evaluation suggest there is a relatively small area of contamination that may pose an unacceptable risk (based on the screening-level risk evaluation), it may be more efficient and cost effective to invest resources in eliminating the area of contamination potentially posing the risk than in performing more quantitative evaluations and risk assessments. Confirmatory samples can always be collected following the interim action to ensure residual concentrations are acceptable.

Step 6—Evaluation of Historical Site Information and Spatial Distribution

As a final check before exiting the PA/SI decision analysis with a NFA decision document, the historical site information and spatial distribution of constituents and constituent concentrations are evaluated to ensure the potential source area for a CERCLA-related release has been sufficiently characterized. If so, NFA is recommended via a NFA decision document. If not, additional data collection is recommended, after which the process returns to Step 2.

1.1.1 Examples of Potentially Non-CERCLA-related Constituents

Pesticides and Herbicides

In accordance with their intended use, pesticides and herbicides were commonly applied to the soil at Department of Defense (DoD) facilities to control pests and weeds, which may have resulted in pesticides and herbicides accumulating in environmental media. This type of pesticide presence is distinct from pesticide contamination that is the result of a spill, or from improper storage, disposal, or use. A Public Works Technical Bulletin prepared by the U.S. Army Corps of Engineers (USACE) addresses DoD procedures regarding management of pesticide-contaminated soil (USACE, 2004). Although it specifically references chlordane, the process is equally applicable to other pesticides registered under the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA). It states:

> *"Not all chlordane in the environment is required to be remediated under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) or Resource Conservation and Recovery Act (RCRA). The requirements for managing chlordane contaminated soil will depend upon whether it was legally applied or whether it was illegally disposed or 'released' into the environment."*

The memo further states:

> *"Concentrations of chlordane should not be used as the basis for concluding whether a spill occurred. It was DoD practice to periodically reapply pesticide, thus chlordane may have accumulated without being indicative of a spill. The location of chlordane, rather than its concentration, should be used as the basis for determining whether it is reasonably present due to intentional use."*

It also states that "[l]egally applied chlordane is not required to be remediated under either CERCLA . . . " and that:

> *"It is not appropriate to undertake a CERCLA response for legally applied chlordane. This is because courts have found that normal application of pesticide does not constitute a release or disposal under CERCLA. Section 107(i) of CERCLA specifically addresses application of registered pesticide product by stating, 'No person may recover under the authority of this section for any response costs or damages resulting from the application of a pesticide product registered under FIFRA . . . .' This has been found to mean that contamination caused by the application of a pesticide product registered under FIFRA, such as chlordane, is explicitly exempted from CERCLA liability. So not only is a CERCLA response not required for legally applied chlordane, but because there is no liability, there is no ability to expend environmental restoration funds under CERCLA for legally applied chlordane."*

RCRA has similar guidance that can be found at 42 USC 6901 through 6992. The three most common pesticides found at multiple Vieques sites are dichlorodiphenyltrichloroethane (DDT), dichlorodiphenyldichloroethene (DDE), and dichlorodiphenyldichloroethane (DDD). Both DDE and DDD are contaminants in technical grade DDT as well as breakdown products of DDT (ATSDR, 2002). Numerous studies have been performed on global DDT concentrations and its persistence in the environment. In 1975, EPA published a report entitled: "DDT: A Review of Scientific and Economic Aspects of the Decision to Ban Its Use as a Pesticide." In this report, EPA indicates that DDT degradation rates are highly variable because they are dependent on such factors as rate of pesticide application, mode of application, soil type, climatic conditions, and several other factors. Studies cited by EPA indicated that in the early 1970s, average DDT concentrations in soils from eight major US cities were between 6,000 micrograms per kilogram (µg/kg) and 350 µg/kg and that significant variations in DDT degradation rates had been measured (EPA, 1975). ATSDR noted that half of the DDT initially present can remain after 30 or more years (ATSDR, 2002). EPA also noted that as levels of DDT decline, the ratio of DDE to DDT should increase (EPA, 1975).

As indicated above, pesticide concentrations should not be used as the sole basis to determine whether a pesticide release has occurred at a site because of the nature of pesticide application (e.g., targeted application, periodic reapplication). In addition, none of the historical information for the 20 sites included in this PA/SI Report indicates that the sites were used for pesticide handling, storage, or disposal. This information, coupled with the nature of the sites and the fact that pesticides were detected at nearly all of the 20 sites,

suggests the pesticides are present as a result of normal pesticide application associated with maintenance of the facilities when they were active. However, while the pesticide concentrations at a particular site were not used to conclude whether a pesticide release occurred, because pesticides were detected at most sites, the pesticide concentrations across all sites were evaluated relative to each other to help identify if and where a pesticide release may have occurred.

Tables A-1 and A-2 in Appendix A summarize the pesticides and associated concentrations that have been detected in surface soil and subsurface soil, respectively, at all east Vieques sites. The data show that while the concentrations of pesticides vary within and across sites, the concentration of any particular pesticide in any particular sample is generally similar to that found at other sites, with the exception of one site, PAOC L. While the concentrations of individual pesticides across multiple sites (other than PAOC L) vary from less than 1 μg/kg to around 1,200 μg/kg, pesticide concentrations more than an order of magnitude higher than at any other site (i.e., up to 67,000 μg/kg) were detected at PAOC L. It is certainly possible that the pesticide concentrations at PAOC L are consistent with normal, legal application. Further, there is no historical information that suggests the building at PAOC L stored pesticides. However, because the structure was used to store chemicals (i.e., paints) and because the pesticide concentrations at this location were an order of magnitude higher than any other site, the Navy is taking the conservative approach to evaluate the pesticide concentrations at PAOC L as a potential release. Therefore, the pesticide concentrations at PAOC L are addressed in Section 18 accordingly through the decision analysis process. The remainder of the pesticide detections (i.e., all other sites) are considered representative of normal pesticide application and, in accordance with CERCLA, are not evaluated on a site-specific basis.

Dioxins

Dioxins are another potential example of contaminants that, even if detected, are not necessarily the result of a CERCLA-related release. Dioxins are produced when chlorine-based chemical compounds are burned with hydrocarbons. They are unintended byproducts of combustion, the most common sources of which are industrial, municipal, and domestic waste burning (which accounts for more than 90 percent of dioxin releases to the environment) and production of paper, polyvinyl chloride (PVC) plastics, and certain chlorinated chemicals, such as phenoxy herbicides (EPA, 1994). Other anthropogenic sources of small quantities of dioxins are cigarette smoke, home heating systems, and combustion of fossil fuels (e.g., oil, gas, diesel, coal). They are also formed in minor quantities by natural burning processes such as forest fires and volcanic eruptions. In 1997, the National Center for Environmental Assessment (NCEA) estimated the mean dioxin concentration (in terms of toxicity equivalence [TEQ]) within the continental United States at 20 parts per trillion (ppt) for urban soils and 4 ppt for rural soils (NCEA, 1997). In 1994, EPA estimated the background concentration of dioxins (in terms of TEQ) in soils within the continental United States to be approximately 8 ppt (EPA, 1994).

Table A-3 in Appendix A provides the TEQ calculations for all sites and samples for which dioxin analysis was conducted. Based on historical records and personnel interviews, there is no knowledge that dioxin-producing activities such as waste burning of paper or plastic, or herbicide production occurred at these sites.. In fact, there are no known site-related

sources of dioxins at any of the 20 sites under investigation. Based on the above information, dioxin presence is likely attributable to background. Dioxin analysis at the 12 Consent Order sites was done simply because the investigation took place under RCRA; the Appendix IX list, which is commonly used for RCRA investigations, includes dioxins. Dioxin analysis at the 12 Consent Order sites was not warranted based on historical site activities and would very likely not have been included in the analytical parameter list had the investigation been conducted under CERCLA.

TEQ concentrations detected at sites included in this PA/SI Report were all approximately 8 ppt or less. As stated in the "Approach for Addressing Dioxin in Soil and CERCLA and RCRA Sites" (EPA, 1998), EPA has proposed 1,000 ppt (TEQ) as the starting point for setting cleanup levels for dioxin in soil involving a residential exposure scenario, and 5,000 ppt (TEQ) to 20,000 ppt (TEQ) as the starting point for setting cleanup levels for dioxin in soil involving commercial/industrial exposure scenarios. The 1,000 ppt (TEQ) dioxin level is based on an upper bound excess lifetime cancer risk from residential exposure of 2.5×10^{-4} but is generally considered protective of the environment (i.e., ecological receptors) as well. In addition, unacceptable risks to upper trophic level receptors (such as birds and mammals) from exposure via the food web (generally the most sensitive exposure pathway for dioxins in soil) are not evident at the maximum TEQ soil concentration detected on east Vieques (8.03 ppt) based upon the food web model and terrestrial receptor species applied to previous CERCLA site assessments on west Vieques (see Appendix A).

Based on the above information (i.e., no likely dioxin source at the sites, and no likely unacceptable risk to potential human or ecological receptors at the dioxin concentrations detected), dioxins are not evaluated on a site-specific basis.

Polycyclic Aromatic Hydrocarbons

A third class of chemicals that may have non-site-related sources is polycyclic aromatic hydrocarbons (PAHs), which are a subset of semivolatile organic compounds (SVOCs). PAHs have both natural and anthropogenic sources on a local, regional, and global scale. Natural sources include volcanic eruptions and forest fires. Anthropogenic sources, which contribute much more than natural sources (on a global scale), include domestic wood burning and automobile emissions (ATSDR, 1995). Background concentrations of PAHs reported for the United States vary by setting (i.e., rural, agricultural, and urban) and by specific PAH, as shown in Table A-4 in Appendix A.

Unlike pesticides and dioxins, PAHs found at the sites may be from CERCLA-related releases due to the nature of historical activities at the sites. Therefore, where PAHs are detected at the sites, they are evaluated from a decision analysis process and risk-based perspective. The information above regarding sources and background levels of PAHs is presented primarily to emphasize that non-site-related sources are possible and to provide a basis of comparison in the event that site data other than PAHs (i.e., absence of other constituents) and historical information about a particular site indicate a release of PAHs is unlikely.

1.1.2 Examples of More Realistic Data Evaluations

For constituents that are found above the conservative screening values, additional evaluation using more realistic assumptions is conducted to help determine whether further

action is warranted. One example of a more realistic evaluation is to re-screen SSL (at a DAF of 1) exceedance data against SSLs at a higher DAF. EPA's Soil Screening Guidance: User's Guide states: "Because of the uncertainty resulting from the wide variability in subsurface conditions that affect contaminant migration in groundwater, defaults are not provided for the dilution model equations. Instead, a default DAF of 20 has been selected as protective for contaminated soil sources up to 0.5 acre in size. Analyses using the mass-limit models suggest that a DAF 20 may be protective of larger sources as well; however, this hypothesis should be evaluated on a site-specific basis." (EPA, 1996). Where a particular site has a potential source area that is less than about 0.5 acre, re-screening of SSL (at a DAF of 1) exceedances using a higher DAF is conducted.

Another more realistic evaluation that is commonly done where SSL exceedances (at a DAF of 1) are identified is to consider the constituent concentrations in other media. For example, if there are SSL exceedances in the surface soil and there are subsurface and/or groundwater data available in the same area, these additional data are incorporated into the evaluation of the SSL exceedances to help put the exceedances into perspective. Where subsurface and/or groundwater data show the presence of a constituent below screening criteria, the SSL at a DAF of 1 is not likely a realistic predictor of the constituents' leaching through soil to groundwater.

Where there are exceedances of the most conservative human health screening criteria, more realistic evaluations are performed that further evaluate the significance of the exceedances from a human health risk standpoint. Based on the number of samples available, the potential type of exposure point concentration (EPC) (maximum concentration or upper confidence limit [UCL]) that might be used in a risk assessment is identified. At the SI stage, it is reasonable to consider other EPCs besides the maximum detected concentration (e.g., the UCL on the mean) for comparison purposes to put screening criteria exceedances into perspective and obtain a general indication of conservative conclusions that may result from a quantitative risk assessment. At the SI stage, samples are collected from areas expected to be the most impacted (i.e., where the potential release likely occurred). Therefore, the constituent concentrations in the dataset are likely biased high for a receptor's exposure area, which would likely result in overestimations of EPCs. If a site is moved to the RI stage, a quantitative risk assessment would be conducted, and the EPC for a chemical would be the 95% UCL on the mean concentration (if enough samples are available), in accordance with EPA guidance, not the maximum concentrations.

In addition to the above, the following are considered, as applicable:

- The basis for the screening levels (i.e., carcinogenic or non-carcinogenic effects)
- The applicability of the screening levels to the site (e.g., use of more realistic screening values based on anticipated land use)
- The acceptable target risk range or level at which risk-based decisions would likely be made (e.g., target groundwater concentrations would not be lower than MCLs)

Based on the EPC type, screening level basis, target risk range/level, and extent of exceedances, a conclusion is made regarding whether target risks would likely be exceeded if a risk assessment was prepared. This approach also accounts for cumulative effects from multiple constituents.

Where there are exceedances of the most conservative ecological screening values, more realistic evaluations consider the following types of information:

- The size of the site
- The type and quality of the habitat present on the site and in surrounding areas, and the potential receptors likely to be present
- The frequency and magnitude of screening value and background exceedances
- Average soil exposure concentrations
- The spatial pattern of exceedances
- Additional screening values from the literature, where applicable
- Other site-specific factors that might be relevant to assessing potential exposures (e.g., soil type, fate, transport properties)

In addition to the above, exceedances of background UTLs are sometimes further evaluated. During the east Vieques soil background inorganics study (CH2M HILL, 2007b), outliers were identified for several inorganics. As discussed in Section 3.2.2.1 of the *East Vieques Background Soil Inorganics Investigation Report, Former Vieques Naval Training Range, Vieques Island, Puerto Rico* (CH2M HILL, 2007b), it is very likely that the outliers for these inorganics represent the upper tail of true background concentrations. As a conservative measure, all outliers were eliminated from the UTL calculation to avoid elevating background UTLs in case they are not representative of innate background. It is important to note, however, that the UTL is not an estimate of the maximum concentration expected; rather, it is an estimate of the 95th percentile. In other words, it is anticipated that 5 percent of true background inorganics concentrations are higher than the UTL. As an example, calcium, magnesium, potassium, and sodium represent more than 50 percent of the outliers identified during the background soil inorganics study, and none of these inorganics is considered a contaminant.

Because it is believed that the east Vieques outlier concentrations may represent true background, it is reasonable to make observations of site-specific inorganic concentrations relative to the full range of inorganics detected during the background study, including outliers. It is important to note, however, that these kinds of observations are never solely used to make site-specific determinations regarding the presence of releases and the need for further action; these observations are simply used as part of the comprehensive evaluation performed (i.e., they are one piece of the evidence comprehensively evaluated to make the site-specific determinations).

It is also important to note that the site-specific observations relative to outlier concentrations are performed relatively infrequently and for only three inorganics (arsenic at SWMUs 2, 4, 10, and AOC F; barium at AOC F; and zinc at SWMUs 5, 12, and PAOC K).

Where more realistic evaluations of the data are conducted, the rationale for those evaluations is included in the discussion. It is recognized that these more realistic evaluations may have uncertainty due to the limited amount of data generally available at the PA/SI stage. However, these additional risk evaluations provide yet another line of

evidence that, when considered with all other site-specific information and evaluations, increase the level of confidence by which conclusions for each site are drawn.

1.2 Organization of the PA/SI Report

The PA/SI Report is organized as follows:

- **Section 1, Introduction,** provides the objectives and decision analysis process of the PA/SI, provides a timeline of previous investigations conducted at the former VNTR that are relevant to this PA/SI Report, describes the physical characteristics of the former VNTR, and summarizes the investigation activities to date at each site included in the PA/SI. Because the decision analysis for each site is provided in site-specific sections, the analytical results from the investigations are provided in the site-specific sections, rather than in Section 1.
- **Section 2, Investigation Methodology,** summarizes the PA/SI investigation and data collection activities.
- **Sections 3 through 21** summarize the conceptual site model (CSM) and decision analysis for each of the 12 Consent Order and 8 PI/PAOC sites. Each section also includes the conclusions and recommendations for the particular site.
- **Section 22, Summary of Conclusions and Recommendations,** summarizes the conclusions and recommendations made for each site.
- **Section 23, References,** lists the documents used in preparation of this report.

Tables and figures are presented at the end of each section, as applicable.

1.3 Investigations

Table 1-2 lists the various studies conducted on the former VNTR that are relevant to the 20 sites included in this PA/SI Report. These studies are summarized below, including their relevance to the 20 sites.

- The Environmental Impact Statement (TAMS/E&E, 1979) presents the history of military use and types and quantities of munitions used on the VNTR. SWMU 1 is discussed briefly and states "The Navy has submitted an application for a permit and an operating plan for the sanitary landfill at Camp Garcia (Court testimony, 1978); however, a permit for this facility has not yet been issued by the EQB."
- The Initial Assessment Study (IAS) (Greenleaf/Telesca and E&E, 1984) identifies and assesses sites posing potential threats to human health or the environment as a result of potential contamination from past site operations. Former VNTR sites SWMU 1 and SWMU 2 are included in this assessment. For SWMU 1, the assessment determined: "No hazardous materials were placed in this disposal area. The materials disposed of at the site present no threat to ground water or to the wildlife and sea life at or in proximity to the site." For SWMU 2, the assessment stated that the Environmental Impact Statement (TAMS/E&E, 1979), "shortly after the tanks were dismantled and the refueling halted,

failed to find any indications of stressed vegetation or fauna; no oiled beaches or other indications of pollution were found."

- The *Phase II RCRA Facility Assessment of the Atlantic Fleet Weapons Training Facility (LANT) Including The Eastern Maneuver Area Camp Garcia and Inner Range, Vieques Island, Puerto Rico* (Kearney, 1988), hereafter referred to as the Phase II RCRA Facility Assessment (RFA) Report or RFA Report, summarizes the results from the Preliminary Review (PR) and Visual Site Inspection (VSI) phases of the RFA at the former VNTR. SWMUs 1, 2, 4, 5, 6/7, 8, 10, and 12, as well as AOCs A, F and G, are discussed in this report (although some are described with different nomenclature). The general recommendations of the RFA are as follows: SWMU 1 – additional soil sampling; SWMUs 5, 6/7, 8, and AOC A –secondary containment; SWMU 10 – determine if hazardous constituents are present; SWMUs 2, 4, and 12, AOCs F and G – NFA.
- The Revised *RCRA Facility Assessment Report,* prepared by the Land Pollution Control Area, Hazardous Waste Bureau, of the Puerto Rico Environmental Quality Board (PREQB, 1995), revises the earlier RFA submitted by Kearney (1988). This report intended to identify the SWMUs and AOCs that could have potential releases at the former VNTR. SWMUs 1, 2, 4, 5, 6/7, 8, 10, and 12, as well as AOCs A, F, and G, were evaluated and the general conclusions and recommendations of this RFA Report are the same as those identified in the Phase II RFA Report (Kearney, 1988).
- The *Results of the Hydrogeologic Investigation*, *Vieques, Puerto Rico* (Baker, 1999) report presents the results of hydrogeologic investigations completed in August 1999 at the EMA, an ecological screening evaluation (ESA), and a Baseline Human Health Risk Assessment (HHRA) for soil and groundwater exposure pathways. While this study did not include any of the 20 sites, its findings facilitate an understanding of regional hydrogeology of east Vieques.
- The Phase I Environmental Assessment was conducted in June 2000 in support of planned transfer of the public works department from NASD to Camp Garcia, which ultimately did not occur. During this assessment, sampling was conducted at SWMU 4, SWMU 6, SWMU 7, SWMU 10, and AOC F. Sample results from the Phase I Environmental Assessment were compiled and evaluated along with the data collected during the Phase I RFI (2004 PA/SI) and included in the *Draft Phase I RCRA Facility Investigation Report, Former Atlantic Fleet Weapons Training Facility, Vieques Island, Puerto Rico* (CH2M HILL, 2004), as stated in the Phase I RFI Work Plan.
- The Aerial Photographic Analysis (ERI, 2000) is a study that supported the 2004 PA/SI at the former VNTR. The aerial photograph evaluation at various magnifications enabled the analysts to identify features on the photographs that may have some significance regarding environmental conditions at the 12 Consent Order sites, PI-4, and PI-7.
- The Description of Current Conditions Report (CH2M HILL, 2001) summarizes the ERI aerial photographic analysis; discusses the current conditions at the 12 Consent Order sites, PI-4, and PI-7; and identifies five additional PAOC sites (PAOC J, PAOC K, PAOC L, and PAOC N, and PAOC S), based on an archive records search and interviews with former employees.

- The Draft Final Environmental Baseline Survey (EBS) (NAVFACENGCOM, 2003) documents the environmental condition of the property in support of land transfer from the Navy to the Department of the Interior (DOI). All SWMUs, AOCs, and PI/PAOC sites included in this PA/SI Report are identified in the EBS Report. This report also updated the recommendations made in the RFA reports by the Puerto Rican Environmental Quality Board (PREQB) (1995) and Kearney (1988) in that some sites recommended for NFA (SWMU 2, SWMU 4, SWMU 12, AOC F, and AOC G) in the RFA reports were recommended for further investigation. In addition some sites recommended for secondary containment (SWMU 5, 6/7, 8, and AOC A) in the RFA reports were also recommended for further investigation. The report categorizes areas as either "Clean" or "Requires Further Investigation."

  The sites identified as Requiring Further Investigation include SWMU 1, 2, 4, 5, 6/7, 8, 10, 12, AOC A, F, G, and PI-7. Sites characterized as Clean include PI-4, PAOC J, K, L, N, S, U. The report includes historical and visual surveys at the 23 PI sites and the four PAOC sites previously mentioned, and identifies 20 additional PAOC sites. Surface soil sampling was conducted on several of the PI/PAOC sites, including PI-4, PI-7, and PAOC U.

- The UST Closure Assessment Report (CAPE, 2003) documented the removal of a 15,000-gallon UST at OP-1 in response to the closure of the VNTR and transfer of property to DOI.

- The Draft Phase I RFI Report (CH2M HILL, 2004) summarizes and evaluates the data collected at the 12 Consent Order sites in accordance with the Phase I RFI Work Plan (CH2M HILL, 2003c). The RFI Report is superseded by this PA/SI Report.

- The Background Soil Inorganics Investigation Report (CH2M HILL, 2007b) presents east Vieques background soil inorganic constituent concentrations to which site-specific soil inorganic analytical data are compared.

1.4 Physical Characteristics of the Former VNTR

This subsection summarizes the regional environmental setting of the former VNTR, including location, history and land use, climate, topography, surface water, geology, and hydrogeology. Site-specific information pertinent to the release assessment is included in the site-specific sections.

1.4.1 Location

Vieques has a land area of approximately 33,000 acres. This island is located on the Antillean Island Arc separating the Caribbean Sea from the Atlantic Ocean, and is approximately 7 miles southeast of the eastern coast of the island of Puerto Rico (Figure 1-1). Vieques is approximately 21 miles long (east to west) and 4.5 miles wide (north to south).

The former VNTR is located on the eastern one-third of the island, and comprises the SIA, Live Impact Area (LIA), and Eastern Conservation Area (ECA) (comprising 3,600 acres), as well as the adjacent and wholly contiguous EMA, comprising 11,000 acres. The former VNTR was under the command of Naval Station Roosevelt Roads (NSRR), now referred to

as Naval Activity Puerto Rico (NAPR). On May 1, 2003, the former VNTR came under jurisdiction of the DOI, to be managed as part of the National Wildlife Refuge System by the United States Fish and Wildlife Service (USFWS). Figure 1-2 shows the locations of the EMA, SIA, LIA, ECA, and Camp García on the former VNTR.

1.4.2 VNTR History

Military training at the former VNTR was initiated in the EMA and SIA in the mid-1950s and continued until the facility was closed in 2003. Marine forces simulated amphibious assault operations over suitable beachheads that included Blue, Green, Purple, Red, and Yellow beaches. These simulated assaults involved pre-assault operations, ship-to-shore movement, assault, consolidation, and withdrawal. While amphibious assaults were conducted with blank ammunition, Marine forces would conduct live firing on ranges in the EMA with weapons that included pistols, rifles, machine guns, grenades, tanks, artillery, recoilless rifles, and mortars (TAMS/E&E, 1979).

During 1966, six ranges were established in the EMA along the Northern Coast of east Vieques as shown on Figure 1-5. These ranges remained operational through February 1999, when they were deactivated. The EMA also provided maneuvering space and ranges for the training of Marine amphibious units and battalion landing teams in exercises of amphibious landings, small arms fire, artillery and tank fire, shore fire control, and combat engineering tasks.

The ranges comprised the following:

- **Range 1—**Small Arms Range using service rifles, pistols, and machine guns
- **Range 2—**Small Arms Range using pistols and shotguns
- **Range 3—**40mm Projected Grenade Range and small arms
- **Range 4—**Anti-armor/Antipersonnel Live Fire Tracking Range using 3.5-inch rockets and light anti-craft weapons (LAWs)
- **Range 5—**Hand Grenade Range using various types of grenades
- **Range 6—**Demolition and small arms range

The Navy began developing facilities in the LIA in 1964 when it established a gunnery range used for air-to-ground ordnance delivery and naval gunfire training. By the 1970s, the LIA maintained several targets for aerial bombing, including old tanks and vehicles which were used as mock-ups, two bulls-eye targets, and a strafing target. In addition, several point and area targets upon which ships could practice naval gunfire support were established in the LIA. Unserviceable military munitions were periodically received from the former NASD on the west end of Vieques for demolition at the open burn/open detonation (OB/OD) area at the LIA. The locations of the ranges, targets, and gun positions are shown on Figure 1-5.

A RCRA Consent Order was signed on January 2000 that addressed known and potential environmental sites suspected to have had releases of hazardous constituents. On April 30, 2003, the Navy ceased training exercises on the VNTR. Following termination of training operations on Vieques, the 14,573 acres of the former VNTR were transferred to the

jurisdiction of the DOI, to be managed by the USFWS as a National Wildlife Refuge pursuant to section 1049 of the National Defense Authorization Act for Fiscal Year 2002 (Public Law 107–107). In addition, the former LIA, a 900-acre area, must be managed as a wilderness area without public access (Public Law 106–398; Public Law 107–107). The other former operational areas of the former VNTR comprise the 2,500-acre SIA, the 11,000-acre EMA, and the 200-acre ECA. On May 26, 2004 the former Naval facilities on eastern and western Vieques were designated as an NPL site, which put the environmental restoration program under CERCLA.

1.4.3 Land Use

Conservation Zones were established at the former VNTR in accordance with a 1983 Memorandum of Understanding (MOU) between the Commonwealth of Puerto Rico and the Navy. Four Class I Conservation Zones and five Class II Conservation Zones were established (Geomarine, 2003). Under former Navy operational guidelines, Class I areas could not be used for purposes other than conservation, were protected from damaging activities, and were managed to protect and maintain their natural value. Class II areas were managed to protect various environmentally sensitive habitats and natural areas. Certain restricted military and civilian uses were permitted in these Class II areas.

The Class I and Class II Conservation Zones are illustrated in Figure 1-6. The Class I Zones are described below:

- The Punta Este Conservation Zone, which is located on the southeastern end of the LIA, consists primarily of drought-resistant scrub that no longer can be found in Puerto Rico except on former Navy property on Vieques.
- The Cayo Conejo Conservation Zone, a small island located southwest of the LIA in the Bahia Salina del Sur area, is an important nesting habitat for the endangered brown pelican and one of the last nesting areas for this species in Puerto Rico.
- The Ensonada Honda Conservation Zone, which lies between Blue and Yellow Beaches on the southern coast of Vieques, has the best example of lowland forest growth on Vieques and is also home to a variety of extensive mangrove populations that appear to be healthy and expanding.
- The South Coast Bays Conservation Zone is located on the southern coastline of Vieques directly south of the Camp García area and western portions of the EMA. Two bays at this location, Bahia Tapon and Puerto Mosquito, have bioluminescent properties and are valuable tourism resources for the island.

The intent of the conservation zones is preservation of these unique areas as important components of the overall environmental health of Vieques.

As stated in Section 1.4.2 the former VNTR is currently owned by DOI and managed by USFWS as part of the National Wildlife Refuge System. Following the property transfer, the Blue Beach and Red Beach areas of the former VNTR were opened for recreational use by the public. However, the easternmost two-thirds of the former VNTR are restricted from public access because of the potential hazards associated with MEC.

DOI has developed a Comprehensive Conservation Plan (CCP) for the Vieques National Wildlife Refuge that outlines its concept for managing the refuge (USFWS, 2007). Information in this CCP is included in environmental restoration evaluations and determinations for the former VNTR, as applicable.

1.4.4 Climate

The climate of Vieques is characterized as warm and humid (tropical-marine), with frequent showers occurring throughout the year. The easterly trade winds blowing across the island year-round moderate the temperature on Vieques, resulting in an annual mean temperature of 79°F to 80°F. The island's average rainfall is approximately 36 inches, with extremes of 25 inches in the east and 45 to 50 inches in the west (PREQB, 1995).

1.4.5 Topography and Surface Water

The topography of Vieques consists generally of hills and valleys throughout the entire island. The western side of the island consists of gently rolling hills with a deeper soil profile than the eastern side, which consists of more exposed, rugged terrain. The highest point on the western side is approximately 1,000 feet (ft) above mean sea level (amsl) at Monte Pirata. The highest point on the eastern side is approximately 420 ft amsl at Cerro Matias. The coastal areas contain generally level terrain made up of primarily beaches, lagoons, and mangrove swamps. Figure 1-2 shows the topography of the former VNTR.

The streambeds found on Vieques are generally oriented to the north or to the south toward the coasts from higher areas in the central part of the island. Vieques does not have any perennial surface drainage; rather, streamflow on Vieques is ephemeral (intermittent), controlled by surface runoff from rainfall. Approximately 90 percent of the rainfall is lost to evaporation, based on statistical data from the U.S. Virgin Islands. Of the remaining 10 percent, approximately 5 percent infiltrates into the ground to recharge groundwater, and 5 percent becomes surface runoff. Based on their geographic locations toward the southern part of the island, surface runoff at the 12 Consent Order sites and the 8 PI/PAOC sites is anticipated to generally flow south toward the sea (PREQB, 1995).

1.4.6 Geology and Soils

Vieques was formed from sedimentary and volcanic and other igneous rocks. The island bedrock is mostly granodiorite, quartz diorite, and some lava. In the central portion of the former VNTR, the bedrock is exposed and weathered. Because of the weathering of the bedrock, gravel, sands, and finer particles (silts and clays) can be transported downhill during storms. Over the years, this material has gathered in valleys near the ocean, forming alluvial deposits. The alluvial sedimentary deposits generally consist of a mixture of gravel, sand, silt, and clay. Based on the generalized geology of Vieques Island map (Torres-Gonzalez, 1989), five general categories, based on geologic origin, are present in eastern Vieques:

1. Qa - Alluvial deposits (sand, silt, and clay)
2. Qb - Beach and dune deposits (calcite, quartz, volcanic rock fragments and minor magnetite)
3. TI - Marine sedimentary rocks (report indicated variable limestones)

4. Kv - Sandstone, siltstone, conglomerate, lava, tuff, and *tuffaceous breccia*
5. KTd - Plutonic rock made up largely of granodiorite and quartz diorite

The distribution of these geologic zones in eastern Vieques is illustrated on Figure 1-7. The upland areas are underlain by three rock types: Upper Cretaceous volcanic rocks such as Andesite, Upper Cretaceous or Lower Tertiary intrusive rocks such as granodiorite, and Upper Tertiary and Quaternary sedimentary rocks such as limestone (Figure 1-7). The lowland areas are unconsolidated sediments of Quaternary age, consisting of alluvial deposits, beach and dune deposits, and swamp and marsh deposits (CH2M HILL, 2001).

The Upper Cretaceous rocks in the upland areas are the oldest exposed rocks on Vieques. These rocks are believed to have been deposited in a marine environment, as was the case with rocks of the same age on the main island of Puerto Rico.

Limestone of the upper Tertiary age is found in peninsulas extending into the sea from the southern and eastern coasts of Vieques. Limestone of the Tertiary-Miocene age is also found along these coasts, and is commonly referred to as Puerto Ferro limestone. Quaternary age deposits are typically found in the valleys and coastal areas. These deposits include beach, swamp, and alluvial deposits. Areas of sand, swamp, and salt mud occur in the coastal areas.

Rocks are the primary sources of the constituents that make up the unconsolidated deposits and that are found in soil. Most rocks are formed from elements such as oxygen, silicon, aluminum, iron, magnesium, calcium, potassium, and sodium (USGS, 1997). Specifically, the common bedrock types found on Vieques (granodiorite and quartz diorite) typically are composed of approximately 61 to 66 percent silicon dioxide, 16 to 17 percent aluminum oxide, 2 to 3 percent ferric oxide, 2 to 4 percent ferrous oxide, 1 to 3 percent magnesium oxide, 3 to 6 percent calcium oxide, 3 to 4 percent sodium oxide, and 2 to 3 percent potassium oxide (Travis, 1955).

Chemical and physical processes break down the rocks and form minerals that are characteristic of the parent material. The soil on Vieques is a direct product of the island's bedrock which, as indicated previously, consists mostly of granodiorite, quartz diorite, some volcanic lavas, and marine sedimentary deposits such as limestone. Soils on Vieques are primarily residual, because of both climatic conditions (i.e., weathering) and parent rock type. The eastern side of the island has less developed soil due to the relatively impermeable volcanic rock and less precipitation than the west side. Human influences, such as agricultural processes and air pollution, and other natural process, such as vegetative decay, likely contribute to the constituents found in the soil.

Figure 1-7 shows where the 12 Consent Order sites and the 8 PI/PAOC sites lie with respect to each geologic zone. The figure shows that SWMUs 4, 6, and 7, PI 4 and 7, and PAOCs J, K, L, N, S (powerhouse), and U are located in the geologic zone identified as KTd. SWMUs 2, 5, 8, and 12, and AOC A are located in the geologic zone identified as Kv. SMWU 1 and AOC F cross geologic zones Kv and Qa. SWMU 10 and AOC G cross geologic zones KTd and Qa. The PAOC S (pipeline) site crosses the KTd, Kv, and Qa geologic zones.

1.4.7 Groundwater

The groundwater on eastern Vieques occurs in both the unconsolidated alluvial deposits and the bedrock. A groundwater aquifer within alluvial deposits, designated the Valle de Esperanza aquifer, is located beneath the southern portion of the island and includes the area near Camp García (Figure 1-8). As discussed previously, approximately 5 percent of the annual precipitation infiltrates through the ground and supplies the aquifers. The Valle de Esperanza aquifer previously supplied drinking water to Camp García and OP-1 prior to 1978. The Puerto Rico Aqueduct and Sewer Authority (PRASA) provided the water through of a series of 16 wells that pumped approximately 450,000 gallons per day (gpd) of water. These wells are no longer active because the groundwater supply was replaced by the installation of a water pipeline from Puerto Rico to Vieques in 1978 that has since supplied the potable water for Vieques.

The U.S. Geological Survey (USGS) performed a groundwater study on Vieques, including tests on the wells near Esperanza (Torres-Gonzalez, 1989). The results indicated that the groundwater contained high concentrations of naturally occurring sodium bicarbonate. Because of its high sodium content, the groundwater in the Valle de Esperanza aquifer is not suitable for extended irrigation use. The high levels of sodium result from sea spray infiltrating into the ground, and saltwater entering the groundwater supply as a result of excessive groundwater withdrawal.

Unexposed bedrock in the upland areas of the former VNTR is predominantly unweathered, highly impermeable granodiorite, the porosity is very low, and the potential for groundwater development is limited. In the vicinity of Camp García, clayey alluvium overlies the granodiorite. Samples from wells in the Camp García area show mostly saline water in the clayey alluvium. Historical data show that prior to the development of the well field in Esperanza Valley in 1945, groundwater levels in the Camp García area were approximately 10 ft below land surface (bls). From 1961 to 1965, water level declines from 2 to 20 ft were recorded in three wells in the area. Well yields also declined from approximately 35 gallons per minute (gpm) to approximately 10 gpm (Torres-Gonzalez, 1989).

During a hydrogeologic investigation in August 1999 (Baker, 1999), monitoring wells were installed along the western perimeter of the VNTR. During the study, depth to groundwater ranged from approximately 36 ft bls in the alluvial deposits in the valleys to a depth 131 ft bls in the bedrock within the hills near the center of the island. Figure 1-9 shows the transect of the hydrogeologic cross sections that are portrayed in Figures 1-10 and 1-11. The groundwater elevation data from these wells indicate that a groundwater flow divide exists within the bedrock at the approximate mid point of the island, north of Camp García. (Figure 1-12). Generally, groundwater north of monitoring well NW-3 flows north toward the Atlantic Ocean and groundwater south of NW-3 flows south toward the Caribbean Sea (Baker, 1999).

The bedrock potentiometric surface is located at an elevation significantly higher that the elevations where groundwater was first encountered during drilling of the bedrock wells and piezometers. Also, groundwater occurrence within the bedrock formation is associated with secondary porosity features (i.e., fractures and joints). These data indicate that the fractures and joints within the bedrock store the groundwater and that the recharge areas for the fractures and joints are at higher elevations than the portions intersected by the wells

and piezometers. This also indicates that the primary porosity of the bedrock formation is low enough to limit groundwater occurrence and movement to secondary porosity features (i.e., fractures and joints).

There are a number of sites included in this PA/SI Report that are in relatively close proximity to one another (i.e., sites within and immediately adjacent to Camp Garcia). Because groundwater beneath a particular site may interact with groundwater at downgradient sites as it migrates along its flowpath, it is sometimes beneficial to evaluate groundwater data on a more regional scale than on a site-specific scale. However, the decision on whether to evaluate groundwater data on a site-specific or more regional basis is influenced by such factors as presence and extent of contamination. If data suggest groundwater contamination is widespread and co-mingled across multiple sites, then a comprehensive evaluation would likely be beneficial. However, if data suggest either there is no contamination in the groundwater or the contamination is localized to individual sites, site-specific evaluation of groundwater data is likely more appropriate. Figure 1-13 displays all detections and exceedances of VOCs and exceedances of inorganics in groundwater collected from wells within and immediately adjacent to Camp Garcia. The figure demonstrates the absence of broad, multiple-site groundwater contamination. Therefore, groundwater data are evaluated on a site-specific basis in this PA/SI Report, as presented in Sections 3 through 21. In order to help confirm that from the sites within Camp Garcia there have not been releases that have adversely affected groundwater quality further downgradient, a monitoring well will be installed just south of the eastern and western halves of Camp Garcia during an Expanded SI (see Sections 5 and 16).

1.4.8 Ecological Resources

Vegetation

Vegetative cover on the eastern third of Vieques consists of heavy, dense vegetation dominating most available land area. The canopy consists primarily of deciduous trees with the non-native mesquite dominating the species distribution. A number of tree species are thorny and low-lying brush is present throughout. Tall grasses are interspersed within the thorny tree and brush landscape. The majority of the island's vegetation, with the exception of populated areas in the center of the island and some of the exposed mountainous areas, tends to form a complete ground cover.

Twelve distinct community types have been delineated and described on the VNTR. These comprise bare ground disturbed by human activities, open sandy beach and adjacent beach vegetation in salt spray zone, shallow salt/sand flat, open-water lagoon, mangrove communities, evergreen scrub of drought-resistant shrubs on rocky coasts and limestone formations, mixed woodland of deciduous formations on inner hills and slopes, forest scrub along drainages in mangrove forests, forested, sparse thorn scrub, thick thorn scrub, and grassland that is slowly changing back to thorn scrub (NAVFACENGCOM, 2003).

The 20 sites included in this report are located in the following terrestrial flora habitats (Geo-Marine, 2003):

- SWMU 1 forest and thick thorn scrub
- SWMU 2 thick thorn scrub and sparse thorn scrub

- SWMU 4, 5, 6/7, 8, AOC A, PAOC L, PAOC N, PAOC S (powerhouse), and PAOC U grass
- SWMU 10, 12, AOC G, PI-4, PI-7, PAOC J, PAOC K, PAOC S (pipeline) thick thorn scrub
- AOC F bare ground, thick thorn scrub, and sparse thorn scrub

Sites PAOC J and PAOC K were formerly identified as being located in the grass habitat. However, they have become overgrown and are now located in the thick thorn scrub area.

Conservation Zones

As previously stated, four Class I Conservation Zones have been established to protect the natural resources in those areas, which are illustrated in Figure 1-6. These Zones are described in Section 1.4.3. Of the 20 sites, only SWMU 2 (Bahia de la Chiva Conservation Zone Class II) and the southern portion of SWMU 1 (Bahia de la Chiva Conservation Zone Class II) are located in Conservation Zones. The Conservation Zones are identified in the 2003 Geo-Marine INRMP Report.

Wildlife

Because of its island ecosystem, neither abundance nor diversity of terrestrial vertebrates is found on Vieques. The ocean barrier impedes natural dispersion. Some 25 orders of insects, represented by 5,066 species, are present on Vieques. Eight species of crustaceans and six species of mollusks are known to occur in the nearshore coastal habitat of Vieques. At least 22 amphibious and reptilian species have been reported on Vieques: 3 frog types, the marine toad, 11 lizards and geckos, the worm snake, the ground snake, 1 freshwater turtle, and 4 sea turtles. Approximately 120 species of land birds have been reported on the island, along with 39 species of lagoon birds and 13 species of seabirds. While some of these birds breed on Vieques, others are non-breeding residents, winter migrants, or accidental strays. Bats are the most numerous group of mammals on Vieques and one species, the red fruit bat, is reported to be the only surviving endemic mammal on the island. All other mammals, including house mice, rats, mongooses, domestic animals, wild horses, and feral cats and dogs, have been introduced by humans (TEC, 2002).

All 20 sites contain terrestrial upland habitat, and none directly encompass aquatic habitats (freshwater or marine). However, SWMU 2 and the fuel pipeline part of PAOC S are located immediately adjacent to the Caribbean and its bays. It is expected that the variety of birds, insects, reptiles, amphibians, and mammals described above occur at these sites, with greater diversity occurring at less disturbed sites.

Federally Listed Species

Several plant and animal species that occur on Vieques Island have been identified by Federal authorities as threatened or endangered, and Table 1-3 lists the terrestrial plants and semi-aquatic bird species that potentially occur at or near the sites included in this report. Though protected sea turtles, manatees, and whales are also known to occur off of Vieques Island, none of the sites encompass the marine habitat required to support these species; therefore, none are listed in Table 1-3.

TABLE 1-1
Updated Human Health and Ecological Screening Values
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

	Human Health Screening Value		Ecological Screening Value		
	Previous Value[1]	New Value[2]	Previous Value[1]	New Value[2]	Reference
Soil					
VOCs					
Toluene	66,000 μg/kg	630,000 μg/kg			Updated toxicity values in Integrated Risk Information System (IRIS)
SVOCs					
2-Methylnaphthalene	160,000 μg/kg	31,000 μg/kg			Updated toxicity values in Integrated Risk Information System (IRIS)
Pentachlorophenol			3,000 μg/kg	5,000 μg/kg	EPA. 2007. *Ecological Soil Screening Levels for Pentachlorophenol* . OSWER Directive 9285.7-58. April.
Explosives					
Perchlorate	0.78 mg/kg	55 mg/kg			Updated toxicity values in Integrated Risk Information System (IRIS)
Metals					
Barium	540 mg/kg	1,600 mg/kg			Updated toxicity values in Integrated Risk Information System (IRIS)
Copper			50 mg/kg	70 mg/kg	EPA. 2007. *Ecological Soil Screening Levels for Copper* . OSWER Directive 9285.7-68. February.
Manganese			100 mg/kg	220 mg/kg	EPA. 2007. *Ecological Soil Screening Levels for Manganese* . OSWER Directive 9285.7-71. April.
Nickel			30 mg/kg	38 mg/kg	EPA. 2007. *Ecological Soil Screening Levels for Nickel* . OSWER Directive 9285.7-76. March.
Selenium			1 mg/kg	0.52 mg/kg	EPA. 2007. *Ecological Soil Screening Levels for Selenium* . OSWER Directive 9285.7-72. July.
Silver			2 mg/kg	560 mg/kg	EPA. 2006. *Ecological Soil Screening Levels for Silver* . OSWER Directive 9285.7-77. September.
Zinc			50 mg/kg	120 mg/kg	EPA. 2007. *Ecological Soil Screening Levels for Zinc* . OSWER Directive 9285.7-73. June.
Groundwater and Surface Water					
VOCs					
Toluene	72 μg/L	230 μg/L			Updated toxicity values in Integrated Risk Information System (IRIS)
SVOCs					
Acetophenone	42 μg/L	61 μg/L			Updated toxicity values in Integrated Risk Information System (IRIS)
2-Methylnaphthalene	12 μg/L	2.4 μg/L			Updated toxicity values in Integrated Risk Information System (IRIS)
Explosives					
Perchlorate	24 μg/L	26 μg/L			Updated toxicity values in Integrated Risk Information System (IRIS)
Metals					
Barium	260 μg/L	730 μg/L			Updated toxicity values in Integrated Risk Information System (IRIS)

Notes:
[1] From the *Final Master Quality Assurance Project Plan, Environmental Restoration Program, Vieques, Puerto Rico* (CH2M HILL, May 2007)
[2] Value used for screening in PA/SI Report

TABLE 1-2
Study Timeline
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Study	Author	Purpose of Study	Study Date(s)	Report Date	Sites in PA/SI Report Included in Study
Environmental Impact Statement	Tippetts, Abbett, McCarthy, Stratton (TAMS) and Ecology and Environment, Inc.	Evaluate the environmental impacts of the continued use of the Naval facilities on Vieques	1978 through 1979	December 1979	No sites identified in this report, but contains information on the physical environment of the study areas.
Initial Assessment Study (IAS)	Greenleaf-Telesca, Planners, Engineers, Architects, Inc. and Ecology and Environment, Inc.	Identify and assess sites posing a potential threat to human health or to the environment due to contamination from past hazardous waste operations	January through September 1984	September 1984	SWMU 1, SWMU 2
Phase II RCRA Facility Assessment (RFA)	A.T. Kearney, Inc. and K.W. Brown and Associates, Inc.	Evaluates past, present, or potential releases of hazardous waste or hazardous constituents from any unit or activity that involves management of solid waste	August through October 1988	October 1988	SWMU 1, SWMU 2, SWMU 4, SWMU 5, SWMU 6/7, SWMU 8, SWMU 10, SWMU 12, AOC A, AOC F, AOC G
Revised RFA	Puerto Rico Environmental Quality Board (PREQB)	Evaluates past, present, or potential releases of hazardous waste or hazardous constituents from any unit or activity that involves management of solid waste	June through September 1995	September 1995	SWMU 1, SWMU 2, SWMU 4, SWMU 5, SWMU 6/7, SWMU 8, SWMU 10, SWMU 12, AOC A, AOC F, AOC G
Hydrogeologic Investigation	Baker Environmental, Inc.	Provide specific information regarding soil and groundwater conditions at the western property boundary of the EMA.	August through November 1999	November 1999	No sites identified in this report, but contains hydrogeologic information of east Vieques.
Phase I Environmental Assessment	CH2M HILL	Evaluate the environmental conditions of various sites in support of transfer of public works department from NASD to Camp Garcia	June 2000	No report submitted; public works did not transfer; data included in PA/SI Report	SWMU 4, SWMU 6/7, SWMU 10, AOC F
Aerial Photographic Analysis	Environmental Research, Inc.	Support the ongoing Phase I RFI	August 2000	August 24, 2000	SWMU 1, SWMU 2, SWMU 4, SWMU 5, SWMU 6/7, SWMU 8, SWMU 10, SWMU 12, AOC A, AOC F, AOC G, PI-4, PI-7
Current Conditions Evaluation	CH2M HILL	Support the Phase I RFI by providing information on the Naval Facility and to describe existing conditions at the 9 SWMUs, 3 AOCs, 12 PAOCs, and 23 PIs.	Site visit February 2000	February 2001	SWMU 1, SWMU 2, SWMU 4, SWMU 5, SWMU 6/7, SWMU 8, SWMU 10, SWMU 12, AOC A, AOC F, AOC G, PI-4, PI-7, PAOC J, PAOC K, PAOC L, PAOC N, PAOC S
Environmental Baseline Survey (EBS)	Naval Facilities Engineering Command	Characterize the existing environmental conditions on east Vieques prior to the planned property transfer to the Department of Interior.	September 2002 through April 2003	April 2003 (Draft Final)	SWMU 1, SWMU 2, SWMU 4, SWMU 5, SWMU 6/7, SWMU 8, SWMU 10, SWMU 12, AOC A, AOC F, AOC G, PI-4, PI-7, PAOC J, PAOC K, PAOC L, PAOC N, PAOC S, PAOC U
Underground Storage Tank (UST) Closure Assessment	CAPE Environmental, Inc	Close a 15,000 gallon UST on Vieques.	April through August 2003	August 2003	AOC A
Phase I RCRA Facility Investigation (RFI) (a.k.a. 2004 PA/SI)	CH2M HILL	Release assessment at 12 Consent Order sites and PI/PAOC sites (including Phase I Environmental Assessment, EBS, and UST closure)	January through February 2004	June 2004 (Draft)	SWMU 1, SWMU 2, SWMU 4, SWMU 5, SWMU 6/7, SWMU 8, SWMU 10, SWMU 12, AOC A, AOC F, AOC G, PI-4, PI-7, PAOC J, PAOC K, PAOC L, PAOC N, PAOC S, PAOC U
East Vieques Background Soil Inorganics Investigation Report	CH2M HILL	Establish representative background concentrations of soil inorganics that can be compared to site-specific soil inorganic data to assess whether inorganic concentrations detected at a particular environmental site are attributable to releases from these sites or consistent with background levels.	June through July 2006	October 2007	No sites studied; developed background soil inorganics dataset for use in site-specific evaluations.
Preliminary Assessment/Site Inspection (PA/SI)	CH2M HILL	Release assessment at 8 PI/PAOC sites identified for study in Draft Phase I RFI Report	January 2006 through October 2007		PI-4, PI-7, PAOC J, PAOC K, PAOC L, PAOC N, PAOC S, PAOC U (PA/SI Report includes the 12 Consent Order Sites)

TABLE 1-3
Federally Listed Plants and Animals Potentially Occurring within Study Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Species	Federal Status
Plants	
Cobana negra	T
Thomas' lidflower	E
Chamaecrista glandulosa var. mirabilis	E
Beautiful goetzea	E
Eugenia woodburyana	E
Birds	
Brown Pelican	E
Roseate tern	T

T = threatened
E = endangered
Source: TEC, 2002

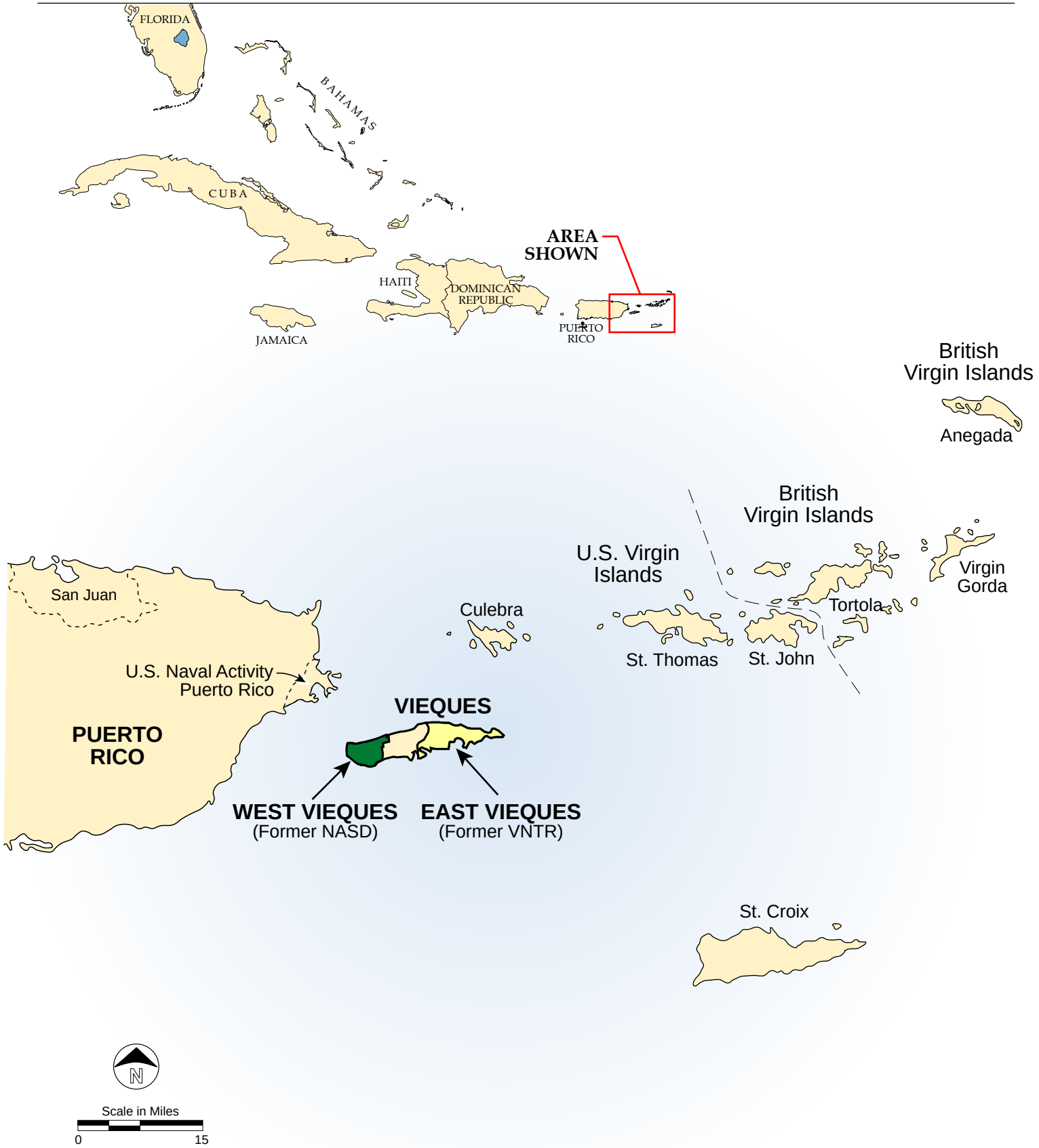
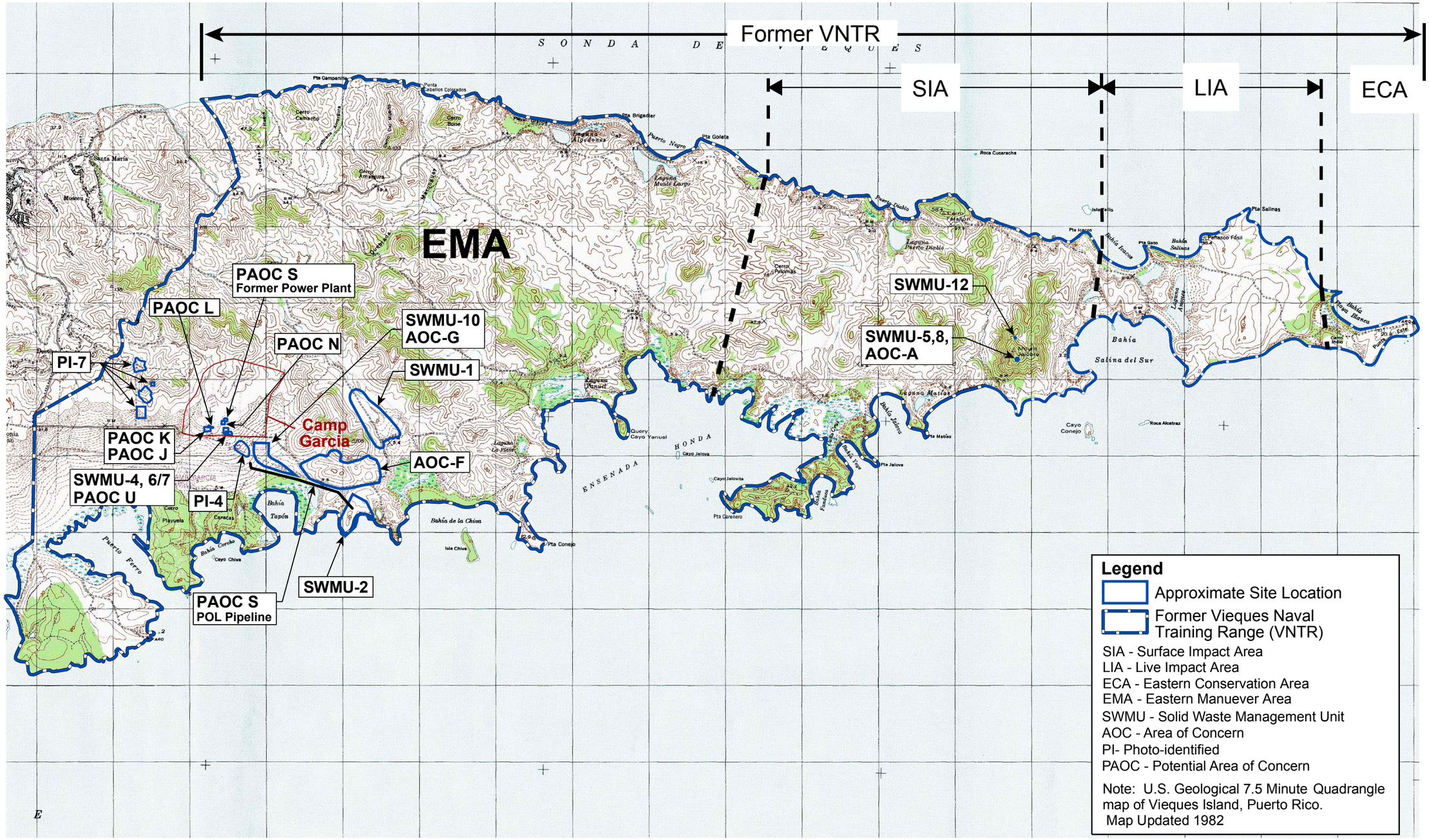


Figure 1-1
Regional Location Map
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



0 2,500 5,000 10,000 15,000 20,000
Feet

CH2MHILL

Figure 1-2
Former VNTR Site Location Map
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

PHOTO DATE 1994

PHOTO DATE 1994

PI-7

PI-7

PAOC L

PAOC S
Former Power Plant

PAOC K

PAOC N

PAOC U

SWMU 6/7

PAOC J

SWMU 4

PI 4

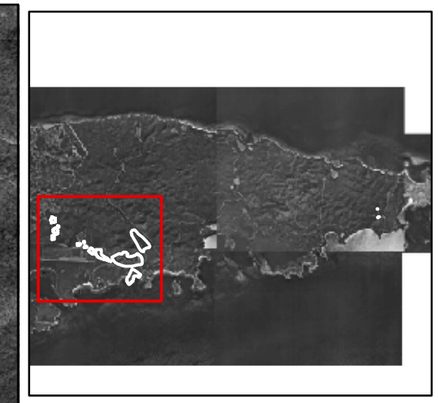
SWMU-10
AOC G

SWMU-1

AOC-F

PAOC S
POL Pipeline

SWMU-2



LEGEND

Location of Figure 1-3

Camp Garcia

EMA -Eastern Maneuver Area

N

0 900 1,800 Feet

FIGURE 1-3
PA/SI Sites within the EMA
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

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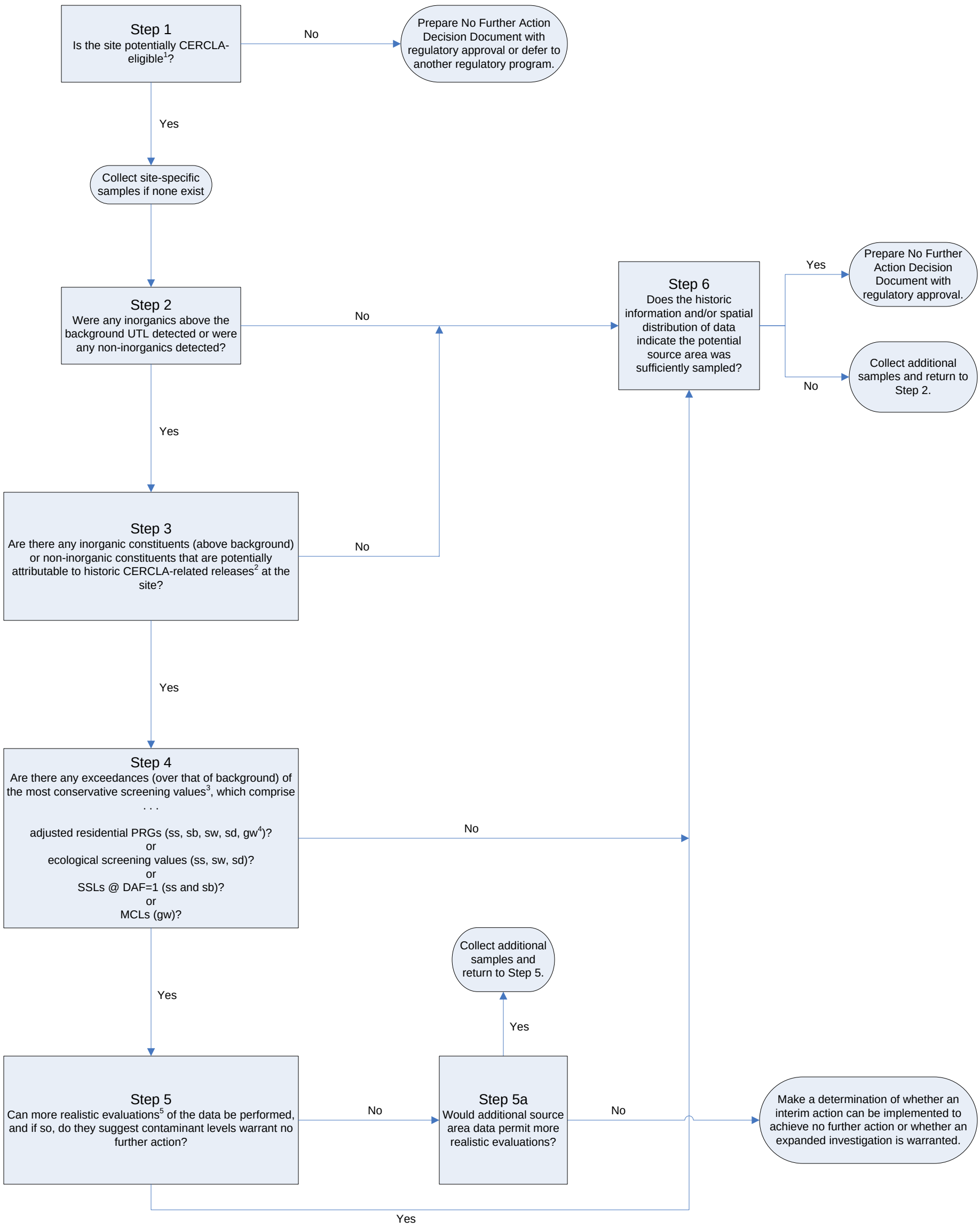


[1] Determination of CERCLA eligibility is described in Section 1.1

[2] CERCLA-related releases are defined in Section 1.1

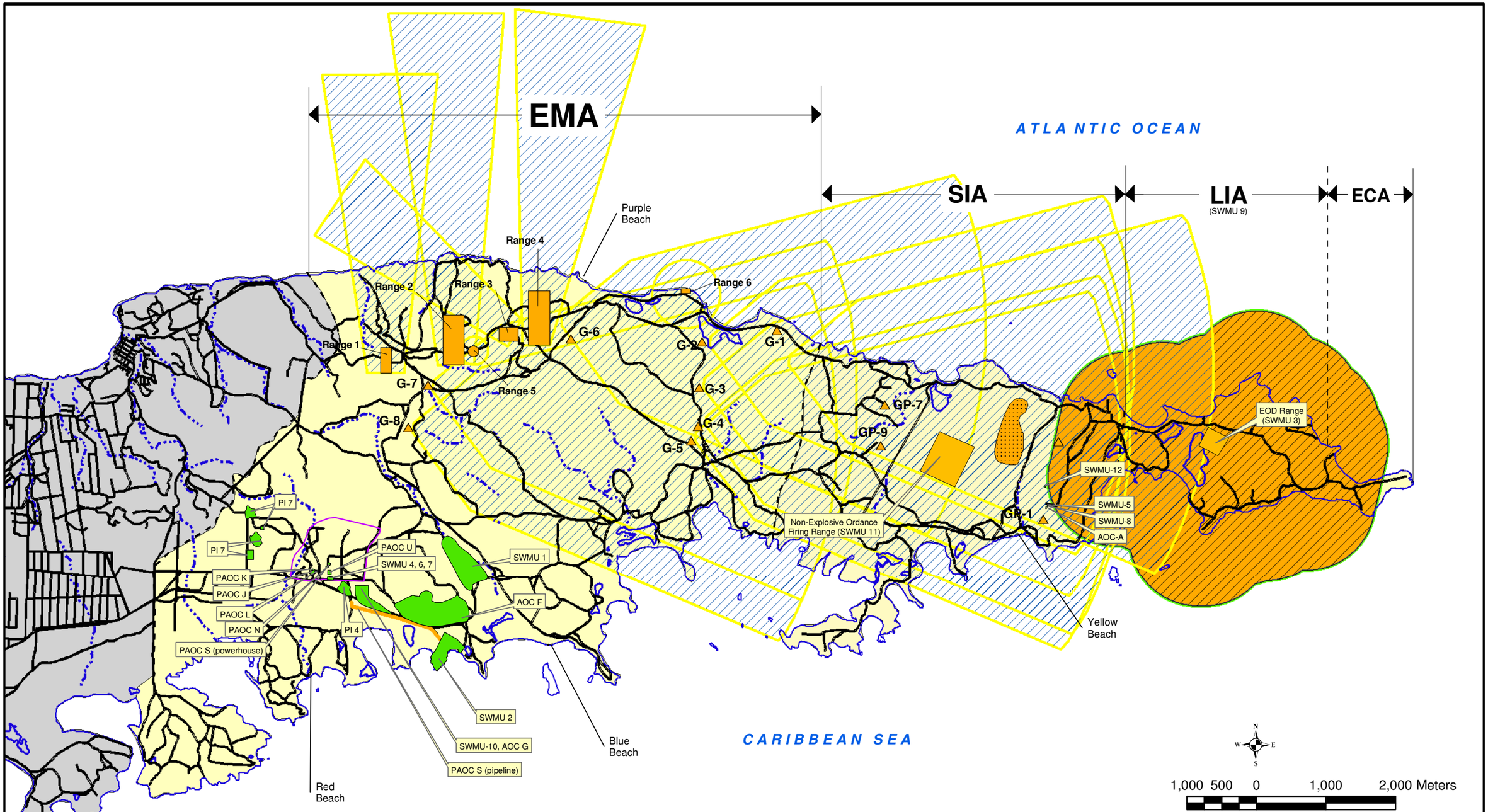
[3] For UST sites, PREQB UST Corrective Action Criteria are also included in the evaluation

[4] ss = surface soil; sb = subsurface soil; sw = surface water; sd = sediment; gw = groundwater

[5] Examples of the types of more realistic evaluations that may be performed are described in Section 1.1.2

Figure 1-4
PA/SI Evaluation Decision Tree
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

File Path: \\aphrodite\proj\18gis\vieques2\figures\mxd\AFWTF\Figure_1_5_Spatial_Relationship_Between_Ordance_Explosives_ImpactedAreas_and_PA_SI_Sites.mxd



LEGEND

- Roads
- Ephemeral Streams
- Property Line
- Non-Navy Property
- Former VNTR
- Camp Garcia

Ordnance / Explosives Sites

- Gun Position
- General Location of Marine Artillery Targets
- Small Arms/Artillery Ranges
- Explosive Safety Quantity Distance Arc
- Artillery Safetyfan

Environmental Sites

- SWMU, AOC, and PI/PAOC Sites

EMA - Eastern Maneuver Area
SIA - Surface Impact Area
LIA - Live Impact Area
ECA - Eastern Conservation Area

SWMU - Solid Waste management Unit
AOC - Area of Concern
PI/PAOC - Photo-identified/Potential Area of Concern

Figure 1-5
Spatial Relationship Between Ordnance/Explosives Impacted Areas and PA/SI Sites
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

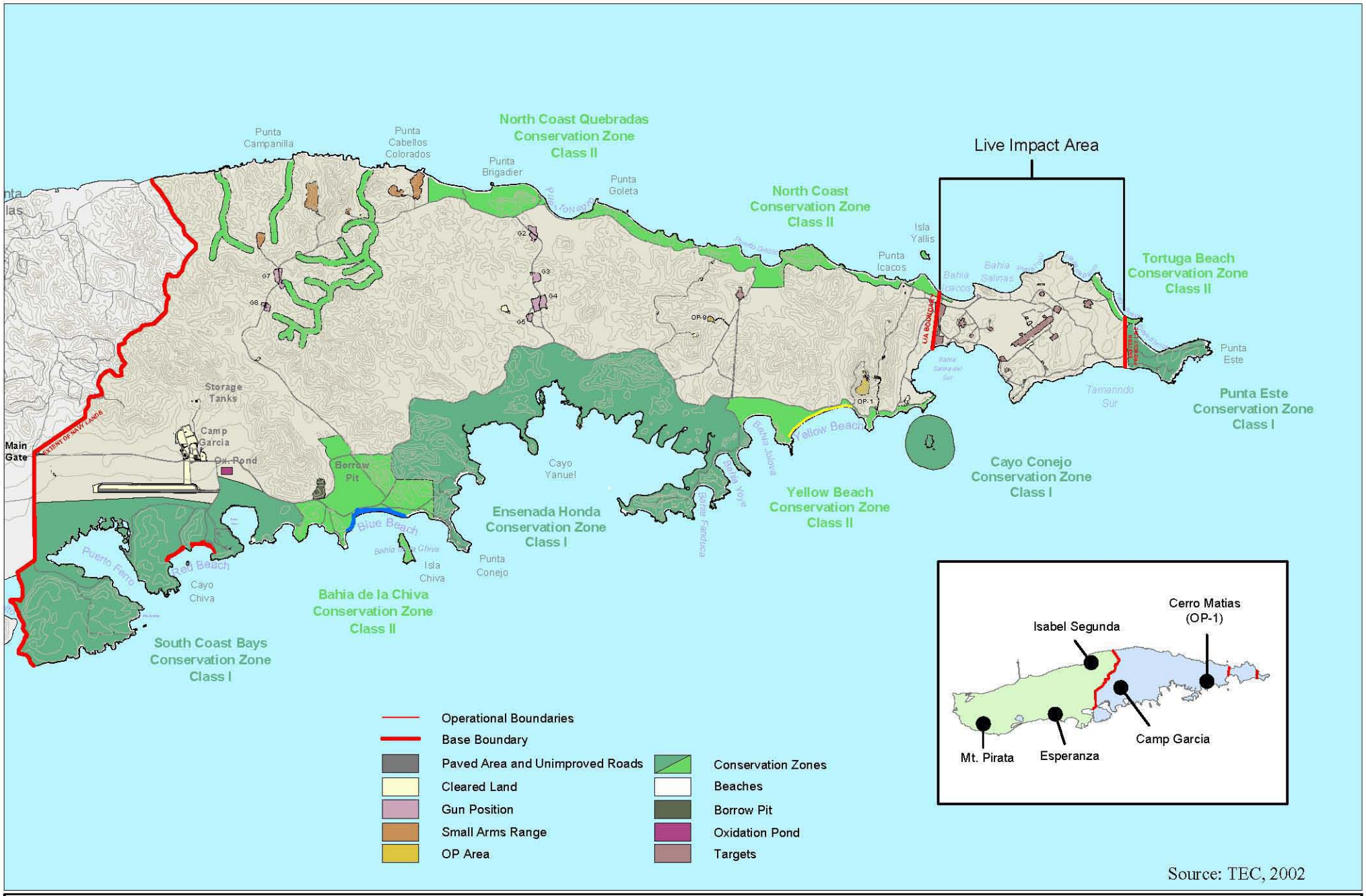
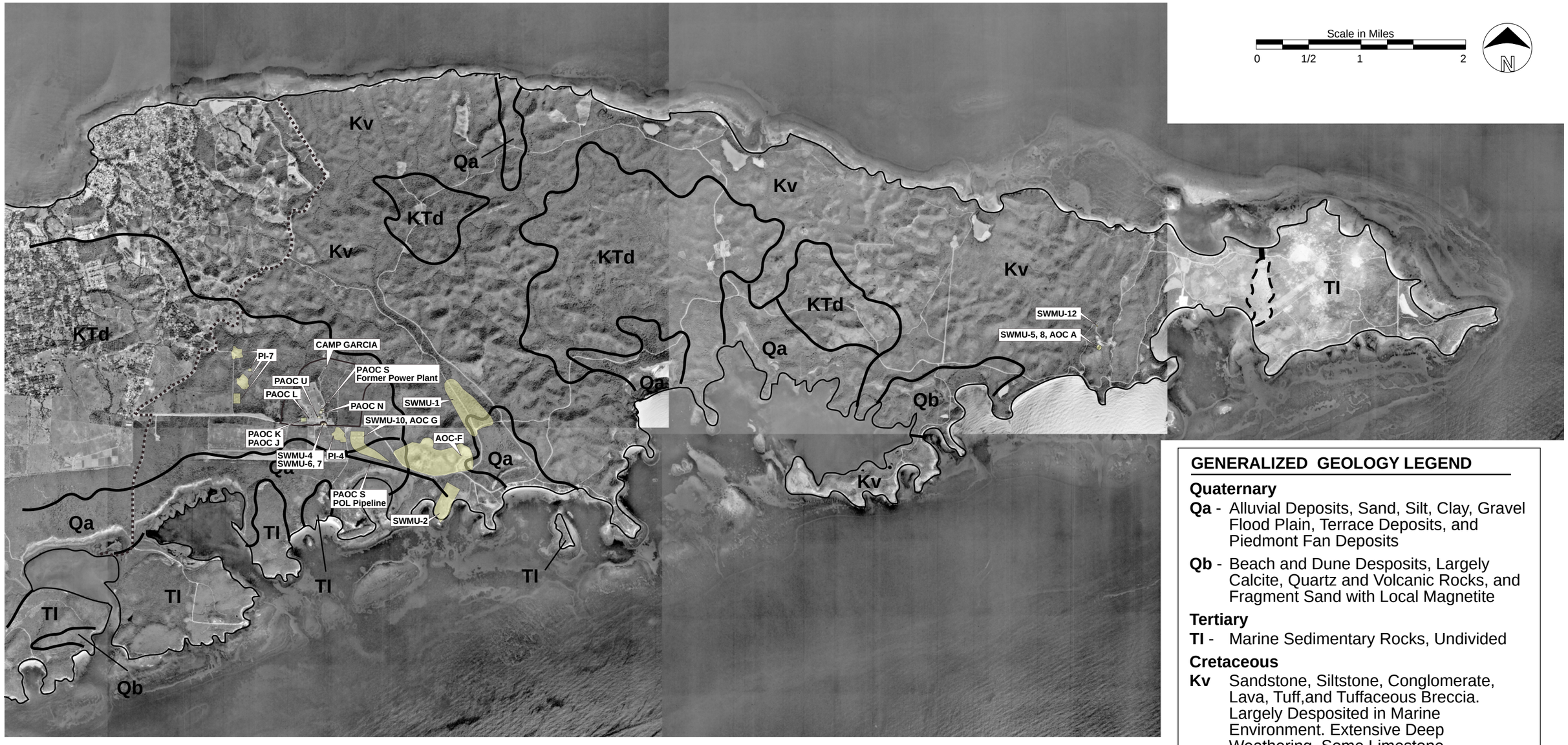


Figure 1-6
Conservation Zones of Vieques
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



Base imagery is comprised of 1994 1-meter USGS Digital Ortho-imagery quarter quadrangles (DOQQs).

GENERALIZED GEOLOGY LEGEND

Quaternary

Qa - Alluvial Deposits, Sand, Silt, Clay, Gravel Flood Plain, Terrace Deposits, and Piedmont Fan Deposits

Qb - Beach and Dune Desposits, Largely Calcite, Quartz and Volcanic Rocks, and Fragment Sand with Local Magnetite

Tertiary

Tl - Marine Sedimentary Rocks, Undivided

Cretaceous

Kv Sandstone, Siltstone, Conglomerate, Lava, Tuff,and Tuffaceous Breccia. Largely Desposited in Marine Environment. Extensive Deep Weathering. Some Limestone.

KTd- Plutonic Rocks, Largely Grandiorite,and Quartz Diorite, Locally Deeply Weathered (from Torres-Gonzalez, 1989)

LEGEND

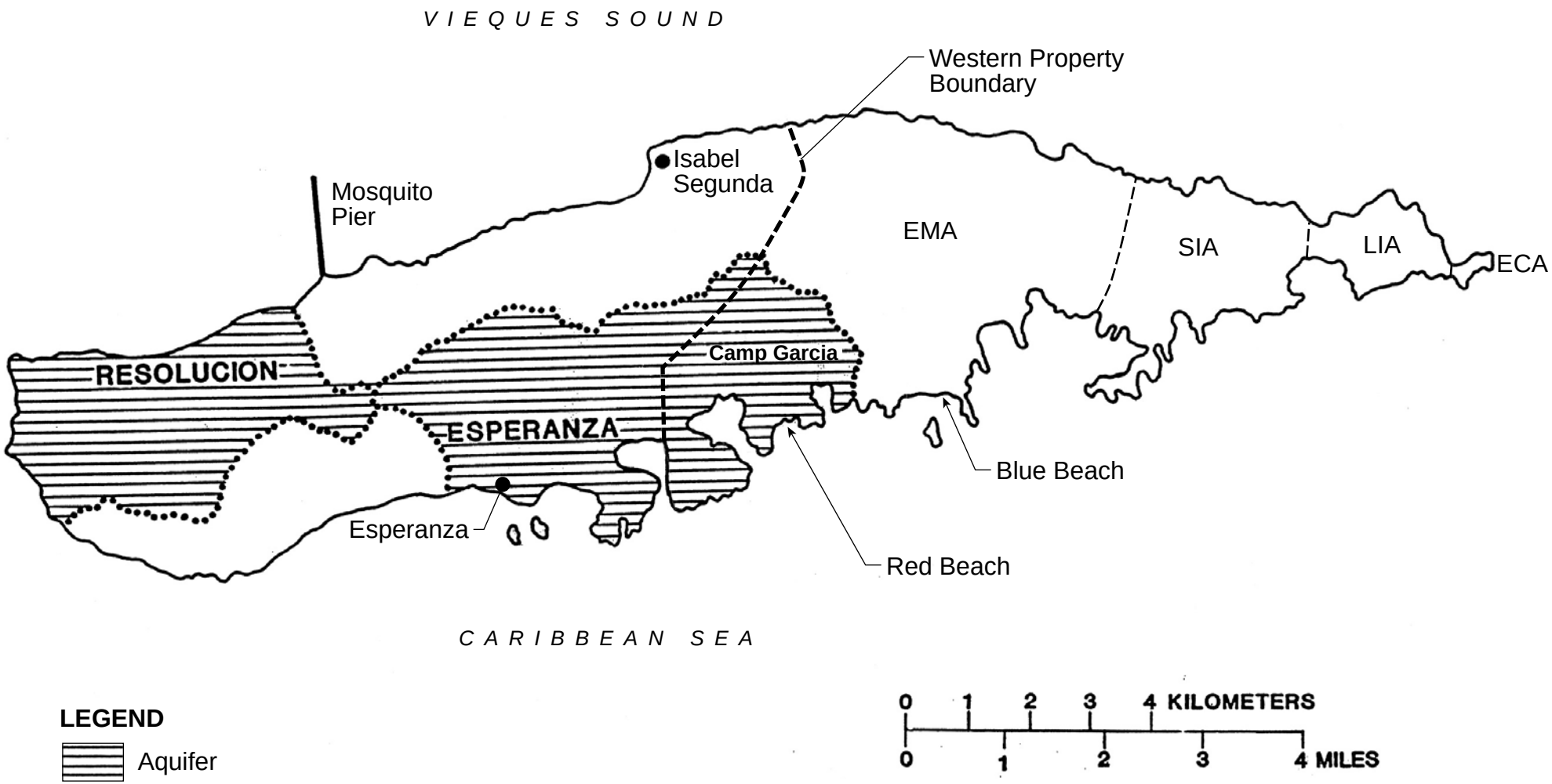
AOC = Area of Concern

PAOC = Potential Area of Concern

PI = Photo Identified Site

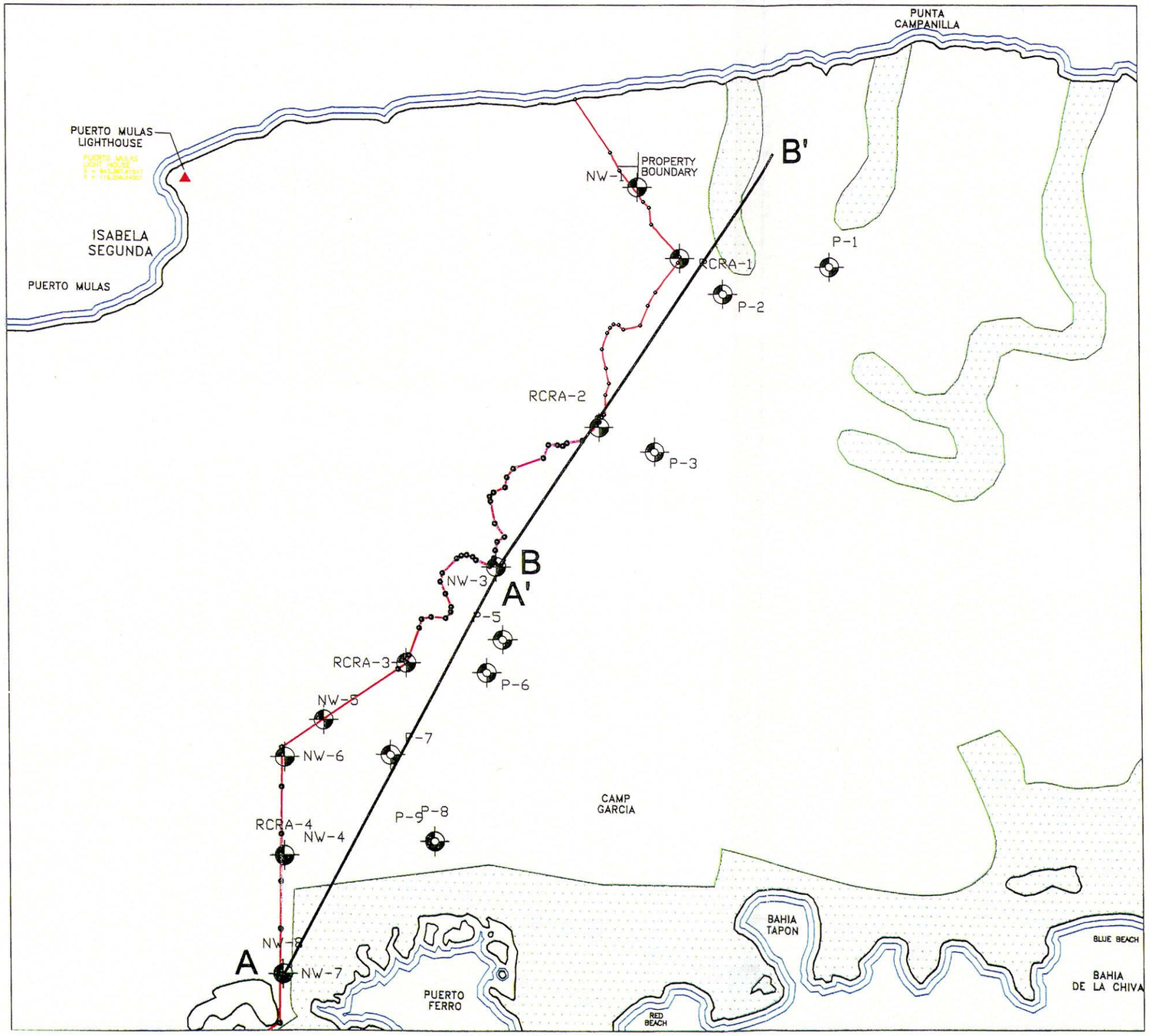
SWMU = Solid Waste Management Unit

Figure 1-7
Generalized Geology of Former VNTR
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



(Reference: Torres - Gonzalez, 1989)

Figure 1-8
Resolución and Esperanza Aquifers
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



LEGEND

RCRA-1 MONITORING WELL

P-1 PIEZOMETER

SHORELINE

A —— A' HYDROGEOLOGIC CROSS-SECTION

VNTR PROPERTY LINE

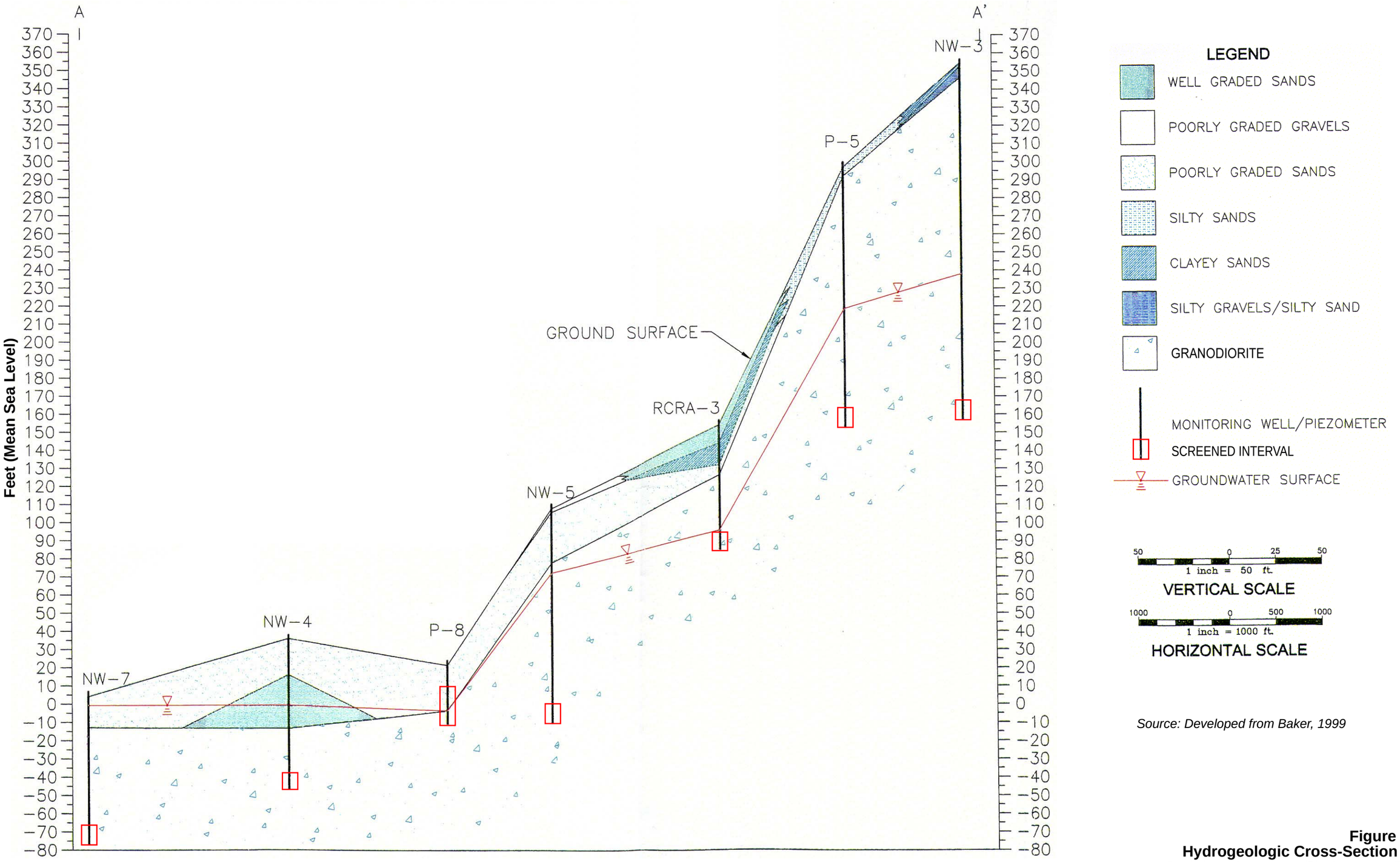
2400 0 1200 2400

1 inch = 2400 ft.

N W E S

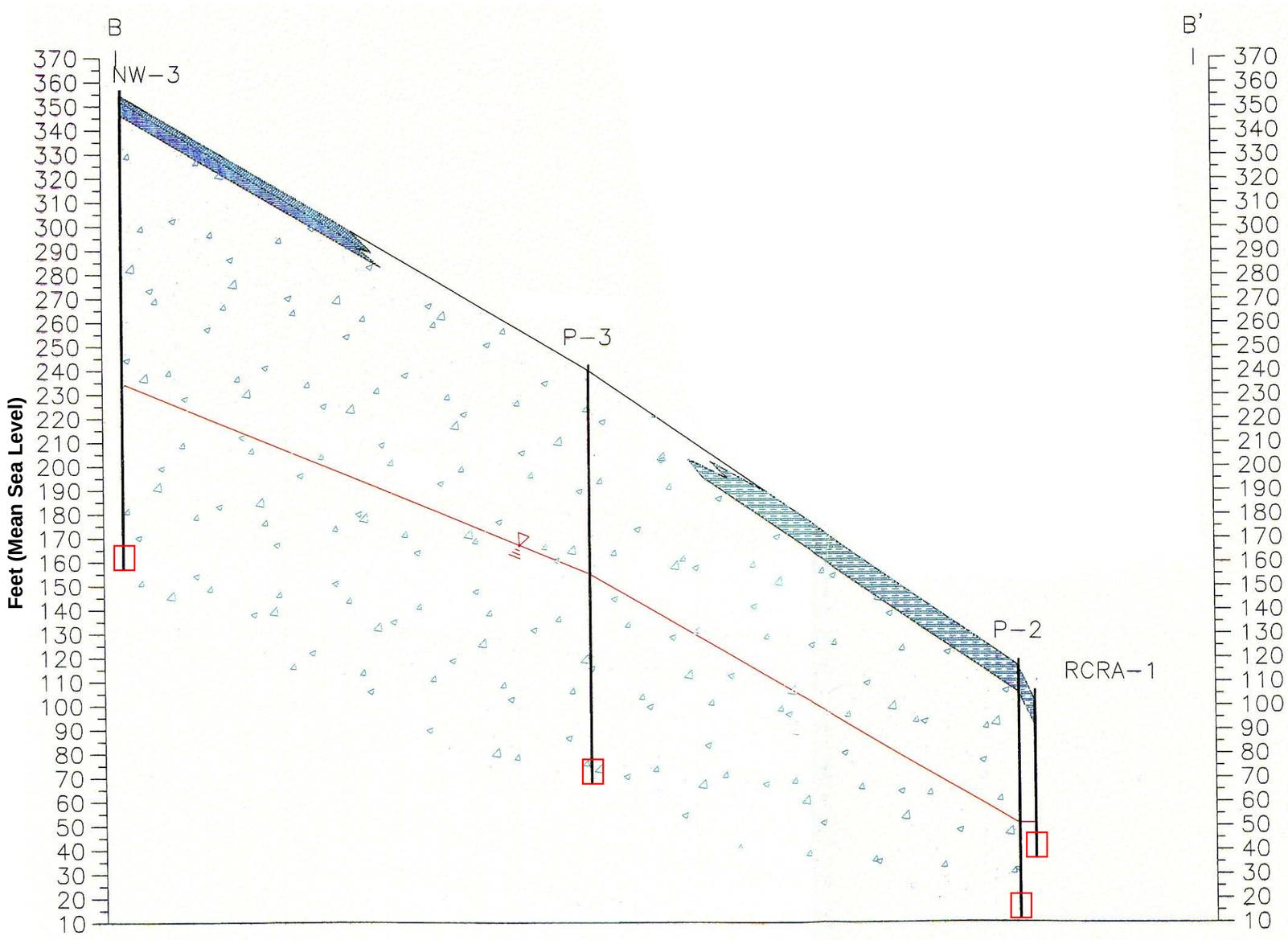
Source: Developed from Baker, 1999

FIGURE 1-9
Hydrogeologic Cross-Section Location Map
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



Source: Developed from Baker, 1999

Figure 1-10
Hydrogeologic Cross-Section A-A'
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



LEGEND

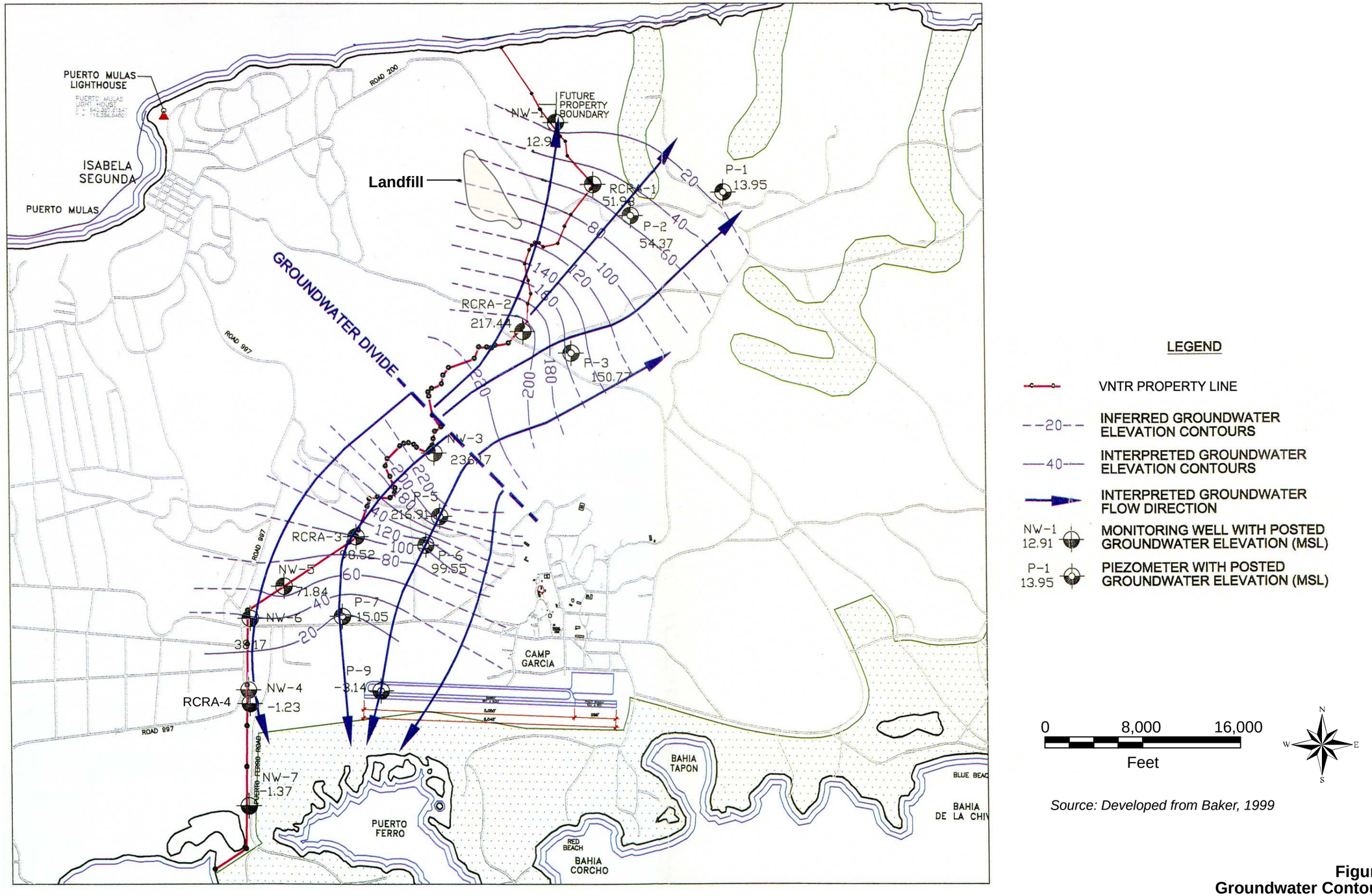
- SANDY CLAY/SILTY CLAY
- CLAYEY SANDS
- SILTY GRAVELS/SILTY SAND
- GRANODIORITE
- MONITORING WELL/PIEZOMETER
- SCREENED INTERVAL
- GROUNDWATER SURFACE

50 0 25 50
1 inch = 50 ft.
VERTICAL SCALE

1000 0 500 1000
1 inch = 1000 ft.
HORIZONTAL SCALE

Source: Developed from Baker, 1999

Figure 1-11
Hydrogeologic Cross-Section B-B'
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

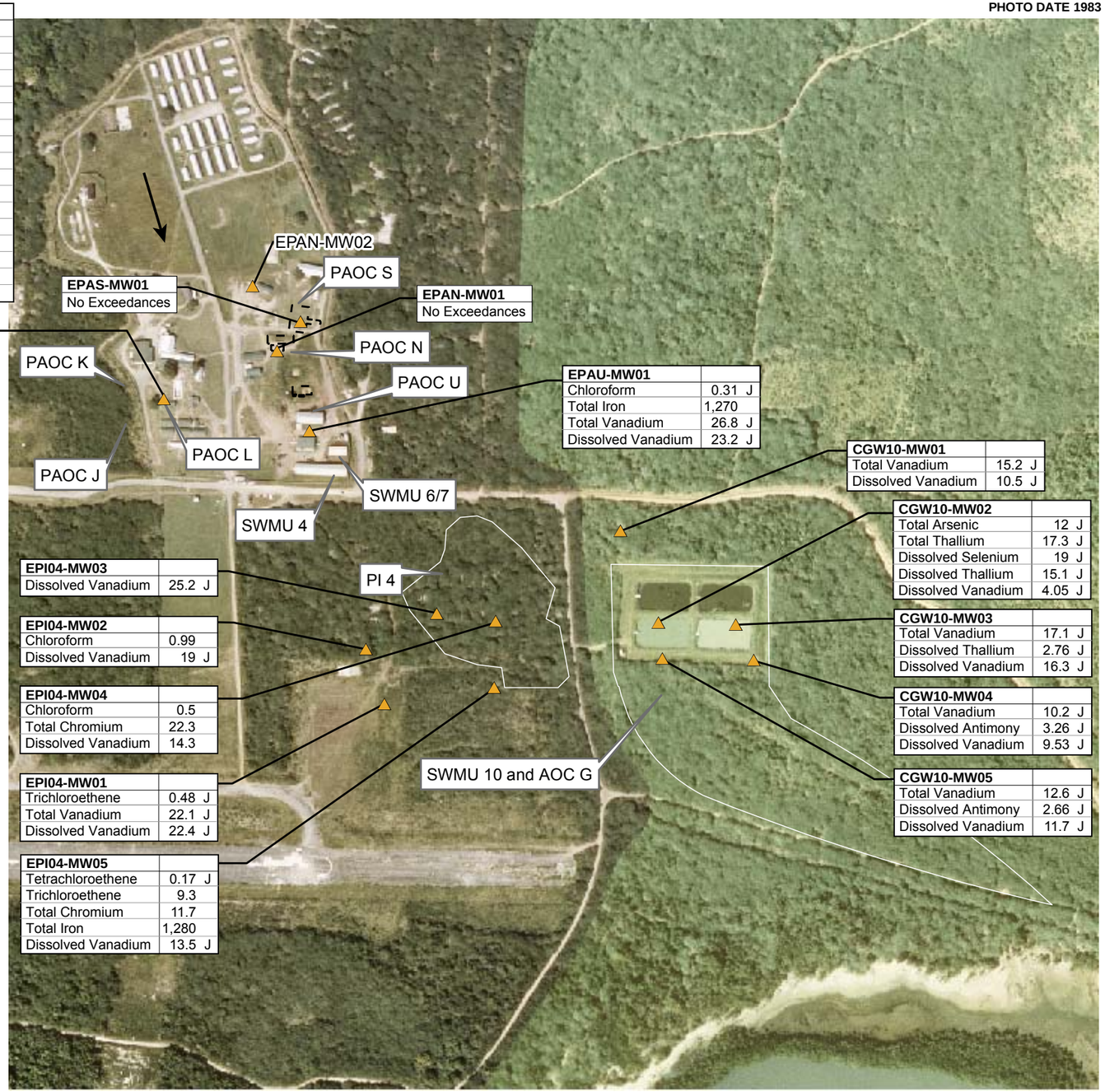


Source: Developed from Baker, 1999

Figure 1-12
Groundwater Contour Map
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Screening Criteria	HHRA	MCL
VOCs		
Chloroform	0.17	
Trochloroethene	0.028	
Trichloroethene	0.028	5
Tetrachloroethene	0.1	
Inorganics		
Dissolved Selenium	18	
Dissolved Vanadium	3.6	
Dissolved Thallium	0.24	2
Dissolved Antimony	1.5	
Total Chromium	11	
Total Iron	1,100	
Total Vanadium	3.6	
Total Selenium	18	
Total Chromium	11	
Total Arsenic	0.045	10
Total Thallium	0.24	

PHOTO DATE 1983



EPAL-MW01	
Chloroform	0.49 J
Trochloroethene	0.11 J
Total Selenium	22.4 J
Dissolved Selenium	22.5 J
Dissolved Vanadium	7 J

EPAU-MW01	
Chloroform	0.31 J
Total Iron	1,270
Total Vanadium	26.8 J
Dissolved Vanadium	23.2 J

CGW10-MW01	
Total Vanadium	15.2 J
Dissolved Vanadium	10.5 J

CGW10-MW02	
Total Arsenic	12 J
Total Thallium	17.3 J
Dissolved Selenium	19 J
Dissolved Thallium	15.1 J
Dissolved Vanadium	4.05 J

CGW10-MW03	
Total Vanadium	17.1 J
Dissolved Thallium	2.76 J
Dissolved Vanadium	16.3 J

CGW10-MW04	
Total Vanadium	10.2 J
Dissolved Antimony	3.26 J
Dissolved Vanadium	9.53 J

CGW10-MW05	
Total Vanadium	12.6 J
Dissolved Antimony	2.66 J
Dissolved Vanadium	11.7 J

EPI04-MW03	
Dissolved Vanadium	25.2 J

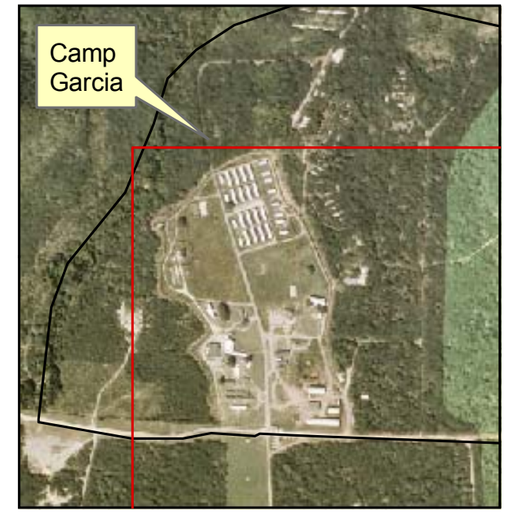
EPI04-MW02	
Chloroform	0.99
Dissolved Vanadium	19 J

EPI04-MW04	
Chloroform	0.5
Total Chromium	22.3
Dissolved Vanadium	14.3

EPI04-MW01	
Trichloroethene	0.48 J
Total Vanadium	22.1 J
Dissolved Vanadium	22.4 J

EPI04-MW05	
Tetrachloroethene	0.17 J
Trichloroethene	9.3
Total Chromium	11.7
Total Iron	1,280
Dissolved Vanadium	13.5 J

PHOTO DATE 1983



LEGEND

- ▲ PA/SI Monitoring Well Location
- J Estimated result

All constituent concentrations in µg/L

Approximate regional groundwater flow direction (estimated because not all monitoring well water levels were measured on the same day)"

North

0 600 1,200 Feet

CH2MHILL

FIGURE 1-13

VOC Detections and Exceedances and Inorganic Exceedances in Groundwater

SI/Expanded SI Sampling and Analysis Plan

Vieques, Puerto Rico

SECTION 2

Investigation Methodology

This section summarizes the procedures employed for data collection, analysis, and validation at the 12 Consent Order and 8 PI/PAOC sites included in this PA/SI Report.

As stated in the Phase I RFI Work Plan (CH2M HILL, 2003c), the following environmental media data collection activities took place at the 12 Consent Order sites:

- Phase I Environmental Assessment (June 2000)—Surface soil sampling at SWMUs 4, 6, and 7 and AOC F; and surface soil, subsurface soil, and water sampling at SWMU 10
- UST Closure (April 2003)—Subsurface soil sampling at AOC A
- Phase I RFI (2004 PA/SI) (January–February 2004)—Surface soil sampling at SWMUs 5, 8, and 12, and AOC G; subsurface soil sampling at SWMU 4; surface soil and subsurface soil sampling at SWMU 2; surface soil and groundwater sampling at SWMU 1; and surface soil, subsurface soil, and groundwater sampling at SWMU 10

In accordance with the PA/SI Work Plan (CH2M HILL, 2006), the following environmental media data collection activities took place at the 8 PI/PAOC sites:

- 2006 PA/SI (December 2005 – April 2006) – Surface soil, subsurface soil, and groundwater sampling at PI-4, PI-7, PAOC L, PAOC N, PAOC S, and PAOC U; and surface soil and subsurface soil sampling at PAOC J and PAOC K.

Table 2-1 summarizes, by site, the investigation during which the samples were collected, the media sampled, analyses performed, sample identifications, and depth of sampling (for soil samples).

During the PA/SI for the 12 Consent Order sites and 8 PI/PAOC sites, representatives from EPA and PREQB were present onsite at various times to observe the field investigation activities. EPA and PREQB collected split samples from various sample locations at the 12 Consent Order sites. The samples split between the Navy and EPA and/or PREQB for analysis at their respective contracted laboratories are listed in Table 2-2.

Prior to the 12 Consent Order sites field work, vegetation clearing was done at SWMUs 1, 2, and 10 using a bulldozer. At SWMU 1, transects were cleared to allow the geophysical survey equipment to be operated, monitoring wells to be installed, and surface soil samples to be collected. At SWMU 2, the former tank locations were cleared and at SWMU 10, the area of the four lagoons was cleared to allow sample collection and well installation.

Prior to the 8 PI/PAOC sites field work, vegetation clearing was accomplished using a track hoe with a cutting head, referred to as the TAZ. Sites PI-4, 7, PAOC J, and K were cleared for the sampling team and drill rigs. Prior to the vegetation clearing activities at the 8 PI/PAOC sites, an archaeological survey and a habitat characterization survey were completed to ensure no cultural resources and/or threatened or endangered species would be impacted by the vegetation clearance and sampling activities. The archaeological survey results are

included in Appendix B, and the habitat characterization results are included in Appendix C. No cultural resources or threatened or endangered species/habitats were identified in the study areas.

Summaries of the various field activities during the 2004 and 2006 PA/SIs are provided in the following subsections. Samples were collected in general accordance with the standard operating procedures (SOPs) presented in the Master Work Plans available at the times the investigations were conducted: *Master Work Plan, Final RCRA Facility Investigation, September 1995 prepared for Naval Station Roosevelt Roads (NSRR)* (Baker, 1995) for the Phase I Environmental Assessment; *Master Work Plan for the Atlantic Fleet Weapons Training Facility, Vieques, Puerto Rico* (CH2M HILL, 2003a) for the 2004 and 2006 PA/SIs.

2.1 Surface Soil Sampling

Surface soil samples were collected during the Phase I Environmental Assessment in 2000, the EBS in 2002, the 2004 Consent Order site PA/SI, and the 2006 8 PI/PAOC site PA/SI. All surface soil samples, analyses, nomenclature, and sampling depths are shown on Table 2-1. The table includes explanations for sampling depth intervals other than those defined in the work plans. Boring logs for soil samples are included in Appendix D.

Phase I Environmental Assessment (2000)

Surface soil samples were collected at SWMUs 4, 6/7, 10, and AOC F using a hand auger. Samples were collected from the approximate length of the hand auger bucket (i.e., 0 to 0.7 ft bls) in accordance with the Master Work Plan (Baker, 1995).

EBS (2002)

Surface soil samples were collected using stainless steel scoops and trowels from sites PI-4, PI-7, and PAOC U. Samples were collected from 0 to 0.5 ft bls. It is important to note that the general areas of all EBS samples were re-sampled during the 2006 PA/SI.

12 Consent Order Sites PA/SI (2004)

Surface soil samples were collected at SWMUs 1, 2, 5, 8, 10, 12, and AOC G during the January/February 2004 sampling event. Surface soil samples were collected from the surface to approximately 0.7 ft bls (i.e., the length of the hand auger bucket). In order to collect VOC soil samples for VOCs from the target interval using En Core™ sampler, soil from within that interval was first removed from the ground. The soil column was removed from the ground with a hand auger, extracted from the hand auger into a stainless steel bowl, and then collected by pushing the En Core™ sampler into the soil several times to fill the sampler with soil from the target interval. After the VOC sample was collected, the soil in the bowl was homogenized with a stainless steel spoon, and soil for other parameters was then transferred into the appropriate sample containers. Soil samples were collected in accordance with the SOPs “Soil Sampling” and “Shallow Soil Sampling.” All soil borings were logged in the field using the Unified Soil Classification System (USCS) in accordance with the SOP “Logging of Soil Borings.” (CH2M HILL, 2003a).

8 PI/PAOC Sites PA/SI (2006)

Surface soil samples were collected at PI-4, PI-7, PAOCs J, K, L, N, S, and U during the December 2005 through April 2006 sampling event. Surface soil samples were collected using a stainless steel hand auger or split-spoon sampler. Soil sampling procedures followed those described above for the 2004 PA/SI. An additional soil sample was collected at PAOC S (SS05) for grain size analysis, the results of which are provided in Appendix E.

Several deviations from the Work Plan occurred during surface soil sampling, as shown in Table 2-1. At PI-4, the surface soil samples at the former fuel bladder storage area were collected from 0 to 0.5 ft bls instead of 0 to 1 ft bls, as specified in the Work Plan. This is because concrete was encountered at 0.5 ft bls. The concrete was subsequently drilled through in order to collect the subsurface soil samples.

In addition to the above, two of the four surface soil samples at PAOC L (SS01 and SS03) were inadvertently collected from 0 to 2 ft bls instead of 0 to 1 ft bls, as specified in the Work Plan. Although inadvertent, the dual sampling depths help delineate the vertical extent of contamination, as discussed in Section 18.

2.2 Subsurface Soil Sampling

Subsurface soil samples were collected during the Phase I Environmental Assessment in 2000, the UST removal at AOC A in 2003, the 2004 12 Consent Order site PA/SI, and the 2006 8 PI/PAOC site PA/SI. All subsurface soil samples, analyses, nomenclature, and sampling depths are shown on Table 2-1. The table includes explanations for sampling depth intervals other than those defined in the work plans. Boring logs for soil samples are included in Appendix D.

Phase I Environmental Assessment (2000)

Subsurface soil samples were collected at SWMU 10 using a hand auger. In accordance with the Work Plan, subsurface samples were collected between 3.5 and 5 ft bls (Table 2-1).

UST removal at AOC A (2003)

Subsurface soil samples were collected at four locations at AOC A in July 1997, during UST replacement activities. The four samples collected in 1997 are not included in this report because a new UST was installed and subsequently excavated with additional soil in 2003. However the closure report for the initial UST (IT, 2000) can be found on the Vieques website. Following removal of the second UST in 2003, confirmatory subsurface soil samples were collected from 10 locations at varying depths adjacent to the former UST and associated piping, as shown in Table 2-1.

12 Consent Order Sites PA/SI (2004)

Subsurface soil samples were collected at SWMUs 2, 4, and 10 during the January/February 2004 sampling event. Subsurface soil samples were collected using a hand auger (SWMU 10) or a 3-inch-diameter split-spoon sampler (SWMUs 2 and 4) with a drilling rig to obtain a sufficient amount of soil for all of the analyses. Soil sample collection into sample containers was performed in the same manner as that used for surface soil samples.

For SWMU 2, the Work Plan stated soil would be sampled continuously to 15 ft, and samples would be collected from the soil within the three intervals with the highest organic vaporizer analyzer (OVA) headspace readings. However, bedrock was encountered at 4 ft to 5 ft and there were no OVA headspace detections above background. Therefore, the subsurface soil sample in each boring was collected directly above bedrock. Appendix D includes soil boring logs with flame ionization detector (FID) and organic vapor meter (OVM) headspace readings collected in the field.

The SWMU 4 soil boring (CGW4SB01) was advanced to 6 ft bls and soil samples were screened continuously with an OVA. No elevated OVA readings were observed, as shown in Appendix D. Therefore, the subsurface soil sample for analysis was collected from the 4-to-6-ft interval.

Sixteen subsurface soil samples were obtained at SWMU 10. These samples were obtained by boring with a hand auger until the black plastic liner was encountered. Once this was found, a sample was obtained from just below the liner to approximately 8 inches below the liner (i.e., one auger bucket length). The subsurface samples were collected immediately below the liner to determine if the liner had remained intact. The black plastic liner was approximately 2 millimeters (mm) in thickness and appeared to be in good condition. The assumed use of this liner was to prevent leaching of the waste into the soils below the liner**.** All subsurface soil borings were grouted to the surface after completion to effectively re-seal the liner.

8 PI/PAOC Sites PA/SI (2006)

Subsurface soil samples were collected at PI-4, PI-7, PAOC J, K, L, N, S, and U during the December 2005 through April 2006 sampling event. Subsurface soil samples were collected using the hollow stem auger drilling method with a 3-inch-diameter stainless steel split spoon. Subsurface soil samples were collected for analysis as follows:

- At each location, a subsurface soil sample was collected in the 2-ft interval within the 2-ft to 6-ft zone, based on where visual and/or OVA screening suggested the presence of contamination. In the absence of visual or screening evidence of potential contamination, the subsurface soil sample was collected from the 4-ft to 6-ft interval (or just above the water table or bedrock, if encountered before this depth).
- If bedrock was found deeper than 6 ft, and if contamination was suspected below 6 ft, based on visual and/or OVA screening, an additional subsurface soil sample was to be collected from the interval where the highest level of contamination was suspected. This condition was not encountered during the investigation.

The subsurface soil sampling depth and associated rationale are included in Table 2-1 and discussed in each 8 PI/PAOC site section. Actual PID and/or FID readings and refusal depths can be found on the soil boring logs in Appendix D.

2.3 Monitoring Well Installation and Development

Five monitoring wells were installed at SWMU 1 and five monitoring wells were installed at SWMU 10 during the 2004 PA/SI. During the 2006 PA/SI at the 8 PI/PAOC sites, five

monitoring wells were installed at PI-4, three at PI-7, one at PAOC L, two at PAOC N, one at the PAOC S powerhouse, and one at PAOC U. Well construction details are provided in Table 2-3. PAOC J was scoped to have a monitoring well installed, but groundwater was not encountered at the site during the borehole drilling, so the boring was subsequently abandoned in accordance with the SOP "Soil Boring Drilling and Abandonment" (CH2M HILL, 2003a). It is noted that surface and subsurface soil data collected at PAOC J suggest a release did not likely occur at the site (see Section 16).

Each monitoring well was constructed following the SOPs "Installation of Shallow Monitoring Wells" and "Installation of Bedrock Monitoring Wells" (CH2M HILL, 2003a). Each monitoring well is equipped with a concrete pad, a protective above ground casing with a locking cap to minimize the potential for unauthorized access to the wells, and two protective bollards.

The monitoring well screens were installed into the first encountered groundwater within the bedrock using hollow stem auger and air rotary/hammer drilling methods. Monitoring well CGW1MW03 at SWMU 1 was the only monitoring well installed using only the hollow stem auger drilling technique. All others used a combination of hollow stem auger drilling to bedrock followed by air rotary drilling to the water zone. During the drilling of the boreholes for the monitoring wells, split spoon samples were collected either continuously or at approximately 5-ft intervals for the 12 Consent Order sites, and continuously for the 8 PI/PAOC sites until bedrock was encountered. Split spoon sampling followed the SOP "Soil Boring Sampling-Split Spoon" (CH2M HILL 2003a). The cuttings were examined for lithology and all borings for wells were logged in the field during drilling. Soil boring logs are shown in Appendix D.

During drilling, drill cuttings were screened with an OVM or an OVA for the potential presence of volatile organic compound (VOC) vapors. OVM and OVA screening was in accordance with the SOPs "Volatiles Monitoring by OVM" and "Volatiles Monitoring with an OVA" (CH2M HILL, 2003a).

The unconsolidated material was unsaturated, and the saturated zone was first encountered in the bedrock, at a depth of approximately 35 to 40 ft bls or more. Because the PA/SI is intended as a release assessment, and because there were no existing wells at these sites, it was important to identify the first encountered groundwater during the PA/SI for proper screen placement. Therefore, coring was performed only where multiple wells per site were planned, or where single wells were to be installed at sites that are in close proximity to each other. Specifically, coring was done at three sites at the following monitoring well borings:

- PI-4: MW-2 and MW-4
- PI-7: MW-1
- PAOC S: MW-1

A core was intended to be collected at PAOC J, K or L, but the first borehole drilled (at PAOC J) remained dry to 100 ft bls for 2 days. Because only one additional well remained to be installed in that area, it was not cored so that the first-encountered groundwater could be identified. However, PAOCs J, K, and L are close to PAOC S, where a core was collected, as shown above. Where coring was performed, continuous coring (from top of bedrock through the screen interval [i.e., approximately 10 ft below the water table]) was attempted.

Two-inch-diameter or 4-inch-diameter core samples were collected using a 5-ft or 10-ft core barrel with the minimal amount of water required. Descriptions of the rock cores are presented in Appendix D. Photographs of the rock cores for PI-7 MW-1 are included in Appendix F. The cores were described in the field by a geologist to include features such as fractures, weathering, rock type, bedding, and joints. Following coring, the air hammer method to the total depth of the boring was accomplished. The wells were then installed and screened across the piezometric surface.

Although not required by the Work Plan, to supplement information from the rock coring, video logging was performed on various wells. The video logs provide information over that of the cores, such as first encountered groundwater and fracture features in their relatively undisturbed state. They also assist in identifying optimal intervals for well screen placement. Video logs for four boring locations (PI-7, MW-1 and MW-3; PAOC J, MW-1; and PAOC L, MW-1) are included in Appendix G. Monitoring well completion diagrams are presented in Appendix H.

Well development procedures followed protocols established in the SOP "Installation of Shallow Monitoring Wells (Section C)" (CH2M HILL, 2003a). All well development logs are presented in Appendix I.

2.4 Monitoring Well Purging and Sampling

This subsection summarizes the well purging and sampling activities conducted during the 2004 and 2006 PA/SIs. New, dedicated Teflon® tubing was used for sampling each well. For both PA/SI events, measurements of temperature, conductivity, redox potential, dissolved oxygen (DO), pH, turbidity, and depth to water were collected during purging. Table 2-1 lists the groundwater samples and analyses by site and Table 2-4 lists a summary of the field parameter measurements taken just prior to groundwater sample collection. All groundwater sampling data sheets are shown in Appendix J.

The pump and cables were decontaminated between wells by washing with Alconox® and potable water, rinsing with potable water, rinsing with isopropyl alcohol, and then performing a final rinse with distilled water. Potable water and distilled water were pumped through the submersible pump during rinsing.

12 Consent Order Sites PA/SI (2004)

Wells at SWMU 1 and SWMU 10 were purged and sampled either with a stainless steel Grundfos® submersible pump or a bladder pump, depending on the water volume and recharge rate of the well. There were several deviations from the low flow procedures outlined in the SOP "Low-Flow Groundwater Sampling from Monitoring Wells" (CH2M HILL, 2003a). For the monitoring wells sampled during the 2004 PA/SI, the following deviations were noted:

- Water level readings collected at intervals greater than every 5 minutes
- Purging flow rate sometimes exceeded 500 ml/min (SWMU 1, MW-1 and MW-2; and SWMU 10, MW-1 and MW-4)

- Water level drawdown during purging exceeded 0.3 ft (SWMU 1, MW-1, 3, 4, 5; and SWMU 10, MW-2, 3, 5)
- Redox potential last three readings were greater than 10% difference (SWMU 1, MW-4, 5; and SWMU 10 MW-5)
- Turbidity readings last three readings were greater than 10% difference (SWMU 1, MW-1, 2, 3, 4, 5; and SMWU 10, MW-1, 2, 3, 4, 5)
- Conductivity readings last three readings were greater than 3% difference (SMWU 1, MW-4)
- Sampling flow rate sometimes exceeded 200 ml/min (SMWU 1, MW-1, 2, 3, 4; and SWMU 10, MW-1, 4, 5)
- One monitoring well was pumped dry (SWMU 1, MW-5)

Although there were deviations from the low flow sampling procedures, it is unlikely the sampling methodology affected the quality of the data such that conclusions would be affected. However, as discussed in the site-specific sections for SWMU 1 and SWMU 10, resampling of the wells is proposed as part of an expanded SI.

8 PI/PAOC Sites PA/SI (2006)

The wells at the PI/PAOC sites were either purged and sampled with a stainless steel Grundfos® submersible pump, a bailer, or a peristaltic pump, depending on the depth to water and the water recharge rate of the well. There were a few deviations from the low flow procedures outlined in the SOP "Low-Flow Groundwater Sampling from Monitoring Wells" (CH2M HILL, 2003a). For the monitoring wells sampled during the 2006 PA/SI, the following deviations were noted:

- Water level drawdown during purging exceeded 0.3 ft at monitoring wells PI-4 MW-4, PI-7 MW-1, MW-2, and MW-3, PAOC N MW-1, PAOC S MW-1, and PAOC U MW-1 due to low well capacities (i.e., the aquifer permeability was lower than the lowest flow rate possible).
- PAOC L MW-1 was purged dry and allowed to recover prior to sampling, as described in guidance.
- DO for the last three reading varied by more than 10% at monitoring well PI-4 MW-1 (1.04, 2.07, and 2.09 milligrams per liter [mg/L]), but the final two readings differed by less than 1%. All other parameters had stabilized to within target levels.
- Turbidity for the last three readings varied by more than 10% at monitoring wells PI-4 MW-2 and MW-3, PI-7 MW-2 and MW-3, PAOC L MW-1, PAOC U MW-1. Most were close to 10%, with the highest being 29% in PI-4 MW-2. This is likely due to the wells being unable to sustain even the low flow rate utilized. Further, the other parameters had stabilized to within target levels and the turbidity values were all below 7 NTUs.

2.5 Groundwater Elevation Measurements

All groundwater elevation measurements were conducted in accordance with the SOP "Water Level Measurements" (CH2M HILL, 2003a). An electronic water level meter was used to measure the depth to water from the top of casing (TOC) of each monitoring well. Groundwater elevations were determined by measuring the depth to water from the TOC elevations. Water level measurements are presented in Table 2-5. It is noted that some of the water elevation values are negative. The most likely reason for this is the surveyed well elevations used local benchmarks that were not current with the national standard. However, this does not affect the estimated direction and magnitude of groundwater flow for each site because the measured water levels are accurate relative to each other.

12 Consent Order Sites PA/SI (2004)

Depth to water measurements were obtained prior to groundwater sampling from monitoring wells at SWMU 1 on February 5, 2004, and from monitoring wells at SWMU 10 on February 7, 2004. Groundwater flow diagrams developed from the groundwater elevation measurements are located in Section 3 (SWMU 1) and Section 9 (SWMU 10).

8 PI/PAOC Sites PA/SI (2006)

Depth to water measurements were obtained prior to groundwater sampling from monitoring wells at PI-4, PI-7, and PAOCs L, N, S, and U on March 6, 2006. A groundwater flow diagram for PI-4 developed from the groundwater elevation measurements is located in Section 14.

2.6 Surveying

Both global positioning system (GPS) and traditional surveying techniques were used to record sample locations for the base mapping of the sites. Prior to surveying any sample locations, a first order control network was set up. This was done by using an array of control points that were strategically located across the entire island. Three dual frequency GPS instruments were used to tie in all of the control points to two National Geodetic Monuments. The horizontal accuracy level of this network is ± 0.005 mm. This GPS network provided the horizontal control for all survey activities.

Real-Time Kinematic (RTK) GPS was used for the majority of sampling locations. These locations comprised monitoring wells, surface soil samples, and soil borings. The RTK GPS method uses a base station and rover units to establish a position with an accuracy level of ±0.02 centimeters (cm). Traditional techniques were used in areas where GPS signals were not available. A total station system was used to tie in positions where satellites were obstructed. Elevations for the TOCs of the monitoring wells were surveyed using traditional techniques. An automatic level was used to determine elevations for each site.

Different sets of data were generated for the activities completed in 2000, 2004, and 2006. In 2000, horizontal coordinates of all the samples were expressed in the World Grid System of 1984 (WGS84), latitude and longitude. The elevations for the monitoring wells were reported in meters and converted to feet, to the nearest 0.01 ft. These elevations refer to the

National Geodectic Vertical Datum of 1929 (NGVD29). Elevations were established from a standard tablet found in a concrete wall, stamped "53 R 1941, 3.1 meters."

In 2004 and 2006, all horizontal coordinates were given in WGS84 latitude and longitude, as well as Universal Transverse Mercator Zone 20 (UTM20) northing and easting (meters). The 2004 elevations refer to NGVD29 and were in meters with an accuracy level of ±0.003 mm. Elevations at each monitoring well were surveyed and adjusted to mean sea level. Historical, island-based benchmarks were used to determine the vertical control on the island. It appears from the groundwater elevations (some being negative, as shown in Table 2-5) that the benchmarks may not be accurate in relation to sea level. However, the groundwater flow direction and magnitude are accurate relative to each other. RTK GPS methods were used to help locate and stake transect lines during clearing activities at SWMU 1. All survey data information is shown in Appendix L.

2.7 Geophysical Survey

A geophysical survey was conducted across the SWMU 1 landfill from January 27 to 30, 2004, to map the spatial extent of former disposal cells and trenches. The geophysical investigation was performed by Geoview, Inc. using electromagnetic (EM) and Total Field Magnetics (magnetic) techniques, which can determine the presence and location of buried metallic debris.

Geophysical transects were run on approximately 100-ft line spacings in both east-west and north-south directions over the former landfill areas mapped from aerial photographs. Data were collected digitally and locations maintained using a GPS.

The starting points for the geophysical survey transects were located based on the locations (latitude and longitude) of the former landfill cells and trenches determined through interpretation of aerial photographs of the site (ERI, 2000). Profiles of magnetic and EM data were developed for each transect. Geophysical anomalies were interpreted from the profiles and plotted on a SWMU 1 base map. The geophysical investigation results can be found in Appendix M and maps showing the results are presented in Section 3.

2.8 Munitions and Explosives of Concern Avoidance Surveys

A munitions and explosives of concern (MEC) avoidance survey was conducted by USA Environmental, Inc. at SWMUs 1, 2, 5, 8, 10, 12, and AOC G during the 2004 PA/SI. The MEC avoidance survey was conducted at soil boring locations, egress pathways, at drilling locations for monitoring wells, and along 18 transects at SWMU 1.

The majority of time spent for the MEC avoidance survey work was at SWMU 1, which consisted of one unexploded ordnance (UXO) technician walking in the woods with a Schonstedt metal detector and a GPS to perform a sweep to check for the presence of ordnance in advance of the bulldozer. An additional UXO technician followed the bulldozer as it cleared a path through the woods and visually inspected for any MEC items that might have been uncovered by the bulldozer clearing activities. This procedure was used for all sites where vegetation was cleared (SWMU 1, 2, and 10). SWMU 1 and SWMU 10

monitoring well locations were cleared using a Schonstedt metal detector before drilling began and at 2-ft intervals from ground surface to 10 ft bls.

No MEC items were identified during the clearing and survey efforts at the seven sites surveyed. The only military operations-related items identified during the 2004 PA/SI field activities comprised two expended M125 Series Signal Flares (Slap Flares) found in the SWMU 1 area.

2.9 Decontamination of Sampling Equipment and Investigation-derived Waste Management

All decontamination of non-disposable sampling equipment used during the 12 Consent Order PA/SI and the 8 PI/PAOC PA/SI was done in accordance with the SOPs "Decontamination of Personnel and Equipment" and "Decontamination of Drill Rigs and Equipment" (CH2M HILL, 2003a). The Phase I Environmental Assessment decontamination procedures were performed in 2000, prior to finalization of the Master Work Plan, but were completed in accordance with the draft version.

All decontamination fluids, well purging water and soils from drilling activities for the 12 Consent Order Sits (33 drums) and the 8 PI/PAOC Sites (61 drums) were collected and stored onsite in labeled 55-gallon drums and managed in accordance with the Investigation-derived waste (IDW) procedure in the IDW Management Plan (CH2M HILL, 2003a). Drums of decontamination fluids and soils were stored at a designated location within Camp Garcia (tent structure in northwest corner of Camp Garcia) and composite water and soil samples were collected and analyzed for toxicity characteristic leaching procedure (TCLP) analysis, ignitability, reactive cyanide, reactive sulfide, and corrosivity. Laboratory data for the IDW samples are included in Appendix K. Drums were disposed of as non-hazardous waste at the BFI landfill in Ponce, Puerto Rico (33 drums of soil and water from the 12 Consent Order site PA/SI) and the Penuelas Valley Landfill in Penuelas, Puerto Rico (61 drums from the 8 PI/PAOC site PA/SI. Landfill acceptance forms are included in Appendix K. The landfill acceptance form for the 12 Consent Order sites lists 77 drums, but this drum count includes 44 drums from west Vieques sites with the 33 drums from the 12 Consent Order sites on east Vieques. No IDW was collected during the 2000 Phase I Environmental Assessment.

2.10 Laboratory and Field Sampling Protocol

Surface soil, subsurface soil, and groundwater samples collected for analyses were placed on ice and shipped via overnight courier to Progress Environmental Laboratories located in Tampa, Florida for the 12 Consent Order sites, and to CompuChem Laboratories in Cary, North Carolina for the 8 PI/PAOC sites. Both contracted laboratories fulfilled the requirements of the U.S. Navy's QA/QC Program Manual and followed procedures outlined in the Master QAPPs (Baker, 1995; CH2M HILL, 2003a).

2.11 Sample Analysis and Quality Assurance/Quality Control

Samples were analyzed for constituents shown in Table 2-1. All analytical tests were conducted in accordance with the appropriate analytical methods described in the Data Quality Evaluation Reports (Appendix N). The number and frequency of the quality assurance/quality control (QA/QC) samples are also presented in the Data Quality Evaluation Reports. All raw laboratory data are included in Appendix O. Tables of detected constituents and screening value exceedances are included in the site-specific sections (i.e., Sections 3 through 21).

2.12 Data Validation and Evaluation

Analytical results were validated by independent, third-party validators approved by the Navy. Data validators used EPA's Region 2 worksheets utilizing the EPA guidance document *Contract Laboratory Program National Functional Guidelines for Organic Data Review* (EPA, 1999c) and *Inorganic Data Review* (EPA, 2002b), modified for SW846 criteria. Areas of review (when applicable to the method) include holding time compliance, calibration verification, blank results, matrix spike precision and accuracy, method accuracy as demonstrated by laboratory confirmation samples (LCSs), field duplicate results, surrogate recoveries, internal standard performance, and interference checks. A Region 2 data review worksheet was completed for each method of each data package and any non-conformance was documented. This data review and validation process is independent of the laboratory's checks and focuses on the usability of the data to support the project data interpretation and decision-making processes.

The validation of data was done in accordance with the Master QAPPs (Baker, 1995; CH2M HILL, 2003). Site specific data validation information is included in the Data Quality Evaluation Reports in Appendix N.

TABLE 2-1
Site Sample Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site	Investigation	Media Samples[1]	Analytes	Sample Identification	Soil Sample Depth (ft bls)
SWMU 1	2004 Phase I RFI (PA/SI)	45 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGW1SS01 through CGW1SS07, CGW1SS09 through CGW1SS16, CGW1SS18 through CGW1SS32, CGW1SS34, CGW1SS36 thru CGW1SS47, CGW1SS49, CGW1SS50	0 - 0.7; depth in general accordance with Work Plan
		5 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals; Explosives, Perchlorate, Cyanide, Sulfide	CGW1SS08,CGW1SS17, CGW1SS33, CGW1SS35, CGW1SS48	0 - 0.7; depth in general accordance with Work Plan
		3 GW	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals (total and dissolved); Explosives, Perchlorate	CGW1MW01, CGW1MW03, CGW1MW05	
		2 GW	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals (total and dissolved); Explosives, Perchlorate, Cyanide, Sulfide	CGW1MW02, CGW1MW04	
SWMU 2	2004 Phase I RFI (PA/SI)	8 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGW2SS01, CGW2SS02, CGW2SS04, CGW2SS05, CGW2SS06, CGW2SS08, CGW2SS10, CGW2SS11	0 - 0.7; depth in general accordance with Work Plan
		4 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals; Explosives, Perchlorate, Cyanide, Sulfide	CGW2SS03, CGW2SS07, CGW2SS09,CGW2SS12	0 - 0.7; depth in general accordance with Work Plan
		1 SB	Appendix IX VOCs, SVOCs, Dioxins; Cyanide, Sulfide	CGW2SB01	3 - 5; depth just above bedrock
		1 SB	Appendix IX VOCs, SVOCs	CGW2SB02	3 - 5; depth just above bedrock
SWMU 4	2000 Phase I Environmental Assessment	12 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals	CGSWMU4SS001 through CGSWMU4SS012	0 - 0.7; depth in general accordance with Work Plan
	2004 Phase I RFI (PA/SI)	1 SB	Appendix IX VOCs, SVOCs	CGW4SB01	4-6; depth in accordance with Work Plan
SWMU 5	2004 Phase I RFI (PA/SI)	1 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals; Explosives, Perchlorate, Cyanide, Sulfide	CGW5SS01	0 - 0.7; depth in general accordance with Work Plan
		3 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGW5SS02, CGW5SS03, CGW5SS04	0 - 0.7; depth in general accordance with Work Plan
SWMU 6/7	2000 Phase I Environmental Assessment	10 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals	CGSWMU6/7SS001 through CGSWMU6/7SS010	0 - 0.7; depth in general accordance with Work Plan
SWMU 8	2004 Phase I RFI (PA/SI)	4 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGW8SS01, CGW8SSS03, CGW8SS04, CGW8SS05	0 - 0.7; depth in general accordance with Work Plan
		1 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals; Explosives, Perchlorate, Cyanide, Sulfide	CGW8SS02	0 - 0.7; depth in general accordance with Work Plan
SWMU 10	2000 Phase I Environmental Assessment	4 SS	TCLP VOCs, SVOCs, Metals	CGWWTPSS001 through CGWWTPSS004	0 - 0.7; depth in general accordance with Work Plan
		4SB	Appendix IX VOCs, SVOCs, Metals (for TCLP parameters); TPH; TCLP VOCs, SVOCs, Metals, Cyanide	CGWWTPSB001 through CGWWTPSB004	4 -5 (SB001 through SB003); 3.5 - 4.5 (SB004); depths in general accordance with Work Plan
		1 WW	Appendix IX VOCs, SVOCs, Metals; TPH, Cyanide, Nitrate, Nitrite, Sulfate, Sulfide	CGWWTPWW001	
	2004 Phase I RFI (PA/SI)	9 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGW10SS05, CGW10SS08, CGW10SS09, CGW10SS12, CGW10SS14, CGW10SS16, CGW10SS17, CGW10SS18, CGW10SS20	0 - 0.7; depth in general accordance with Work Plan
		7 SS/4 SB	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals; Explosives, Perchlorate, Cyanide, Sulfide	CGW10SS06/CGW10SB06, CGW10SS07, CGW10SS10, CGW10SS11/CGW10SB11, CGW10SS13/CGW10SB13, CGW10SS15, CGW10SS19/CGW10SB19	0 - 0.7 (SS); 3 - 3.6 (SB06); 2 - 2.7 (SB11); 0.7 - 1.3 (SB13); 0.8 - 1.5 (SB19); depths in general accordance with Work Plan
		12 SB	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGW10SB05, CGW10SB07, CGW10SB08, CGW10SB09, CGW10SB10, CGW10SB12, CGW10SB14, CGW10SB15, CGW10SB16, CGW10SB17, CGW10SB18, CGW10SB20	0.7 - 1.3 (SB05, SB07, SB08, SB14); 0.9 - 1.5 (SB09); 0.8 - 1.5 (SB10); 1.1 - 1.8 (SB12); 0.7 - 1.5 (SB15); 0.8 - 1.4 (SB16); 0.5 - 1.2 (SB17); 1 - 1.6 (SB18); 0.8 - 1.5 (SB20); depths just below liner depth, in accordance with work plan
		3 GW	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals (total and dissolved); Explosives, Perchlorate	CGW10MW01, CGW10MW02, CGW10MW03	
		2 GW	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals (total and dissolved); Explosives, Perchlorate, Cyanide, Sulfide	CGW10MW04, CGW10MW05	
SWMU 12	2004 Phase I RFI (PA/SI)	4 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGW12SS01 through CGW12SS04	0 - 0.7; depth in general accordance with Work Plan
		1 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals; Explosives, Perchlorate, Cyanide, Sulfide	CGW12SS05	0 - 0.7; depth in general accordance with Work Plan
AOC A	April 2003 UST Closure	10 SB	BTEX, TPH-GRO, TPH-DRO, Naphthalene, Lead	CGAAUST01 through CGAAUST10	6 - 10 (ST01, ST02); 4 - 5 (ST03 through ST06); 2 - 3 (ST07 through ST10); depths at bottom and sidewalls of excavation
AOC F	2000 Phase I Environmental Assessment	5 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals	CGAOCFSS001 through CGAOCFSS005	0 - 0.7; depth in general accordance with Work Plan
AOC G	2004 Phase I RFI (PA/SI)	4 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Explosives, Perchlorate	CGAGSS01, CGAGSS02, CGAGSS03, CGAGSS05	0 - 0.7; depth in general accordance with Work Plan
		1 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Dioxins, Metals; Explosives, Perchlorate, Cyanide, Sulfide	CGAGSS04	0 - 0.7; depth in general accordance with Work Plan
PI 4	2002 EBS	2 SS	TPH-GRO and DRO	PI4-1, PI4-2	0 - 0.5
	2006 PA/SI	7 SS/SB	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals	EPI04-SS04-0001/EPI04-SB04-0406, EPI04-SS08-0001/EPI04-SB08-0406 through EPI04-SS13-0001/EPI04-SB13-0406	0 - 1 (SS); 4 - 6 (SB); default depths in accordance with Work Plan
		6 SS/SB	TCL VOCs, SVOCs, Pesticides; TAL Metals	EPI04-SS01-0001/EPI01-SB01-0406 through EPI04-SS03-0001/EPI04-SB03-0406, EPI04-SS05-0001/EPI04-SB05-0406 through EPI04-SS07-0001/EPI04-SB07-0406	0 - 1 (SS); 4 - 6 (SB); default depths in accordance with Work Plan
		2 SS/SB	TCL VOCs, SVOCs; TAL Metals	EPI04-SS14-0001/EPI04-SB14-0406, EPI04-SS15-0001/EPI04-SB15-0406	0 - 0.5 (SS); 4 - 6 (SB); surface soil samples hit refusal (concrete; subsequently drilled through) at approximately 0.5 foot bls; default subsurface depth in accordance with Work Plan
		5 GW	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals (total and dissolved)	EPI04-GW01-06B, EPI04-GW02-06B, EPI04-GW03-06B, EPI04-GW04-06B, EPI04-GW05-06B	

Notes:
1 SS = surface soil; SB = subsurface soil; GW = groundwater; WW = water

TABLE 2-1
Site Sample Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site	Investigation	Media Samples[1]	Analytes	Sample Identification	Soil Sample Depth (ft bls)
PI 7	2002 EBS	2 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Sulfide, Cyanide, Mercury	PI7-3, PI7-4	0 - 0.5
		2 SS	Appendix IX VOCs, SVOCs, Pesticides, PCBs, Herbicides, Metals; Sulfide, Cyanide, Mercury; TPH-GRO and DRO	PI7-1, PI7-2	0 - 0.5
	2006 PA/SI	22 SS/18 SB	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals	EPI07-SS01-0001/EPI07-SB01-0406 through EPI07-SS10-0001/EPI07-SB10-0406, EPI07-SS11-0001/EPI07-SB11-0102, EPI07-SS12-0001, EPI07-SS13-0001, EPI07-SS14-0001/EPI07-SB14-0406, EPI07-SS15-0001/EPI07-SB15-0204, EPI07-SS16-0001/EPI07-SB16-SB-0204, EPI07-SS17-0001/EPI07-SB17-0102, EPI07-SS18-0001/EPI07-SB18-0204, EPI07-SS19-0001/EPI07-SB19-0204, EPI07-SS20-0001, EPI07-SS21-0001/EPI07-SB21-0103, EPI07-SS22-0001	0 - 1 (SS); 4 - 6 (SB01 - SB10, SB14); 1 - 2 (SB11, SB17); 1 - 3 (SB21); 2 - 4 (SB15, SB16, SB18, SB19); surface and subsurface soil depths in accordance with Work Plan; subsurface soil sample depths shallower than 4 - 6' due to refusal
		3 GW	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals (total and dissolved)	EPI07-GW01-06B, EPI07-GW02-06B, EPI07-GW03-06B	
PAOC J	2006 PA/SI	6 SS/SB	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals	EPAJ-SS01-0001/EPAJ-SB01-0405 through EPAJ-SS06-0001/EPAJ-SB06-0406	0 - 1 (SS); 4 - 6 (SB except SB01); 4 - 5 (SB01); depths in accordance with Work Plan, including refusal in SB01
PAOC K	2006 PA/SI	5 SS/SB	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals	EPAK-SS01-0001/EPAK-SB01-0406 through EPAK-SS05-0001/EPAK-SB05-0406	0 - 1 (SS); 4 - 6 (SB); default depths in accordance with Work Plan
PAOC L	2006 PA/SI	4 SS/SB	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals	EPAL-SS01-0002/EPAL-SB01-0204, EPAL-SS02-0001/EPAL-SB02-0406, EPAL-SS03-0002/EPAL-SB03-0406, EPAL-SS04-0001/EPAL-SB04-0204	0 - 1 (SS02, SS03, SS04); 0 - 2 (SS01); 2 - 4 (SB01, SB04); 4 - 6 (SB02, SB03); SS01 and SS03 inadvertently collected 0 - 2'; all other depths in accordance with Work Plan, including refusal at SB01 and SB04
		1 GW	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals (total and dissolved)	EPAL-GW01-06B	
PAOC N	2006 PA/SI	4 SS/SB	TCL VOCs, SVOCs; TAL Metals; TPH-GRO, TPH-DRO, TPH-ORO	EPAN-SS01-0001/EPAN-SB01-0406, EPAN-SS02-0001/EPAN-SB02-0406, EPAN-SS03-0001/EPAN-SB03-0103, EPAN-SS04-0001/EPAN-SB04-0406	0 - 1 (SS); 4 - 6 (SB except SB03); 1 - 3 (SB03); depths in accordance with Work Plan, including area of slightly elevated PID reading for SB03
		2 GW	TCL VOCs, SVOCs; TAL Metals (total and dissolved); TPH-GRO, TPH-DRO, TPH-ORO	EPAN-GW01-06B, EPAN-GW02-06B	
PAOC S	2006 PA/SI	5 SS/SB	TCL VOCs, SVOCs, Pesticides, PCBs; TAL metals	EPAS-SS01-0001/EPAS-SB01-0406 through EPAS-SS05-0001/EPAS-SB05-0406	0 - 1 (SS); 4 - 6 (SB); default depths in accordance with Work Plan
		16 SS/14 SB	TCL VOCs and SVOCs	EPAS-SS06-0002/EPAS-SB06-0406 through EPAS-SS14-0002/EPAS-SB014-0406, EPAS-SS15-0002/EPAS-SB015-0204, EPAS-SS16-0002/EPAS-SB016-0406, EPAS-SS17-0002/EPAS-SB017-0204, EPAS-SS18-0002/EPAS-SB018-0406, EPAS-SS19-0002/EPAS-SB019-0204, EPAS-SS20-0002, EPAS-SS21-0002	0 - 2 (SS); 4 - 6 (SB06 through SB14, SB16, SB18); 2 - 4.5 (SB15); 2 - 3.8 (SB17); 2 - 4 (SB19); depths in accordance with Work Plan, including refusal at SB15, SB17, and SB19
		1 GW	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals (total and dissolved)	EPAS-GW01-06B	
PAOC U	2002 EBS	4 SS	Appendix IX VOCs, SVOCs, Pesticides, Herbicides, PCBs, Metals; Sulfide, Cyanide, Mercury, TPH-DRO, TPH-GRO	U-1, U-2, U-3, U-4	0 - 0.5
	2006 PA/SI	9 SS/SB	TCL VOCs, SVOCs, Pesticides, PCBs; TAL Metals; pH	EPAU-SS01-0001/EPAU-SB01-0406 through EPAU-SS09-0001/EPAU-SB09-0406	0 - 1 (SS); 4 - 6 (SB); default depths in accordance with Work Plan

Notes:
1 SS = surface soil; SB = subsurface soil; GW = groundwater; WW = water

TABLE 2-2
Navy Samples Split with EPA and PREQB During PA/SI Field Work
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site	Navy	EPA	PREQB
	Surface Soil Samples		
SWMU 1	CGW1SS01 through CGW1SS50	SS-08, SS-17, SS-33, SS-35, SS-48	
	Groundwater Samples		
	CGW1MW01 through CGW1MW05	MW-02, MW-04	MW-01, MW-03
	Surface Soil Samples		
SWMU 2	CGW2SS01 through CGW2SS12	SS-03, SS-07, SS-09, SS-12	
	Soil Boring Samples		
	CGW2SB01, CGW2SB02	SB-01, SB-02	
	Surface Soil Samples		
SWMU 4	CGW4SS01 through CGW4SS12		
	Soil Boring Samples		
	CGW4SB01	SB-01	
	Surface Soil Samples		
SWMU 5	CGW5SS01 through CGW5SS04	SS-01	
	Surface Soil Samples		
SWMU 6/7	CGW6/7SS01 through CGW6/7SS11		
	Surface Soil Samples		
SWMU 8	CGW8SS01 through CGW8SS05	SS-02	
	Surface Soil Samples		
SWMU 10	CGW10SS01 through CGW10SS20	SS-06, SS-07, SS-10, SS-11, SS-13, SS-15, SS-19	
	Soil Boring Samples		
	CGW10SB01 through CGW10SB20	SB-06, SB-11, SB-13, SB-19,	
	Groundwater Samples		
	CGW10MW01 through CGW10MW05	MW-04, MW-05	MW-02, MW-03
	Surface Soil Samples		
SWMU 12	CGW12SS01 through CGW12SS05	SS-05	
	Soil Boring Samples		
AOC A	CGAUST01 through CGAUST10		
	Surface Soil Samples		
AOC F	CGAOCFSS01 through CGAOCFSS05		
	Surface Soil Samples		
AOC G	CGAGSS01 through CGAGSS05	SS-04	

Notes:
MW = signifies a groundwater sample
SS = signifies a surface soil sample
SB = signifies a subsurface soil sample

TABLE 2-3
Summary of Well Construction Details
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site	Well ID	Date Installed	Top of Casing Elevation (ft amsl)	Ground Surface Elevation (ft amsl)	Well Depth (ft bls)	Screen Interval Depth (ft bls)	Screen Interval Elevation (ft amsl)
SWMU 1	CGW1MW01	1/15/2004	54.47	51.77	20.73	10.7 to 20.7	41.1 to 31.1
	CGW1MW02	1/15/2004	18.98	16.04	34.06	24.1 to 34.1	-8.1 to -18.1
	CGW1MW03	1/16/2004	15.32	12.75	29.98	19.9 to 29.9	-7.1 to -17.1
	CGW1MW04	1/17/2004	18.76	16.12	31.52	21.5 to 31.5	-5.4 to -15.4
	CGW1MW05	1/23/2004	19.04	16.17	37.08	22.0 to 37.0	-5.8 to -20.8
SWMU 10	CGW10MW01	1/23/2004	36.57	33.89	41.27	31.2 to 41.2	2.7 to -7.3
	CGW10MW02	1/20/2004	30.44	27.18	36.82	21.8 to 36.8	5.4 to -9.6
	CGW10MW03	1/20/2004	30.30	27.48	36.68	21.6 to 36.6	5.9 to -9.1
	CGW10MW04	1/21/2004	30.68	27.92	42.34	27.3 to 42.3	0.6 to -14.4
	CGW10MW05	1/23/2004	30.30	27.6	41.25	31.2 to 41.2	-3.6 to -13.6
PI 4	EPI04-MW01	1/30/2006	37.20	33.8	49.25	39 to 49	-5.2 to -15.2
	EPI04-MW02	2/2/2006	42.11	40.0	46.75	36.5 to 46.5	5.61 to -4.39
	EPI04-MW03	1/23/2006	44.10	41.0	47.25	37 to 47	4.0 to -6.0
	EPI04-MW04	1/27/2006	41.28	38.6	48.25	38 to 48	0.6 to -9.4
	EPI04-MW05	1/23/2006	34.71	32.1	43.25	33 to 43	-0.9 to -10.9
PI 7	EPI07-MW01	3/2/2006	106.67	103.4	72.25	57 to 72	46.4 to 31.4
	EPI07-MW02	2/22/2006	110.21	107.4	74.25	59 to 74	48.4 to 33.4
	EPI07-MW03	3/7/2006	184.90	181.7	72.25	47 to 72	134.7 to 109.7
PAOC L	EPAL-MW01	3/13/2006	81.74	78.7	31.25	21 to 31	57.7 to 47.7
PAOC N	EPAN-MW01	2/6/2006	71.43	68.5	42.25	32 to 42	36.5 to 26.5
	EPAN-MW02	2/2/2006	77.05	74.2	42.25	32 to 42	42.2 to 32.2
PAOC S	EPAS-MW01	2/10/2006	72.36	69.7	42.25	32 to 42	37.7 to 27.7
PAOC U	EPAU-MW01	2/17/2006	63.86	61.0	47.25	37 to 47	24.0 to 14.0

Notes:
amsl = Above Mean Sea Level
ft = feet
bls = Below Land Surface

TABLE 2-4
Summary of Final Water Indicator Parameters Prior to Groundwater Sample Collection
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site	Well ID	Purged Vol. (gals)	pH	Cond. (mmhos/cm)	Temp. (°C)	DO (mg/L)	ORP	Turbidity (NTU)
SWMU 1	CGW1MW01	14	6.67	510	31.67	4.7	137	14.2
	CGW1MW02	13.5	6.85	5,959	28.61	2.15	183	3.66
	CGW1MW03	9	6.7	10,137	27.99	0.62	137	30.9
	CGW1MW04	11.5	7.22	4,251	28.13	8.05	209.3	76.1
	CGW1MW05	6.8	7.35	4,885	28.08	5.31	122	35.6
SWMU 10	CGW10MW01	5.1	6.73	6,620	30.75	4.86	165	8.8
	CGW10MW02	3.3	6.16	20,925	28.2	2.67	111	3.94
	CGW10MW03	3	7.25	5,200	27.4	1.32	182	2.01
	CGW10MW04	7.8	6.73	8,117	29.12	7.15	127	0.92
	CGW10MW05	14	6.75	7,776	29.95	1.6	59.13	8.15
PI 4	EPI04-MW01	5	6.87	2110	29.89	2.09	251	5.87
	EPI04-MW02	3.1	6.73	2176	29.74	5.45	255.9	1.78
	EPI04-MW03	5	6.81	1672	30.19	9.3	290.8	6.23
	EPI04-MW04	0.4	6.75	3207	29.29	4.02	240.1	63.1
	EPI04-MW05	5.8	6.66	6127	28.89	4.72	180.8	9.42
PI 7	EPI07-MW01	3.8	6.59	1278	29.96	4.46	254.6	6.89
	EPI07-MW02	4.1	6.58	1250	30.15	2.88	223.6	4.09
	EPI07-MW03	5.2	6.65	1667	28.54	4.54	237.3	3.9
PAOC L	EPAL-MW01	1.1	7.43	1840	29.29	4.67	37.1	36
PAOC N	EPAN-MW01	2.2	7.04	1479	30.9	9.93	256.7	8.93
	EPAN-MW02	6.5	6.88	2252	28.64	10.91	253.7	7.35
PAOC S	EPAS-MW01	6.5	6.86	1969	29.74	9.3	250.4	5.4
PAOC U	EPAU-MW01	7.5	6.96	142.9	30.64	10.63	257	4.65

TABLE 2-5
Summary of Water Level Measurements
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site	Well ID	Date	Elevation (TOC) (ft amsl)	Depth to Water (ft btoc)	Groundwater Level (ft amsl)
SWMU 1	CGW1MW01	2/5/2004	54.47	19.19	35.28
	CGW1MW02	2/5/2004	18.98	25.75	-6.77
	CGW1MW03	2/5/2004	15.32	19.05	-3.73
	CGW1MW04	2/5/2004	18.76	21.09	-2.33
	CGW1MW05	2/5/2004	19.04	23.70	-4.66
SWMU 10	CGW10MW01	2/7/2004	36.57	40.36	-3.79
	CGW10MW02	2/7/2004	30.44	34.28	-3.84
	CGW10MW03	2/7/2004	30.30	34.02	-3.72
	CGW10MW04	2/7/2004	30.68	34.26	-3.58
	CGW10MW05	2/7/2004	30.30	33.88	-3.58
PI 4	EPI04-MW01	4/4/2006	37.20	39.08	-1.88
	EPI04-MW02	4/4/2006	42.11	43.38	-1.27
	EPI04-MW03	4/4/2006	44.10	46.03	-1.93
	EPI04-MW04	4/5/2006	41.28	43.71	-2.43
	EPI04-MW05	4/5/2006	34.71	37.46	-2.75
PI 7	EPI07-MW01	4/6/2006	106.67	64.80	41.87
	EPI07-MW02	4/6/2006	110.21	67.30	42.91
	EPI07-MW03	4/6/2006	184.90	46.15	138.75
PAOC L	EPAL-MW01	4/5/2006	81.74	27.75	53.99
PAOC N	EPAN-MW01	4/4/2006	71.43	37.80	33.63
	EPAN-MW02	4/3/2006	77.05	34.31	42.74
PAOC S	EPAS-MW01	4/3/2006	72.36	36.68	35.68
PAOC U	EPAU-MW01	4/3/2006	63.86	45.21	18.65

Notes:
ft btoc = feet below top of casing
amsl = Above Mean Sea Level
TOC = top of casing

SECTION 3

SWMU 1—Camp García Landfill

This section presents the results of the Phase I RFI (PA/SI) performed at SWMU 1—Camp García Landfill.

3.1 Conceptual Site Model

The CSM for SWMU 1 is based on review of historical information such as records, aerial photographs, site inspection documentation, site visit documentation, and interviews, as well as site-specific data collection.

3.1.1 Site History and Potential Sources of Release

SWMU 1 is located in the EMA, approximately 4,000 ft north-northwest of Blue Beach, roughly a mile east of the Camp García Compound Area (Figures 1-2 and 1-3). The landfill was not a permitted landfill, and according to the IAS, the landfill was unlined and in operation from approximately 1954 to 1978 (Greenleaf/Telesca and E&E, 1984). A VSI and interviews were done on August 10, 1988 and described the site as capped, re-vegetated, and showing no sign of stress or erosion (Kearney, 1988). When the landfill was operational, it was reportedly used for the disposal of municipal waste such as waste paper, corrugated containers, cans and food packaging material, rags, wood, scrap metal, and yard waste. Interviews of base employees indicated that one 5-ton dump truck was used every day, 5 days per week, to transport waste to this site (NAVFACENGCOM, 2003). No hazardous materials reportedly were placed in this disposal area (Greenleaf/Telesca and E&E, 1984). Since 1978, all waste from the former VNTR has been disposed in the Vieques municipal landfill. When operation of the landfill ceased in 1978, a cover consisting of compacted native soils was installed (NAVFACENGCOM, 2003). From 1954 through 1978, the landfill serviced an average population of 150 individuals that were stationed at Camp García. This number experienced short-term increases during maneuvers and other military exercises. According to the 1995 RFA, approximately 1,800 to 3,120 tons of waste were disposed in the landfill (PREQB 1995).

During its operation, the trench method of disposal was employed and land clearing was kept to a minimum to minimize erosion potential. A bulldozer was used to dig a trench into which materials were disposed. The trench was then covered with about 6 inches of soil to control blowing of litter. A final 2-ft-thick soil cover was placed over the trench (Greenleaf/Telesca and E&E, 1984).

An aerial photographic analysis of the landfill indicated that the fill area extended over an area of approximately 55 acres (ERI, 2000). The analysis of aerial photographs from 1959, 1962, 1964, and 1970 identified several trenches and landfill cells, as well as ground scarring and cleared vegetation, within the fill area, as shown in Figures 3-1 through 3-4. Figure 3-5 shows a composite of the features identified by ERI on the 2005 aerial photograph.

A dirt road was constructed down the center of the landfill in the mid-1980s. During the 1995 RFA (PREQB, 1995), no signs of erosion or stresses on vegetation were observed in the landfill area, and no documentation was found regarding releases of hazardous constituents from the landfill. During the February 2000 site visit as part of the joint EPA-Navy visit to all Consent Order sites, no signs of previous landfill activities were visible (CH2M HILL, 2001). A geophysical survey was completed as part of the 2004 PA/SI (Appendix M). The metallic anomaly areas identified within the disposal area during the geophysical survey are shown in Figure 3-6 (CH2M HILL, 2004). It is noted that the geophysical survey may not have extended far enough to delimit the landfill boundaries to the north and south, as indicated by the dashed lines in Figure 3-6.

There is no known historic information suggesting release(s) of hazardous waste or hazardous constituents occurred at SWMU 1. In fact, historical information indicates hazardous waste was not disposed of in the landfill. Further, during the site inspections and site visits described above, no physical evidence of a release was observed. However, as a conservative measure, the trenched areas containing municipal waste were considered potential sources of a release and were identified for PA/SI sampling. Potential releases would likely be leaching of constituents from the waste into soil and groundwater.

3.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted during the 1984 IAS (Greenleaf/Telesca and E&E, 1984), 1988 Phase II RFA (Kearney, 1988), 1995 Revised RFA (PREQB, 1995), 2000 Current Conditions assessment (CH2M HILL, 2001), 2002 EBS (NAVFACENGCOM, 2003), and the 2004 PA/SI, as well as on regional information.

Observations made during the various site visits indicated that the landfill is vegetated with dense grasses and trees. Several areas of debris (fill material) were observed during the clearing of geophysical transects. Debris observed included galley (kitchen) waste (cans, bottles, forks, knives), metal pipes, and a small metal tank. The trenches appeared as depressions after clearing, probably due to compaction of the decomposing galley waste. A barbed wire fence was installed at SWMU 1 along roads to limit public access to the site.

The topography at SWMU 1 consists of gently sloping terrain from the northwest to the southeast with approximately a 50-ft change in elevation from its highest point (approximately 65 ft amsl) to its lowest (approximately 15 ft amsl). An ephemeral stream is present at the site, along the eastern portion of the landfill, as shown in the aerial photographs (Figures 3-1 through 3-4) and the topographic map of the site (Figure 3-7). Mountainous terrain is located immediately west of the western edge of the site (Figure 1-2).

Figure 3-8 and Figure 3-9 show the generalized stratigraphy adjacent to the southern boundary (Figure 3-4) and through the landfill (Figure 3-9), based on the monitoring well boring logs. The geology encountered during drilling operations at SWMU 1 indicated sand is present from 0 to approximately 10 ft bls. Clay and clay with gravel was found from approximately 10 to 20 ft bls. The southern portion of the SWMU had a lean clay with sand from approximately 15 ft to 20 ft bls. This layer was not present to the north of SWMU 1, at location MW-01. Bedrock was encountered at approximately 15 ft to 30 ft bls. The shallowest bedrock was found at location MW-01 (furthest north, highest elevation) and the deepest bedrock was found at MW-05 (furthest south and lowest elevation). The majority of the site

resides within the geological unit Kv, which comprises sedimentary and igneous rocks deposited largely in a marine environment. The southern quarter of the site is within the Qa geologic unit, which consists of alluvial deposits of clay, silt, sand, and gravel. For more information on the regional bedrock geology, see Section 1.4.6.

Groundwater was encountered above bedrock at locations MW-1, 4, and 5. At locations MW-2 and MW-3 groundwater was first encountered below the bedrock surface. However, the potentiometric surface stabilized within the alluvial deposits at all drilling locations except MW-2 (furthest east), where the measured surface was within the bedrock. The groundwater elevation data, illustrated on Figure 3-10, show that groundwater flow is generally from the north toward the coast (south-southeast), which is located approximately ½ mile southeast of the landfill, and that the horizontal hydraulic gradient is approximately 0.012 ft/ft. Section 1.4.7 describes the regional groundwater flow in the vicinity of SWMU 1.

3.2 Sampling Approach and Chemical Constituents Identified

As presented in the Phase I RFI Work Plan (CH2M HILL, 2003c), 50 surface soil samples were collected throughout the landfill, focusing primarily on the areas where geophysical anomalies were identified (Figure 3-6). All surface soil samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, polychlorinated biphenyls (PCBs), and metals; and explosives, including perchlorate. Five surface soil samples (CGW1SS08, 17, 33, 35, and 48) were additionally analyzed for dioxins, cyanide, and sulfide.

As shown in Figure 3-6, five monitoring wells were installed at SWMU 1. Well MW-01 was installed north of the landfill to represent background conditions, while wells MW-02 through MW-05 were installed along the southern and southeastern boundary to characterize downgradient groundwater conditions. All groundwater samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, and metals (total and dissolved); and explosives, including perchlorate. The groundwater samples from two downgradient monitoring wells (MW-02 and MW-04) were additionally analyzed for dioxins, cyanide, and sulfide.

Table 3-1 and Table 3-2 summarize the constituents detected in SWMU 1 surface soil and groundwater samples, respectively, collected during the PA/SI and identify screening criteria exceedances. Raw analytical data for the samples are provided in Appendix O.

3.3 SWMU-1 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 3-1 and 3-2). It is important to note that the soil data discussed below are from the cover material of the landfill and do not likely reflect constituent concentrations associated with potential releases from the landfilled waste. They do, however, reflect the surficial material to which surface exposures would occur.

Appendix N, Section N.3 discusses the evaluation of the SWMU 1 data quality. As detailed in Section N.3, the SWMU 1 data are acceptable for use in evaluating aspects of environmental conditions at SWMU 1, which is done in Steps 1 through 5 below. However,

it is recognized that sufficient data have not been collected to draw conclusions regarding potential releases with adequate confidence, as discussed in Step 6 below. Therefore, additional data collection will be performed, as defined in Section 3.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information indicates the site is an unlined, non-permitted landfill used for approximately 25 years (1954 to 1978) for disposal of non-hazardous, municipal waste from personnel stationed at Camp Garcia. Although there were no signs of releases during site visits, due to the nature of the disposal activity, subsurface releases could occur. Because the site was identified as a Consent Order site, sample collection took place during the 2004 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background upper tolerance limits (UTLs) and non-inorganics were detected by medium:

<u>Surface soil</u>

- VOCs: methylene chloride, styrene
- SVOCs: 4-methylphenol, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, bis(2-ethylhexyl)phthalate, di-n-butylphthalate, pyridine
- Pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin ketone
- Herbicides: none detected
- PCBs: Aroclor-1221, Aroclor-1248, Aroclor-1254, Aroclor-1260
- Dioxins: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,4,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,6,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,7,8,9-heptachlorodibenzo-p-dioxin, 1,2,3,7,8-pentachlorodibenzo-p-dioxin, octachlorodibenzo-p-dioxin, total heptachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin, total pentachlorodibenzo-p-dioxin, total tetrachlorodibenzo-p-dioxin
- Explosives: none detected
- Inorganics above background UTLs: antimony, arsenic, beryllium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, zinc

<u>Groundwater</u>

- VOCs: none detected
- SVOCs: none detected
- Pesticides: none detected
- Herbicides: none detected
- PCBs: none detected

- Dioxins: none detected
- Explosives: none detected
- Total inorganics above background (well MW-01): antimony, barium, cadmium, cobalt, mercury, selenium, silver, thallium
- Dissolved inorganics above background (well MW-01): antimony, barium, chromium, cobalt, cyanide, mercury, nickel, selenium, silver, thallium, vanadium, zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Because there are no known records of all material placed in the SWMU 1 landfill, it is possible that constituents detected in SWMU 1 media are attributable to historic CECRLA-related releases. However, as discussed in Section 3.1.1, 2 ft of soil cover were placed over the waste material following cessation of disposal activities in 1978. Because the only soil samples collected at the site were surface soil samples, it is likely that none of the constituents detected in the surface soil samples are attributable to CERCLA-related releases from the landfill. Further, the pesticides detected at this site are the same pesticides and of similar concentrations detected at other sites across east Vieques. This information, coupled with the depth of sample collection, suggests the pesticides are present due to normal pesticide use, not a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1). Therefore, pesticides are not considered further in the decision analysis process.

Similarly, dioxins are not likely associated with the landfill because there is no record of burning of the municipal waste and, again, the soil samples were collected from the cover material. Further, as shown in Table A-3, the highest dioxin concentration at SWMU 1 (in TEQ) is approximately 7.1 ppt, which is more than two orders of magnitude below the residential remediation level (i.e., 1,000 ppt) cited by EPA. The other dioxin concentrations at SWMU 1 are even lower. Therefore, dioxins are not considered further in the decision analysis process.

As a conservative measure, the concentrations of the other detected constituents (i.e., VOCs, SVOCs, PCBs, and metals) are considered to be potentially CERCLA-related and are further evaluated in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

<u>Surface Soil</u>

- VOCs: no exceedances
- SVOCs: no exceedances
- PCBs: no exceedances

- Antimony: one detection (sample SS32) at a concentration (4.08 milligrams per kilogram [mg/kg]) above the adjusted PRG (3.1 mg/kg), SSL at DAF of 1 (0.3 mg/kg), and background UTL (3.60 mg/kg)
- Arsenic: six detections (samples SS17, SS32, SS35, SS39, SS45) at concentrations (1.81 mg/kg to 4.25 mg/kg) above the PRG (0.39 mg/kg), SSL at DAF 1 (1.0 mg/kg), and background UTL (1.6 mg/kg)
- Chromium: two detections (SS31 and SS32) at concentrations (80 mg/kg and 113 mg/kg, respectively) above the ecological screening value (0.40 mg/kg), SSL at DAF 1 (2.0 mg/kg), and background UTL (72 mg/kg)
- Cobalt: six detections (samples SS31, SS32, SS35, SS39, SS45, SS46) at concentrations (17.6 mg/kg to 32.1 mg/kg) above the ecological screening value (13 mg/kg) and background UTLs (26 mg/kg for Kv [SS31] and 16 mg/kg for Qa [SS32, SS35, SS39, SS45, and SS46])
- Copper: two detections (samples SS10, SS32) at concentrations (145 mg/kg and 130 mg/kg, respectively) above the ecological screening value (70 mg/kg), SSL at DAF 1 (46 mg/kg), and background UTLs (94 mg/kg for Kv [SS10] and 53 mg/kg for Qa [SS32, SS37, SS46])
- Lead: four detections (samples SS10, SS15, SS23, SS32) at concentrations (17.2 mg/kg to 36.5 mg/kg) above the SSL at DAF 1 (14 mg/kg) and background UTL (5.4 mg/kg)
- Mercury: one detection (SS24) at a concentration (0.188 mg/kg) above the ecological screening value (0.10 mg/kg), SSL at DAF 1 (0.10 mg/kg), and background UTL (0.06 mg/kg)
- Nickel: four detections (SS32, SS35, SS45, SS46) at concentrations (22.2 mg/kg to 33.9 mg/kg) above the SSL DAF 1 (7 mg/kg) and background UTL (22 mg/kg)
- Selenium: 35 detections (SS01, SS02, SS04 - SS07, SS10, SS12, SS16, SS19, SS21 - SS29, SS31, SS32, SS34 - SS39, SS42 - SS49) at concentrations (0.514 mg/kg to 1.07 mg/kg) above the ecological screening value (0.52 mg/kg; all but SS04, SS22, SS38, and SS50), the SSL at DAF 1 (0.3 mg/kg), and background UTL (0.51 mg/kg)
- Thallium: 44 detections (SS01 to SS22, SS24, SS26 to SS28, SS30, SS31, SS33, SS34, SS36 to SS47, SS49, SS50) at concentrations (0.293 mg/kg to 4.44 mg/kg) above the adjusted PRG (0.52 mg/kg; by all except SS04, SS27, SS28, and SS34), ecological screening value (1.0 mg/kg; by SS01, SS03, SS06, SS08, SS10, SS11, SS12, SS14, SS16, SS18, SS20, SS21, SS24, SS26, SS31, SS36 – SS40, SS43 – SS47, SS49, SS50), SSL at DAF 1 (0.04 mg/kg), and background UTL (0.13 mg/kg)
- Vanadium: five detections (SS17, SS31, SS35, SS45, SS46) at concentrations (147 mg/kg to 192 mg/kg) above the adjusted PRG (7.80 mg/kg), ecological screening value (2 mg/kg), background UTL (144 mg/kg)
- Zinc: three detections (SS10, SS15, and SS24) at concentrations (123 mg/kg to 521 mg/kg) above the ecological screening value (120 mg/kg; by SS10, SS15, and SS24) and background UTL (32 mg/kg)

Groundwater

- Antimony (total): two detections (wells MW-3 and MW-5) at concentrations (3.25 µg/L and 3.02 µg/L, respectively) above the adjusted tap water PRG (1.5 µg/L) and background (1.25 µg/L)
- Antimony (dissolved): one detection (well MW-3) at a concentration (2.83 µg/L) above the adjusted tap water PRG (1.5 µg/L) and background (1.25 µg/L)
- Mercury (total): one detection (well MW-2) at a concentration (1.29 µg/L) above the adjusted tap water PRG (1.1 µg/L) and background (0.0081 µg/L)
- Thallium (total): three detections (wells MW-2, MW-3, MW-4) at concentrations (5.08 µg/L, 2.99 g/L, 3.89 µg/L, respectively) above the adjusted tap water PRG (0.24 µg/L), the MCL (2.0 µg/L), and background (1.1 µg/L)
- Thallium (dissolved): one detection (well MW-2) at a concentration (2.99 µg/L) above the adjusted tap water PRG (0.24 µg/L), the MCL (2.0 µg/L), and background (1.1 µg/L)
- Vanadium (dissolved): four detections (wells MW-2, MW-3, MW-4, MW-5) at concentrations (9.48 µg/L, 10.6 µg/L , 10.9 µg/L, 22.1 µg/L, respectively) above the adjusted tap water PRG (3.6 µg/L) and background (1.25 µg/L)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Soil

Four constituents (antimony, arsenic, thallium, and vanadium) were detected in surface soil samples above the human health screening levels and background. Antimony was detected in only 1 of 50 surface soil samples above the background UTL and the adjusted PRG (3.1 mg/kg based on a hazard quotient [HQ]=0.1), at a concentration of 4.1 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 31 mg/kg (HQ=1). Based on the relatively low maximum detected concentration and the EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for antimony would be at an acceptable level and antimony would not be identified as a risk driver.

Arsenic was detected in only 6 of 50 surface soil samples above the background UTL and PRG (0.39 mg/kg based on 1×10^{-6} excess lifetime cancer risk [ELCR]), at a maximum concentration of 4.25 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (22 mg/k), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the relatively low maximum detected concentration and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver.

Thallium was detected in 41 of 50 surface soil samples above the background UTL and adjusted PRG (0.52 mg/kg based on an HQ=0.1), at a maximum concentration of 4.44 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 5.2 mg/kg (HQ=1). Based on the relatively low maximum concentration and the EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), the risk estimate for thallium would be at an acceptable level and thallium would not be identified as a risk driver. Further, the thallium concentrations in the samples collected at SWMU 1 are suspect because the analytical method utilized was prone to providing falsely elevated results. This supposition is supported by the fact that at several PI/PAOC sites where samples were analyzed for thallium using both the older method and the newer method (e.g., PAOC U), the thallium concentrations in the samples analyzed with the newer method were lower.

Vanadium was detected in only 5 of 50 surface soil samples above the background UTL and its adjusted PRG (7.8 mg/kg based on an HQ=0.1), at a maximum concentration of 192 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 78 mg/kg (HQ=1). However, as long as the landfill remains, a residential scenario is unrealistic. The risk-based screening level for an industrial scenario is 1,000 mg/kg (HQ=1). Because all detected concentrations are less than the industrial screening level, and a resultant low EPC would be used in risk calculations for this scenario (based on a calculated UCL of the mean concentration), risk estimates for vanadium would be at an acceptable level and vanadium would not be identified as a risk driver for the industrial scenario. Further, vanadium is not likely related to the site because the soil data are from the cover material, not from within the landfilled waste, as noted previously.

As indicated above, only four constituents (antimony, arsenic, thallium, and vanadium) were detected in soil above human health screening levels and background. In fact, no other constituent was detected above its PRG. Only the PRG for arsenic is based on potential carcinogenic effects. A second PRG is available for arsenic based on non-cancer effects (i.e., skin and vascular effects). The PRGs for the remaining constituents (antimony, thallium, and vanadium) are based on decreased longevity, decreased blood glucose, and altered blood cholesterol levels (antimony); liver effects (thallium); and increased mortality (vanadium). Because the non-cancer effects listed above are different for each constituent, potential cumulative effects from multiple chemicals in soil are not a concern.

Eight inorganics (chromium, cobalt, copper, mercury, selenium, thallium, vanadium, and zinc) detected in at least one surface soil sample of the cover material exceed ecological screening values and background. However, none of these constituents likely poses an unacceptable risk over background to ecological receptors on a site-wide basis based upon the following:

- The waste was reportedly covered with 2 ft of soil when the trenches were full and an additional soil cover was added to the site when it was closed in 1978. The most significant ecological exposures typically occur within the top 2 ft of the soil column.
- The site is heavily vegetated, with no signs of stressed vegetation.
- Chromium exceeds the ecological screening value and background in only 2 of 50 samples across the site, at a maximum ratio of 1.57. This information suggests exposures

to chromium in surface soil on a site-wide basis are not significant ecologically relative to background.

- Cobalt exceeds the ecological screening value and background in only 6 of 50 samples across the site, at a maximum ratio of 1.68. The mean cobalt concentration (13.1 mg/kg) is comparable to the ecological screening value (13 mg/kg). The screening value, however, is based upon potential impacts to plants. As indicated in Section 3.1, the site is heavily vegetated and there is no sign of stress to plants. Soil screening values based on other receptors (e.g., soil invertebrates) are not currently available. However, the information above suggests exposures to cobalt in surface soil on a site-wide basis are not significant ecologically.
- Copper exceeds the ecological screening value and background in only 2 of 50 samples across the site, at ratios of 2.07 (1.61 in the duplicate of this sample) and 1.86. In addition, the mean copper concentration (39 mg/kg) is less than the ecological screening value (70 mg/kg). This information suggests exposures to copper in surface soil on a site-wide basis are not significant ecologically.
- Mercury exceeds the ecological screening value in only 1 of 50 samples across the site, at an HQ of 1.88. In addition, the mean mercury concentration (0.029 mg/kg) is less than the ecological screening value (0.10 mg/kg). This information suggests exposures to mercury in surface soil on a site-wide basis are not significant ecologically.
- Selenium exceeds the ecological screening value in 32 of 50 samples across the site, at a maximum HQ of 2.60. The screening value, however, is based on potential impacts to plants. As indicated in Section 3.1, the site is heavily vegetated and there is no sign of stress to plants. Further, the maximum concentration is less than soil screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). This information suggests exposures to selenium in surface soil on a site-wide basis are not significant ecologically.
- Thallium exceeds background and the ecological screening value in 27 of 50 samples across the site, although the thallium concentrations in only 4 samples (SS24, SS26, SS31, and SS46) exceed the screening value by a factor of 2 or more (the maximum HQ was 4.4). In addition, the mean thallium concentration (1.15 mg/kg) is comparable to the screening value (1.0 mg/kg). The screening value, however, is based upon potential impacts to plants. As indicated in Section 3.1, the site is heavily vegetated and there is no sign of stress to plants. However, soil screening values based on other receptors (e.g., soil invertebrates) are not currently available. As noted previously, the analytical method used for thallium analysis for the SWMU 1 samples was prone to falsely elevated results. Therefore, the thallium results are suspect, especially considering thallium was the only constituent with so many screening value exceedances, that there is no suspected source of elevated thallium in the surface soil, and that the background thallium UTL is based on the updated thallium analytical method, while the thallium results for SWMU 1 are from the older thallium method.
- Vanadium exceeds background and the ecological screening value in only 5 of 50 samples across the site, at a maximum ratio of 1.33. This information suggests exposures

to vanadium in surface soil on a site-wide basis are not significant ecologically relative to background.

- Zinc exceeds the ecological screening value and background in 3 of the 50 samples across the site, and the mean concentration (49.9 mg/kg) is less than the screening value (120 mg/kg). This suggests exposures to zinc in surface soil on a site-wide basis are not significant ecologically.

Nine inorganics (antimony, arsenic, chromium, copper, lead, mercury, nickel, selenium, and thallium) were detected in surface soil above SSLs at a DAF of 1 and background UTLs. Of these nine constituents, arsenic and lead were not detected in groundwater and antimony, copper, chromium, mercury, nickel, and selenium were detected in groundwater below tap water PRGs and/or MCLs, as applicable. As stated previously, the thallium concentrations are suspect. All of this information suggests the SSLs at a DAF of 1 are not realistic predictors of leaching to groundwater. At higher DAFs, such as a DAF of 5, only antimony, chromium, and thallium have detections above the SSL.

Groundwater

Four inorganic constituents (antimony, mercury, thallium, and vanadium) were detected in groundwater at concentrations above the adjusted tap water PRGs. However, thallium was the only constituent detected above its MCL. Like the soil thallium results, the groundwater thallium results are suspect due to the analytical method used.

Antimony was detected in two wells above its adjusted tap water PRG (1.5 μg/L based on an HQ=0.1), at a maximum total concentration of 3.25 μg/L and a dissolved concentration of 2.83 μg/L. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 15 μg/L (HQ=1); all detected antimony concentrations are below this level, as well as the MCL (6 μg/L).

Mercury was detected in one well above its adjusted tap water PRG (1.1 μg/L based on an HQ=0.1), at a total concentration of 1.29 μg/L. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 11 μg/L (HQ=1), which is an order of magnitude above the detected concentration. Further, the dissolved mercury concentration was below the adjusted tap water PRG, and all detections of mercury were below the MCL (2 μg/L).

Thallium was detected in three wells above its adjusted PRG (0.24 μg/L based on an HQ=0.1), at a maximum total concentration of 5.08 μg/L and a dissolved concentration of 2.99 μg/L. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 2.4 μg/L (HQ=1). All detected concentrations (three total and one dissolved) exceeded this value, as well as the MCL (2 μg/L). However, as noted above, the thallium concentrations are suspect due to the analytical method used.

Vanadium was detected above background and its adjusted tap water PRG (3.6 μg/L based on an HQ=0.1) in all four wells, at a maximum dissolved concentration of 22.1 μg/L. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 36 μg/L (HQ=1), which is above all detected vanadium concentrations.

As indicated above, four constituents were detected in groundwater at concentrations above background and adjusted tap water PRGs. The PRGs for these four constituents are based on decreased longevity, decreased blood glucose, and altered blood cholesterol levels (antimony); central nervous system effects (mercury); liver effects (thallium); and increased mortality (vanadium). The only other constituent detected above its adjusted PRG was chromium (total), but it was not detected above background in that sample. The PRG for chromium is based on no observed effects. Because the non-cancer effects listed above are different for each constituent, potential cumulative effects from multiple chemicals in groundwater are not a concern.

It is also important to note that only a single well was installed and used to represent background inorganics concentrations in groundwater for SWMU 1. In actuality, background is represented by a range of concentrations because environmental media are not homogeneous. Therefore, the data from the background well at SWMU 1 (MW-01) represent a single point within that range of background concentrations for each inorganic constituent.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historic information (records, interviews, site inspections) suggests that hazardous waste was not disposed of in the SWMU 1 landfill. Evaluation of groundwater data collected at the downgradient boundary of the landfill tends to support this supposition, especially considering the waste had been in place between 25 and 50 years prior to the sampling activities. However, the only soil samples collected within the landfill boundary were from the cover material, the data from which suggest the soil is suitable cover material; no soil samples were collected from within or below the waste material, no samples were collected within the adjacent ephemeral stream, and no groundwater samples were collected within the landfill boundary. Further, the landfilled material has not been visually inspected to verify no hazardous waste was disposed. Therefore, the potential source area has not been sufficiently characterized.

3.4 Conclusions and Recommendations

Table 3-3 summarizes the results of the decision analysis for SWMU 1. Evaluation of the surface soil data, collected from the cover material over the landfilled waste, suggests the soil is suitable for use as cover material. Additionally, the groundwater data collected along the downgradient landfill boundary suggest there has not been a release from the landfill, or that any release has not resulted in contamination of groundwater above acceptable levels, with the possible exception of thallium. However, the thallium data are suspected of being artificially elevated due to the analytical method used.

There is uncertainty associated with the conclusions drawn above regarding the potential for release because data have not been collected within and beneath the landfilled material and because a portion of the landfill boundary to the north and south have not been sufficiently delineated. Additionally, the thallium groundwater data, which indicated it may be present above its MCL, are suspect due to the analytical method used. Therefore, additional data collection is recommended for the site. Because the historical information

about waste disposal and the groundwater data collected along the downgradient landfill boundary suggest hazardous waste or materials were either not disposed of or not released to environmental media, it is recommended that this additional data collection be conducted via an expanded SI, as described below.

Rationale

Additional information is necessary to determine whether hazardous waste or hazardous materials were disposed of in the landfill or if there has been a release to environmental media. In addition, additional information is necessary to sufficiently delineate the landfill boundary. The objectives, approach, and decision analysis for the additional investigation will be detailed in an Expanded SI work plan, but they are briefly discussed below.

Objectives and Approach

Complete the horizontal delineation of the landfill boundary by:

- Performing a geophysical survey within the approximate areas shown in Figure 3-11 to complete the landfill boundary delineation. The actual area covered by the additional geophysical survey will be based on real-time results.

Characterize the waste materials disposed of in the landfill by:

- Performing test pitting at 20 locations spaced approximately evenly across the landfill (Figure 3-11) through the vertical profile of the waste material and performing visual inspection and identification of materials encountered

Characterize the subsurface soil within the waste material by:

- Collecting a three-point composite soil sample through the vertical waste profile (top, middle, bottom) in each of the 20 test pit locations and analyzing the samples for TCL VOCs, SVOCs, pesticides, and PCBs; TAL inorganics; and explosives, including perchlorate

Characterize the subsurface soil beneath the waste material by:

- Collecting subsurface soil samples beneath the waste material in each of the 20 test pit locations and analyzing the samples for TCL VOCs, SVOCs, pesticides, and PCBs; TAL inorganics; and explosives, including perchlorate

Characterize the ephemeral stream(s) adjacent to the landfill by:

- Collecting three samples adjacent to the landfill and one upstream of the landfill in the ephemeral stream and analyzing the samples for TCL VOCs, SVOCs, pesticides, and PCBs; TAL inorganics; and explosives, including perchlorate. Default locations are shown in Figure 3-11, but the target areas for the samples will be likely depositional areas along the stream channel. If standing water is found at the sampling locations, a surface water and sediment sample will be collected; if not, a surface soil and subsurface soil sample will be collected.

- Performing an inter-agency site reconnaissance to determine if there is a second ephemeral stream in the southwestern part of the landfill and, if so, collecting up to three

samples from this ephemeral stream (exact type, number, and locations of samples to be determined during the inter-agency site reconnaissance).

Characterize the groundwater beneath the waste material by:

- Installing a monitoring well within or adjacent to four of the test pits spaced approximately evenly across the landfill (Figure 3-11) and analyzing the samples for TCL VOCs, SVOCs, pesticides, and PCBs; TAL inorganics; and explosives, including perchlorate

Re-assess historical groundwater data by:

- Re-sampling all existing monitoring wells and analyzing the samples for TCL VOCs, SVOCs, pesticides, and PCBs; TAL inorganics; and explosives, including perchlorate

Decision Analysis

Evaluate newly collected and relevant historical data using 6-step decision analysis process. Use data from PA/SI, Expanded SI, and information from test pitting to determine whether hazardous waste or materials were disposed of in the landfill, whether there has been a CERCLA-related release from the landfilled waste, and the most appropriate further action for the site.

TABLE 3-1
SWMU 1 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone Kv SS	Vieques (East) Background Zone Qa SS	CGW1SS01	CGW1SS02	CGW1SS03	CGW1SS04	CGW1SS05	CGW1SS06	CGW1SS07	CGW1SS08	CGW1SS09	CGW1SS10		CGW1SS11	CGW1SS12	CGW1SS13	CGW1SS14
Sample ID						CGW1SS01-R01	CGW1SS02-R01	CGW1SS03-R01	CGW1SS04-R01	CGW1SS05-R01	CGW1SS06-R01	CGW1SS07-R01	CGW1SS08-R01	CGW1SS09-R01	CGW1SS10-R01	CGW1FD01P-R01	CGW1SS11-R01	CGW1SS12-R01	CGW1SS13-R01	CGW1SS14-R01
Sample Date						2/4/04	2/4/04	2/4/04	2/4/04	2/4/04	2/4/04	2/4/04	2/4/04	2/4/04	2/4/04	2/4/04	2/5/04	2/5/04	2/5/04	2/5/04
Chemical Name																				
Volatile Organic Compounds (µg/kg)																				
Methylene chloride	1	9,100	--	--	--	10.5 U	10.4 U	10.9 U	10.7 U	10.9 U	10.5 U	11.4 U	11.1 U	12 U	10.5 U	10.2 U	10.4 U	10.1 U	10.9 U	0.8 J
Styrene	200	440,000	300,000	--	--	10.5 U	10.4 U	10.9 U	10.7 U	10.9 U	10.5 U	11.4 U	11.1 U	12 U	10.5 U	10.2 U	1.3 J	10.1 U	10.9 U	12.2 U
Semivolatile Organic Compounds (µg/kg)																				
4-Methylphenol	--	31,000	--	--	--	395 U	360 U	364 U	355 U	374 U	392 U	367 U	359 U	362 U	378 U	377 U	350 U	391 U	358 U	363 U
Benzo(a)pyrene	400	62	100	--	--	395 U	360 U	364 U	355 U	374 U	392 U	367 U	359 U	362 U	378 U	377 U	350 U	45.8 J	358 U	363 U
Benzo(b)fluoranthene	200	620	--	--	--	395 U	360 U	364 U	355 U	374 U	392 U	367 U	359 U	362 U	378 U	377 U	350 U	56.9 J	358 U	363 U
Benzo(k)fluoranthene	2,000	6,200	--	--	--	395 U	360 U	364 U	355 U	374 U	392 U	367 U	359 U	362 U	378 U	377 U	350 U	47.5 J	358 U	363 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	395 U	360 U	364 U	355 U	374 U	392 U	367 U	359 U	362 U	378 U	377 U	350 U	391 U	358 U	363 U
Di-n-butylphthalate	270,000	610,000	200,000	--	--	395 U	360 U	364 U	355 U	374 U	392 U	367 U	359 U	362 U	378 U	377 U	350 U	391 U	358 U	363 U
Pyridine	--	6,100	--	--	--	395 U	360 U	364 U	355 U	374 U	392 UJ	367 UJ	359 UJ	362 UJ	378 UJ	377 U	350 U	391 U	358 U	363 U
Pesticide/Polychlorinated Biphenyls (µg/kg)																				
4,4'-DDD	800	2,400	10	--	--	3.9 UJ	3.6 UJ	0.43 J	3.6 R	3.7 U	3.9 UJ	3.6 U	3.6 UJ	3.6 UJ	1.4 J	3.8 UJ	0.17 J	3.9 R	1.8 J	3.6 U
4,4'-DDE	3,000	1,700	10	--	--	3.9 UJ	0.29 J	6.1 J	0.83 R	0.34 J	8.8 J	0.21 J	1 J	0.7 J	25 J	29 J	1.3 J	4.1 J	130 J	0.33 J
4,4'-DDT	2,000	1,700	10	--	--	0.41 J	3.6 UJ	6.4 J	0.24 R	3.7 U	0.96 J	3.6 U	0.28 J	0.26 J	5.9 J	7 J	0.5 J	1.6 J	22 J	0.26 J
Aroclor-1221	--	110	40,000	--	--	80 U	73 U	74 U	72 U	76 U	80 U	74 U	73 U	73 U	77 U	77 U	71 U	79 U	15 J	73 U
Aroclor-1248	--	110	40,000	--	--	39 U	36 U	36 U	36 U	37 U	39 U	36 U	36 U	36 U	38 U	38 U	35 U	39 U	1.8 J	36 U
Aroclor-1254	--	110	40,000	--	--	39 U	36 U	36 U	36 U	37 U	39 U	36 U	36 U	36 U	38 U	38 U	35 U	39 U	29 JN	36 U
Aroclor-1260	--	110	40,000	--	--	39 U	36 U	36 U	36 U	37 U	39 U	36 U	36 U	36 U	38 U	38 U	35 U	39 UJ	56	36 U
Endrin ketone	50	1,800	100	--	--	3.9 UJ	3.6 UJ	3.6 UJ	3.6 R	3.7 UJ	3.9 UJ	3.6 UJ	3.6 UJ	3.6 UJ	3.8 UJ	3.8 UJ	3.5 UJ	3.9 UJ	36 UJ	3.6 UJ
Herbicides (µg/kg)																				
No Detections																				
Dioxin/Furans (pg/g)																				
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	5.37	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	1 U	NA	NA	NA	NA	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	50.9	NA	NA	NA	NA	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	10.4	NA	NA	NA	NA	NA	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA	NA	NA	NA	NA	NA
Total pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	1 U	NA	NA	NA	NA	NA	NA	NA
Total tetrachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	NA	1 U	NA	NA	NA	NA	NA	NA	NA
Explosives (µg/kg)																				
No Detections																				
Total Metals (mg/kg)																				
Antimony	0.3	3.1	78	3.60	3.60	0.381 J	0.91 J	0.462 J	0.102 U	0.72 J	0.482 J	0.139 J	0.284 J	0.252 J	1.49 J	1.04 J	0.676 J	0.629 J	0.661 J	0.657 J
Arsenic	1.00	0.39	18	1.60	1.60	0.158 U	0.159 U	0.137 U	0.15 U	0.176 U	0.171 U	0.168 U	0.144 U	0.156 U	0.467 J	0.707 J	0.424 J	0.397 J	0.109 U	0.141 U
Barium	82	1,600	330	212	212	62.7	59.2	54.9	46.7	59.4	53.2	52.8	51.6	44.1	59.8	66.2	80.2 J	60.8 J	91.6 J	49.3 J
Beryllium	3	15	40	0.27	0.27	0.294 J	0.216 J	0.242 J	0.238 J	0.25 J	0.246 J	0.244 J	0.182 J	0.193 J	0.268 J	0.282 J	0.222 J	0.259 J	0.196 J	0.219 J
Cadmium	0.40	3.70	32	2.20	2.20	0.0145 U	0.0146 U	0.0125 U	0.0137 U	0.0161 U	0.0156 U	0.0154 U	0.0132 U	0.0142 U	0.0151 U	0.101 J	0.0105 U	0.013 U	0.00995 U	0.0128 U
Chromium	2	210	0.40	72	72	18.9 J	15.3 J	16.2 J	18.1 J	17.3 J	20.6 J	18.3 J	16.2 J	14.3 J	36.9 J	32.5 J	24.2 J	15.8 J	11.4 J	13.7 J
Cobalt	33	140	13	26	16	12.5	11.8	10.6	10.6	11.1	12.6	12.1	10.4	9.01 J	13.9	15.6	12.2 J	10.4 J	9.43 J	8.6 J
Copper	46	310	70	94	53	39.5	24.6	37.1	32.4	37.9	40.1	31.6	25.5	24.8	113	145	27.8	35.9	30.8	23.9
Cyanide	--	120	1	0.89	0.89	NA	NA	NA	NA	NA	NA	NA	0.146 UJ	NA	NA	NA	NA	NA	NA	NA
Lead	14	400	120	5.40	5.40	7.19	7.06	10.2	6.9	9.94	11.2	4.32	3.49	4.3	34.5	36.5	4.68	4.23	3.48	0.221 J
Mercury	0.10	2.30	0.10	0.06	0.06	0.0321 J	0.0175 J	0.0198 J	0.0199 J	0.0253 J	0.0505	0.0212 J	0.0114 J	0.0145 J	0.0386	0.0429	0.0121 J	0.0314	0.0178 J	0.0182 J
Nickel	7	160	38	41	22	8.11 J	6.11 J	6.62 J	6.95 J	7.09 J	8.79 J	7.32 J	5.23 J	5.26 J	13.7 J	13.4 J	11.4 J	6.93 J	5.09 J	5.95 J
Selenium	0.3	39	0.52	0.51	0.51	0.646 J	0.539 J	0.334 J	0.515 J	0.752 J	0.679 J	0.86 J	0.206 U	0.321 J	0.329 J	0.817 J	0.202 J	0.942	0.492 J	0.342 J
Silver	2	39	560	0.22	0.22	0.0275 U	0.0276 U	0.0238 U	0.026 U	0.0306 U	0.0297 U	0.0292 U	0.025 U	0.027 U	0.0446 J	0.0318 J	0.0199 U	0.0519 J	0.0189 U	0.0244 U
Thallium	0.04	0.52	1	0.13	0.13	1.54 J	0.785 J	1.13 J	0.44 J	0.986 J	1.13 J	0.623 J	1.01 J	0.987 J	1.31 J	0.973 J	1.1 J	1.1 J	0.602 J	1.54 J
Tin	--	4,700	--	N/A	N/A	1.13 J	0.726 J	0.852 J	1.4 J	0.685 J	1.43 J	0.297 J	0.232 U	0.468 J	9.7 J	11.6	0.549 J	0.671 J	0.589 J	0.419 J
Vanadium	300	7.80	2	144	144	85.9	81.3	84.9	81.7	85.4	86.1	87.5	82.5	75.5	109	99.6	60.6 J	74.6 J	65.6 J	68 J
Zinc	620	2,300	120	32	32	48	25.5	36.8	25.9	36	47.4	27	22.5	22.6	209	243	21.8 J	31.6 J	24.5 J	19.5 J
Wet Chemistry (mg/kg)[2]																				
Sulfide		--	--	--	--	NA	NA	NA	NA	NA	NA	NA	8.7 U	NA	NA	NA	NA	NA	NA	NA

Notes:

[1] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO. All other samples were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA

mg/kg - Milligrams per kilogram
µg/Kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
R - Unreliable result
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996 (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, endrin ketone) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (styrene, di-n-butylphthalate, aroclor-1221, aroclor-1248, aroclor-1254, aroclor-1260, nickel, selenium, silver, thallium, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[2] Wet Chemistry consists of sulfide and cyanide (cyanide will be included in the inorganic list for this report)
* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background, ECO and HHRA
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 3-1
SWMU 1 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone Kv SS	Vieques (East) Background Zone Qa SS	CGW1SS15	CGW1SS16	CGW1SS17	CGW1SS18	CGW1SS19	CGW1SS20	CGW1SS20	CGW1SS21	CGW1SS22	CGW1SS23	CGW1SS24	CGW1SS25	CGW1SS26	CGW1SS27	CGW1SS28
Sample ID						CGW1SS15-R01	CGW1SS16-R01	CGW1SS17-R01	CGW1SS18-R01	CGW1SS19-R01	CGW1SS20-R01	CGW1FD02P-R01	CGW1SS21-R01	CGW1SS22-R01	CGW1SS23-R01	CGW1SS24-R01	CGW1SS25-R01	CGW1SS26-R01	CGW1SS27-R01	CGW1SS28-R01
Sample Date						2/5/04	2/5/04	2/4/04	2/5/04	2/5/04	2/5/04	2/5/04	2/5/04	2/5/04	2/9/04	2/9/04	2/9/04	2/9/04	2/9/04	2/9/04
Chemical Name																				
Volatile Organic Compounds (µg/kg)																				
Methylene chloride	1	9,100	--	--	--	11.2 U	9.8 U	11.1 U	12.5 U	0.55 J	11.4 U	0.81 J	13.1 U	11.5 U	9.9 U	10 U	10.5 U	11.2 U	10 U	10.1 U
Styrene	200	440,000	300,000	--	--	11.2 U	9.8 U	11.1 U	12.5 U	10.5 U	11.4 U	12.2 U	13.1 U	11.5 U	9.9 U	10 U	10.5 U	11.2 U	10 U	10.1 U
Semivolatile Organic Compounds (µg/kg)																				
4-Methylphenol	--	31,000	--	--	--	371 U	380 U	352 U	373 U	382 U	349 U	347 U	388 U	363 U	377 U	378 U	304 J	365 U	365 U	354 U
Benzo(a)pyrene	400	62	100	--	--	371 U	380 U	352 U	373 U	382 U	349 U	347 U	388 U	363 U	377 U	378 U	368 U	365 U	365 U	354 U
Benzo(b)fluoranthene	200	620	--	--	--	371 U	380 U	352 U	373 U	382 U	349 U	347 U	388 U	363 U	377 U	378 U	368 U	365 U	365 U	354 U
Benzo(k)fluoranthene	2,000	6,200	--	--	--	371 U	380 U	352 U	373 U	382 U	349 U	347 U	388 U	363 U	377 U	378 U	368 U	365 U	365 U	354 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	371 U	380 U	352 U	373 U	382 U	349 U	347 U	118 J	363 U	377 U	378 U	368 U	365 U	80.2 J	354 U
Di-n-butylphthalate	270,000	610,000	200,000	--	--	371 U	380 U	352 U	87.2 J	382 U	349 U	347 U	388 U	363 U	377 U	378 U	368 U	365 U	365 U	354 U
Pyridine	--	6,100	--	--	--	371 U	380 U	352 U	373 U	382 U	349 U	347 U	388 U	363 U	377 U	378 U	368 UJ	365 U	365 U	354 U
Pesticide/Polychlorinated Biphenyls (µg/kg)																				
4,4'-DDD	800	2,400	10	--	--	3.7 UJ	3.8 U	0.16 J	3.7 U	3.8 U	3.5 U	3.5 U	3.9 U	3.6 UJ	2.9 J	2.3 J	3.7 UJ	3.7 U	0.22 J	3.5 U
4,4'-DDE	3,000	1,700	10	--	--	1.3 J	1.4 J	3.2 J	7.5 J	3.8 U	3.5 U	3.5 U	0.87 J	14 J	140 J	44 J	2.8 J	7.1 J	4.8 J	0.27 J
4,4'-DDT	2,000	1,700	10	--	--	0.67 J	0.74 J	0.51 J	1.8 J	3.8 U	3.5 U	3.5 U	0.53 J	3.8 J	47 J	31 J	0.83 J	3.7 U	0.55 J	3.5 U
Aroclor-1221	--	110	40,000	--	--	75 UJ	77 U	71 U	76 U	77 U	71 U	71 U	79 U	74 U	76 U	76 U	74 U	75 U	75 U	72 U
Aroclor-1248	--	110	40,000	--	--	37 UJ	38 U	35 U	37 U	38 U	35 U	35 U	39 U	36 U	38 U	38 U	37 U	37 U	37 U	35 U
Aroclor-1254	--	110	40,000	--	--	37 UJ	38 U	35 U	37 U	38 U	35 U	35 U	39 U	36 U	38 U	38 U	37 U	37 U	37 U	35 U
Aroclor-1260	--	110	40,000	--	--	37 UJ	38 U	35 U	37 U	38 U	35 U	35 U	39 U	36 U	38 U	38 U	37 UJ	37 U	37 U	35 U
Endrin ketone	50	1,800	100	--	--	3.7 UJ	3.8 UJ	3.5 UJ	3.7 UJ	3.8 UJ	3.5 UJ	3.5 UJ	3.9 UJ	4.9 J	3.8 U	3.8 UJ	3.7 UJ	3.7 U	3.7 UJ	3.5 U
Herbicides (µg/kg)																				
No Detections																				
Dioxin/Furans (pg/g)																				
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	17.8	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	2.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	2.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	2.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	1 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	130	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	33.2	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	12.3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	4.22	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total tetrachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	4.92	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Explosives (µg/kg)																				
No Detections																				
Total Metals (mg/kg)																				
Antimony	0.3	3.1	78	3.60	3.60	1.3 J	0.63 J	0.402 J	1.04 J	0.703 J	0.478 J	0.604 J	0.582 J	0.522 J	1.5 J	1.77 J	1.44 J	1.17 J	0.891 J	0.722 J
Arsenic	1.00	0.39	18	1.60	1.60	0.139 U	0.269 J	1.81 J	0.166 J	0.128 U	0.101 U	0.12 U	0.136 U	0.124 U	0.91 J	0.713 J	0.575 J	1.09 J	0.326 J	0.114 U
Barium	82	1,600	330	212	212	42.5 J	50 J	50.3	46.6 J	49 J	41 J	58.9 J	60.9 J	54.2 J	75.3 J	74.8 J	55.5 J	85.6 J	56.6 J	51 J
Beryllium	3	15	40	0.27	0.27	0.199 J	0.257 J	0.397 J	0.239 J	0.22 J	0.192 J	0.202 J	0.28 J	0.255 J	0.284 J	0.275 J	0.335 J	0.433 J	0.283 J	0.218 J
Cadmium	0.40	3.70	32	2.20	2.20	0.0127 U	0.0132 U	0.0144 U	0.0109 U	0.0117 U	0.00926 U	0.011 U	0.0124 U	0.0114 U	0.177 J	0.309 J	0.0118 U	0.114 J	0.0117 U	0.0104 U
Chromium	2	210	0.40	72	72	13.6 J	18.2 J	49.6 J	17.9 J	14.4 J	9.26 J	10.3 J	15.8 J	16.6 J	31.4 J	30.9 J	30.1 J	31.2 J	24.9 J	16.7 J
Cobalt	33	140	13	26	16	8.89 J	10.7 J	19.6	10.3 J	9.36 J	6.82 J	11 J	10.6 J	12.7 J	13.6 J	12.7 J	12.9 J	17.2 J	9.96 J	12.1 J
Copper	46	310	70	94	53	35.4	30.7	37.7	39.5	25.1	18.4	21.2	34.2	30.4	47.2 J	41.2 J	56.2 J	34.8 J	29.2 J	26.4 J
Cyanide	--	120	1	0.89	0.89	NA	NA	0.37 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Lead	14	400	120	5.40	5.40	19.3	2.49	11.8	12.6	0.175 U	0.138 U	0.164 U	1.69	0.868	17.2	10.7	7.85	0.634	2.61	1.12
Mercury	0.10	2.30	0.10	0.06	0.06	0.038	0.0255 J	0.028	0.0391	0.0182 J	0.00937 J	0.00908 J	0.0331	0.0153 J	0.0203 J	0.188	0.0413	0.0285	0.0258	0.0177 J
Nickel	7	160	38	41	22	6.61 J	8.07 J	16.4 J	8.8 J	5.98 J	4.09 J	4.78 J	7.58 J	7.7 J	16.6 J	17.5 J	14.9 J	15.7 J	11.3 J	6.15 J
Selenium	0.3	39	0.52	0.51	0.51	0.483 J	0.66 J	0.343 J	0.393 J	0.689 J	0.379 J	0.272 J	0.736 J	0.517 J	0.795	0.608 J	0.876	0.965	0.848	0.634 J
Silver	2	39	560	0.22	0.22	0.0242 U	0.0261 J	0.0274 U	0.0207 U	0.0222 U	0.0176 U	0.0209 U	0.0322 J	0.0216 U	0.0196 U	0.018 U	0.0321 J	0.0225 U	0.0223 J	0.0198 U
Thallium	0.04	0.52	1	0.13	0.13	0.828 J	1.22 J	0.609 J	1.14 J	0.916 J	0.862 J	1.13 J	1.26 J	0.883 J	0.0993 U	4.02 J	0.113 U	4.44 J	0.44 J	0.438 J
Tin	--	4,700	--	N/A	N/A	3.52 J	0.693 J	0.845 J	3.72 J	0.315 J	0.354 J	0.338 J	0.919 J	0.373 J	138 J	2.29 J	4.56 J	14.5 J	1.07 J	0.935 J
Vanadium	300	7.80	2	144	144	58.1 J	76.9 J	191	75.7 J	72.1 J	55 J	58.4 J	74.7 J	74.1 J	89.5 J	95 J	89 J	123 J	89.4 J	77 J
Zinc	620	2,300	120	32	32	123 J	38.6 J	32.8	77.5 J	17.7 J	13.8 J	15.6 J	30.5 J	23.8 J	76.3 J	521 J	67.3 J	23.4 J	44.3 J	21.9 J
Wet Chemistry (mg/kg)[2]																				
Sulfide		--	--	--	--	NA	NA	34.2 J	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

[1] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO. All other samples were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA

mg/kg - Milligrams per kilogram
µg/Kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
R - Unreliable result
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)

Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996 (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, endrin ketone) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (styrene, di-n-butylphthalate, aroclor-1221, aroclor-1248, aroclor-1254, aroclor-1260, nickel, selenium, silver, thallium, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)

[2] Wet Chemistry consists of sulfide and cyanide (cyanide will be included in the inorganic list for this report)

* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background, ECO and HHRA
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 3-1
SWMU 1 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone Kv SS	Vieques (East) Background Zone Qa SS	CGW1SS29	CGW1SS30		CGW1SS31	CGW1SS32[1]	CGW1SS33[1]	CGW1SS34[1]	CGW1SS35[1]	CGW1SS36[1]	CGW1SS37[1]	CGW1SS38[1]	CGW1SS39[1]	CGW1SS40[1]		CGW1SS41
Sample ID						CGW1SS29-R01	CGW1SS30-R01	CGW1FD03P-R01	CGW1SS31-R01	CGW1SS32-R01	CGW1SS33-R01	CGW1SS34-R01	CGW1SS35-R01	CGW1SS36-R01	CGW1SS37-R01	CGW1SS38-R01	CGW1SS39-R01	CGW1SS40-R01	CGW1FD04P-R01	CGW1SS41-R01
Sample Date						2/9/04	2/9/04	2/9/04	2/9/04	2/9/04	2/4/04	2/9/04	2/4/04	2/10/04	2/10/04	2/10/04	2/10/04	2/10/04	2/10/04	2/10/04
Chemical Name																				
Volatile Organic Compounds (µg/kg)																				
Methylene chloride	1	9,100	--	--	--	10.8 U	10.6 U	10.4 U	11.9 U	10.4 U	11.6 U	11.3 U	12 U	12.1 U	11.5 U	10.5 U	12 U	10.1 U	10.6 U	10.2 U
Styrene	200	440,000	300,000	--	--	10.8 U	10.6 U	10.4 U	11.9 U	10.4 U	11.6 U	11.3 U	12 U	12.1 U	11.5 U	10.5 U	12 U	10.1 U	10.6 U	10.2 U
Semivolatile Organic Compounds (µg/kg)																				
4-Methylphenol	--	31,000	--	--	--	374 U	342 U	353 U	373 U	755	369 U	356 U	367 U	371 U	368 U	362 U	371 U	374 U	373 U	354 U
Benzo(a)pyrene	400	62	100	--	--	374 U	342 U	353 U	373 U	342 U	369 U	356 U	367 U	371 U	368 U	362 U	371 U	374 U	373 U	354 U
Benzo(b)fluoranthene	200	620	--	--	--	374 U	342 U	353 U	373 U	342 U	369 U	356 U	367 U	371 U	368 U	362 U	371 U	374 U	373 U	354 U
Benzo(k)fluoranthene	2,000	6,200	--	--	--	374 U	342 U	353 U	373 U	342 U	369 U	356 U	367 U	371 U	368 U	362 U	371 U	374 U	373 U	354 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	374 U	342 U	353 U	373 U	342 U	369 U	356 U	367 U	371 U	368 U	362 U	371 U	374 U	373 U	354 U
Di-n-butylphthalate	270,000	610,000	200,000	--	--	374 U	342 U	353 U	373 U	342 U	369 U	356 U	367 U	371 U	368 U	362 U	371 U	374 U	373 U	354 U
Pyridine	--	6,100	--	--	--	374 U	342 U	353 U	373 U	342 U	369 U	356 U	367 U	371 U	368 U	362 U	371 U	374 U	373 U	354 U
Pesticide/Polychlorinated Biphenyls (µg/kg)																				
4,4'-DDD	800	2,400	10	--	--	3.8 UJ	3.4 U	3.6 U	3.7 U	3.4 U	3.7 U	3.6 U	3.7 U	3.7 U	3.7 U	3.6 U	3.7 U	3.8 U	3.8 U	3.6 U
4,4'-DDE	3,000	1,700	10	--	--	2.3 J	3.4 U	3.6 U	3.7 U	19 J	0.31 J	0.28 J	3.7 U	3.7 U	2.4 J	0.1 J	24 J	1.5 J	1.1 J	0.67 J
4,4'-DDT	2,000	1,700	10	--	--	0.7 J	3.4 U	3.6 U	3.7 U	1.8 J	3.7 U	0.22 J	3.7 U	3.7 UJ	3.7 UJ	3.6 UJ	14 J	0.64 J	0.44 J	0.54 J
Aroclor-1221	--	110	40,000	--	--	76 U	70 U	72 U	76 U	69 U	75 U	72 U	74 U	76 U	75 U	74 U	75 U	76 U	76 U	73 U
Aroclor-1248	--	110	40,000	--	--	38 U	34 U	36 U	37 U	34 U	37 U	36 U	37 U	37 U	37 U	36 U	37 U	38 U	38 U	36 U
Aroclor-1254	--	110	40,000	--	--	38 U	34 U	36 U	37 U	34 U	37 U	36 U	37 U	37 U	37 U	36 U	37 U	38 U	38 U	36 U
Aroclor-1260	--	110	40,000	--	--	38 U	34 U	36 U	37 U	34 U	21 J	36 U	37 U	37 U	37 U	36 U	37 U	38 U	38 U	36 U
Endrin ketone	50	1,800	100	--	--	3.8 UJ	3.4 U	3.6 U	3.7 U	3.4 U	3.7 UJ	3.6 U	3.7 UJ	3.7 U	3.7 U	3.6 U	3.7 U	3.8 U	3.8 U	3.6 U
Herbicides (µg/kg)																				
No Detections																				
Dioxin/Furans (pg/g)																				
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	141	NA	236	NA	NA	NA	NA	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	2.5 U	NA	2.99	NA	NA	NA	NA	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	3.2	NA	7.26	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	3.75	NA	12.8	NA	NA	NA	NA	NA	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	1 U	NA	1.55	NA	NA	NA	NA	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	1,120	NA	2,950	NA	NA	NA	NA	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	256	NA	456	NA	NA	NA	NA	NA	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	31.5	NA	64.8	NA	NA	NA	NA	NA	NA	NA
Total pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	1.73	NA	8.49	NA	NA	NA	NA	NA	NA	NA
Total tetrachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	2.32	NA	3.5	NA	NA	NA	NA	NA	NA	NA
Explosives (µg/kg)																				
No Detections																				
Total Metals (mg/kg)																				
Antimony	0.3	3.1	78	3.60	3.60	0.653 J	0.538 J	0.879 J	1.4 J	4.08 J	0.118 J	0.664 J	0.478 J	0.192 J	3.27 J	0.398 J	0.5 J	0.418 J	0.399 J	0.148 J
Arsenic	1.00	0.39	18	1.60	1.60	0.182 J	0.119 U	0.126 U	1.39 J	2.71	0.147 U	0.12 U	3.28	0.763 J	1.13 J	0.742 J	2.03	1.2	1.1 J	0.789 J
Barium	82	1,600	330	212	212	66.9 J	29.8 J	36.8 J	66.2 J	69.6 J	61.1	47.7 J	91.8	61.2	75.8	45.1	106	49.3	66.8	53.1
Beryllium	3	15	40	0.27	0.27	0.278 J	0.173 J	0.208 J	0.375 J	0.32 J	0.266 J	0.205 J	0.402 J	0.252 J	0.275 J	0.212 J	0.351 J	0.246 J	0.265 J	0.201 J
Cadmium	0.40	3.70	32	2.20	2.20	0.0118 U	0.0545 U	0.0574 U	0.011 U	0.0108 U	0.0134 U	0.011 U	0.133 J	0.0119 U	0.0115 U	0.0112 U	0.0117 U	0.00866 U	0.0102 U	0.00998 U
Chromium	2	210	0.40	72	72	21.9 J	13.1 J	14.9 J	80 J	113 J	21.2 J	18.1 J	62.7 J	19.5 J	18.1 J	13 J	38.7 J	24.4 J	26.9 J	13.5 J
Cobalt	33	140	13	26	16	13.9 J	8.33 J	12.1 J	32.1 J	17.6 J	11.9	9.36 J	26.3	11	15.6	8.65	20.1	8.5	12.9	9.79
Copper	46	310	70	94	53	39.6 J	22.5 J	34.2 J	28.5 J	130 J	48.5	23.8 J	39.9	28.3	61.4	36.6	38.6	30.9	39.9	21.8
Cyanide	--	120	1	0.89	0.89	NA	NA	NA	NA	NA	0.595 J	NA	0.439 J	NA	NA	NA	NA	NA	NA	NA
Lead	14	400	120	5.40	5.40	3.18	0.814 U	0.858 U	0.824 U	22.9	6.29	4.59	9.46	2.77	4.81	3.47	8.68	3.77	4.89	3.21
Mercury	0.10	2.30	0.10	0.06	0.06	0.0239 J	0.00688 J	0.00703 J	0.055	0.0476	0.0203 J	0.0144 J	0.059	0.018 J	0.0324	0.0207 J	0.0368	0.0176 J	0.0196 J	0.0172 J
Nickel	7	160	38	41	22	9.77 J	4.82 J	6.94 J	23.9 J	31.5 J	8.31 J	5.87 J	22.5 J	7.77	7.74	5.57 J	20.9	7.64	10.4	5.43
Selenium	0.3	39	0.52	0.51	0.51	0.908	0.339 J	0.38 J	1.35	0.559 J	0.465 J	0.623 J	1.07	0.556 J	0.54 J	0.514 J	0.532 J	0.483 J	0.379 J	0.449 J
Silver	2	39	560	0.22	0.22	0.0224 U	0.0207 U	0.0218 U	0.021 U	0.0745 J	0.0254 U	0.0208 U	0.0292 U	0.0225 U	0.0218 U	0.0212 U	0.357 J	0.0164 U	0.0194 U	0.0189 U
Thallium	0.04	0.52	1	0.13	0.13	0.113 U	0.609 J	0.694 J	2.89 J	0.104 U	0.735 J	0.293 J	0.148 U	1.26 J	1.38 J	1.72	1.78	0.778 J	1.32 J	0.88 J
Tin	--	4,700	--	N/A	N/A	1.06 J	0.536 J	0.784 J	1.04 J	6.3 J	0.909 J	0.74 J	1.84 J	0.331 J	0.265 J	0.5 J	0.571 J	0.974 J	0.376 J	0.175 U
Vanadium	300	7.80	2	144	144	88.7 J	77.7 J	91.4 J	191 J	143 J	80.4	79.2 J	192	78.3	90.3	78.8	116	89.6	93	71.5
Zinc	620	2,300	120	32	32	47 J	13.8 J	15.7 J	21.2 J	73.1 J	40.2	21.1 J	61.9	18.6 J	28.9 J	21.5 J	36.5 J	54.6 J	52.1 J	18 J
Wet Chemistry (mg/kg)[2]																				
Sulfide		--	--	--	--	NA	NA	NA	NA	NA	26.9 J	NA	8.91 U	NA	NA	NA	NA	NA	NA	NA

Notes:

[1] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO. All other samples were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA

mg/kg - Milligrams per kilogram
µg/Kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
R - Unreliable result
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)

Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996 (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, endrin ketone) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (styrene, di-n-butylphthalate, aroclor-1221, aroclor-1248, aroclor-1254, aroclor-1260, nickel, selenium, silver, thallium, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)

[2] Wet Chemistry consists of sulfide and cyanide (cyanide will be included in the inorganic list for this report)

* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background, ECO and HHRA
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 3-1
SWMU 1 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone Kv SS	Vieques (East) Background Zone Qa SS	CGW1SS42[1]	CGW1SS43[1]	CGW1SS44[1]	CGW1SS45[1]	CGW1SS46[1]	CGW1SS47[1]	CGW1SS48[1]	CGW1SS49[1]	CGW1SS50	
Sample ID						CGW1SS42-R01	CGW1SS43-R01	CGW1SS44-R01	CGW1SS45-R01	CGW1SS46-R01	CGW1SS47-R01	CGW1SS48-R01	CGW1SS49-R01	CGW1SS50-R01	CGW1FD05P-R01
Sample Date						2/10/04	2/10/04	2/10/04	2/10/04	2/10/04	2/10/04	2/4/04	2/10/04	2/10/04	2/10/04
Chemical Name															
Volatile Organic Compounds (µg/kg)															
Methylene chloride	1	9,100	--	--	--	0.64 J	10.7 U	0.59 J	11.6 U	10.9 U	10.9 U	10.5 U	13.6 U	10.4 U	11.1 U
Styrene	200	440,000	300,000	--	--	10.3 U	10.7 U	10.5 U	11.6 U	10.9 U	10.9 U	10.5 U	13.6 U	10.4 U	11.1 U
Semivolatile Organic Compounds (µg/kg)															
4-Methylphenol	--	31,000	--	--	--	340 U	366 U	386 U	372 U	363 U	374 U	360 U	378 U	361 U	362 U
Benzo(a)pyrene	400	62	100	--	--	340 U	366 U	386 U	372 U	363 U	374 U	360 U	378 U	361 U	362 U
Benzo(b)fluoranthene	200	620	--	--	--	340 U	366 U	386 U	372 U	363 U	374 U	360 U	378 U	361 U	362 U
Benzo(k)fluoranthene	2,000	6,200	--	--	--	340 U	366 U	386 U	372 U	363 U	374 U	360 U	378 U	361 U	362 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	340 U	366 U	386 U	372 U	363 U	130 J	360 U	378 U	361 U	362 U
Di-n-butylphthalate	270,000	610,000	200,000	--	--	340 U	366 U	386 U	372 U	363 U	374 U	360 U	378 U	361 U	362 U
Pyridine	--	6,100	--	--	--	340 U	366 U	386 U	29.3 J	363 U	374 U	360 U	378 U	361 U	362 U
Pesticide/Polychlorinated Biphenyls (µg/kg)															
4,4'-DDD	800	2,400	10	--	--	3.4 U	3.7 U	3.9 U	3.7 U	3.6 U	3.7 U	3.6 UJ	3.8 U	6.2 J	5.6 J
4,4'-DDE	3,000	1,700	10	--	--	3.4 U	3.7 U	1.8 J	0.42 J	2.7 J	0.7 J	0.71 J	0.76 J	190	180
4,4'-DDT	2,000	1,700	10	--	--	3.4 UJ	3.7 UJ	1.2 J	0.67 J	2.7 J	3.7 UJ	3.6 UJ	0.39 J	49 J	58 J
Aroclor-1221	--	110	40,000	--	--	70 U	74 U	79 U	76 U	74 U	76 U	74 U	77 U	74 U	74 U
Aroclor-1248	--	110	40,000	--	--	34 U	37 U	39 U	37 U	36 U	37 U	36 U	38 U	36 U	36 U
Aroclor-1254	--	110	40,000	--	--	34 U	37 U	39 U	37 U	36 U	37 U	36 U	38 U	36 U	36 U
Aroclor-1260	--	110	40,000	--	--	34 U	37 U	39 U	37 U	36 U	37 U	36 U	38 U	36 U	36 U
Endrin ketone	50	1,800	100	--	--	3.4 U	3.7 U	3.9 U	3.7 U	3.6 U	3.7 U	3.6 UJ	3.8 U	3.6 U	3.6 U
Herbicides (µg/kg)															
No Detections															
Dioxin/Furans (pg/g)															
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	56.1	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	1 U	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	512	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	99.1	NA	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	11.3	NA	NA	NA
Total pentachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	1 U	NA	NA	NA
Total tetrachlorodibenzo-p-dioxin	--	*	--	--	--	NA	NA	NA	NA	NA	NA	1 U	NA	NA	NA
Explosives (µg/kg)															
No Detections															
Total Metals (mg/kg)															
Antimony	0.3	3.1	78	3.60	3.60	0.166 J	0.227 J	0.569 J	0.636 J	1.13 J	0.526 J	0.275 J	0.197 J	0.359 J	0.376 J
Arsenic	1.00	0.39	18	1.60	1.60	0.939 J	0.755 J	1.16 J	2.23	4.25	1.09 J	0.915 J	0.722 J	0.766 J	0.888 J
Barium	82	1,600	330	212	212	29.5	52.4	63.3	95.3	74	59	70.3	67.2	58.8	57.1
Beryllium	3	15	40	0.27	0.27	0.185 J	0.25 J	0.294 J	0.288 J	0.444 J	0.265 J	0.251 J	0.267 J	0.226 J	0.258 J
Cadmium	0.40	3.70	32	2.20	2.20	0.0102 U	0.0112 U	0.012 U	0.0123 U	0.0114 U	0.0115 U	0.0138 U	0.013 U	0.0114 U	0.0103 U
Chromium	2	210	0.40	72	72	10.1 J	15.1 J	23.6 J	57.5 J	58 J	19.8 J	22.5 J	17.2 J	17.1 J	23 J
Cobalt	33	140	13	26	16	6.36 J	9.63	12.4	26.9	23.4	10.9	13.9	11.6	10.3	10.3
Copper	46	310	70	94	53	19.5	24.5	53	41.5	55.4	31.5	40.8	34.9	31.3	33.1
Cyanide	--	120	1	0.89	0.89	NA	NA	NA	NA	NA	NA	0.276 J	NA	NA	NA
Lead	14	400	120	5.40	5.40	2.67	2.09	6	4.93	12.4	4.44	5.4	3.79	5.03	5.08
Mercury	0.10	2.30	0.10	0.06	0.06	0.00988 J	0.0229 J	0.0269 J	0.0329	0.0213 J	0.0243 J	0.0166 J	0.0367	0.0258 J	0.0293 J
Nickel	7	160	38	41	22	4.29 J	6.36	9.68	33.9	22.2	8.23	8.82 J	7.78	7.08	8.73
Selenium	0.3	39	0.52	0.51	0.51	0.588 J	0.655 J	0.582 J	0.803 J	0.619 J	0.663 J	0.65 J	0.574 J	0.52 J	0.408 J
Silver	2	39	560	0.22	0.22	0.0194 U	0.0212 U	0.0228 U	0.0233 U	0.0217 U	0.0218 U	0.0367 J	0.0246 U	0.0217 U	0.0196 U
Thallium	0.04	0.52	1	0.13	0.13	0.843 J	1.22 J	1.31 J	1.45 J	3.07	1.33 J	0.132 U	1.57 J	1.31 J	1.85
Tin	--	4,700	--	N/A	N/A	0.18 U	0.239 J	0.523 J	0.694 J	0.971 J	0.843 J	0.661 J	0.274 J	0.886 J	0.181 U
Vanadium	300	7.80	2	144	144	61.2	70.4	84.5	147	180	82.4	92.7	80.3	77.1	89.2
Zinc	620	2,300	120	32	32	14.8 J	16.5 J	36.7 J	36.5 J	72.9 J	23.7 J	30.4	30.4 J	24.9 J	26.7 J
Wet Chemistry (mg/kg)[2]															
Sulfide		--	--	--	--	NA	NA	NA	NA	NA	NA	8.79 U	NA	NA	NA

Notes:

[1] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO. All other samples were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA

mg/kg - Milligrams per kilogram
µg/Kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
R - Unreliable result
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996 (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, endrin ketone) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (styrene, di-n-butylphthalate, aroclor-1221, aroclor-1248, aroclor-1254, aroclor-1260, nickel, selenium, silver, thallium, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[2] Wet Chemistry consists of sulfide and cyanide (cyanide will be included in the inorganic list for this report)
* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background, ECO and HHRA
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

Table 3-2
SWMU 1 Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Vieques HHRA GW**	**GW - MCL**	**E-SWMU-1 CGW1MW01 Background**	CGW1MW02	CGW1MW03	CGW1MW04	CGW1MW05
Sample ID				CGW1GW02-R01	CGW1GW03-R01	CGW1GW04-R01	CGW1GW05-R01
Sample Date				2/5/04	2/6/04	2/7/04	2/13/04
Chemical Name							
Volatile Organic Compounds (µg/L)							
No Detections							
Semivolatile Organic Compounds (µg/L)							
No Detections							
Pesticide/Polychlorinated Biphenyls (µg/L)							
No Detections							
Herbicides (µg/L)							
No Detections							
Dioxin/Furans (pg/L)							
No Detections							
Explosives (µg/L)							
No Detections							
Total Metals (µg/L)							
Antimony	1.5	6	--	2.5 U	3.25 J	2.5 U	3.02 J
Barium	730	2,000	36.8	47.8 J	238	45.7 J	81.8 J
Beryllium	7.3	4	0.18	0.0973 J	0.0945 U	0.0945 U	0.0945 U
Cadmium	1.8	5	--	0.492 J	0.356 U	0.356 U	0.356 U
Chromium	11*	100	29	20.2	0.774 J	1.47 J	2.01 J
Cobalt	73	--	3.81	2.47 J	11 J	0.569 U	0.738 J
Copper	150	1,300	15.3	3.83 J	1.74 J	1.26 J	8.74 J
Mercury	1.1	2	--	1.29	0.0507 J	0.0888 J	0.0162 U
Nickel	73	--	17.2	15.5 J	4.71 J	2.28 J	5.34 J
Selenium	18	50	--	4.74 J	2.1 U	3.49 J	4.93 J
Silver	18	--	--	0.858 J	0.547 J	0.472 U	0.656 J
Thallium	0.24	2	--	5.08 J	2.99 J	3.89 J	2.54 U
Vanadium	3.6	--	31.5	14.9 J	11.7 J	12.9 J	24.3 J
Zinc	1100	--	14	4.66 J	0.409 U	0.409 U	10.8 J
Dissolved Metals (µg/L)							
Antimony	1.5	6	--	2.5 U	2.83 J	2.5 U	2.5 U
Barium	730	2,000	18	39.6 J	236	41.8 J	77.2 J
Chromium	11*	100	7.91	9.93 J	0.595 J	1.25 J	1.27 J
Cobalt	73	--	--	0.569 U	11 J	0.569 U	0.569 U
Copper	150	1,300	5.24	3.25 J	1.96 J	1.31 J	5.2 J
Cyanide	73	200	--	3.73 U	NA	4.79 J	NA
Mercury	1.1	2	--	0.461	0.0162 U	0.0264 J	0.0162 U
Nickel	73	--	6.66	10.4 J	4.36 J	1.84 J	4.74 J
Selenium	18	50	--	3.62 J	2.1 U	2.38 J	3.25 J
Silver	18	--	--	0.472 U	0.515 J	0.472 U	0.472 U
Thallium	0.24	2	--	2.99 J	2.54 U	2.54 U	2.54 U
Tin	2,200	--	--	0.994 U	0.994 U	1.8 J	0.994 U
Vanadium	3.6	--	8.88	9.48 J	10.6 J	10.9 J	22.1 J
Zinc	1100	--	5.89	0.409 U	0.409 U	0.409 U	17.2 J
Wet Chemistry (mg/L)[1]							
Sulfide	--	--	NA	1 J	NA	1 J	NA

Notes:
µg/L - Micrograms per Liter
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Vieques HHRA GW - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards (40 Code of Federal Regulations [CFR] 141)
[1] Wet Chemistry consists of sulfide and cyanide (cyanide will be included in the inorganic list for this report)
* - Chromium VI PRG value used as surrogate PRG value for chromium

Exceeds Background and HHRA Criteria
Exceeds Background, HHRA and MCL Criteria

Table 3-3
SWMU 1 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; however, neither subsurface soil nor the ephemeral stream have been characterized.
		VOCs	Yes	No	N/A	
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		PCB	Yes	No	N/A	
		Dioxins	No	N/A	N/A	
		Inorganics	Yes	Sb > PRG, SSL, BKG	acceptable HH risk level; detected in groundwater below PRG (unadjusted) and MCL	
				As > PRG, SSL, BKG	within acceptable HH risk range; not detected in groundwater	
				Cr > ECO, SSL, BKG	site-wide chromium likely acceptable ECO risk; detected in groundwater below PRG and MCL	
				Co > ECO, BKG	mean concentration = ECO	
				Cu > ECO, SSL, BKG	mean concentration < ECO; detected in groundwater below PRG and MCL	
				Pb > SSL, BKG	not detected in groundwater	
				Hg > ECO, SSL, BKG	mean concentration < ECO; detected in groundwater below PRG (unadjusted) and MCL	
				Ni > SSL, BKG	detected in groundwater below PRG	
				Se > ECO, SSL, BKG	ECO criterion based on plants; no sign of stress to plants; < ECO for soil invertebrates; detected in groundwater below PRG and MCL	
				Th > PRG, ECO, SSL, BKG	acceptable HH risk level; mean concentration comparable to ECO; > PRG and MCL in dissolved phase; thallium results suspected of being falsely elevated	
				V > PRG, ECO, BKG	acceptable HH risk level for industrial scenario; site-wide vanadium likely acceptable ECO risk; vanadium not likely site-related	
				Zn > ECO, BKG	mean concentration < ECO	
Groundwater	Yes					Medium not sufficiently characterized because groundwater not characterized within landfill boundary. Also, resampling of existing wells recommended due to existence of new thallium method.
		Inorganics	Yes	Sb > PRG, BKG	acceptable HH risk level; < MCL	
				Hg > PRG, BKG	acceptable HH risk level; < MCL	
				Th > PRG, MCL, BKG	thallium results suspect	
				V > PRG, BKG	acceptable HH risk level	

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_1_1959.mxd

Legend

Apparent Landfill trench/cell evident in 1959 Aerial Photograph

SWMU 1 area identified by ERI (2000)

N
W E
S

0 175 350 700 Feet

Figure 3-1
1959 Aerial Photograph of
Camp Garcia Landfill (SWMU 1)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

ES062007002TPA

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_1_1962_zoom_in.mxd

Legend

Apparent Landfill trench/cell evident in 1962 Aerial Photograph

SWMU 1 area identified by ERI (2000)

N
W E
S

0 175 350 700 Feet

Figure 3-2
1962 Aerial Photograph of Camp Garcia Landfill (SWMU 1)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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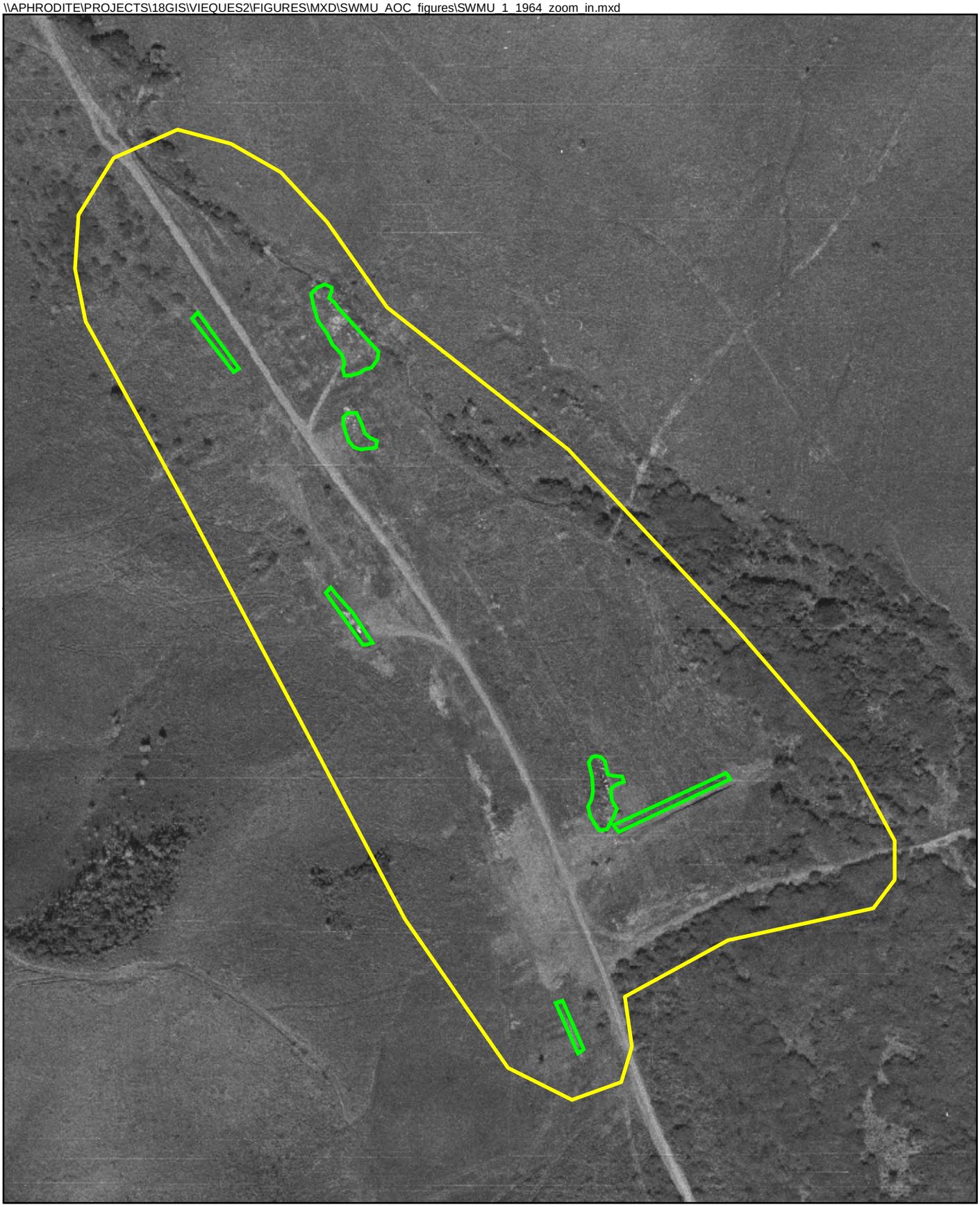
\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_1_1964_zoom_in.mxd



Legend

Apparent Landfill trench/cell evident in 1964 Aerial Photograph

SWMU 1 area identified by ERI (2000)

N
W E
S

0 175 350 700 Feet

Figure 3-3
1964 Aerial Photograph of Camp Garcia Landfill (SWMU 1)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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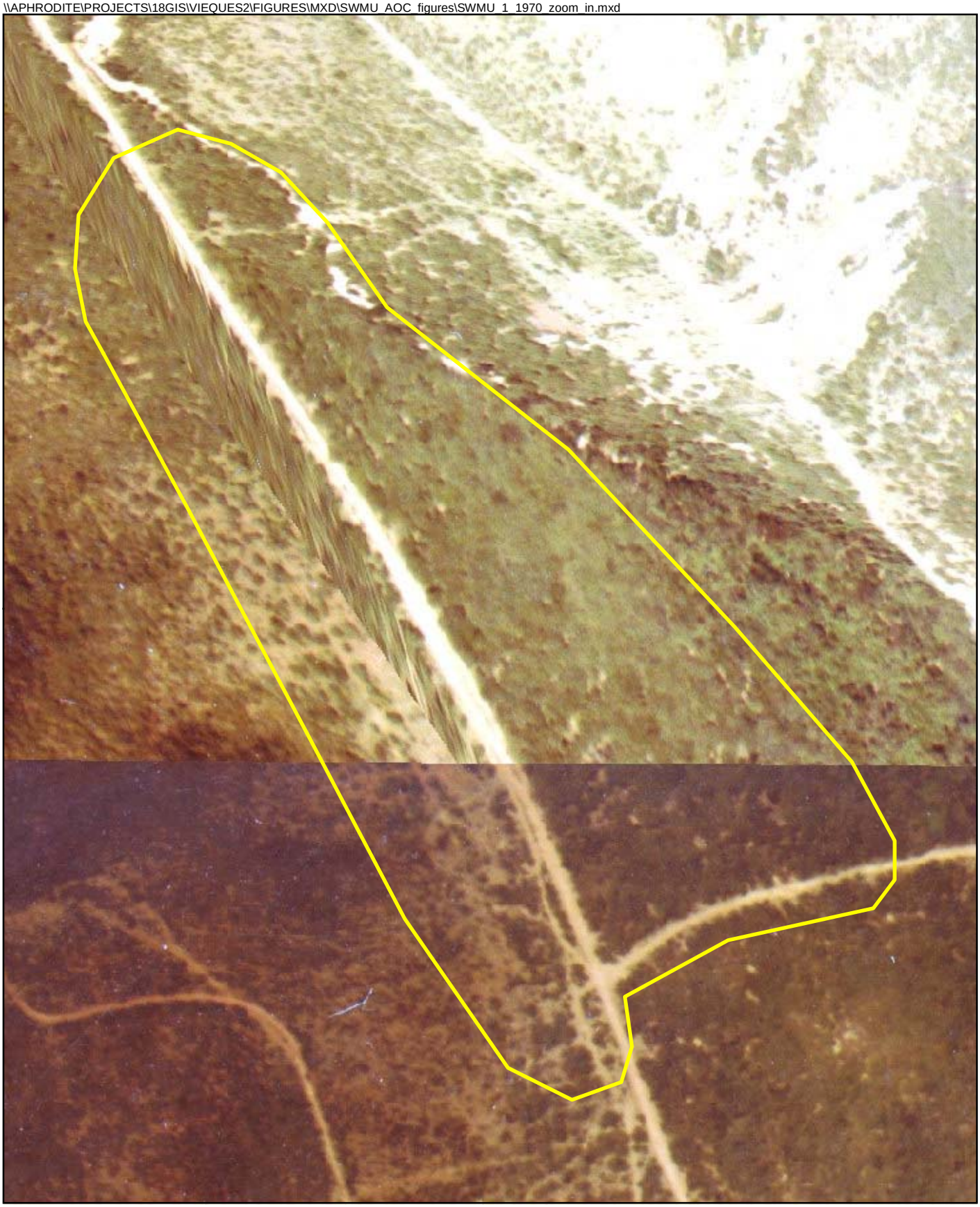

Legend

SWMU 1 area identified by ERI (2000) - No landfill trenches or cells were observed in the 1970 Aerial Photograph

N
W E
S

0 175 350 700 Feet

Figure 3-4
1970 Aerial Photograph of Camp Garcia Landfill (SWMU 1)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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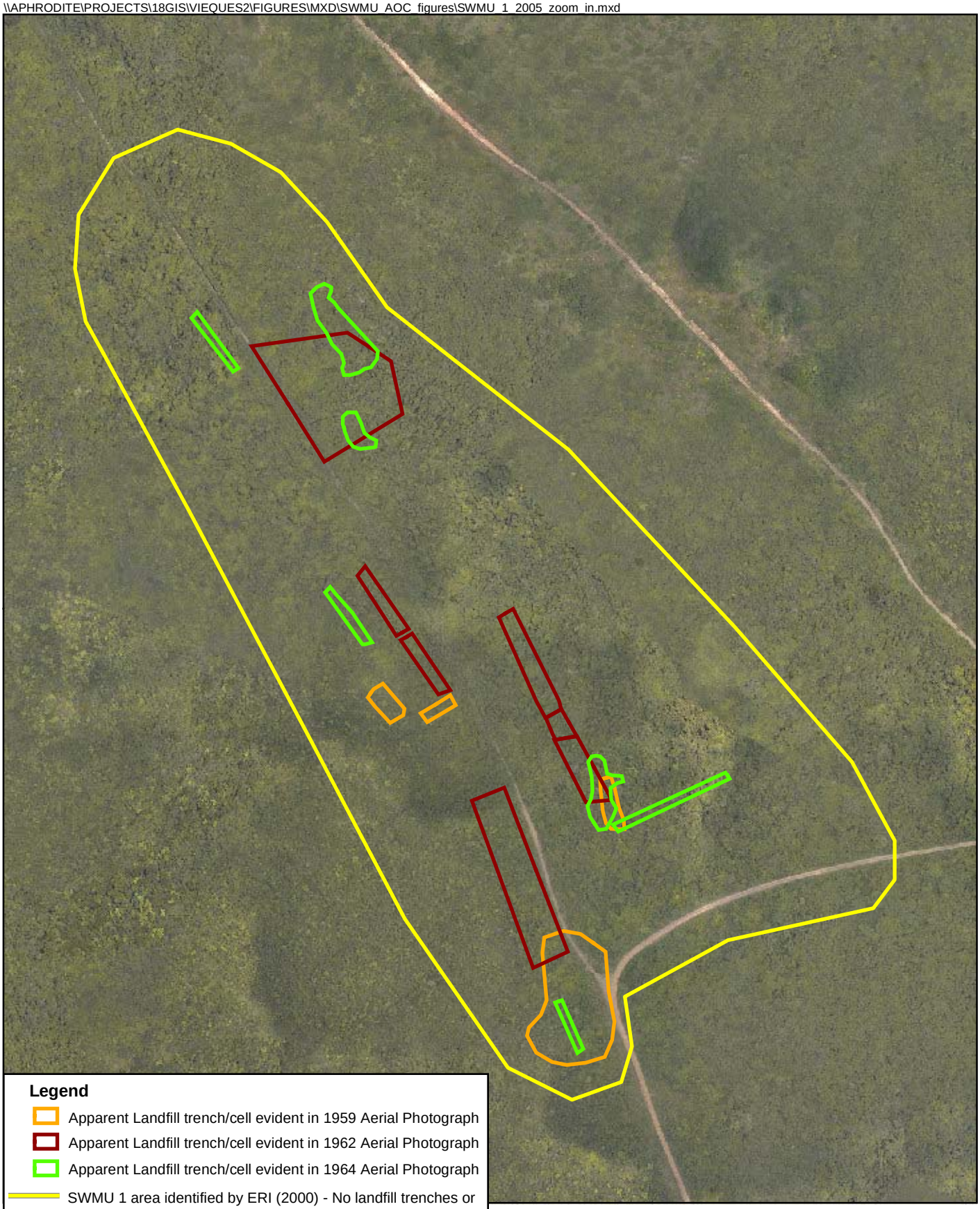
ES062007002TPA

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_1_2005_zoom_in.mxd



Source: ERI 2000

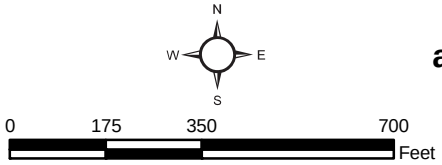


Figure 3-5
Approximate Area of SWMU 1 Landfill as Identified in ERI Aerial Photography
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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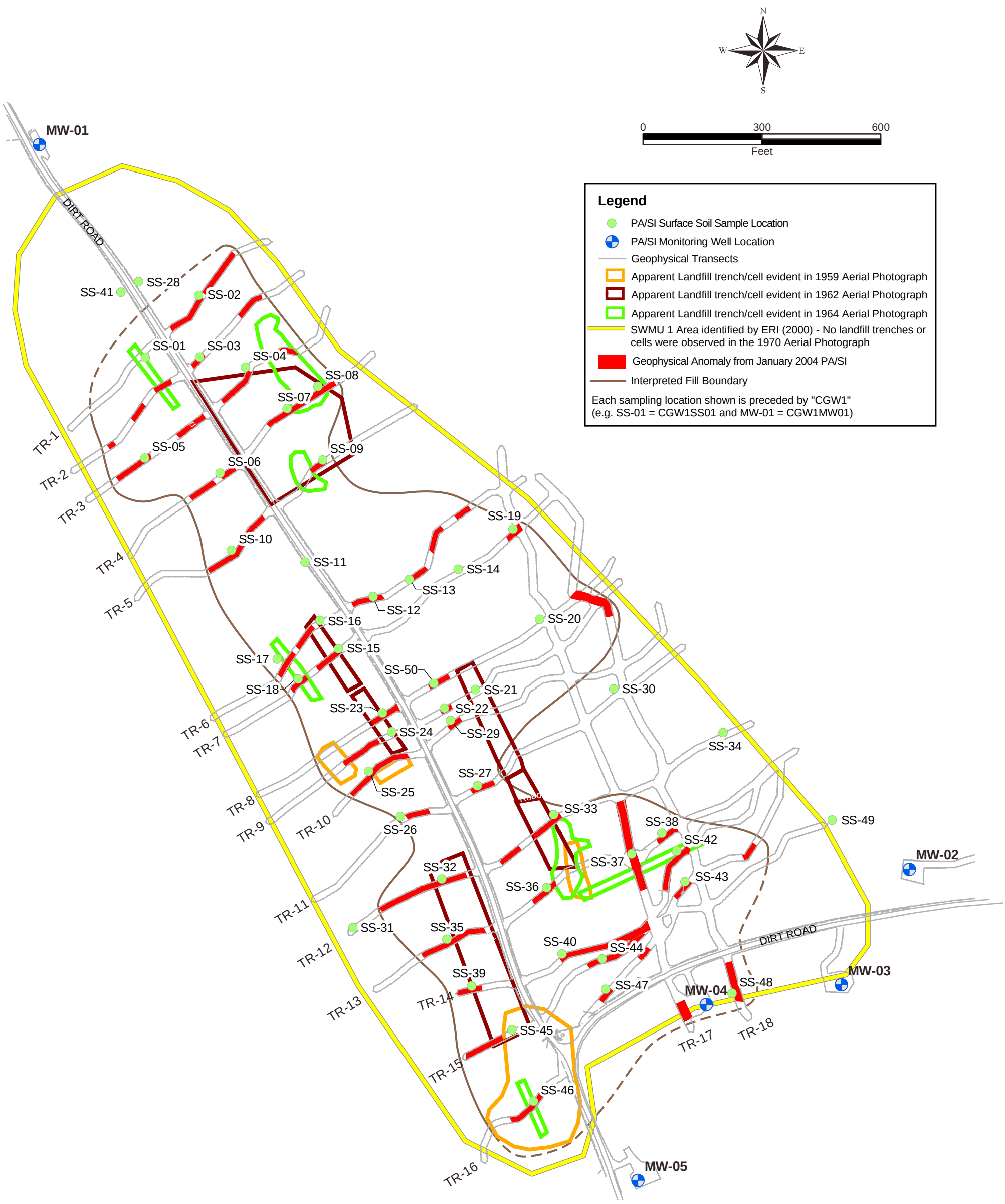


Figure 3-6
Geophysical Survey and Sample Location Map, SWMU 1
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

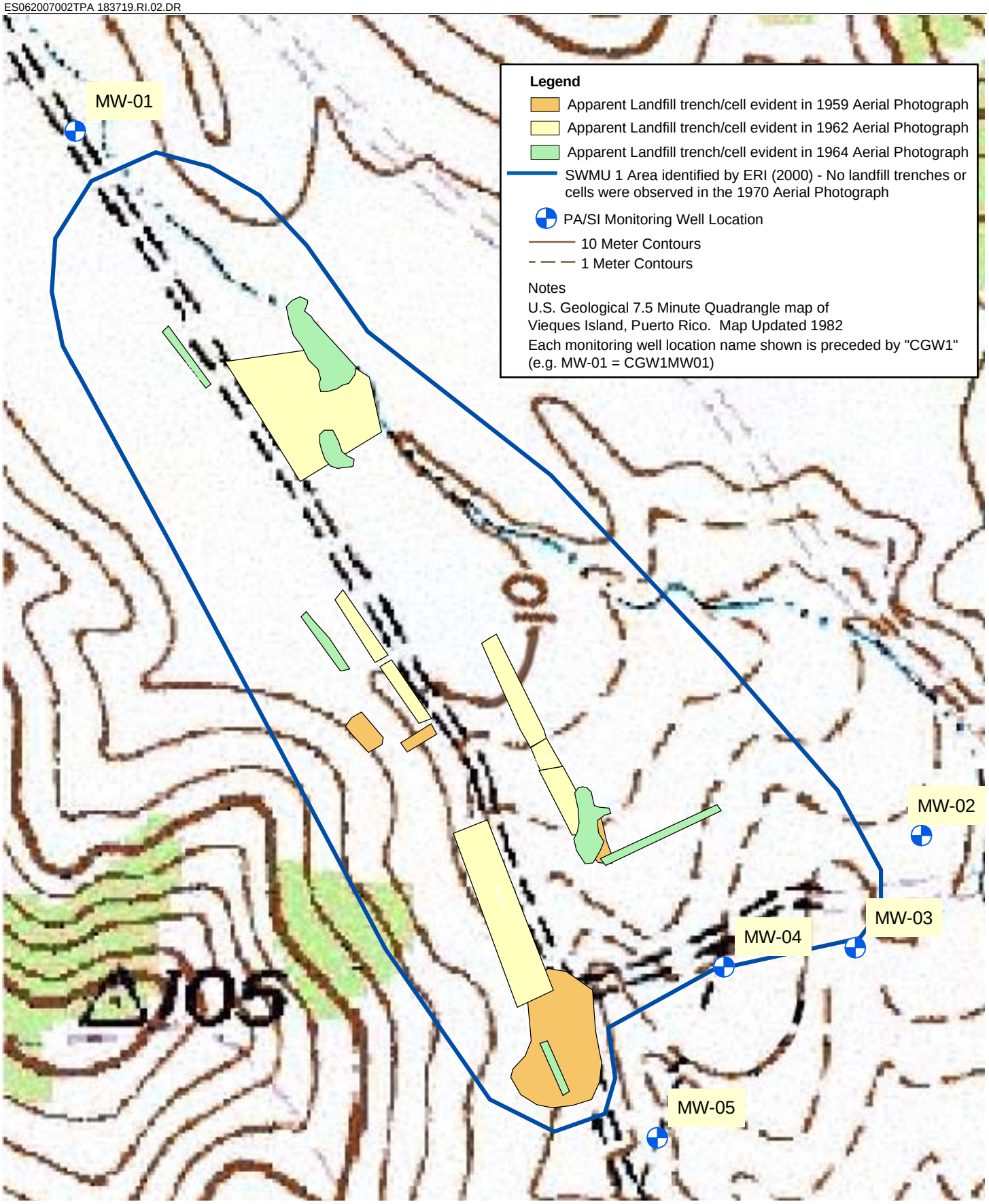


Figure 3-7
SWMU 1 Topographic Map
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

0 300 600
Feet

CH2MHILL

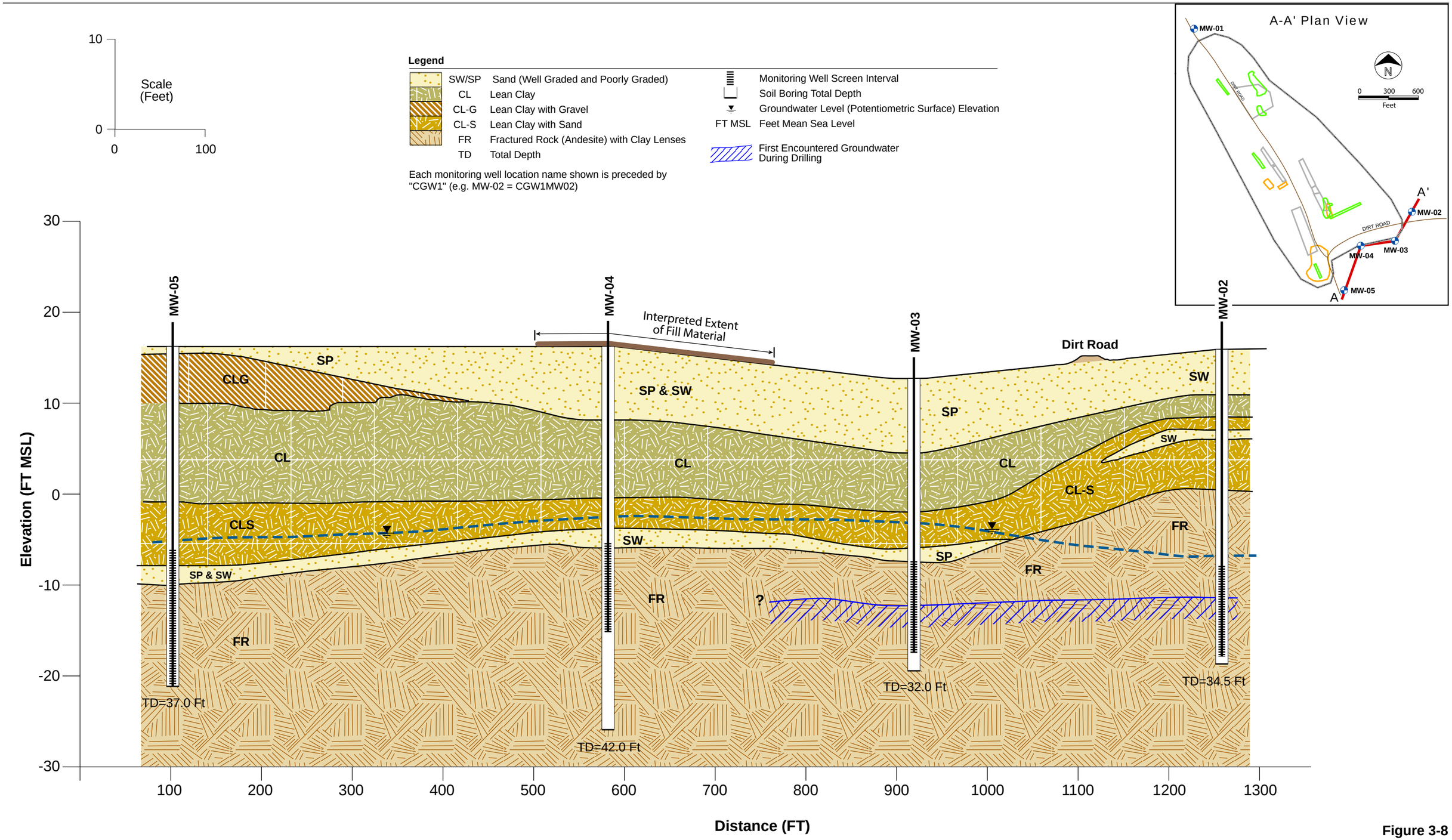
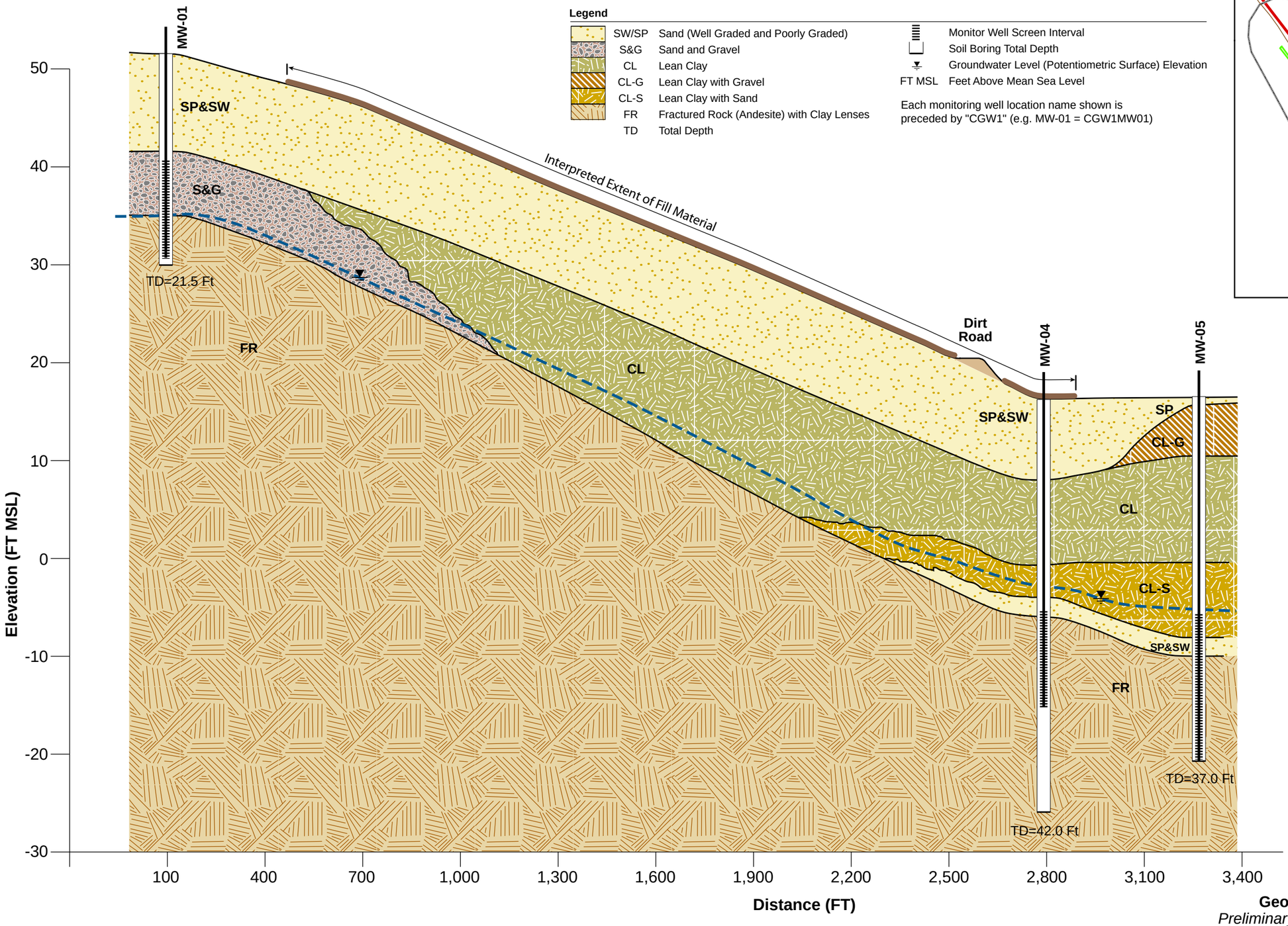


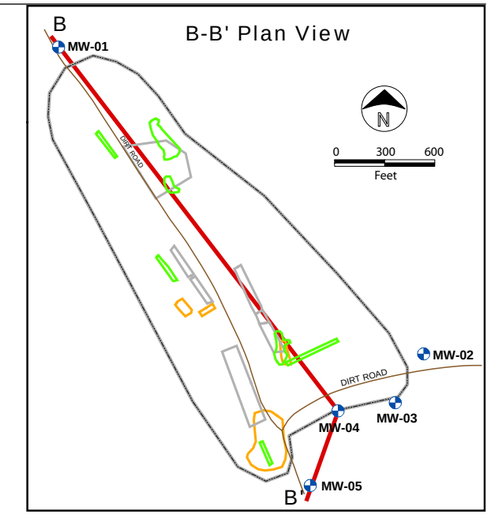
Figure 3-8
Geologic Cross Section A-A', SWMU 1
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



Legend

SW/SP	Sand (Well Graded and Poorly Graded)
S&G	Sand and Gravel
CL	Lean Clay
CL-G	Lean Clay with Gravel
CL-S	Lean Clay with Sand
FR	Fractured Rock (Andesite) with Clay Lenses
TD	Total Depth
	Monitor Well Screen Interval
	Soil Boring Total Depth
	Groundwater Level (Potentiometric Surface) Elevation
FT MSL	Feet Above Mean Sea Level

Each monitoring well location name shown is preceded by "CGW1" (e.g. MW-01 = CGW1MW01)



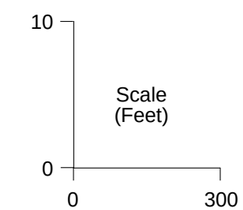


Figure 3-9
Geologic Cross Section B-B', SWMU 1
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

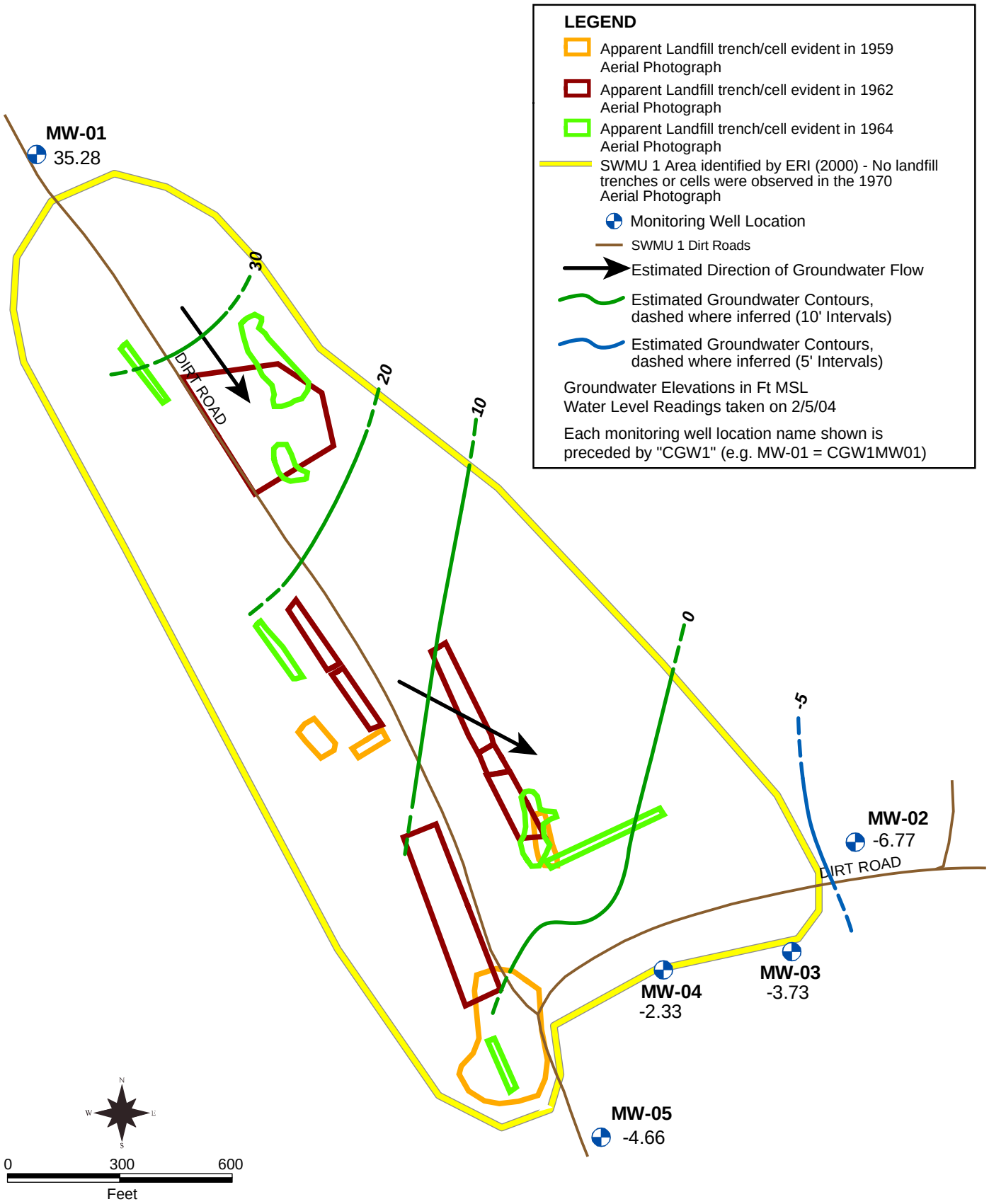
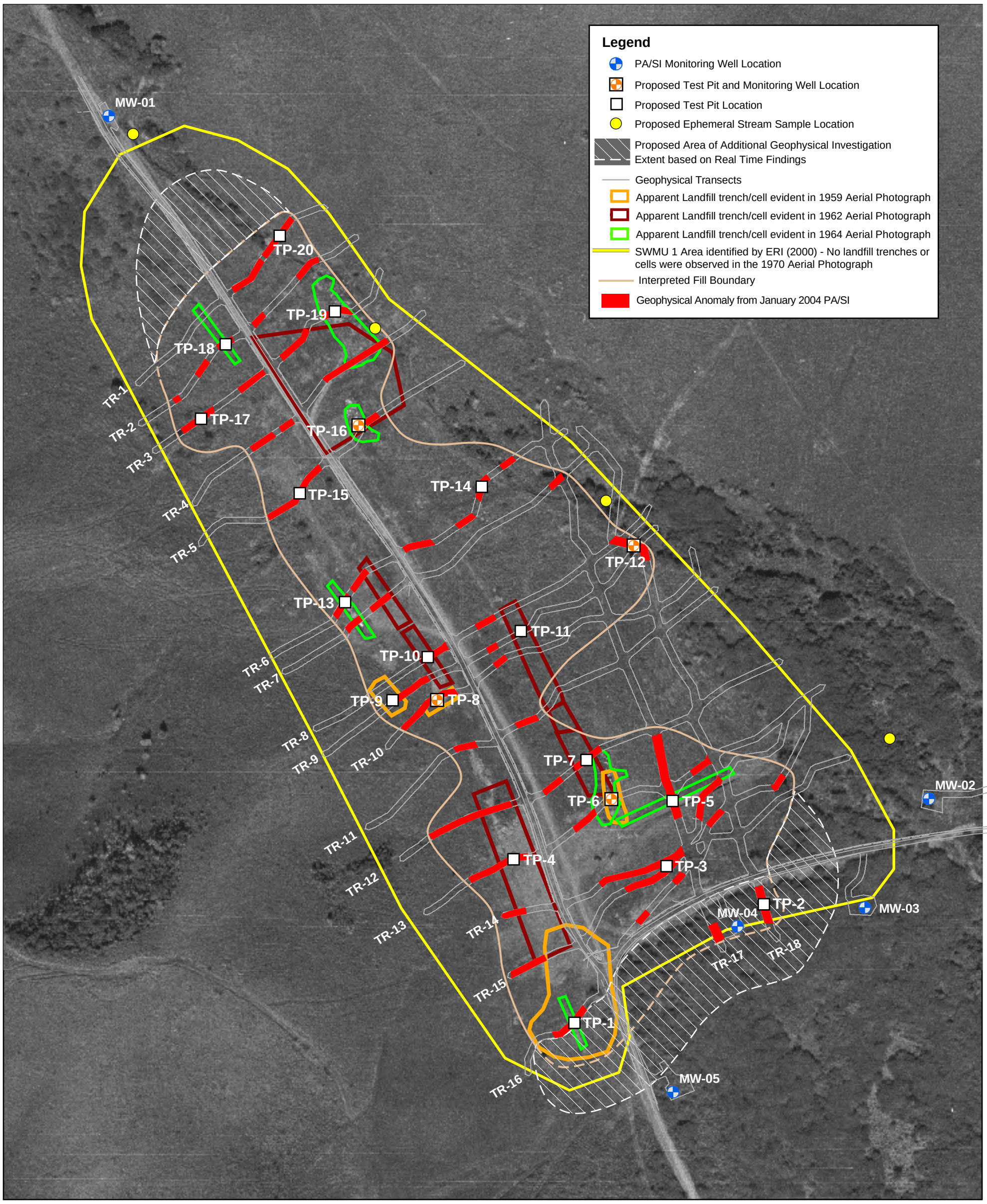


Figure 3-10
Estimated Potentiometric Surface
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



N
W E
S

0 125 250 500 Feet

Figure 3-11
Proposed Additional Investigation (SWMU 1)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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SECTION 4

SWMU 2—Fuels Off-loading Site (Camp García)

This section presents the results of the PA/SI performed at SWMU 2—Fuels Off-Loading Site in January and February 2004.

4.1 Conceptual Site Model

The CSM for SWMU 2 is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews, as well as site-specific data.

4.1.1 Site History and Potential Sources of Release

SWMU 2 is located at Camp García (Figures 1-2 and 1-3), and is the former location of aboveground fuel storage tanks (ASTs) and an area where fuels were offloaded from barges and pumped through an 8-inch underground line to each of these tanks. Two 20,000-gallon tanks and two 30,000-gallon tanks at this location were reported to have been used to store diesel fuel, unleaded gasoline (MOGAS), leaded gasoline, aviation gasoline (AVGAS), and JP-5 fuel (Greenleaf/Telesca and E&E, 1984). The tanks became operational in 1953, during which tank refueling occurred approximately every 3 months, and were reportedly removed between 1978 and 1979. According to the 1984 IAS (Greenleaf/Telesca and E&E, 1984), this refueling process took place for approximately 25 years. The sludge that accumulated in the bottom of the tanks was removed periodically by a private contractor and disposed of on the main island of Puerto Rico (Kearney, 1988). The locations of tanks are shown in the 1959 (Figure 4-1), 1962 (Figure 4-2), 1964 (Figure 4-3), and 1970 (Figure 4-4) aerial photographs, which indicate that eight tanks were historically present at the site. It is noted that the fuel offloading area identified in the 1970 aerial photograph (Figure 4-4) is not present in the 1959, 1962, or 1964 aerial photographs (Figures 4-1 through 4-3) even though tank refueling operations reportedly began in 1953. It is also noted that the samples shown on all the aerial photographs were collected in 2004, at which time the fuel offloading area was present.

The only remaining visual signs of historical site activities are the concrete loading ramp and the steel pipeline supports next to the loading ramp (Figure 4-5). The 1995 RFA (PREQB, 1995) stated that the potential for waste or accumulated liquids to migrate into the soil, groundwater or surface water was very low. However, prior to the start of refueling, seawater had to be flushed from the underground line, which reportedly resulted in the discharge of fuel mixed with seawater into the ocean and onto the soil along the shoreline in the vicinity of the concrete loading ramp that is shown in Figures 4-4 and 4-5.

An environmental survey was conducted in 1978 as part of preparation of an Environmental Impact Statement for continued range use (TAMS/E&E, 1979), shortly after the tanks were dismantled and the refueling halted. The survey did not find any indications of stressed vegetation, impacts to the fauna, oil-stained beaches, or other indications of pollution. Because no effects on the environment or to human health were observed or postulated,

SWMU 2 was not recommended for a Confirmation Study (Greenleaf/Telesca and E&E, 1984).

A Phase II RFA was conducted by Kearney in 1988. The study concluded SWMU 2 had low to no potential for exposure to environmental receptors and recommended NFA (Kearney, 1988). No staining or other evidence of release was found during a VSI conducted in June 1995 (PREQB, 1995). The RFA Reports recommended NFA for this site based on the following conditions: the remote location, the inactive nature of the site, the minimal exposure potential from this SWMU to human receptors, and the absence of visible petroleum contamination on surface media (Kearney, 1988; PREQB, 1995). These same conditions were observed during the February 2004 PA/SI site visit.

Although SWMU 2 was recommended for NFA in the Phase II RFA Reports, the site was investigated during the 2004 PA/SI to determine whether there was evidence of historical releases. Based on the site history information summarized above, two areas were identified as potential source areas: (1) former AST area and (2) fuel offloading area.

4.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 1979 during an Environmental Impact Statement evaluation (TAMS/E&E, 1979), the IAS (Greenleaf/Telesca and E&E, 1984), the Phase II RFA (Kearney, 1988), the Revised RFA (PREQB, 1995), the EBS (NAVFACENGCOM, 2003), the current conditions inspection (CH2M HILL, 2001), and the 2004 PA/SI, as well as on regional information.

The site is currently overgrown with grasses and small shrubs. The SWMU 2 area is located on a bluff on the southern coast of the island with its highest elevation at approximately 32 ft amsl, as shown on the topographic map (Figure 4-6). Figures 4-2 and 4-6 show the site is relatively flat with steep relief on all sides of the former AST location, as well as along the coast. The site resides within the geological unit Kv, which comprises sedimentary and igneous rocks deposited largely in a marine environment. For more information on the bedrock geology see Section 1.4.6. Soils consist of sand in the upper 2 ft and grade into a clay just above the bedrock, which is encountered at approximately 5 ft bls at the site.

Other than the ocean, there are no surface water bodies at or immediately adjacent to SWMU 2. Groundwater was not encountered in the unconsolidated material, but regional groundwater flow in the bedrock (as well as overland runoff) is anticipated to be toward the ocean, immediately adjacent to the site (USGS, 1989), as described in Section 1.4.7.

4.2 Sampling Approach and Chemical Constituents Identified

As presented in the Phase I RFI Work Plan (CH2M HILL, 2003c), eight surface soil samples and one subsurface soil sample were collected around the former fuel tanks (Figure 4-7) and four surface soil samples and one subsurface soil sample were collected around the former fuel loading area (Figure 4-8). The soil borings were advanced to 5 ft bls in the former fuel tank area and 4.5 ft bls in the fuel pipe support area (depths correspond to where bedrock was encountered), and soil samples were screened continuously with an OVA. No elevated OVA readings were observed, as shown in Appendix D. Therefore, one subsurface soil sample was collected for analysis from each soil boring from the 2-ft interval directly above

bedrock. All surface soil samples were analyzed for Appendix IX VOCs, SVOCS, pesticides, PCBs, herbicides, and metals; and explosives, including perchlorate. Four surface soil samples (CGW2SS03, 07, 09, and 12) were additionally analyzed for dioxins, cyanide, and sulfide. Both subsurface soil samples were analyzed for Appendix IX VOCs and SVOCs. One subsurface soil sample (CGW2SB01) was additionally analyzed for dioxins, cyanide, and sulfide.

Tables 4-1 and Table 4-2 summarize the constituents detected in SWMU 2 surface soil and subsurface soil samples, respectively, collected during the PA/SI and identify screening criteria exceedances. Raw analytical data for the samples are provided in Appendix O.

4.3 SWMU 2 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 4-1 and 4-2).

Appendix N, Section N.4 discusses the evaluation of the SWMU 2 data quality. As detailed in Section N.4, the SWMU 2 data are acceptable for use in evaluating aspects of environmental conditions at SWMU 2, which is done in Steps 1 through 5 below. However, it is recognized that sufficient data have not been collected to draw conclusions regarding potential releases with adequate confidence, as discussed in Step 6 below. Therefore, additional data collection will be performed, as defined in Section 4.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former fuels off-loading site with several ASTs. Although historic information suggests fuel may have been released to the ocean during flushing of the fuel line, there are no records of past releases to the ground surface at the site and there was no evidence of past releases observed during the site visits. However, the potential presence of hazardous substances could not be confidently ruled out without sample collection due to the nature of the historical activities at the site. Sample collection took place during the 2004 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

<u>Surface Soil</u>

- VOCs: none detected
- SVOCs: benzo(a)pyrene, di-n-butylphthalate, indeno(1,2,3-cd)pyrene
- Pesticide: 4,4'-DDE
- Herbicides: none detected
- Dioxins: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,6,7,8- hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9- hexachlorodibenzo-p-dioxin, octachlorodibenzo-p-dioxin, total

heptachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin, total pentachlorodibenzo-p-dioxin

- PCBs: none detected
- Explosives: none detected
- Inorganics above background UTLs: arsenic, beryllium, cobalt, lead, selenium, tin, zinc

Subsurface Soil

- VOCs: none detected
- SVOCs: none detected
- Dioxins: none detected

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

As stated in Section 4.1.1, potential releases at SWMU 2 would have involved petroleum hydrocarbons. Therefore, of the constituents detected in soil samples, only SVOCs and inorganics are potentially attributable to historic CERCLA-related releases. The presence of the pesticide 4,4′-DDE is likely due to normal pesticide use, not a CERCLA-related release, especially because its detected concentrations are similar to those found at multiple sites across Vieques (see *Pesticides and Herbicides* under Section 1.1.1 for a detailed discussion of pesticides). Consequently, pesticides are not considered further in the decision analysis process.

Similarly, dioxins are not likely associated with fuels. Further, as shown in Table A-3, the highest dioxin concentration at SWMU 2 (in TEQ) is approximately 2 ppt, which is almost three orders of magnitude below the residential remediation level (i.e., 1,000 ppt) cited by EPA. The other dioxin concentrations at SWMU 2 are even lower. Therefore, dioxins are not considered further in the decision analysis process. Therefore, dioxins are not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Surface Soil

- SVOCs: no exceedances
- Arsenic: four detections (sample SS07, SS10, SS11, and SS12) at concentrations (1.66 mg/kg to 2.33 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and background UTL (1.6 mg/kg)

- Cobalt: one detection (sample SS12) at a concentration (51.2 mg/kg) above the ecological screening value (13 mg/kg), SSL at a DAF of 1 (33 mg/kg), and background UTL (26 mg/kg)
- Lead: two detections (samples SS01 and SS03) at a concentrations (16 mg/kg and 15.6 mg/kg, respectively) above the SSL at a DAF of 1 (14 mg/kg), and background UTL (5.4 mg/kg)
- Selenium: two detections (samples SS01 and SS03) at concentrations (0.55 mg/kg and 0.63 mg/kg, respectively) above the ecological screening value (0.52 mg/kg), SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Arsenic is the only constituent detected in a SWMU 2 surface soil sample above the PRG and the background UTL. However, it was detected in only 4 of 12 surface soil samples above background and its human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR). Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (which is based on skin and vascular effects), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1), the latter of which is an order of magnitude higher than the maximum arsenic concentration detected at the site (i.e., 2.3 mg/kg). Based on the low maximum detected concentration and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver. Further, although the arsenic background UTL is 1.6 mg/kg, arsenic concentrations up to 5 mg/kg were detected during the east Vieques background soil inorganics investigation (CH2M HILL, 2007b). Although concentrations above 1.6 mg/kg were considered outliers for the purposes of establishing a background UTL, those concentrations may very well be representative of true background arsenic concentrations.

Although vanadium was detected in soil above the adjusted PRG, its PRG is based on increased mortality, so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all vanadium concentrations are below the background UTL.

Cobalt and selenium exceed ecological soil screening values and background in only one and two surface soil samples, respectively, collected at the site. These constituents do not likely pose an unacceptable risk to ecological receptors on a site-wide basis based upon the following:

- The ecological screening value for selenium is based upon effects to plants. The site is overgrown with vegetation, with no signs of stress. The maximum concentration (0.63 mg/kg) is less than soil screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates).

- The ecological screening value for cobalt is based on effects to plants, but the site is overgrown with vegetation, with no signs of stress.
- The potentially impacted area is small, reducing the potential for site-related exposure.
- Cobalt exceeds background in only 1 of 12 samples at a maximum ratio of 1.97. All other cobalt concentrations are below the background UTL, indicating that exposures are generally attributable to background.

Four inorganics (arsenic, cobalt, lead, and selenium) were detected above their respective SSLs at a DAF of 1 in surface soil. However, due to the small area where these constituents were detected above the SSL and background UTL (i.e., in one [arsenic] or two [lead and selenium] of the eight samples collected around the former ASTs, and three [arsenic] or one [cobalt] of the four samples collected around the former fuel offloading area), an SSL at a higher DAF is likely to be more realistic, as indicated in Section 1.1.2. This supposition is supported by data from site SWMU 1 (also located in the Kv zone), where SSLs at a DAF of 1 are shown to be unrealistic predictors of leaching to groundwater. At SWMU 1, arsenic, lead, and selenium were detected in soil above the SSLs at a DAF of 1, but were either not detected in groundwater or were detected below screening criteria. For the SWMU 2 data, none of the arsenic, cobalt, lead, and selenium concentrations exceeds SSLs at a DAF of 2 (cobalt and lead) or 3 (arsenic and selenium).

All of the above information, together with the fact that no non-inorganic contaminants exceeded conservative screening criteria, suggests no CERCLA-related release has resulted in constituent levels that likely pose an unacceptable human health or ecological risk or leaching risk over that of background.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases at SWMU 2 are historical fuel transfer activities around the former ASTs and fuel offloading area. However, as shown in Figures 4-1 through 4-4, the spatial coverage of the samples collected was not adequate to evaluate potential releases from all of the tanks historically present, especially considering the large volume of fuel stored and transferred over the years. Therefore, the potential source areas were not sufficiently sampled.

4.4 Conclusions and Recommendations

Table 4-3 summarizes the results of the decision analysis for SWMU 2. Although the data collected does not suggest there has been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater, the spatial coverage of the samples was inadequate to draw this conclusion with certainty. Therefore, additional data collection is recommended for the site. Because the existing data suggest that there has not been a release or that the release has not resulted in significant (as defined by the decision analysis) contamination of soil, it is recommended that this additional data collection be conducted via an expanded SI, as described below.

Rationale

Additional information is necessary to provide adequate spatial data in order to determine whether a CERCLA-related release has occurred. The objective, approach, and decision analysis for the additional data collection will be detailed in an Expanded SI work plan, but they are briefly discussed below.

Objective and Approach

Sufficiently characterize the potential source areas by:

- Using a slide hammer or direct-push rig to collect surface and subsurface soil samples in the vicinity of the eight historic tanks, the former fuel offloading area, and the former fuel transfer pipeline (if its location can be ascertained), the locations of which are shown in the composite figure (Figure 4-9). At a minimum, a soil boring will be placed in the location of each of the eight tanks, four borings will be placed around the fuel offloading area, and two borings will be placed along the former pipeline path (if it can be ascertained). The soil samples collected from each boring will be screened visually and with a photoionization detector (PID). Samples will be submitted to the laboratory for analysis of TCL VOCs and SVOCs, TAL metals, TPH-GRO, and TPH-DRO. Additional borings may be placed depending on the results of the screening in order to sufficiently characterize any source area identified
- If residual soil contamination is observed (visually or with PID) during the soil borings, the need for and location of well(s) will be discussed with the regulatory agencies and installed during the mobilization

Decision Analysis

Evaluate newly collected and relevant historical data using 6-step decision analysis process (Figure 1-4).

TABLE 4-1
SWMU 2 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone Kv SS**	CGW2SS01	CGW2SS02	CGW2SS03	CGW2SS04	CGW2SS05	CGW2SS06	CGW2SS07	CGW2SS08	
Sample ID					CGW2SS01-R01	CGW2SS02-R01	CGW2SS03-R01	CGW2SS04-R01	CGW2SS05-R01	CGW2SS06-R01	CGW2SS07-R01	CGW2SS08-R01	CGW2FD01P-R01
Sample Date					1/21/04	1/21/04	1/21/04	1/21/04	1/21/04	1/21/04	1/21/04	1/21/04	1/21/04
Chemical Name													
Volatile Organic Compounds (µg/kg)													
No Detections													
Semivolatile Organic Compounds (µg/kg)													
Benzo(a)pyrene	400	62	100	--	53.5 J	389 U	388 U	372 U	373 U	379 U	391 U	386 U	389 U
Di-n-butylphthalate	270,000	610,000	200,000	--	372 U	146 J	386 J	418	373 U	331 J	416	140 J	227 J
Indeno(1,2,3-cd)pyrene	700	620	--	--	372 U	389 U	388 U	372 U	373 U	379 U	391 U	386 U	389 U
Pesticide/Polychlorinated Biphenyls (µg/kg)													
4,4'-DDE	3,000	1,700	10	--	3.7 U	3.9 U	0.4 J	0.28 J	0.73 J	3.8 U	0.16 J	3.9 U	3.9 U
Herbicides (µg/kg)													
No Detections													
Dioxin/Furans (pg/g)													
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	12.7	NA	NA	NA	5.4	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	2.5 U	NA	NA	NA	2.5 U	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	2.5 U	NA	NA	NA	2.5 U	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	173	NA	NA	NA	70.6	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	28.3	NA	NA	NA	14.4	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	3.5	NA	NA	NA	2.5 U	NA	NA
Total pentachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	1 U	NA	NA	NA	1 U	NA	NA
Explosives (µg/kg)													
No Detections													
Total Metals (mg/kg)													
Antimony	0.3	3.1	78	3.6	0.64 J	0.582 J	0.147 J	0.289 J	0.219 J	0.211 J	0.458 J	0.093 UJ	0.093 UJ
Arsenic	1	0.39	18	1.6	1.25 J	0.231 J	1.1 J	0.719 J	1.31 J	0.46 J	1.66	1.11 J	1.39 J
Barium	82	1,600	330	212	53.6 J	66.3 J	69.3 J	74.2 J	73.2 J	65.4 J	67 J	60.6 J	62.4 J
Beryllium	3	15	40	0.27	0.348 J	0.376 J	0.342 J	0.314 J	0.32 J	0.263 J	0.364 J	0.37 J	0.389 J
Cadmium	0.4	3.7	32	2.2	0.189 J	0.125 J	0.0504 J	0.0107 U	0.0451 J	0.0111 U	0.0441 J	0.0124 U	0.0928 J
Chromium	2	210	0.4	72	19.4 J	18.1 J	20.7 J	56.2 J	18.8 J	16.8 J	18.9 J	19 J	20.4 J
Cobalt	33	140	13	26	13 J	11 J	14 J	10.3 J	13.4 J	11 J	15.1 J	12.2 J	12.6 J
Copper	46	310	70	94	28 J	17.1 J	24.1 J	22.4 J	33.2 J	10.7 J	28.8 J	29.1 J	29.8 J
Cyanide	--	120	1	0.89	NA	NA	0.3 J	NA	NA	NA	0.155 U	NA	NA
Lead	14	400	120	5.4	16 J	3.21 J	15.6 J	5.05 J	4.17 J	1.19 J	5.87 J	2.58 J	2.44 J
Mercury	0.1	2.3	0.1	0.057	0.0181 J	0.0108 J	0.0125 J	0.0108 J	0.0152 J	0.00537 J	0.02 J	0.00927 J	0.0104 J
Nickel	7	160	38	41	7.98 J	7.89 J	10 J	23.7 J	8.47 J	6.77 J	6.36 J	8.38 J	8.6 J
Selenium	0.3	39	0.52	0.51	0.551 J	0.207 J	0.627 J	0.331 J	0.352 J	0.174 U	0.424 J	0.23 J	0.453 J
Silver	2	39	560	0.22	0.101 J	0.156 J	0.0722 J	0.126 J	0.0572 J	0.106 J	0.0775 J	0.0565 J	0.0369 J
Tin	--	4,700	--	N/A	0.237 J	0.216 U	0.29 J	0.188 U	0.194 U	0.195 U	0.209 U	0.218 U	0.218 U
Vanadium	300	7.8	2	144	117 J	114 J	89.4 J	97.3 J	67.2 J	95.4 J	140 J	58 J	67.2 J
Zinc	620	2,300	120	32	21.2 J	19.1 J	17.6 J	14.8 J	15.5 J	19.6 J	19.2 J	9.81 J	9.62 J
Wet Chemistry (mg/kg)[1]													
Sulfide	--	--	--	--	NA	NA	119	NA	NA	NA	46 U	NA	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996b
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDE, cyanide) (MHSPE, 2000).
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, silver, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[1] Wet Chemistry consists of sulfide and cyanide (cyanide was included with the inorganics
* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 4-1
SWMU 2 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone Kv SS**	CGW2SS09	CGW2SS10	CGW2SS11	CGW2SS12
Sample ID					CGW2SS09-R01	CGW2SS10-R01	CGW2SS11-R01	CGW2SS12-R01
Sample Date					1/21/04	1/21/04	1/21/04	1/21/04
Chemical Name								
Volatile Organic Compounds (µg/kg)								
No Detections								
Semivolatile Organic Compounds (µg/kg)								
Benzo(a)pyrene	400	62	100	--	343 U	46.5 J	353 U	48.1 J
Di-n-butylphthalate	270,000	610,000	200,000	--	78.9 J	54.7 J	45.2 J	48.6 J
Indeno(1,2,3-cd)pyrene	700	620	--	--	343 U	114 J	116 J	342 U
Pesticide/Polychlorinated Biphenyls (µg/kg)								
4,4'-DDE	3,000	1,700	10	--	0.59 J	0.5 J	0.13 J	0.08 J
Herbicides (µg/kg)								
No Detections								
Dioxin/Furans (pg/g)								
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	114	NA	NA	3.7
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	2.9	NA	NA	2.5 U
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	4.8	NA	NA	2.5 U
Octachlorodibenzo-p-dioxin	--	*	--	--	781	NA	NA	48.3
Total heptachlorodibenzo-p-dioxin	--	*	--	--	220	NA	NA	10.3
Total hexachlorodibenzo-p-dioxin	--	*	--	--	52.9	NA	NA	2.5 U
Total pentachlorodibenzo-p-dioxin	--	*	--	--	9	NA	NA	1 U
Explosives (µg/kg)								
No Detections								
Total Metals (mg/kg)								
Antimony	0.3	3.1	78	3.6	0.705 J	0.675 J	0.48 J	0.653 J
Arsenic	1	0.39	18	1.6	1.16 J	2.03	2.33	1.84
Barium	82	1,600	330	212	54.9 J	53.9 J	89 J	45.1 J
Beryllium	3	15	40	0.27	0.0976 J	0.122 J	0.137 J	0.113 J
Cadmium	0.4	3.7	32	2.2	0.153 J	0.112 J	0.192 J	0.0528 J
Chromium	2	210	0.4	72	11.1 J	19.7 J	18.6 J	12.5 J
Cobalt	33	140	13	26	18.8 J	20.6 J	24.7 J	51.2 J
Copper	46	310	70	94	76.7 J	70.7 J	48.3 J	42.9 J
Cyanide	--	120	1	0.89	0.14 U	NA	NA	0.14 U
Lead	14	400	120	5.4	3.09 J	3.69 J	1.7 J	2.52 J
Mercury	0.1	2.3	0.1	0.057	0.00358 J	0.0146 J	0.00462 J	0.00524 J
Nickel	7	160	38	41	8.47 J	10.6 J	12.7 J	7.26 J
Selenium	0.3	39	0.52	0.51	0.197 J	0.175 J	0.443 J	0.319 J
Silver	2	39	560	0.22	0.0534 J	0.0841 J	0.0752 J	0.0815 J
Tin	--	4,700	--	N/A	0.192 U	0.368 J	0.262 J	0.18 U
Vanadium	300	7.8	2	144	82.4 J	73.8 J	96.7 J	71.1 J
Zinc	620	2,300	120	32	40.2 J	31 J	28.9 J	23.7 J
Wet Chemistry (mg/kg)[1]								
Sulfide	--	--	--	--	8.28 U	NA	NA	41.1 U

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996b
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDE, cyanide) (MHSPE, 2000).
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, silver, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[1] Wet Chemistry consists of sulfide and cyanide (cyanide was included with the inorganics
* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 4-2
Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites Report
Vieques, Puerto Rico

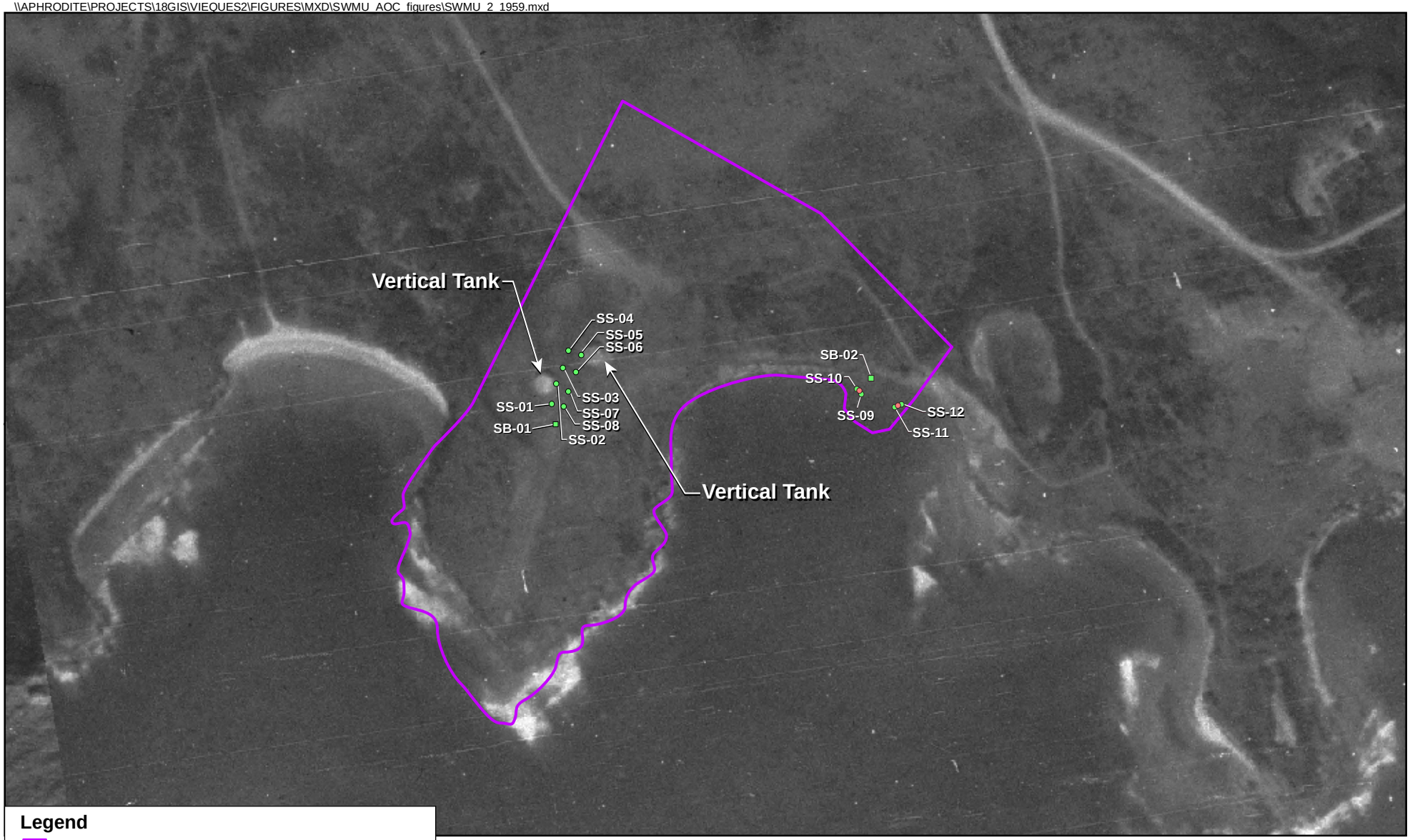
Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone Kv SB**	CGW2SB01	CGW2SB02
Sample ID				CGW2SB01-R01-10	CGW2SB02-R01-5
Sample Date				1/21/04	1/22/04
Chemical Name					
Volatile Organic Compounds (µg/kg)					
No Detections					
Semivolatile Organic Compounds (µg/kg)					
No Detections					
Dioxin/Furans (pg/g)					
No Detections					N/A
Wet Chemistry (mg/kg)[1]					
No Detections					N/A

Notes:
[1] Wet Chemistry consists of sulfide and cyanide
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
pg/g - Picograms per gram
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Vieques HHRA SO - Screening values from the October EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
N/A - Not Analyzed

TABLE 4-3
SWMU 2 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium not sufficiently characterized because more tanks are present than represented by the area sampled
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Dioxins	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; < SSL at a DAF of 3	
				Co > Eco, SSL, BKG	small site; no vegetative stress; all but one detect are attributable to background; < SSL at a DAF of 2	
				Pb > SSL, BKG	< SSL at DAF of 2	
				Se > ECO, SSL, BKG	ECO criterion based on plants; no sign of stress to plants; < ECO for soil invertebrates; < SSL at DAF of 3	
Subsurface Soil	Yes					Medium not sufficiently characterized because more tanks are present than represented by the area sampled. In addition, regional groundwater data are warranted.

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_2_1959.mxd



Legend

- SWMU 2 Area as identified in the EBS, 2003
- PA/SI Subsurface Soil Sample Location
- PA/SI Surface Soil Sample Location
- Steel Pipe Supports

Each sampling location shown is preceded by "CGW2" (e.g. SS-01 = CGW2SS01 and SB-01 = CGW2SB01)

N
W E
S

0 400 800 Feet

Figure 4-1
1959 Aerial Photograph of the SWMU 2 Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_2_1962.mxd

Legend

- SWMU 2 Area as identified in the EBS, 2003
- PA/SI Subsurface Soil Sample Location
- PA/SI Surface Soil Sample Location
- Steel Pipe Supports
- Estimated Location of Buried Pipeline

Each sampling location shown is preceded by "CGW2" (e.g. SS-01 = CGW2SS01 and SB-01 = CGW2SB01)

N
W E
S

0 400 800 Feet

Figure 4-2
1962 Aerial Photograph of the SWMU 2 Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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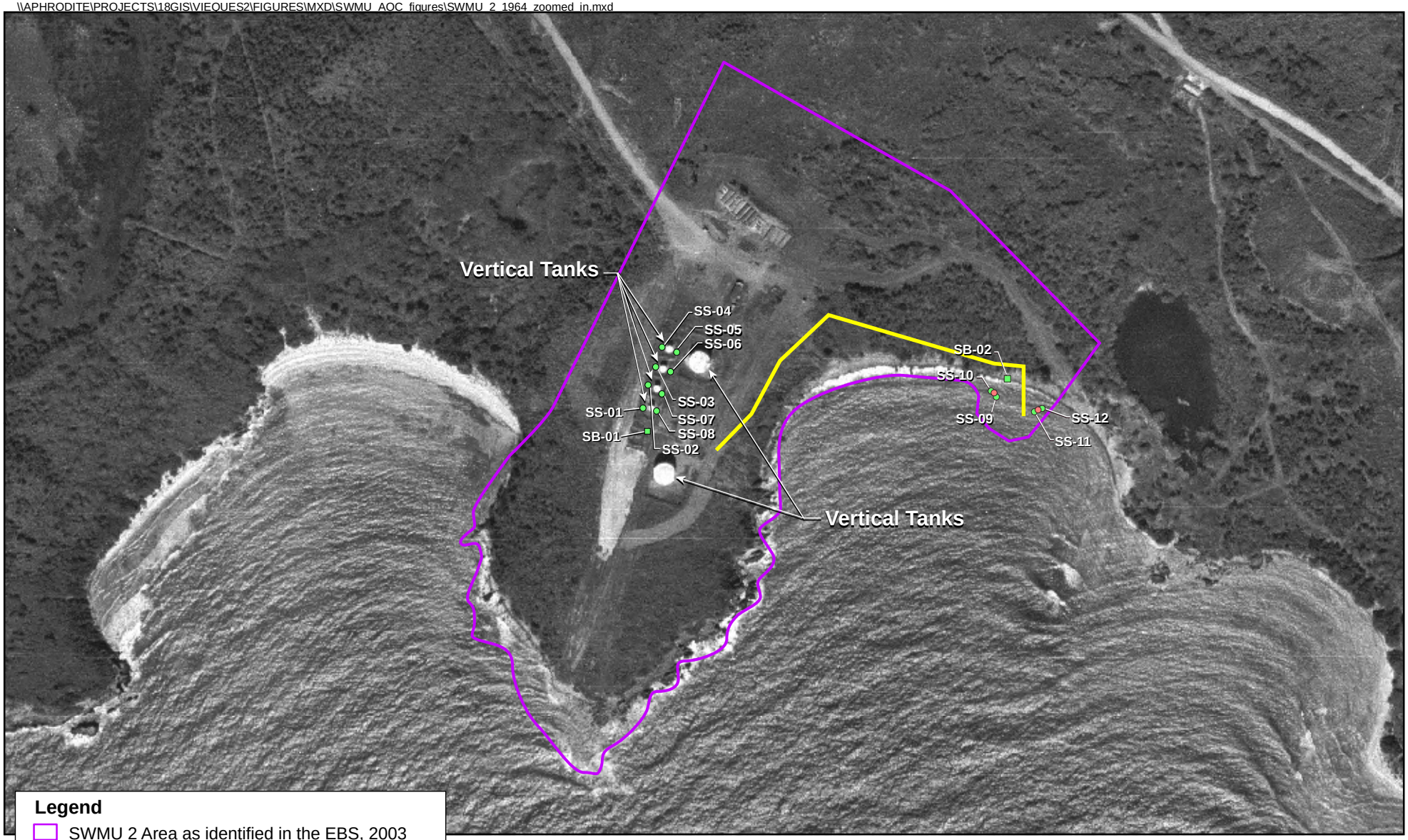
\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_2_1964_zoomed_in.mxd



Legend

- SWMU 2 Area as identified in the EBS, 2003
- PA/SI Subsurface Soil Sample Location
- PA/SI Surface Soil Sample Location
- Steel Pipe Supports
- Estimated Location of Buried Pipeline

Each sampling location shown is preceded by "CGW2" (e.g. SS-01 = CGW2SS01 and SB-01 = CGW2SB01)

N W E S

0 175 350 700 Feet

Figure 4-3
1964 Aerial Photograph of the SWMU 2 Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_2_1970.mxd

Legend

- SWMU 2 Area as identified in the EBS, 2003
- PA/SI Subsurface Soil Sample Location
- PA/SI Surface Soil Sample Location
- Steel Pipe Supports
- Estimated Location of Buried Pipeline

Each sampling location shown is preceded by "CGW2" (e.g. SS-01 = CGW2SS01 and SB-01 = CGW2SB01)

N
W E
S

0 400 800 Feet

Figure 4-4
1970 Aerial Photograph of the SWMU 2 Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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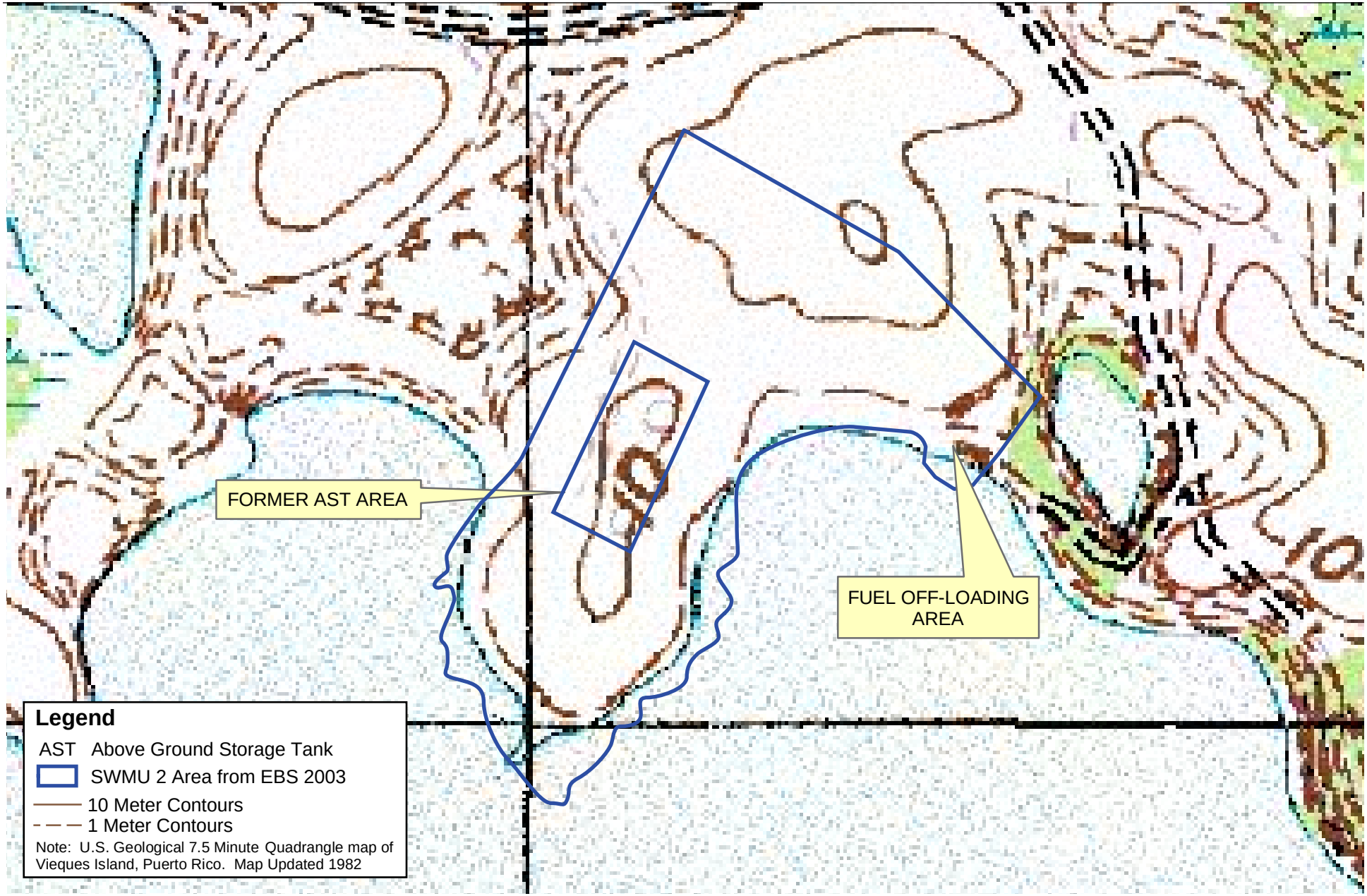
Photograph taken February 3, 2000

Figure 4-5
SWMU 2 Fuel Offloading Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



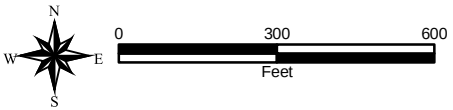


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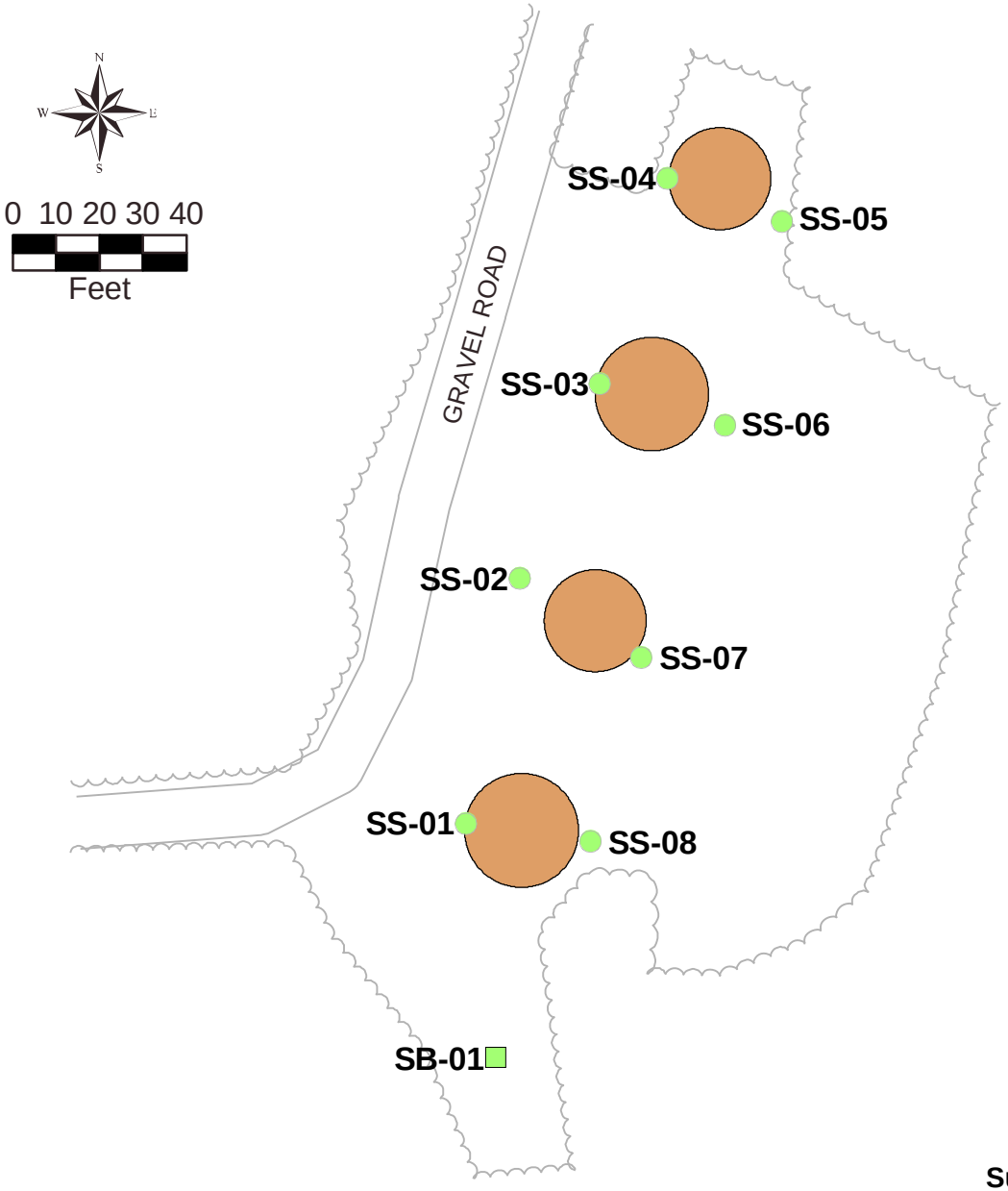
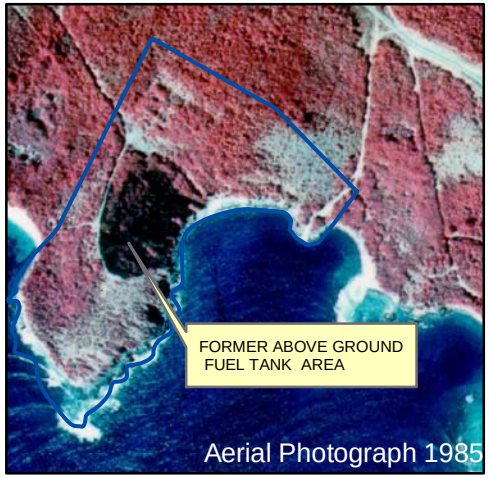
Figure 4-6
SWMU 2 Topographic Map
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico





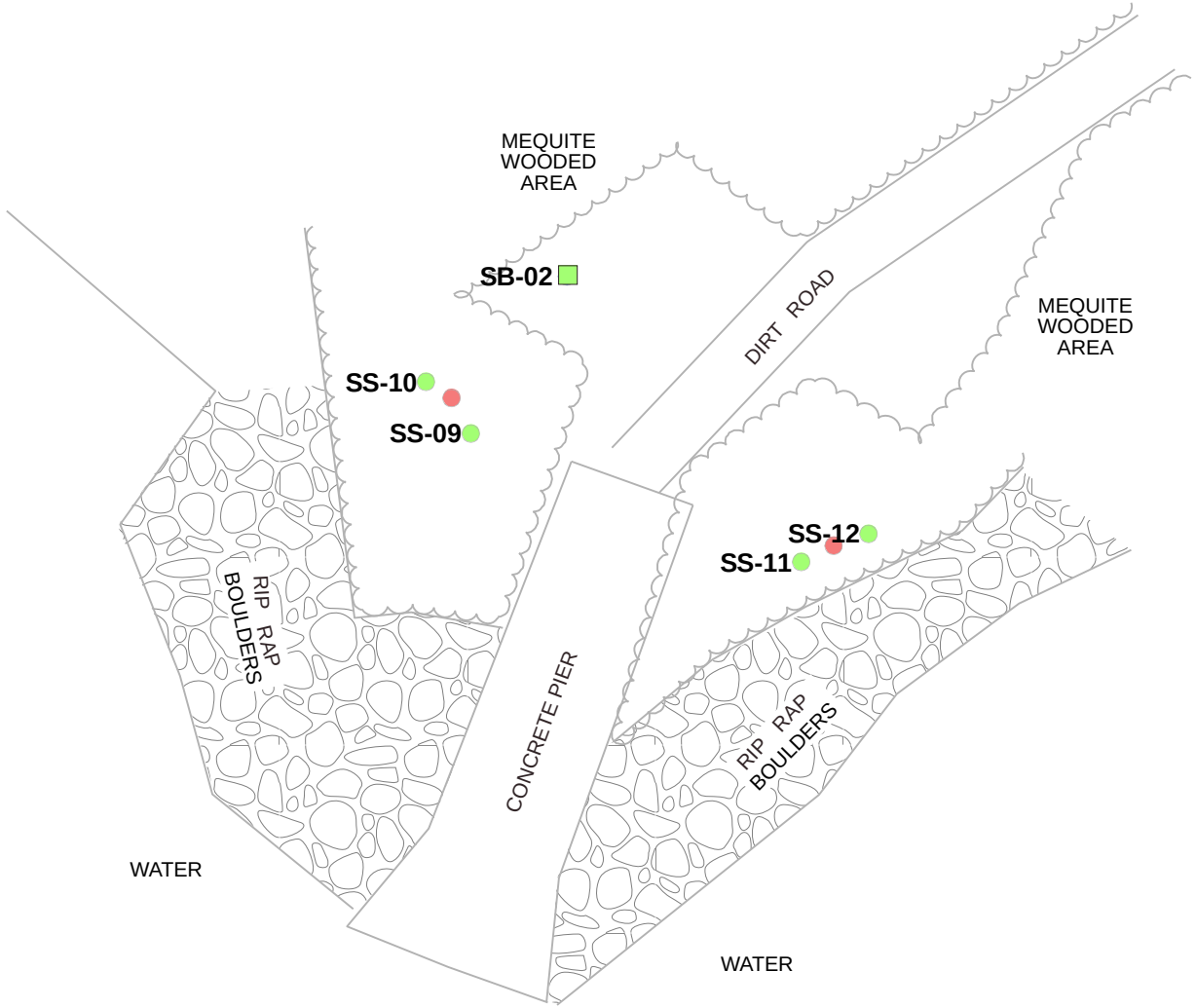
Location Map

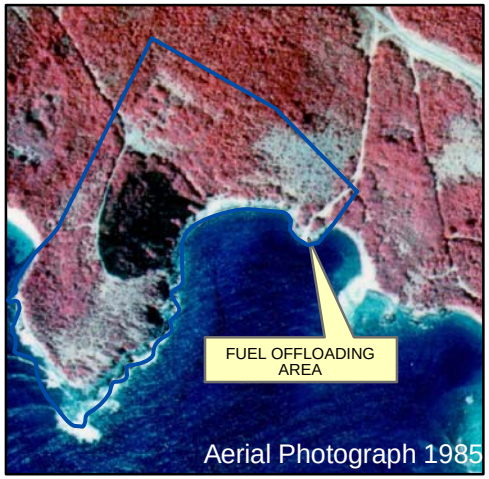
Legend

- PA/SI Subsurface Soil Sample Location
- PA/SI Surface Soil Sample Location
- Former Above Ground Fuel Tank Locations

Each sampling location shown is preceded by "CGW2"
(e.g. SS-01 = CGW2SS01 and SB-01 = CGW2SB01)

Figure 4-7
Surface and Subsurface Soil Sample Locations, SWMU 2
(Former Above Ground Fuel Tank Area)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico





Location Map

Legend

- Steel Pipe Supports
- PA/SI Subsurface Soil Sample Location
- PA/SI Surface Soil Sample Location

Each sampling location shown is preceded by "CGW2" (e.g. SS-01 = CGW2SS01 and SB-01 = CGW2SB01)

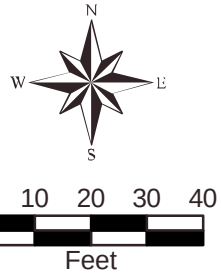
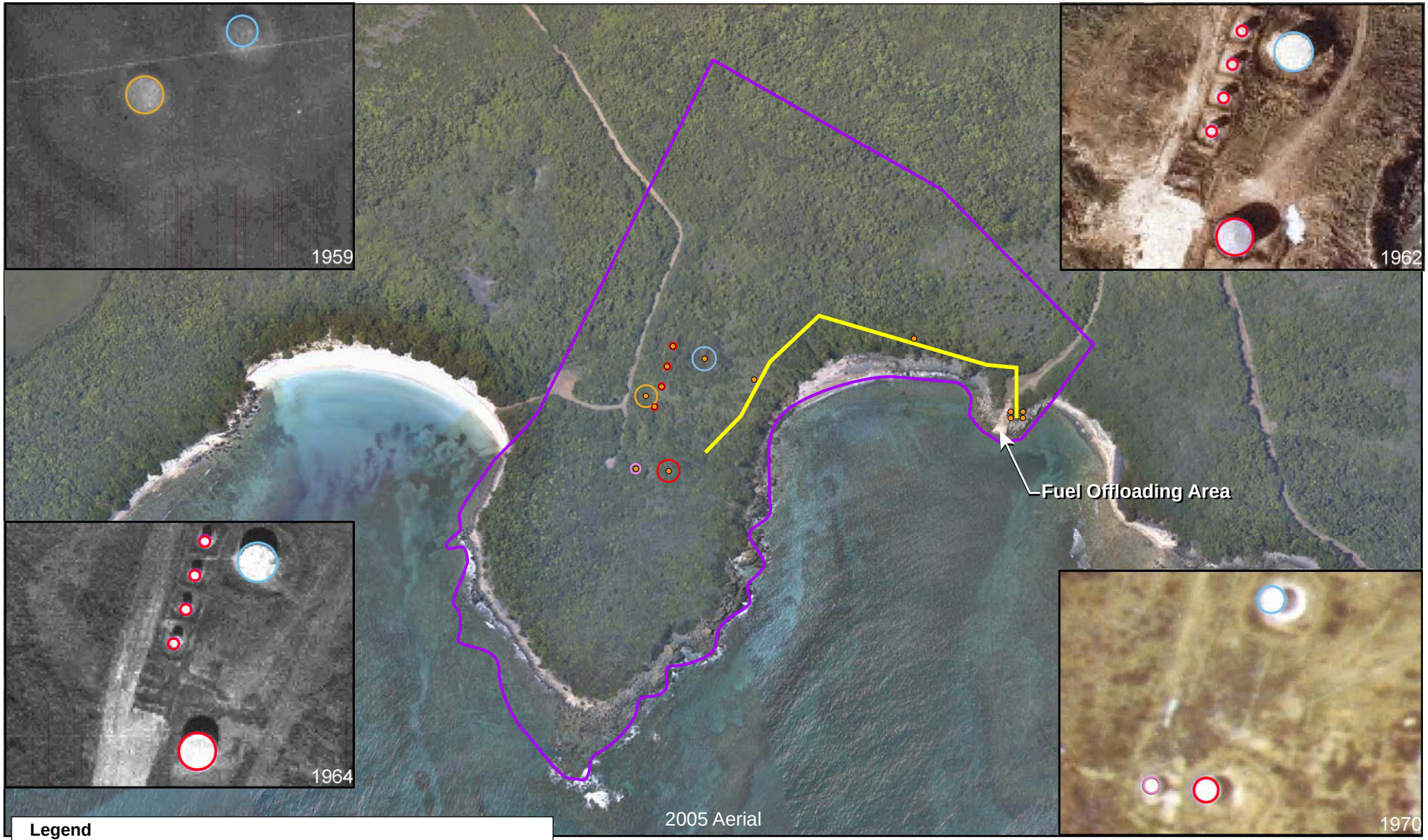


Figure 4-8
Surface and Subsurface Soil Sample Locations, SWMU 2 (Fuel Offloading Area)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



Legend

- Former Vertical Tank Location - 1959
- Former Vertical Tank Location - 1970
- Former Vertical Tank Location - 1959, 1962, 1964, and 1970
- Former Vertical Tank Location - 1962, 1964, and1970
- SWMU, AOC Sites
- Estimated Location of Buried Pipeline
- Proposed Surface and Subsurface Soil Sample Location

N
W E
S

0 175 350 700 Feet

Figure 4-9
Surface and Subsurface Soil Sample Locations, SWMU 2 (Fuel Offloading Area)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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SECTION 5

SWMU 4—Waste Areas of Building 303 (Camp García)

This section presents the results of the PA/SI performed at SWMU 4—Waste Areas of Building 303.

5.1 Conceptual Site Model

The CSM for SWMU 4 is based on review of historical information such as records, aerial photographs, site inspection documentation, interviews, as well as site-specific data.

5.1.1 Site History and Potential Sources of Release

The SWMU 4 former waste areas were located at Building 303 within the Camp Garcia compound area (Figures 1-2 and 1-3) and comprised a spent battery accumulation area, a catch basin for hydraulic oil, a cleaning/degreasing basin, and a storage area for waste rags, absorbent material, and grease (Figure 5-1). Building 303 was established as a storage area for batteries when it was erected in the 1960s. Per the classifications in the 1988 and 1995 RFA reports, the oil catch basin, cleaning/degreasing basin, and storage area for rags, absorbent material, and grease were designated as AOCs C, D, and E, respectively (Kearney, 1988; PREQB, 1995). The sites were combined and re-named SWMU 4 in the January 2000 RCRA Consent Order. Building 303 is currently being used by USFWS as a storage facility for property maintenance equipment.

The catch basin for hydraulic oil consisted of a metal gutter approximately 5 ft long and 6 inches wide, located beneath several containers of hydraulic oil on a rack. The gutter was designed to catch drips that occurred when hydraulic oil was removed from the drums. The unit was located inside Building 303 and was placed above the concrete floor, which was flat and continuous throughout the entire building. No sign of release was observed during the 1988 RFA (Kearney, 1988).

The cleaning basin was a square metal container, approximately 24 inches long, 18 inches wide, and 12 inches deep, used to hold solvents for the cleaning and degreasing of parts. The unit was formerly located inside Building 303 (Kearney, 1988).

The rags, absorbent, and grease storage area was originally located inside Building 303 and consisted of a small area of the shop where several barrels of grease, rags, and adsorbent generated during cleanup of spills within Building 303 were stored. Facility personnel stated that this was also the approximate area where spent batteries were originally stored. No visual signs of a release or spill to the floor were observed during the 1988 RFA (Kearney, 1988). The 1988 RFA report recommended NFA for all four areas included as SWMU 4.

The 1995 RFA (PREQB, 1995) addressed the spent battery accumulation area, catch basin for hydraulic oil, and the rags, adsorbent, and grease storage area in Building 303. The

conclusion for the Spent Battery Accumulation Area was that the potential for migration of waste or accumulated liquids to the soil, groundwater or surface water was very low. According to the 1995 RFA, no batteries or acid were present at the former corrosive materials storage building, nor were there visible signs of acid leakage on the concrete floor from previous storage of these materials. No evidence of release was found and the exposure potential from this SWMU was deemed minimal. NFA was recommended (PREQB, 1995).

A site inspection was conducted in February 2000 to visually assess potential releases at SWMU 4. Like previous inspections, no staining or signs of releases were observed on the concrete floor during the 2000 site inspection. As noted in the Current Conditions Report (CH2M HILL, 2001), an additional building adjacent to Building 303 was identified. This building was used as a battery accumulation area and consisted of a small building adjacent to Building 303 designated as "Corrosive Materials Storage." In the past, it contained spent batteries and battery acid, which were disposed offsite at the former NSRR (now referred to as NAPR). Also noted in the Current Conditions Report was an additional area identified as a storage location for rags, adsorbent material, and grease contained in barrels. This area was described as a small building located adjacent to Building 303 and designated as "Flammable Storage." Both small buildings were reported to have concrete floors.

Figure 5-1 illustrates the locations of the Corrosive Materials Storage building and the Flammable Materials Storage building at SWMU 4**.** Figure 5-2 is a photograph of the Corrosive Materials Storage building, and Figure 5-3 is a photograph of the Flammable Materials Storage building. Both the battery accumulation area and the rags, absorbent material, and grease areas were originally located inside building 303 as described in the 1988 RFA (Kearney, 1988) and the 1995 Revised RFA (PREQB, 1995). The observations made during the RFAs were during a time when the building was being used by the Seabees, who reportedly moved items around frequently. These two areas were moved to the outside sheds (Corrosive Materials Storage Building and Flammable Materials Storage Building) shown in Figures 5-1, 5-2, and 5-3 sometime between 1995 and 2000, prior to the February 2000 site inspection.

Jay Gonzalez, an employee of the DOI USFWS, stated in a January 2004 interview that Building 303 was cleared of all its contents and that the concrete floor was washed with a high pressure hose. He further stated that there were no floor drains, sumps, or cracks in the concrete floor.

Although none of the areas that make up what became SWMU 4 were recommended for further action in the RFA Reports (Kearney, 1988; PREQB, 1995), the site was investigated during the 2000 Phase I Environmental Site Assessment and again during the 2004 PA/SI to determine whether there was evidence of historical releases. Based on the site history information summarized above, three areas were identified as potential source areas: (1) catch/cleaning/degreasing basin, (2) Corrosive Materials Storage building, and (3) Flammable Materials Storage building. Releases from these potential source areas would have been to the ground surface. However, as shown in Figures 5-2 and 5-3, the storage was intended for small quantities of material and the materials were stored in covered buildings intended to protect their contents, rather than in an open area.

5.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in February 2000 to visit the consent order sites, in 2000 for the Phase I Environmental Assessment, and in 2004 for the PA/SI, as well as on regional information.

Building 303 sits in the southeastern portion of the area referred to as the Camp Garcia Compound. This building has the Camp Garcia perimeter fence on its east and south sides. To the north is a gravel parking area and to the west is an open grassy field periodically cut and maintained by the USFWS.

The topography of the area surrounding Building 303 is flat, at an elevation of approximately 60 ft amsl. The site resides in the geologic unit KTd, which comprises plutonic igneous rocks. More detailed description of geologic conditions within the east Vieques study area is provided in Section 1.4.6. Bedrock was not encountered during sampling at SWMU 4, but was found at approximately 25 and 30 ft bls at PAOC U, which is located just north of SWMU 4 (Figure 1-3). Groundwater was encountered in the bedrock, at a depth of about 45 ft bls at PAOC U.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon along the coast, a little less than 1 mile to the south and southeast, respectively. Based on nearby wells, the topographic slope, and the regional groundwater gradient determined by the USGS (1989), groundwater in this area exists within the fractured bedrock and is presumed to flow in a southerly direction toward the coast.

5.2 Sampling Approach and Chemical Constituents Identified

A Phase I Environmental Assessment was conducted in June 2000 as part of the transfer of Navy Public Works operations from west Vieques to east Vieques. As shown in Figure 5-1, five surface soil samples were collected around the Flammable Materials Storage building, five surface soil samples were collected around the Corrosive Materials Storage building, and two surface soil samples were collected adjacent to the catch basin and cleaning/degreasing basin. All 12 surface soil samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, and metals.

In accordance with the Phase I RFI Work Plan (CH2M HILL, 2003c), one subsurface soil sample was collected adjacent to the catch basin and cleaning/degreasing basin, as shown in Figure 5-1. The SWMU 4 soil boring (CGW4SB01) was advanced to 6 ft bls and soil samples were screened continuously with an OVA. No elevated OVA readings were observed, as shown in Appendix D. Therefore, the subsurface soil sample for analysis was collected from the 4-to-6-ft interval. The sample was analyzed for Appendix IX VOCs and SVOCs.

Table 5-1 summarizes the constituents detected in SWMU 4 surface soil samples collected during the Phase I Environmental Assessment and identifies screening criteria exceedances. Similarly, Table 5-2 summarizes the constituents detected in the SWMU 4 subsurface soil sample collected during the PA/SI. Raw analytical data for the samples are provided in Appendix O.

5.3 SWMU 4 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 5-1 and 5-2).

Appendix N, Section N.5 discusses the evaluation of the SWMU 4 data quality. As detailed in Section N.5, the SWMU 4 data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at SWMU 4, which is done in Steps 1 through 5 below. To increase the level of confidence in this determination, however, additional regional data collection will be performed, as defined in Section 5.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was used to store waste materials that were potentially hazardous or contained hazardous constituents. Although there was no evidence of releases observed during the various site visits, the potential presence of hazardous substances could not be confidently ruled out without sample collection due to the nature of the historical activities at the site. Sample collection took place during the 2000 Phase I Environmental Assessment and 2004 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the Phase I Environmental Assessment and PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

<u>Surface Soil</u>

- VOCs: 2-hexanone, dibromomethane, m-, p-, and total xylenes, toluene
- SVOCs: acetophenone, anthracene, benzyl alcohol, bis(2-ethylhexyl)phthalate, di-n-octylphthalate, fluoranthene, phenanthrene, pyrene
- Pesticides: 4,4'-DDE, 4,4'-DDT
- Herbicides: 2,4-D
- PCBs: none detected
- Inorganics above background UTLs: arsenic, beryllium, cobalt, copper, lead, mercury, nickel, selenium, tin, zinc

<u>Subsurface Soil</u>

- VOCs: none detected
- SVOCs: bis(2-ethylhexyl)phthalate, di-n-butylphthalate

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Based on the potential contaminant sources identified at the site, the presence of VOCs, SVOCs, and inorganics may be attributable to historic CERCLA-related releases at the site. Therefore, these constituents are further evaluated in the decision analysis process. The presence of the pesticides and herbicide is likely due to normal use, not a CERCLA-related release, especially because its detected concentrations are similar to those found at multiple sites across Vieques (see *Pesticides and Herbicides* under Section 1.1.1 for a detailed discussion of pesticides). Consequently, pesticides and herbicides are not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

<u>Surface Soil</u>

- VOCs: no exceedances
- Anthracene: one detection (sample SS02) at a concentration (105 µg/kg) just above the ecological screening value (100 µg/kg)
- Fluoranthene: one detection (sample SS02) at a concentration (123 µg/kg) just above the ecological screening value (100 µg/kg)
- Phenanthrene: one detection (sample SS02) at a concentration (105 µg/L) just above the ecological screening value (100 µg/kg)
- Arsenic: five detections (samples SS01, SS02, SS03, SS04, SS05) at concentrations (1.7 mg/kg to 2.5 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Cobalt: two detections (samples SS01, SS03) at concentrations (19.1 mg/kg and 16.4 mg/kg respectively) above the ecological screening value (13 mg/kg) and background UTL (16 mg/kg)
- Copper: four detections (samples SS01, SS03, SS04, SS05) at concentrations (66.3 mg/kg to 76.9 mg/kg) above the SSL at a DAF of 1 (46 mg/kg), ecological screening value (70 mg/kg; by SS01, SS04, and SS05), , and background UTL (66 mg/kg)
- Lead: five detections (samples SS01 through SS05) at concentrations (17.3 mg/kg to 29.7 mg/kg) above the SSL at a DAF 1 (14 mg/kg), and background UTL (5.4 mg/kg)
- Nickel: one detection (sample SS01) at a concentration (22.7 mg/kg) above the SSL at a DAF 1 (7 mg/kg) and background UTL (22 mg/kg)

- Selenium: 11 detections (SS01, SS03 through SS12) at concentrations (0.64 mg/kg to 1.1 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)
- Zinc: six detections (samples SS01, SS02, SS04,SS05, SS11, and SS12) above the ecological screening value (120 mg/kg) and background UTL (32 mg/kg)

Subsurface Soil

- SVOCs: no exceedances

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Arsenic is the only constituent detected above its PRG and background UTL. However, it was detected in only five of 12 surface soil samples above background and its human health screening level (0.39 mg/kg, based on 1×10^{-6} ELCR). Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (which is based on skin and vascular effects), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1), the latter of which is an order of magnitude higher than the maximum arsenic concentration detected at the site (i.e., 2.5 mg/kg). Based on the relatively low maximum detected concentration and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver. Further, although the arsenic UTL is 1.6 mg/kg, arsenic concentrations up to 5 mg/kg were detected during the east Vieques background soil inorganics investigation (CH2M HILL, 2007b). Although concentrations above 1.6 mg/kg were considered outliers for the purposes of establishing a background UTL, those concentrations may very well be representative of true background arsenic concentrations.

Although vanadium was detected in soil above the adjusted PRG, its PRG is based on increased mortality, so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all vanadium concentrations are below the background UTL.

Three PAHs (anthracene, fluoranthene, and phenanthrene) and four inorganics (cobalt, copper, selenium, and zinc) exceed ecological soil screening values (and background UTLs for the inorganics) in at least one surface soil sample. None of these constituents likely poses an unacceptable risk to ecological receptors on a site-wide basis based upon the following:

- The area evaluated is immediately adjacent to buildings, is very small, and provides very limited habitat, especially considering the area is maintained by periodic mowing. Thus, the potential exposures to ecological receptors are minimal.
- Concentrations of the three PAHs exceed conservative soil screening values in only 1 of 12 samples. Maximum HQs are 1.05, 1.23, and 1.05 for anthracene, fluoranthene, and phenanthrene, respectively. These low magnitude exceedances are not significant given

the low potential for exposures discussed above and the low frequency of exceedance (1 of 12 samples).

- Cobalt concentrations exceed the ecological screening value and background UTL in only 2 of 12 samples. Exceedances of the background UTL are at a maximum ratio of 1.19, indicating that exposures are near background levels and, therefore, are not likely to be significant ecologically. Further, the mean cobalt concentration (11.9 mg/kg) is lower than the ecological screening value (13 mg/kg).
- Copper concentrations exceed the ecological screening value and background in 3 of 12 samples. Exceedances of the background UTL are at a maximum ratio of 1.17, indicating that exposures are near background levels and, therefore, are not likely to be significant ecologically. Further, the mean soil copper concentration (51.2 mg/kg) is less than the ecological screening value (70 mg/kg), which is based on potential impacts to plants. The site consists of periodically maintained grass, so plant endpoints are not appropriately representative of ecological exposures. Concentrations are less than soil screening values based upon other receptors (e.g., 80 mg/kg for soil invertebrates).
- Selenium concentrations exceed the ecological screening value and background UTL in 11 of 12 samples. The site consists of periodically maintained grass, so plant endpoints are not appropriately representative of ecological exposures. Concentrations are less than soil screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates).
- Zinc concentrations exceed the ecological screening value and background in 6 of the 12 samples. The mean concentration (134 mg/kg) is comparable to the screening value (120 mg/kg). Thus, zinc has a low potential for unacceptable risk to ecological receptors on a site-wide basis. In addition, zinc is not elevated relative to the screening value in the five samples (SS-06 through SS-10) collected adjacent to the battery accumulation area. Other battery-related metals (such as nickel and cadmium) are not elevated in these samples either, indicating that a release from that area has not likely occurred.

Five inorganics (arsenic, copper, lead, nickel, and selenium) were detected above their respective SSLs at a DAF of 1 in surface soil. However, due to the small area where these constituents were detected above the SSLs and background UTLs (i.e., primarily around the Flammable Materials Storage building), an SSL at a higher DAF is likely to be more realistic, as indicated in Section 1.1.2. This supposition is supported by data from sites such as PI-7, PAOC J, PAOC K, and PAOC L (also located in the KTd zone), where SSLs at a DAF of 1 are shown to be likely unrealistic predictors of leaching to groundwater. None of the concentrations of arsenic, copper, lead, nickel, or selenium detected in SWMU 4 soil exceeds the SSL at a DAF of 4.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases at SWMU 4 are the former spent battery accumulation area, the former catch basin for hydraulic oil and cleaning/degreasing basin, the former storage area for waste rags (absorbent material and grease). Based on this information, multiple soil samples were collected at or adjacent to each of these areas, the

spatial distribution and resulting data of which indicate they likely have been sufficiently characterized.

5.4 Conclusions and Recommendations

Table 5-3 summarizes the results of the decision analysis for SWMU 4, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Small quantities of materials were stored at the site, in covered buildings. Any releases from these potential sources would have been to the ground surface and soil samples were collected throughout these areas. Although several constituents were detected in surface and subsurface soil, their concentrations are below human health and ecological exposure estimates for unacceptable effects. Further, pesticide and herbicide detections at the site are consistent with normal pesticide and herbicide application associated with maintenance of the historical facilities present at the site. Therefore, based on the above information, it is likely that NFA is warranted for SWMU 4. However, to help confirm that from the sites within the eastern half of Camp Garcia (including SWMU 4) there have not been releases that have adversely affected groundwater quality, a monitoring well will be installed just south of the eastern half of Camp Garcia. The actual location of the well will be based on a synoptic round of groundwater elevations collected from all Camp Garcia wells to ensure it is positioned in the downgradient flow direction from the eastern half of Camp Garcia. A groundwater sample will be collected from this well and analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL total and dissolved inorganics.

TABLE 5-1
SWMU 4 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone KTd SS**	CGSWMU4SS007	CGSWMU4SS008	CGSWMU4SS009	CGSWMU4SS010	CGSWMU4SS011	CGSWMU4SS012	
Sample ID					NDD027	NDD028	NDD029	NDD030	NDD031	NDD032	NDD033FD1
Sample Date					6/13/00	6/13/00	6/13/00	6/13/00	6/13/00	6/13/00	6/13/00
Chemical Name											
Volatile Organic Compounds (µg/kg)											
2-Hexanone	--	310,000	--	--	61 UJ	58 UJ	64 U	50 U	72 UJ	2 J	51 U
Dibromomethane	--	6,700	--	--	6 UJ	6 UJ	6 U	5 U	7 UJ	5 UJ	5 U
m- and p-Xylene	10,000	27000*	100	--	6 UJ	6 UJ	0.9 J	5 U	7 UJ	5 UJ	5 U
Toluene	600	630,000	200,000	--	6 UJ	6 UJ	6 U	5 U	8 J	5 UJ	5 U
Xylene, total	10,000	27,000	--	--	6 UJ	6 UJ	0.9 J	5 U	7 UJ	5 UJ	5 U
Semivolatile Organic Compounds (µg/kg)											
Acetophenone	--	780,000	--	--	456 UJ	433 UJ	355 J	549 UJ	391 UJ	543 UJ	504 UJ
Anthracene	590,000	2,200,000	100	--	456 UJ	433 UJ	423 UJ	549 UJ	391 UJ	543 UJ	504 UJ
Benzyl alcohol	--	1,800,000	--	--	912 UJ	866 UJ	65 J	1100 UJ	782 UJ	1090 UJ	1010 UJ
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	456 UJ	433 UJ	423 UJ	549 UJ	391 UJ	543 UJ	504 UJ
Di-n-octylphthalate	10,000,000	240,000	--	--	456 UJ	433 UJ	423 UJ	549 UJ	391 UJ	543 UJ	504 UJ
Fluoranthene	210,000	230,000	100	--	456 UJ	433 UJ	423 UJ	549 UJ	391 UJ	543 UJ	504 UJ
Phenanthrene	590,000	230,000	100	--	456 UJ	433 UJ	423 UJ	549 UJ	391 UJ	543 UJ	504 UJ
Pyrene	210,000	230,000	100	--	456 UJ	433 UJ	423 UJ	549 UJ	391 UJ	543 UJ	504 UJ
Pesticide/Polychlorinated Biphenyls (µg/kg)											
4,4'-DDE	3,000	1,700	10	--	2.3 J	3.2 J	4.5 J	3.8 J	1.9 UJ	1.9 UJ	2 UJ
4,4'-DDT	2,000	1,700	10	--	0.59 J	1.8 J	3.4 J	0.66 J	3.9 UJ	3.8 UJ	3.9 UJ
Herbicides (µg/kg)											
2,4-D	--	69,000	--	--	345 UJ	345 UJ	351 UJ	418 UJ	420 UJ	408 UJ	431 UJ
Total Metals (mg/kg)											
Antimony	0.3	3.1	78	3.6	0.53 UJ	0.53 UJ	0.54 UJ	0.63 UJ	0.65 UJ	0.63 UJ	0.65 UJ
Arsenic	1	0.39	18	1.6	0.62 J	0.8 J	0.64 J	0.89 J	0.68 J	0.63 U	0.65 U
Barium	82	1,600	330	147	65.4	65.3	73.5	75.5	67.5	55.5	53
Beryllium	3	15	40	0.27	0.17 J	0.2 J	0.23	0.23 J	0.21 J	0.2 J	0.19 J
Cadmium	0.4	3.7	32	2.2	0.11 U	0.11 U	0.11 U	0.13 U	0.13 U	0.13 U	0.13 U
Chromium	2	210	0.4	72	11.8	7.7	8.2	8.6	7.6	6	4.9
Cobalt	33	140	13	16	10.1	8.5	8.6	9.8	10.5	9.7	9
Copper	46	310	70	66	50.2	34.5	37.1	41.9	38.1	30.2	22.4
Lead	14	400	120	5.4	5.9	7.6	3.6	5.1	6.4	4.5	3.5
Mercury	0.1	2.3	0.1	0.057	0.01 U	0.02 J	0.021 J	0.021 J	0.02 U	0.02 U	0.02 U
Nickel	7	160	38	22	5.9	3.1 J	3.7 J	3.7 J	2.9 J	2.7 J	2.3 J
Selenium	0.3	39	0.52	0.51	0.98 J	0.86 J	1.1 J	0.86 J	1.1 J	0.68 J	0.82 J
Tin	--	4,700	--	N/A	0.53 U	0.58 J	0.54 U	0.63 U	0.65 U	0.63 U	0.65 U
Vanadium	300	7.8	2	144	71.2	62.4	63.4	72.8	79.9	60	57.4
Zinc	620	2,300	120	32	65.2 J	45.4 J	41.9 J	105 J	231 J	184 J	151 J

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: User's Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 1996)
Vieques Eco SO - Screening values for compounds (4,4'-DDE, 4,4'-DDT) (MSHPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (m,p-Xylene, anthracene, fluoranthene, phenanthrene, pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (toluene, nickel, selenium, vanadium, zinc) (Efroymson et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
* - Total xylene PRG value used as surrogate

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 5-1
SWMU 4 Surface Soil Detection and Exceedance Results
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12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	CGSWMU4SS001	CGSWMU4SS002	CGSWMU4SS003	CGSWMU4SS004	CGSWMU4SS005	CGSWMU4SS006
Sample ID					NDD021	NDD022	NDD023	NDD024	NDD025	NDD026
Sample Date					6/13/00	6/13/00	6/13/00	6/13/00	6/13/00	6/13/00
Chemical Name										
Volatile Organic Compounds (µg/kg)										
2-Hexanone	--	310,000	--	--	62 UJ	52 UJ	50 UJ	59 UJ	55 UJ	60 U
Dibromomethane	--	6,700	--	--	6 UJ	5 UJ	5 UJ	0.6 J	6 UJ	6 U
m- and p-Xylene	10,000	27000*	100	--	0.6 J	5 UJ	5 UJ	0.6 J	6 UJ	2 J
Toluene	600	630,000	200,000	--	6 UJ	5 UJ	5 UJ	6 UJ	6 UJ	6 U
Xylene, total	10,000	27,000	--	--	0.6 J	5 UJ	5 UJ	0.6 J	6 UJ	2 J
Semivolatile Organic Compounds (µg/kg)										
Acetophenone	--	780,000	--	--	412 UJ	644 UJ	528 UJ	473 UJ	402 UJ	461 UJ
Anthracene	590,000	2,200,000	100	--	412 UJ	105 J	528 UJ	473 UJ	402 UJ	461 UJ
Benzyl alcohol	--	1,800,000	--	--	825 UJ	1290 UJ	1060 UJ	946 UJ	804 UJ	921 UJ
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	412 UJ	644 UJ	55 J	473 UJ	402 UJ	461 UJ
Di-n-octylphthalate	10,000,000	240,000	--	--	412 UJ	644 UJ	528 UJ	473 UJ	402 UJ	36 J
Fluoranthene	210,000	230,000	100	--	412 UJ	123 J	528 UJ	473 UJ	402 UJ	461 UJ
Phenanthrene	590,000	230,000	100	--	412 UJ	105 J	528 UJ	473 UJ	402 UJ	461 UJ
Pyrene	210,000	230,000	100	--	412 UJ	67 J	528 UJ	473 UJ	402 UJ	461 UJ
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDE	3,000	1,700	10	--	1.1 J	17 UJ	4.3 J	18 UJ	16 UJ	1.8 UJ
4,4'-DDT	2,000	1,700	10	--	1.2 J	34 UJ	2.2 J	36 UJ	4.1 J	4.3 J
Herbicides (µg/kg)										
2,4-D	--	69,000	--	--	14 J	3780 UJ	397 UJ	393 UJ	354 UJ	392 UJ
Total Metals (mg/kg)										
Antimony	0.3	3.1	78	3.6	0.83 J	0.81 J	0.68 J	0.95 J	0.54 UJ	0.6 UJ
Arsenic	1	0.39	18	1.6	2.5	2.3	1.8	2.1	1.7	0.6 U
Barium	82	1,600	330	147	63.3	71.6	60.4	69.8	64.2	62.7
Beryllium	3	15	40	0.27	0.3	0.28	0.37	0.29	0.22	0.17 J
Cadmium	0.4	3.7	32	2.2	1	1.5	0.69	1.1	0.52	0.12 U
Chromium	2	210	0.4	72	41.3	22.5	22.6	25.7	23.8	4.1
Cobalt	33	140	13	16	19.1	11	16.4	15.8	15.3	8
Copper	46	310	70	66	72.9	58.1	66.3	76.9	76.3	32.4
Lead	14	400	120	5.4	20	26.7	17.3	24.5	29.7	2.7
Mercury	0.1	2.3	0.1	0.057	0.01 U	0.044 J	0.034 J	0.062 J	0.025 J	0.01 U
Nickel	7	160	38	22	22.7	8.8	9.9	10	14.6	2 J
Selenium	0.3	39	0.52	0.51	0.91 J	0.57 U	0.64 J	1 J	0.94 J	0.81 J
Tin	--	4,700	--	N/A	1 J	1 J	1 J	1.2 J	0.7 J	0.6 U
Vanadium	300	7.8	2	144	105	75.8	95.1	82.5	90.2	50.2
Zinc	620	2,300	120	32	355 J	165 J	99.5 J	139 J	127 J	46.3 J

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: User's Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 1996)
Vieques Eco SO - Screening values for compounds (4,4'-DDE, 4,4'-DDT) (MSHPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (m,p-Xylene, anthracene, fluoranthene, phenanthrene, pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (toluene, nickel, selenium, vanadium, zinc) (Efroymson et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
* - Total xylene PRG value used as surrogate

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

Table 5-2
SWMU 4 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	CGW4SB01	
Sample ID				CGW4SB01-R01-5	CGW4FD01P-R01-5
Sample Date				1/21/04	1/21/04
Chemical Name					
Volatile Organic Compounds (µg/kg)					
No Detections					
Semivolatile Organic Compounds (µg/kg)					
bis(2-Ethylhexyl)phthalate	--	35,000	--	161 J	159 J
Di-n-butylphthalate	270,000	610,000	--	109 J	105 J

Notes:
µg/kg - Micrograms per kilogram
J - Result may be estimated
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: User's Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)

TABLE 5-3
SWMU 4 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium; to increase confidence in site-specific determination, regional groundwater data are warranted.
		VOCs	Yes	No	N/A	
		SVOCs	Yes	Anthracene > Eco	detected in only one sample; concentration marginally above screening criterion; small, maintained site	
				Fluoranthene > Eco	detected in only one sample; concentration marginally above screening criterion; small, maintained site	
				Phenanthrene > Eco	detected in only one sample; concentration marginally above screening criterion; small, maintained site	
		Pesticides	No	No	N/A	
		Herbicide	No	No	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; < SSL at a DAF of 3	
				Co > ECO, BKG	mean concentration < ECO	
				Cu > ECO, SSL, BKG	mean concentration < ECO; < SSL at a DAF of 2	
				Pb > SSL, BKG	< SSL at a DAF of 3	
				Ni > SSL, BKG	< SSL at a DAF of 4	
				Se > ECO, SSL, BKG	Maintained area; plant ECO value not likely appropriate; < ECO for soil invertebrates; < SSL at a DAF of 4	
				Zn > ECO, BKG	Small site, maintained site, no ECO exceedance in battery storage area, mean concentration comparable to ECO	
Subsurface Soil	Yes					Medium sufficiently characterized; no further action for medium; to increase confidence in site-specific determination, regional groundwater data are warranted.
		SVOCs	Yes	No	N/A	

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_4_6_7_2005.mxd

Legend

- Phase I Environmental Assessment Surface Soil Sample Location
- PA/SI Subsurface Soil Sample Location

Surface soil sample designations are preceded by "CGSWMU4" (e.g. SS-01 = CGWMU4SS001)

Subsurface soil sample designations are preceded by "CGW4" (e.g. SB-01 = CGW4SB01)

- Proposed Monitoring Well Location

N
W E
S

0 25 50 100 Feet

Figure 5-1
2005 Aerial Photograph of the SWMU 4 and SWMU 6/7 Areas
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

ES062007002TPA

Photograph taken February 3, 2000

Figure 5-2
Corrosive Materials Storage Building, SWMU 4
(Spent battery accumulation area)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Photograph taken February 3, 2000

Figure 5-3
Flammable Materials Storage Building, SWMU 4
(Area of rags, absorbent material, and grease)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 6

SWMU 5—Spent Battery Accumulation Area, OP-1, Inner Range, Former VNTR

This section presents the results of the PA/SI performed at SWMU 5—Spent Battery Accumulation Area OP-1.

6.1 Conceptual Site Model

The CSM for SWMU 5 is based on review of historical information such as records, site inspection documentation, and interviews, as well as site-specific data collection.

6.1.1 Site History and Potential Sources of Release

SWMU 5 is a spent battery accumulation area located in the vicinity of OP-1 at the former VNTR (Figures 1-2 and 6-1). According to the 1988 RFA Report (Kearney, 1988), batteries and battery acid were stored outside on a gravel driveway and the acid from the batteries typically was emptied into plastic containers and shipped to NAPR (the former NSRR). The 1988 and 1995 RFA reports stated that no staining or other signs of release were observed at the unit during the VSI and, therefore, sampling and analysis were not suggested at that time (Kearney, 1988; PREQB, 1995). However, establishment of an area with secondary containment for storage of the batteries and acid was recommended in the 1988 RFA Report.

Although the startup date for SWMU 5 is unknown, the SWMU remained active through May 2003. During the 1995 RFA, nine batteries were observed to be stored at this site on the gravel driveway. During the February 2000 site visit to all Consent Order sites, release controls (plastic storage trays) for battery storage were present, but no batteries were observed at the site. No signs of releases of battery acid were observed at that time. In addition, the storage containers were noted to be on concrete (Figure 6-2).

During the January 2004 PA/SI site visit, no signs of activity were evident at SWMU 5. No batteries were stored at the site. The plastic trays observed in 2000 had been removed as part of the closure of the former VNTR.

Based on the site history information above, the potential source area at SWMU 5 is the former battery accumulation area.

6.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted during the February 2000 EPA and Navy site visit to all Consent Order sites (CH2M HILL, 2001) and during the 2004 PA/SI, as well as on regional information.

SWMU 5 is a flat area at 453 ft amsl, approximately 100 ft southeast of the OP-1 main control tower building. Approximately 35 ft to the east of where the battery storage area was formerly located, the topography drops off by about 240 ft. The site landscape is gravel with

weeds, just off a concrete pad formerly used for vehicles to drive and maneuver around storage buildings. Although bedrock was not encountered during surface soil sampling, the bedrock appears to be very shallow because outcrops were observed around the site. The soil in the first 8 inches consists of well-graded sand with silt and gravel. SWMU 5 lies within the Kv formation, which comprises sandstone, siltstone, conglomerate, lava, tuff, and tuffaceous breccia. For more information on the bedrock geology see Section 1.4.6.

No surface water bodies are present at the site. The closest surface water body is the ocean, located approximately ½ mile to the south and southeast. Based on the depth to groundwater encountered at other locations significantly above sea level (see Figure 1-9 and 1-10), groundwater beneath the OP-1 area is estimated to be more than 100 feet bls.

6.2 Sampling Approach and Chemical Constituents Identified

As presented in the Phase I RFI Work Plan (CH2M HILL, 2003c), four surface soil samples were collected immediately adjacent to the concrete pad on which the spent batteries were stored (Figure 6-3). Samples were analyzed for Appendix IX VOCs, SVOCS, metals, herbicides, pesticides, and PCBs; and explosives, including perchlorate. One surface soil sample, collected at station CGW5SS01, was additionally analyzed for cyanide, sulfide, and dioxins. Although historical information for SWMU 5 did not indicate munitions or explosives-related constituents would be related to potential releases at the site, explosives were included in the sample analyses because the site is located within the safety fan of the artillery firing positions in the EMA.

Table 6-1 summarizes the constituents detected in SWMU 5 surface soil samples collected during the PA/SI and identifies screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O.

6.3 SWMU 5 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection table (Table 6-1).

Appendix N, Section N.6 discusses the evaluation of the SWMU 5 data quality. As detailed in Section N.6, the SWMU 5 data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at SWMU 5, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was used to store spent batteries. Although there was no evidence of releases observed during the various site visits, no secondary containment was present during part of the operational period of the SWMU. Therefore, the potential presence of hazardous substances could not be confidently ruled out without sample collection. Sample collection took place during the 2004 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected:

Surface Soil

- VOCs: none detected
- SVOCs: acetophenone, dimethyl phthalate, di-n-butylphthalate
- Pesticides: none detected
- Herbicides: none detected
- PCBs: none detected
- Dioxins: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin, octachlorodibenzo-p-dioxin, total heptachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin
- Explosives: none detected
- Inorganics above background UTLs: arsenic, lead, zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

There is no documented history or visual evidence of releases at SWMU 5. However, of the constituents listed in Step 1, arsenic, lead, and zinc are potentially associated with battery acid and are, therefore, potentially attributable to a CERCLA-related release. Conversely, it is unlikely that SVOCs are associated with the spent batteries; they are more likely associated with normal vehicular use at the site. However, they are conservatively evaluated as a potential CERCLA-related release, as stated in *Polycyclic Aromatic Hydrocarbons* under Section 1.1.1.

Dioxins are not associated with battery acid. Further, as shown in Table A-3, the dioxin concentration at SWMU 5 (in TEQ) is approximately 2 ppt, which is almost three orders of magnitude below the residential remediation level (i.e., 1,000 ppt) cited by EPA. Therefore, dioxins are not further considered in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection table. Those constituents that exceed one or more criteria (and background for inorganics) are listed below.

Surface Soil

- SVOCs: no exceedances
- Arsenic: four detections (samples SS01 through SS04) at concentrations (3.66 mg/kg to 6.94 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Lead: two detections (samples SS02 and SS03) at concentrations (16.1 mg/kg and 16.1 mg/kg, respectively) above the SSL at a DAF 1 (14 mg/kg) and background UTL (5.4 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

At each location sampled, arsenic was detected in surface soil above background and its residential PRG (0.39 mg/kg based on 1×10^{-6} ELCR). Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (which is based on skin and vascular effects), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the relatively low maximum detected concentration (based on the acceptable risk range) and the relatively low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver.

Although vanadium was detected in soil above the adjusted PRG, its PRG is based on increased mortality, so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all vanadium concentrations are below the background UTL.

Two inorganics (arsenic and lead) were detected above their respective SSLs at a DAF of 1 in surface soil. However, because the former battery storage area (i.e., potential source area) was relatively small, an SSL at a higher DAF is likely to be more realistic, as indicated in Section 1.1.2. This supposition is supported by data from SWMU 1 (also located in the Kv zone), where SSLs at a DAF of 1 are shown to be unrealistic predictors of leaching to groundwater. At SWMU 1, arsenic and lead were detected in soil above the SSLs at a DAF of 1, but were not detected in groundwater. The presumed depth to groundwater of more than about 100 feet at this location further supports a higher DAF. For the SWMU 5 data, none of the arsenic concentrations exceeds the SSL at a DAF of 7, and none of the lead concentrations exceeds the SSL at a DAF of 2.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely source of CERCLA-related releases is the former spent battery accumulation area. Soil samples were collected in the area where the battery storage area was formerly located. Based on the nature of potential releases (i.e., to the ground surface), the nature of

the constituents potentially attributable to CERCLA-related releases (i.e., metals), and that arsenic was the only constituent detected in the surface soil above its PRG (albeit toward the low end of the acceptable risk range), the spatial distribution of samples and resulting data indicate the potential source area has been sufficiently characterized, especially considering the number and locations of samples (and resulting data) collected at adjacent SWMU 8 (see Section 8).

6.4 Conclusions and Recommendations

Table 6-2 summarizes the results of the decision analysis for SWMU 5, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Although several constituents were detected in surface soil, their concentrations do not pose an unacceptable risk to human health and ecological receptors. Further, SVOC and dioxin detections at the site are not likely associated with potential CERCLA-related releases and are nevertheless below risk screening levels. Therefore, it is recommended that a NFA decision document be prepared for SWMU 5.

TABLE 6-1
SWMU 5 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone Kv SS**	CGW5SS01	CGW5SS02	CGW5SS03	CGW5SS04
Sample ID					CGW5SS01-R01	CGW5SS02-R01	CGW5SS03-R01	CGW5SS04-R01
Sample Date					1/19/04	1/19/04	1/19/04	1/19/04
Chemical Name								
Volatile Organic Compounds (µg/kg)								
No Detections								
Semivolatile Organic Compounds (µg/kg)								
Acetophenone	--	780,000	--	--	54.4 J	363 U	357 U	352 U
Dimethyl phthalate	--	61,000,000	200,000	--	350 U	363 U	357 U	1,410 J
Di-n-butylphthalate	270,000	610,000	200,000	--	350 U	59.6 J	52.8 J	63.9 J
Pesticide/Polychlorinated Biphenyls (µg/kg)								
No Detections								
Herbicides (µg/kg)								
No Detections								
Dioxin/Furans (pg/g)								
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	107	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	2.7	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	3.2	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	856	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	209	NA	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	33	NA	NA	NA
Explosives (µg/kg)								
No Detections								
Total Metals (mg/kg)								
Antimony	0.3	3.1	78	3.6	1.04 J	1.36 J	0.904 J	1.34 J
Arsenic	1	0.39	18	1.6	3.66	6.94	5.46	4.38
Barium	82	1,600	330	212	64.3	67.6	65.1	66.8
Beryllium	3	15	40	0.27	0.144 J	0.157 J	0.165 J	0.178 J
Cadmium	0.4	3.7	32	2.2	0.242 J	0.739	0.298 J	0.265 J
Chromium	2	210	0.4	72	36.2 J	54.2 J	38.9 J	47.8 J
Cobalt	33	140	13	26	14.6 J	15.5 J	11.5 J	14.8 J
Copper	46	310	70	94	43	67.1	50.5	48.7
Lead	14	400	120	5.4	11.8 J	16.1 J	16.1 J	11.3 J
Mercury	0.1	2.3	0.1	0.057	0.0128 J	0.0165 J	0.0122 J	0.0126 J
Nickel	7	160	38	41	15.5 J	23.9 J	15.2 J	20 J
Selenium	0.3	39	0.52	0.51	0.472 J	0.456 J	0.476 J	0.45 J
Silver	2	39	560	0.22	0.098 J	0.0936 J	0.0905 J	0.124 J
Tin	--	4,700	--	NA	0.326 J	0.384 J	0.362 J	0.469 J
Vanadium	300	7.8	2	144	79.1 J	83.4 J	76.9 J	96.7 J
Zinc	620	2,300	120	32	77 J	112 J	80.8 J	84 J
Wet Chemistry (mg/kg)[1]								
No Detections								

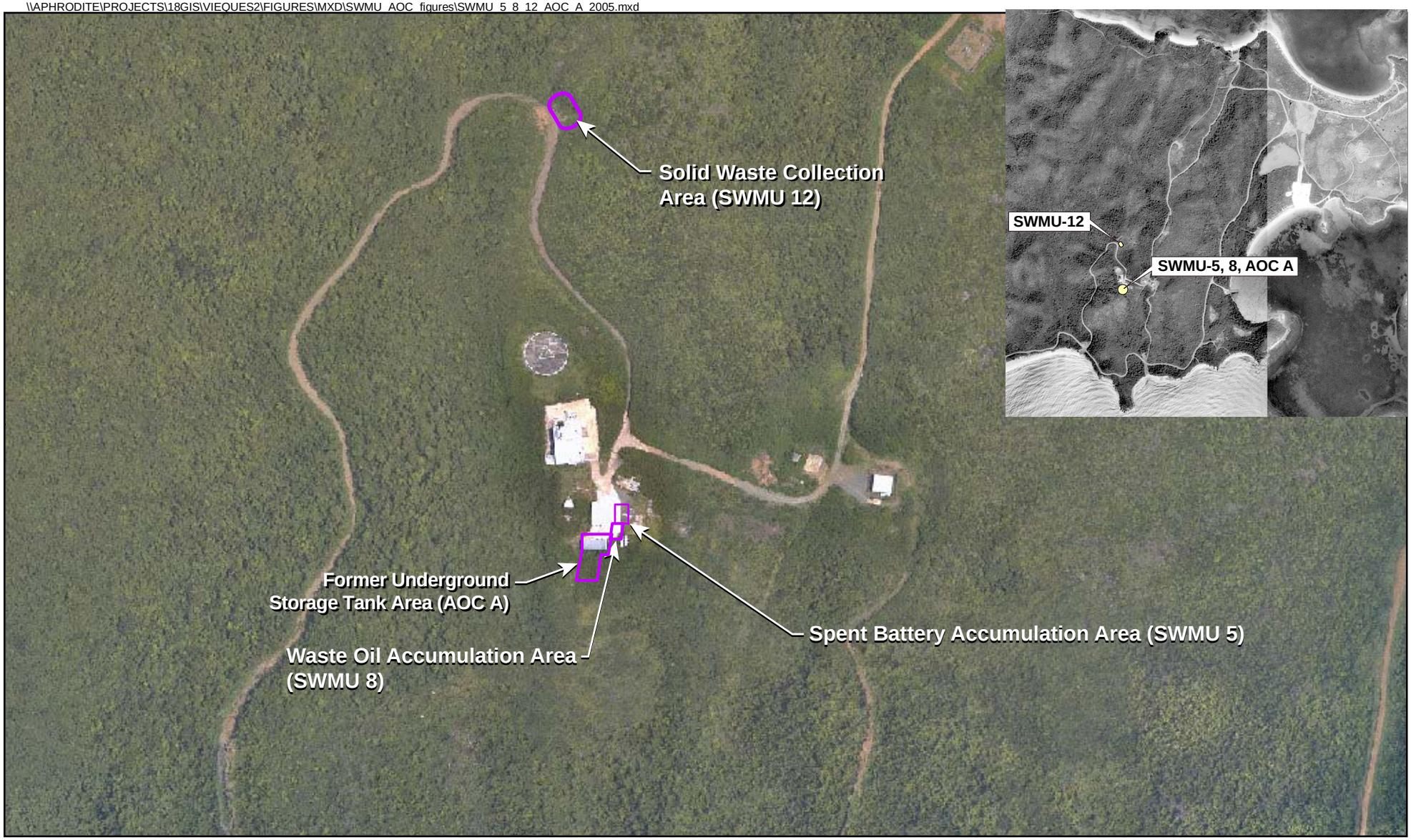
Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: User's Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (dimethylphthalate, chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, silver, vanadium, zinc) (Efroymson et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[1] Wet Chemistry consists of sulfide and cyanide
* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria

TABLE 6-2
SWMU 5 Decision Tree Summary
Preliminary Assessment/Site Inpection Report
12 Consent Order Sites, and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		SVOCs	Yes	No	N/A	
		Dioxins	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; < SSL at a DAF of 7	
				Pb > SSL, BKG	< SSL at a DAF of 2	

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_5_8_12_AOC_A_2005.mxd



Legend

SWMU 5, SWMU 8, SWMU 12, and AOC A Areas

N
W E
S

0 150 300 600 Feet

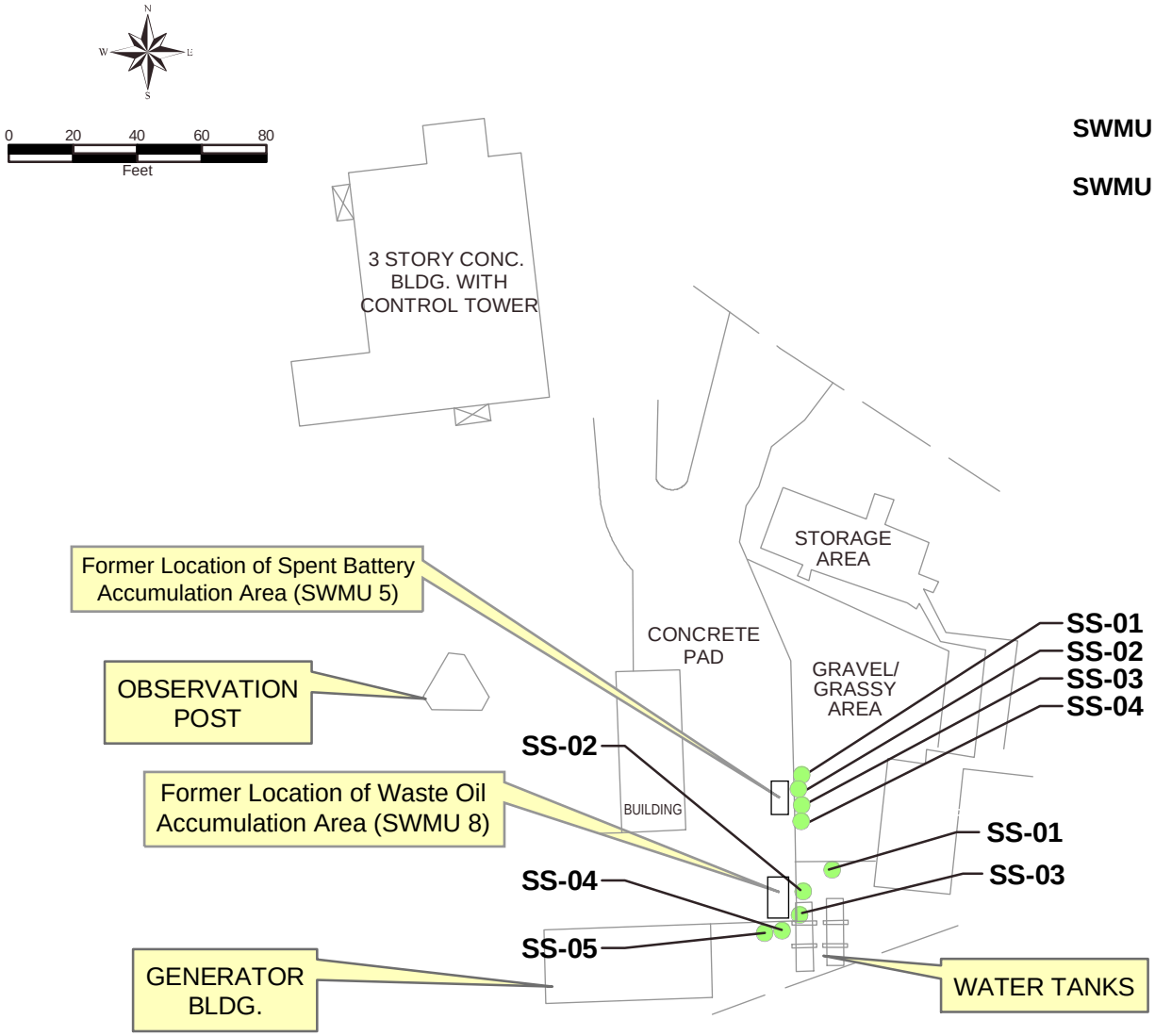
Figure 6-1
2005 Aerial Photograph of the SWMU 5, SWMU 8, SWMU 12, and AOC A Areas
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

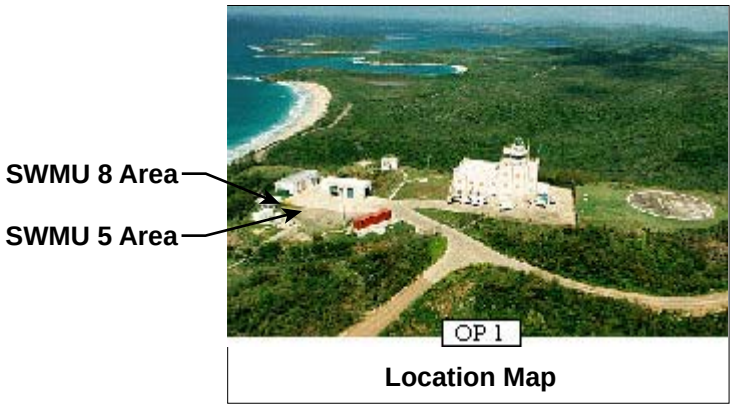
CH2MHILL

ES062007002TPA

Photograph taken February 3, 2000

Figure 6-2
SWMU 5 Spent Battery Accumulation Area
(Observation Post 1, former VNTR)
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico





Legend

PA/SI Surface Soil SampleLocation

Each sampling location shown is preceded by "CGW8" (e.g. SS-01 = CGW8SS01)

Figure 6-3
Surface Soil Sample Locations Map, SWMU 5 and SWMU 8
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 7

SWMU 6 and 7—Waste Oil and Paint Accumulation Areas (Seabees Area, Camp García)

This section presents the results of the PA/SI performed at SWMU 6, a storage area for waste oil and paint, and SWMU 7, a waste oil accumulation area.

7.1 Conceptual Site Model

The CSM for SWMUs 6 and 7 is based on review of historical information such as records, site inspection documentation, and interviews, as well as site-specific data collection.

7.1.1 Site History and Potential Sources of Release

SWMUs 6 and 7 are on the north side of Building 303 in the Camp Garcia Compound (Figures 1-2, 1-3, and 5-1). During interviews with Navy employees in February 2000, it was confirmed that SWMU 6 and SWMU 7 were located adjacent to each other, and, therefore, were investigated as one contiguous unit (CH2M HILL, 2001).

7.1.2 SWMU 6

According to the 1988 RFA report (Kearney, 1988), the SWMU 6 area was used by the Navy Construction Group (Seabees) as a storage area for waste oil and paint. The waste oil at this location was containerized in 55-gallon drums, and the paint was housed in small containers. During the RFA, tires and two drums of lubricating oil were present at the site. The waste oil and tires were stored on a grassy area until they were later shipped offsite to the former NSRR (now referred to as NAPR). The RFA Report stated that this area became active in approximately 1978 and was still active in 1988 (Kearney, 1988). During the 1995 RFA (PREQB, 1995), staining from oil leakage from the drums onto the soil surface was visible, and no release controls were present at the site. During the February 2000 site visit, which was done with the EPA to observe the consent order sites, a small chain-link cage was present at the site, but it had been moved from the concrete pad by the June 2000 sampling event. During the same visit, no drums or waste materials were present at SWMU 6, but a minor amount of soil staining (approximately 4-square feet [ft^2]) was observed off the edge of the concrete pad. During the January 2004 site visit performed during the PA/SI, no staining was observed.

7.1.3 SWMU 7

SWMU 7 was used by the U.S. Marine Corps (USMC) for 3 months per year during training exercises. During these 3 months, Marines conducted training exercises at the EMA, and used the waste oil accumulation area at SWMU 7 to store waste oil from maintenance of their vehicles. During the 1988 RFA, one open-top 55-gallon drum, a 25-gallon trash can,

and two empty drums cut in half were present at SWMU 7. It was reported that the soil in the waste oil accumulation area was stained with oil, likely from spillage during vehicle maintenance operations. Once the USMC completed their training, the stained soil was excavated and mixed with sand, containerized in 55-gallon drums, and shipped to the former NSRR. Based on the above information, both the 1988 RFA Report (Kearney, 1988) and the 1995 RFA Report (PREQB, 1995) stated that "no sampling and analyses were suggested at this time. A general cleanup of the area, however, would help reduce the potential for release. It was suggested that an area with release controls for storage of the waste materials be established and that procedures be developed to minimize spillage of product."

Based on the historical site information above, the potential source areas at SWMUs 6 and 7 were the drums and small containers used to store waste oil and paint. Releases from these SWMUs would have been to the concrete surface, with potential to runoff onto the ground surface.

7.1.4 Physical Setting

The description of the site's physical setting is based on site inspection conducted in February 2000 to visit the consent order sites and in 2000 for the Phase I Environmental Assessment, as well as on regional information.

The area encompassing these two sites currently consists of an open area, which contains a concrete pad, as shown in Figure 7-1. As stated previously, the cage shown in Figure 7-1 has been moved. The concrete pad is surrounded by grass and gravel in a flat area that sits at an elevation of approximately 60 ft amsl. SWMU 6 and 7 lie within the KTd geologic zone, which consists of plutonic rocks, largely granodiorite and quartz diorite. For more information on the bedrock geology see Section 1.4.6. Bedrock was not encountered during sampling at SWMUs 6/7, but was found at approximately 25 and 30 ft bls at PAOC U, which is located just north of SWMUs 6/7 (Figure 1-3). Groundwater was encountered in the bedrock, at a depth of about 45 ft bls at PAOC U.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon along the coast, a little less than 1 mile to the south and southeast, respectively. Based on nearby wells, the topographic slope, and the regional groundwater gradient determined by the USGS (1989), groundwater in this area exists within the fractured bedrock and is presumed to flow in a southerly direction toward the coast.

7.2 Sampling Approach and Chemical Constituents Identified

A surface soil sampling investigation was conducted in June 2000 as part of the transfer of Navy Public Works operations from west Vieques to east Vieques. Ten surface soil samples were collected around the concrete pad, as shown in Figure 5-1. All samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, and inorganics.

Table 7-1 summarizes the constituents detected in SWMUs 6 and 7 surface soil samples collected during the Phase I Environmental Assessment (2000) and identifies screening

criteria exceedances. Raw analytical data for the Phase I Environmental Assessment samples are provided in Appendix O.

7.3 SWMUs 6 and 7 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection table (Table 7-1).

Appendix N, Section N.7 discusses the evaluation of the SWMU 6/7 data quality. As detailed in Section N.7, the SWMU 6/7 data are acceptable for use in evaluating aspects of environmental conditions at SWMU 6/7, which is done in Steps 1 through 5 below. However, it is recognized that sufficient data have not been collected to draw conclusions regarding potential releases with adequate confidence, as discussed in Step 6 below. Therefore, additional data collection will be performed, as defined in Section 7.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was used to store waste oil and paint. Based on the nature of historical activities and the staining observed during a site visit, the potential presence of hazardous substances could not be confidently ruled out without sample collection. Sample collection took place during the 2000 Phase I Environmental Assessment. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the Phase I Environmental Assessment, the following inorganics above the background UTLs and non-inorganics were detected:

<u>Surface Soil</u>

- VOCs: 1,2,3-trichloropropane, 1,2-dichloroethane, 1,4-dichlorobenzene, 2-hexanone, dibromomethane, m- and p-xylene, methylene chloride, vinyl acetate, total xylene
- SVOCs: bis(2-ethylhexyl)phthalate, butylbenzlphalate
- Pesticides: 4,4'-DDD, 4,4-DDE, 4,4'-DDT, chlordane, delta-BHC, heptachlor
- Herbicides: none detected
- PCBs: none detected
- Inorganics above background UTLs: arsenic, cadmium, copper, lead, selenium, silver, tin, zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Because SWMUs 6 and 7 were used to store waste oil and paint, the VOCs, SVOCs, and inorganics detected are potentially attributable to CERCLA-related releases of waste oil and paint and are, therefore, further evaluated in the decision analysis process. The presence of the pesticides is likely due to normal use, not a CERCLA-related release, especially because

its detected concentrations are similar to those found at multiple sites across Vieques (see *Pesticides and Herbicides* under Section 1.1.1 for a detailed discussion of pesticides). Consequently, pesticides are not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection table. Those constituents that exceed one or more criteria (and background for inorganics) are listed below.

Surface Soil

- 1,2-dichloroethane: one detection (sample SS06) at a concentration (3 μg/kg) above the SSL at a DAF 1 (1 μg/kg)
- Methylene chloride: two detections (samples SS01 and SS03) at concentrations (3 μg/kg and 4 μg/kg, respectively) above the SSL at a DAF 1 (1 μg/kg)
- SVOCs: no exceedances
- Arsenic: five detections (samples SS02, SS06 through SS09) at concentrations (1.8 mg/kg to 2.8 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Cadmium: one detection (sample SS10) at a concentration (4.4 mg/kg) above the adjusted PRG (3.7 mg/kg), SSL at a DAF 1 (0.4 mg/kg), and background UTL (2.2 mg/kg)
- Copper: three detections (samples SS01, SS04, SS08) at concentrations (67.4 mg/kg, 68.7 mg/kg, and 86.2 mg/kg, respectively) above the ecological screening value (70 mg/kg; by SS08 only), SSL at a DAF 1 (46 mg/kg), and background UTL (66 mg/kg)
- Lead: four detections (samples SS07, SS08 through SS10) at concentrations (20.8 mg/kg to 56.5 mg/kg) above the SSL at a DAF 1 (14 mg/kg) and background UTL (5.4 mg/kg)
- Selenium: eight detections (samples SS01, SS02, SS04 through SS07, SS09, and SS10) at concentrations (0.55 mg/kg to 1.1 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF 1 (0.3 mg/kg), and background UTL (0.51 mg/kg)
- Zinc: seven detections (samples SS01, SS02, SS05 through SS08, and SS10) at concentrations (129 mg/kg to 587 mg/kg) above the ecological screening value (120 mg/kg) and the background UTL (32 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Arsenic was detected at 5 of 10 locations sampled above background and its human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR), at a maximum concentration of

2.8 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (which is based on skin and vascular effects), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the relatively low maximum detected concentration (based on the acceptable risk range) and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver.

Cadmium was detected at 1 of 10 locations sampled above background and its human health screening level (3.7 mg/kg based on non-cancer HQ of 0.1), at a concentration of 4.4 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 37 mg/kg (HQ=1). Based on the low maximum detected concentration and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for cadmium would be acceptable and cadmium would not be identified as a risk driver.

As noted above, only two constituents were detected in soil at concentrations above PRGs and background. Only the soil PRG for arsenic is based on potential carcinogenic effects. A second PRG is available for arsenic based on non-cancer effects (skin and vascular effects), while the PRG for cadmium is based on kidney effects. Although vanadium was detected in soil above the adjusted PRG, its PRG is based on increased mortality. Further, all vanadium concentrations are below the background UTL. Since the target organs/effects are different for these three constituents, potential cumulative non-cancer effects from multiple constituents in soil are not a concern.

The concentrations of three inorganics (copper, selenium, and zinc) exceed ecological screening values and background UTLs in at least one surface soil sample collected at the site. None of these constituents likely poses an unacceptable risk to ecological receptors based upon the following:

- The area evaluated is immediately adjacent to a concrete pad, is very small, and provides very limited habitat. Thus, the potential exposures to ecological receptors are likely minimal.
- Copper exceeds the ecological screening value in only 1 of 10 samples, at a maximum HQ of 1.2. Further, the mean copper concentration (61 mg/kg) is less than the ecological screening value (70 mg/kg).
- Selenium exceeds the ecological screening value in 8 of 10 samples. The screening value (0.52 mg/kg), however, is based upon potential impacts to plants. The site consists of concrete, gravel, and scrub grass, so plant endpoints are not likely representative of actual exposures. Concentrations are less than soil screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates).
- Zinc concentrations exceed ecological screening values in 7 of 10 samples. Although the maximum HQ is 4.89, the mean HQ is only 1.65 and zinc has a low potential for unacceptable risks given the low potential for exposures.

1,2-dichloroethane and methylene chloride are the only VOCs to exceed an SSL. Methylene chloride exceeds its SSL at a DAF of 1 (1 µg/kg) in two samples at concentrations of 3 µg/kg

and 4 µg/kg, the latter of which represents the highest concentration of a VOC detected at the site. However, the waste oil and paint accumulation area (i.e., potential source area) was relatively small. Therefore, an SSL at a higher DAF is likely to be more realistic, as discussed in Section 1.1.2. This supposition is supported by data from sites such as PI-7, PAOC J, PAOC K, and PAOC L (also located in the KTd zone), where SSLs at a DAF of 1 are shown to be likely unrealistic predictors of leaching to groundwater. Neither of the methylene chloride concentrations exceeds the SSL at a DAF of 4. 1,2-dichloroethane also exceeds its SSL at a DAF of 1 (1 µg/kg) in one sample at a concentration of 3 µg/kg. However, it was not detected in the duplicate sample at that site, and as stated above, a SSL at a higher DAF is likely to be more realistic. The 1,2-dichloroethane concentration does not exceed the SSL at a DAF of 3.

Five inorganics (arsenic, cadmium, copper, lead, and selenium) were detected at concentrations above the SSLs at a DAF of 1. However, as noted above, the site is small and soil/groundwater data from other sites suggests SSLs at a DAF of 1 are not representative predictors of leaching to groundwater. For example, four of same five inorganics were detected in PI-4 soil, which is in the same geologic unit as SWMU 6/7, above the SSLs at a DAF of 1. As discussed in Section 14 for PI-4, none of the constituents were detected in groundwater above screening criteria. At SWMU 6/7, none of the inorganics concentrations that exceeds the SSL at a DAF of 1 exceeds the SSL at a DAF of about 10.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely source of CERCLA-related releases is from the storage area for waste oil and paint. Based on this information, multiple soil samples were collected in the areas just off the concrete pad in the most likely area where releases would contact soil. While the surface soil data suggest constituent concentrations potentially released at the site do not pose an unacceptable human health or ecological risk or leaching potential, because VOCs were detected in the surface soil and because surface soil concentrations may not be sufficiently representative of VOCs concentrations in soil, the spatial distribution of samples and resulting data suggest the potential source area has not been sufficiently characterized.

7.4 Conclusions and Recommendations

Table 7-2 summarizes the results of the decision analysis for SWMU 6 and 7, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of surface soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Although the surface soil data suggest NFA may be warranted, due to the nature of VOCs, surface soil samples may not be sufficient to characterize the potential source area where waste oil and paint were stored. Therefore, additional characterization is warranted, as described below.

<u>Rationale</u>

Presence of VOCs, SVOCS and certain metals above background (e.g., zinc) suggests a CERCLA-related release occurred at SWMU 6 and/or 7. Further, surface soil VOC concentrations may not be sufficiently representative of VOC concentrations present in soil.

Objective

Confirm 2000 data and determine if suspected release has affected subsurface soil by:

- Collecting 10 co-located surface soil (to confirm previous findings) and subsurface soil samples at the locations shown in Figure 7-2 and analyzing all samples for TCL VOCs and SVOCs and TAL metals. If staining is observed during the sampling event, sample(s) will be biased to the location(s) of the staining.

In addition to the above, to help confirm that from the sites within the eastern half of Camp Garcia (including SWMUs 6/7) there have not been releases that have adversely affected groundwater quality, a monitoring well will be installed just south of the eastern half of Camp Garcia. The actual location of the well will be based on a synoptic round of groundwater elevations collected from all Camp Garcia wells to ensure it is positioned in the downgradient flow direction from the eastern half of Camp Garcia. A groundwater sample will be collected from this well and analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL total and dissolved inorganics.

Decision Analysis

Evaluate the concentrations of the constituents detected in the newly collected surface and subsurface soil samples in accordance with the 6-step decision analysis process presented in Figure 1-4.

TABLE 7-1
SWMU 6/7 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Results
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID Sample ID Sample Date Chemical Name	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	CGSWMU6/7SS001 NDD034 6/13/00	CGSWMU6/7SS002 NDD035 6/13/00	CGSWMU6/7SS003 NDD036 6/13/00	CGSWMU6/7SS004 NDD037 6/13/00
Volatile Organic Compounds (µg/kg)								
1,2,3-Trichloropropane	--	34	--	--	5 U	5 UJ	8 U	6 U
1,2-Dichloroethane	1	280	20	--	5 U	5 UJ	8 U	6 U
1,4-Dichlorobenzene	100	3,400	20,000	--	0.3 J	2 UJ	3 U	3 U
2-Hexanone	--	310,000	--	--	54 U	50 UJ	79 U	64 U
Dibromomethane	--	6,700	--	--	0.5 J	5 UJ	0.6 J	6 U
m- and p-Xylene	10,000	27,000*	100	--	0.4 J	0.3 J	2 J	0.4 J
Methylene chloride	1	9,100	--	--	3 J	5 UJ	4 J	6 U
Vinyl acetate	8,000	--	--	--	5 U	5 UJ	8 U	6 U
Xylene, total	10,000	27,000	--	--	0.4 J	0.3 J	2 J	0.4 J
Semivolatile Organic Compounds (µg/kg)								
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	481 UJ	49 J	538 UJ	781 UJ
Butylbenzylphthalate	810,000	1,200,000	--	--	481 UJ	496 UJ	538 UJ	781 UJ
Pesticide/Polychlorinated Biphenyls (µg/kg)								
4,4'-DDD	800	2,400	10	--	3.2 U	3.2 U	3.4 U	3.9 U
4,4'-DDE	3,000	1,700	10	--	98	22	136	3.3
4,4'-DDT	2,000	1,700	10	--	24	7.5	146	0.81 J
Chlordane	500	--	--	--	14 U	14 U	15 U	17 U
delta-BHC	0.1	440	--	--	1.6 UJ	1.6 UJ	1.7 UJ	2 UJ
Heptachlor	1,000	110	0.7	--	1.6 U	1.6 U	1.7 U	2 U
Herbicides (µg/kg)								
No Detections								
Total Metals (mg/kg)								
Antimony	0.3	3.1	78	3.6	0.53 UJ	0.54 UJ	0.57 UJ	0.68 J
Arsenic	1	0.39	18	1.6	1.3	2.7	1.2	1.5
Barium	82	1,600	330	147	70.8 J	106 J	70.6 J	75.9 J
Beryllium	3	15	40	0.27	0.18 J	0.18 J	0.21 J	0.22 J
Cadmium	0.4	3.7	32	2.2	0.11 U	0.71	0.11 U	0.24
Chromium	2	210	0.4	72	20.7	24	17.3	18.1
Cobalt	33	140	13	16	12.3	14.5	11.3	15.2
Copper	46	310	70	66	67.4	58.9	49.8	68.7
Lead	14	400	120	5.4	10.3	13.7	6.5	8.2
Mercury	0.1	2.3	0.1	0.057	0.015 J	0.01 U	0.031 J	0.01 U
Nickel	7	160	38	22	13.1	12.4	6.4	6.3 J
Selenium	0.3	39	0.52	0.51	0.64 J	0.59 J	0.57 U	0.78 J
Silver	2	39	560	0.22	0.12 J	0.11 U	0.13 J	0.13 U
Tin	--	4,700	--	NA	1.6 J	0.76 J	0.61 J	0.81 J
Vanadium	300	7.8	2	144	90.5	79.3	81.8	84.3
Zinc	620	2,300	120	32	239 J	587 J	91.8 J	104 J

Notes:
- mg/kg - Milligrams per kilogram
- µg/kg - Micrograms per kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996b
* Total xylene PRG value used as surrogate.
Vieques HHRA SO - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (1,2-dichloroethane, m,p-xylene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, heptachlor) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (1,4-dichlorobenzene, chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (nickel, selenium, silver, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 7-1
SWMU 6/7 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Results
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone KTd SS**	CGSWMU6/7SS005	CGSWMU6/7SS006		CGSWMU6/7SS007	CGSWMU6/7SS008
Sample ID					NDD038	NDD039	NDD043FD1	NDD058	NDD040
Sample Date					6/13/00	6/13/00	6/13/00	6/13/00	6/13/00
Chemical Name									
Volatile Organic Compounds (µg/kg)									
1,2,3-Trichloropropane	--	34	--	--	6 U	4 J	5 U	6 U	6 UJ
1,2-Dichloroethane	1	280	20	--	6 U	3 J	5 U	6 U	6 UJ
1,4-Dichlorobenzene	100	3,400	20,000	--	2 U	0.3 J	2 U	2 U	3 UJ
2-Hexanone	--	310,000	--	--	61 U	2 J	55 U	57 U	64 UJ
Dibromomethane	--	6,700	--	--	6 U	0.5 J	5 U	6 U	0.5 J
m- and p-Xylene	10,000	27,000*	100	--	0.4 J	6 U	0.4 J	1 J	0.5 J
Methylene chloride	1	9,100	--	--	6 U	6 U	5 U	6 U	6 UJ
Vinyl acetate	8,000	--	--	--	6 U	2 J	5 U	6 U	6 UJ
Xylene, total	10,000	27,000	--	--	0.4 J	6 U	0.4 J	1 J	0.5 J
Semivolatile Organic Compounds (µg/kg)									
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	526 UJ	570 UJ	3140 UJ	2500 UJ	580 UJ
Butylbenzylphthalate	810,000	1,200,000	--	--	526 UJ	570 UJ	3140 UJ	2500 UJ	40 J
Pesticide/Polychlorinated Biphenyls (µg/kg)									
4,4'-DDD	800	2,400	10	--	3.3 U	3.8 UJ	6.6 J	3.2 U	3.8 U
4,4'-DDE	3,000	1,700	10	--	5.7	6.1 J	31 J	8.2	3.2
4,4'-DDT	2,000	1,700	10	--	4.8	3.2 J	54 J	4.8 J	3.8 U
Chlordane	500	--	--	--	14 U	17 U	17 U	14 U	17 U
delta-BHC	0.1	440	--	--	1.6 UJ	0.84 J	1.9 UJ	1.6 UJ	1.9 UJ
Heptachlor	1,000	110	0.7	--	1.6 U	1.9 U	1.9 U	1.6 U	1.9 U
Herbicides (µg/kg)									
No Detections									
Total Metals (mg/kg)									
Antimony	0.3	3.1	78	3.6	0.54 UJ	0.64 UJ	0.64 UJ	0.53 UJ	0.74 J
Arsenic	1	0.39	18	1.6	1.5	1.9	0.64 U	2.8	2.8
Barium	82	1,600	330	147	70.3 J	73.4 J	60.3 J	65.7 J	88.4 J
Beryllium	3	15	40	0.27	0.21 J	0.18 J	0.14 J	0.25	0.17 J
Cadmium	0.4	3.7	32	2.2	0.35	0.89	0.11 U	0.51	1.2
Chromium	2	210	0.4	72	22.4	21.6	19.2	19.6	31.5
Cobalt	33	140	13	16	12.5	12.8	9.8	12.2	15.3
Copper	46	310	70	66	57.1	63	41.3	62.7	86.2
Lead	14	400	120	5.4	10.6	12.6	5.9	20.8	56.5
Mercury	0.1	2.3	0.1	0.057	0.01 U	0.028 J	0.01 U	0.01 U	0.043 J
Nickel	7	160	38	22	8.2	7.7	4.7 J	6.9	8.7
Selenium	0.3	39	0.52	0.51	0.57 J	1.1 J	0.85 J	0.63 J	0.64 U
Silver	2	39	560	0.22	0.12 J	0.18 J	0.15 J	0.18 J	0.21 J
Tin	--	4,700	--	NA	0.93 J	1.2 J	0.64 U	0.81 J	1.9 J
Vanadium	300	7.8	2	144	87.1	99.5	91.3	90.3	83.3
Zinc	620	2,300	120	32	144 J	129 J	29 J	164 J	232 J

Notes:
- mg/kg - Milligrams per kilogram
- µg/kg - Micrograms per kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996b
* Total xylene PRG value used as surrogate.
Vieques HHRA SO - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (1,2-dichloroethane, m,p-xylene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, heptachlor) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (1,4-dichlorobenzene, chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (nickel, selenium, silver, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 7-1
SWMU 6/7 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Results
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID Sample ID Sample Date	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	CGSWMU6/7SS009 NDD041 6/13/00	CGSWMU6/7SS010 NDD042 6/13/00
Chemical Name						
Volatile Organic Compounds (µg/kg)						
1,2,3-Trichloropropane	--	34	--	--	6 UJ	6 UJ
1,2-Dichloroethane	1	280	20	--	0.3 UJ	6 UJ
1,4-Dichlorobenzene	100	3,400	20,000	--	2 UJ	0.2 UJ
2-Hexanone	--	310,000	--	--	55 UJ	55 UJ
Dibromomethane	--	6,700	--	--	0.4 UJ	6 UJ
m- and p-Xylene	10,000	27,000*	100	--	0.3 J	0.7 J
Methylene chloride	1	9,100	--	--	6 UJ	6 UJ
Vinyl acetate	8,000	--	--	--	6 UJ	6 UJ
Xylene, total	10,000	27,000	--	--	0.3 J	0.7 J
Semivolatile Organic Compounds (µg/kg)						
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	333 UJ	2340 UJ
Butylbenzylphthalate	810,000	1,200,000	--	--	333 UJ	2340 UJ
Pesticide/Polychlorinated Biphenyls (µg/kg)						
4,4'-DDD	800	2,400	10	--	3.1 U	26 J
4,4'-DDE	3,000	1,700	10	--	22	3.5
4,4'-DDT	2,000	1,700	10	--	3.1	3.1 U
Chlordane	500	--	--	--	14 U	14
delta-BHC	0.1	440	--	--	1.6 UJ	1.6 UJ
Heptachlor	1,000	110	0.7	--	1.6 U	0.76 J
Herbicides (µg/kg)						
No Detections						
Total Metals (mg/kg)						
Antimony	0.3	3.1	78	3.6	1.1 J	0.54 J
Arsenic	1	0.39	18	1.6	1.8	1.4
Barium	82	1,600	330	147	75.4 J	44.8 J
Beryllium	3	15	40	0.27	0.24	0.1 U
Cadmium	0.4	3.7	32	2.2	0.64	4.4
Chromium	2	210	0.4	72	23.2	20.9
Cobalt	33	140	13	16	13.9	9.2
Copper	46	310	70	66	59	47.5
Lead	14	400	120	5.4	23.8	48.2
Mercury	0.1	2.3	0.1	0.057	0.01 U	0.01 U
Nickel	7	160	38	22	8.1	8.2
Selenium	0.3	39	0.52	0.51	0.57 J	0.55 J
Silver	2	39	560	0.22	0.17 J	0.28 J
Tin	--	4,700	--	NA	0.93 J	0.69 J
Vanadium	300	7.8	2	144	87.6	66.1
Zinc	620	2,300	120	32	81.6 J	205 J

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996b
* Total xylene PRG value used as surrogate.
Vieques HHRA SO - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (1,2-dichloroethane, m,p-xylene, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, heptachlor) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (1,4-dichlorobenzene, chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (nickel, selenium, silver, vanadium, zinc) (Efroymson et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 7-2
SWMU 6 and 7 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Presence of VOCs in surface soil indicate subsurface soil sample collection is warranted.
		VOCs	Yes	Methylene chloride > SSL 1,2-DCA > SSL	< SSL at a DAF of 4 < SSL at a DAF of 3	
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; < SSL at a DAF of 3	
				Cd > PRG, SSL, BKG	acceptable HH risk level; < SSL at a DAF of 11	
				Cu > ECO, SSL, BKG	mean concentraton < ECO; < SSL at a DAF of 2	
				Pb > SSL, BKG	< SSL at a DAF of 5	
				Se > ECO, SSL, BKG	Site concrete, gravel and scrub grass; plant ECO not likely appropriate; < ECO for soil invertebrates; < SSL at a DAF of 4	
				Zn > ECO, BKG	mean concentration similar to ECO	

Photograph taken February 3, 2000

Figure 7-1
Waste Oil and Paint Accumulation Area, SWMU 6 & 7
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_4_6_7_2005.mxd

Legend

- Phase I Environmental Assessment Surface Soil Sample Location
- PA/SI Subsurface Soil Sample Location
- Proposed Surface Soil and Subsurface Soil Sample Location

Surface soil sample designations are preceded by "CGSWMU4" (e.g. SS-01 = CGWMU4SS001)

Subsurface soil sample designations are preceded by "CGW4" (e.g. SB-01 = CGW4SB01)

- Proposed Monitoring Well Location

N W E S

0 25 50 100 Feet

2005 Aerial

Figure 7-2
Proposed Surface Soil and Subsurface Soil Sampling Locations at SWMU 6 and 7
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

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SECTION 8

SWMU 8—Waste Oil Accumulation Area (OP-1, Inner Range, Former VNTR)

This section presents the results of the PA/SI performed at SWMU 8, a waste oil accumulation area.

8.1 Conceptual Site Model

The CSM for SWMU 8 is based on review of historical information such as records, site inspection documentation, and interviews, as well as site-specific data collection

8.1.1 Site History and Potential Sources of Release

SWMU 8 is located outside the generator building at OP-1 of the former VNTR (Figures 1-2 and 6-1). According to the 1988 RFA Report, the waste oil accumulation area contained drums of both waste lubricants and oils. The drums were stored on bare soil prior to being shipped offsite to NSRR. The accumulation area began operation in approximately 1978, and was still active at the time of the first RFA in 1988. During both the 1988 RFA and the 1995 Revised RFA, soil staining indicative of minor spills of lubricating oil onto the soil was present in the accumulation area, and no release controls were present (Kearney, 1988; PREQB, 1995).

During the February 2000 site inspection in which the EPA and Navy inspected the consent order sites, no soil staining was evident in the accumulation area, and the drums were stored on concrete in plastic secondary containment trays for release control (Figure 8-1).

Neither the containment trays nor any waste was present at the time of the 2004 site visit, conducted as part of the PA/SI. They had been removed as part of the closure of the former VNTR.

8.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted during the February 2000 EPA and Navy site visit to all Consent Order sites (CH2M HILL, 2001) and during the 2004 PA/SI, as well as on regional information.

The current site setting consists of a concrete pad, grassy areas to the east and south of the concrete pad, and two ASTs that formerly contained water. SWMU 8 is a flat area at 453 ft amsl, approximately 100 ft southeast of the OP-1 main control tower building. Approximately 35 ft east of the former waste oil accumulation area, the topography drops off by about 240 ft. The site landscape is gravel with weeds, just off a concrete pad formerly used for vehicles to drive and maneuver around storage buildings, and two ASTs that formerly contained water. Although bedrock was not encountered during surface soil sampling, the bedrock appears to be very shallow because outcrops were observed around

the site. The soil in the first 8 inches consists of well graded sand with silt and gravel. SWMU 8 lies within the Kv formation, sandstone, siltstone, conglomerate, lava, tuff, and tuffaceous breccia. For more information on the bedrock geology see Section 1.4.6.

No surface water bodies are present at the site. The closest surface water body is the ocean, located approximately ½ mile to the south and southeast. Based on the depth to groundwater encountered at other locations significantly above sea level (see Figure 1-9 and 1-10), groundwater beneath the OP-1 area is estimated to be more than 100 feet bls.

8.2 Sampling Approach and Chemical Constituents Identified

As presented in the Phase I RFI Work Plan (CH2M HILL, 2003c), five surface soil samples were collected immediately adjacent to the concrete pad where staining had been noted during the RFA (Figure 6-3). Samples were analyzed for Appendix IX VOCs, SVOCS, metals, herbicides, pesticides, and PCBs; and explosives, including perchlorate. One surface soil sample, collected at station CGW8SS02, was additionally analyzed for cyanide, sulfide, and dioxins. Although historical information for SWMU 8 did not indicate munitions or explosives-related constituents would be related to potential releases at the site, explosives were included in the sample analyses because the site is located within the safety fan of the artillery firing positions in the EMA.

Table 8-1 summarizes the constituents detected at SWMU 8 surface soil samples collected during the PA/SI and identifies screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O.

8.3 SWMU 8 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection table (Table 8-1).

Appendix N, Section N.8 discusses the evaluation of the SWMU 8 data quality. As detailed in Section N.8, the SWMU 8 data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at SWMU 8, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was used to store waste oil. Based on the nature of historical activities and the staining observed during a site visit, the potential presence of hazardous substances could not be confidently ruled out without sample collection. Sample collection took place during the 2004 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected:

Surface Soil

- VOCs: acetone
- SVOCs: acetophenone, butylbenzylphthalate, dimethyl phthalate, di-n-butylphthalate
- Pesticides: 4,4′-DDT
- Herbicides: none detected
- Dioxins: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,4,7,8-hexachlorodibenzo-p-dioxin, 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin, 1,2,3,7,8-pentachlorodibenzo-p-dioxin, octachlorodibenzo-p-dioxin, total heptachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin, total pentachlorodibenzo-p-dioxin
- PCBs: none detected
- Explosives: perchlorate
- Inorganics above background UTLs: arsenic, lead, selenium, thallium, tin, and zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

As noted in Section 8.1.1, minor staining indicative of spills at the waste oil accumulation area were noted during the RFA. Therefore, the VOC, SVOCs, and metals detected at the site are assumed to be potentially attributable to CERCLA-related releases. Therefore, these constituents are considered further in the decision analysis process.

Dioxins are not likely associated with waste oil, as discussed under **Dioxins** in Section 1.1.1. Further, as shown in Table A-3, the dioxin concentration at SWMU 8 (in TEQ) is approximately 8 ppt, which is more than two orders of magnitude below the residential remediation level (i.e., 1,000 ppt) cited by EPA. Therefore, dioxins are not considered further in the decision analysis process.

The concentration of 4,4′-DDT detected at this site is comparable to concentrations of 4,4′-DDT detected at other sites across east Vieques. Consequently, the pesticide is likely attributable to normal pesticide use when the facility was active, not to a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1) and is, therefore, not considered further in the decision analysis process.

Likewise, perchlorate is not likely site-related. In fact, its analysis was done because the site is within a safety fan, the activity at which is not site-related. Further, the perchlorate concentration is more than an order of magnitude below its screening level. Therefore, perchlorate is no considered further in the decision analysis process.

Acetone is not likely associated with waste oil; therefore, its detection is not likely site-related, especially considering that it was detected in only one sample, is highly volatile, that no other VOCs were detected, that it is a common laboratory artifact, and that the concentration detected (i.e., 4.2 μg/kg) was low. However, as a conservative measure, acetone is further considered in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection table. Those constituents that exceed one or more criteria (and background for inorganics) are listed below.

Surface Soil

- VOCs: no exceedances
- SVOCs: no exceedances
- Arsenic: five detections (samples SS01 through SS05) at concentrations (3.06 mg/kg to 19.9 mg/kg) above the PRG (0.39 mg/kg), ecological screening value (18 mg/kg; only by SS02), SSL at a DAF 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Lead: three detections (samples SS03, SS04, SS05) at concentrations (62.7 mg/kg, 22.1 mg/kg, and 20.9 mg/kg, respectively) above the SSL at a DAF 1 (14 mg/kg) and background UTL (5.4 mg/kg)
- Selenium: two detections (samples SS01 and SS03) at concentrations (0.72 mg/kg and 0.63 mg/kg, respectively) above the ecological screening value (0.52 mg/kg), the SSL at a DAF 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)
- Thallium: two detections (samples SS01 and SS05) at concentrations (0.493 mg/kg and 0.398 mg/kg, respectively) above the SSL at a DAF 1 (0.036 mg/kg) and background UTL (0.13 mg/kg)
- Zinc: two detections (samples SS03 and SS05) at concentrations (135 mg/kg and 207 mg/kg) above the ecological screening value (120 mg/kg) and background UTL (32 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Arsenic is the only constituent detected above its human health screening criterion and background. It was detected in the five surface soil samples above background and its screening level (0.39 mg/kg based on 1×10^{-6} ELCR), at a maximum concentration of 19.9 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (which is based on skin and vascular effects), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the maximum detected concentration, risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver.

Although vanadium was detected in soil above the adjusted PRG, its PRG is based on increased mortality, so there is no concern about potential cumulative human health effects

from multiple constituents in site soil. Further, all vanadium concentrations are below the background UTL.

The concentrations of three inorganics (arsenic, selenium, and zinc) exceed ecological screening values and background (arsenic in one surface soil sample, selenium in two surface soil samples, and zinc in two surface soil samples). None of these constituents likely poses an unacceptable risk to ecological receptors based upon the following:

- The area evaluated is immediately adjacent to buildings and concrete pads, is very small, and provides very limited habitat (gravel areas with weeds). Thus, the potential exposures to ecological receptors are likely minimal.
- Arsenic exceeds the ecological screening value in only one of five samples, at a maximum HQ of 1.11. The screening value (18 mg/kg), however, is based on potential impacts to plants. The site consists of gravel areas with weeds, so plant endpoints are not likely representative of actual exposures. Maximum concentrations are less than ecological screening values based upon other receptors (e.g., 60 mg/kg for soil invertebrates). Further, the mean arsenic concentration (7.6 mg/kg) is less than the ecological screening value (18 mg/kg).
- Selenium exceeds the ecological screening value in two of five samples, at a maximum HQ of 1.38. The screening value (0.52 mg/kg), however, is based on potential impacts to plants. The site consists of gravel areas with weeds, so plant endpoints are not likely representative of actual exposures. Maximum concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Further, the mean selenium concentration (0.46 mg/kg) is less than the ecological screening value (0.52 mg/kg).
- Zinc concentrations exceed the ecological screening value in two samples, at a maximum HQ of 1.72. The mean zinc concentration (121 mg/kg) is comparable to the screening value (120 mg/kg). Thus, zinc has a low potential for unacceptable risks, especially given the low potential for exposures.

The concentrations of four inorganics (arsenic, lead, selenium, and thallium) exceed the SSL at a DAF 1. However, the waste oil accumulation area (i.e., potential source area) was relatively small. Therefore, an SSL at a higher DAF is likely to be more realistic, as discussed in Section 1.1.2. This supposition is supported by data from SWMU 1 (also located in the Kv zone), where SSLs at a DAF of 1 are shown to be unrealistic predictors of leaching to groundwater. At SWMU 1, arsenic, lead, selenium, and thallium were detected in soil above the SSLs at a DAF of 1; however, arsenic and lead were not detected in groundwater and selenium was detected in groundwater below screening criteria. As discussed previously, the thallium data are suspect. The presumed depth to groundwater of more than about 100 feet at this location further supports a higher DAF. For the SWMU 8 data, none of the four constituents' concentrations exceeds the SSL at a DAF of 20; in fact, none of the lead or selenium concentrations exceeds the SSL at a DAF of 3.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely source of CERCLA-related releases is the former waste oil accumulation area. Soil samples were collected in the former waste oil accumulation area, specifically targeting areas of staining. Based on the nature of potential releases (i.e., to the ground surface), the nature of the constituents potentially attributable to CERCLA-related releases (i.e., SVOCs and metals), and that arsenic was the only constituent detected in the surface soil above its residential PRG, subsurface soil sampling is not necessary. Therefore, the spatial distribution of samples and resulting data indicate the potential source area has been sufficiently characterized, especially considering the number and locations of samples (and resulting data) collected at adjacent SWMU 5 (see Section 6).

8.4 Conclusions and Recommendations

Table 8-2 summarizes the results of the decision analysis for SWMU 8, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Although several constituents were detected in surface soil, their concentrations do not pose an unacceptable risk to human health or ecological receptors. Further, acetone, pesticide, dioxin, and perchlorate detections at the site are not likely associated with potential CERCLA-related releases and are nevertheless below risk-based screening levels. Therefore, it is recommended that a NFA decision document be prepared for SWMU 8.

TABLE 8-1
SWMU 8 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone Kv SS**	CGW8SS01		CGW8SS02	CGW8SS03	CGW8SS04	CGW8SS05
Sample ID					CGW8SS01-R01	CGW8FD01P-R01	CGW8SS02-R01	CGW8SS03-R01	CGW8SS04-R01	CGW8SS05-R01
Sample Date					1/19/04	1/19/04	1/19/04	1/19/04	1/19/04	1/19/04
Chemical Name										
Volatile Organic Compounds (µg/kg)										
Acetone	800	1,400,000	--	--	9.4 U	9.9 U	10.7 U	9.2 U	4.2 J	9.5 U
Semivolatile Organic Compounds (µg/kg)										
Acetophenone	--	780,000	--	--	145 J	341 J	393 U	351 U	204 U	207 U
Butylbenzylphthalate	810,000	1,200,000	--	--	363 U	360 U	393 U	351 U	204 U	47.5 J
Dimethyl phthalate	--	61,000,000	200,000	--	363 U	360 U	1,430	351 U	204 U	207 U
Di-n-butylphthalate	270,000	610,000	200,000	--	45.2 J	57.2 J	62.8 J	73.4 J	27.9 J	35.5 J
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDT	2,000	1,700	10	--	3.6 U	3.6 U	0.46 J	0.31 J	3.4 U	3.4 U
Herbicides (µg/kg)										
No Detections										
Dioxin/Furans (pg/g)										
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	267	NA	NA	NA
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	3.5	NA	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	8.3	NA	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	13.3	NA	NA	NA
1,2,3,7,8-Pentachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	2	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	2,840	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	582	NA	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	113	NA	NA	NA
Total pentachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	13.2	NA	NA	NA
Explosives (µg/kg)										
Perchlorate	--	55,000	--	--	98.2 U	99.5 U	100 U	22.1 J	92.9 U	95.2 U
Total Metals (mg/kg)										
Antimony	0.3	3.1	78	3.6	0.715 J	1.11 J	1.65 J	1.3 J	0.97 J	1.09 J
Arsenic	1	0.39	18	1.6	3.06	3.67	19.9	5.59	3.55	5.47
Barium	82	1,600	330	212	80.9	93	63.5	65.9	36.5	54.5
Beryllium	3	15	40	0.27	0.173 J	0.221 J	0.191 J	0.223 J	0.115 J	0.15 J
Cadmium	0.4	3.7	32	2.2	0.358 J	0.328 J	1.25	1.14	0.178 J	0.221 J
Chromium	2	210	0.4	72	31.7 J	42.9 J	45.9 J	27.3 J	18.2 J	32.1 J
Cobalt	33	140	13	26	13.2 J	16.8 J	14.1 J	11.2 J	10.4 J	15 J
Copper	46	310	70	94	68	63.8	59.8	78.8	49	62
Lead	14	400	120	5.4	12.4 J	11.5 J	12.3 J	62.7 J	22.1 J	20.9 J
Mercury	0.1	2.3	0.1	0.057	0.00872 J	0.011 J	0.0288 J	0.0392	0.0149 J	0.0145 J
Nickel	7	160	38	41	12.6 J	16.4 J	18.6 J	10.3 J	8.62 J	14.6 J
Selenium	0.3	39	0.52	0.51	0.72 J	0.436 J	0.295 J	0.633 J	0.378 J	0.258 J
Silver	2	39	560	0.22	0.148 J	0.111 J	0.124 J	0.083 J	0.0693 J	0.115 J
Thallium	0.036	0.52	1	0.13	0.104 U	0.493 J	0.112 U	0.102 U	0.109 U	0.398 J
Tin	--	4,700	--	NA	0.525 J	0.596 J	0.622 J	1.3 J	0.339 J	1.62 J
Vanadium	300	7.8	2	144	79.4	100	85.2	62.9	60.5	82.4
Zinc	620	2,300	120	32	67.5	80.7	98.3	207	82	135
Wet Chemistry (mg/kg)[1]										
Sulfide	--	--	--	--	NA	NA	9.34 J	NA	NA	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDT) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (dimethylphthalate, chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, silver, thallium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[1] Wet Chemistry consists of sulfide and cyanide
* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 8-2
SWMU 8 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		VOCs	Yes	No	N/A	
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Dioxins	No	N/A	N/A	
		Explosives	No	N/A	N/A	
		Inorganics	Yes	As > PRG, ECO, SSL, BKG	within acceptable HH risk range; mean concentration < ECO; < SSL at a DAF of 20	
				Pb > SSL, BKG	< SSL at a DAF of 2	
				Se > ECO, SSL, BKG	Mean concentration < ECO, ECO based on plants; site is mostly gravel area with weeds, no sign of stress to plants; < ECO for soil invertebrates; < SSL at a DAF of 3	
				Th > SSL, BKG	< SSL at a DAF of 14; thallium results suspected of being falsely elevated	
				Zn > ECO, BKG	Small, maintained site; mean concentration is comparable to ECO	

Photograph taken February 3, 2000

Figure 8-1
Waste Oil Accumulation Area, SWMU 8
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 9

SWMU 10—Sewage Treatment Lagoons (Camp García)

This section presents the results of the PA/SI performed at SWMU 10, the sewage treatment lagoons for Camp Garcia.

9.1 Conceptual Site Model

The CSM for SWMU 10 is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews, as well as site-specific data collection.

9.1.1 Site History and Potential Sources of Release

SWMU 10 is located approximately ½ mile southeast of the main Camp Garcia Compound (Figures 1-2 and 1-3). The original domestic sewage treatment lagoons for Camp García went into service in the early 1950s. The facility originally consisted of four unlined lagoons: two of them serving as receiving/equalization lagoons, and the other two providing polishing treatment (Figure 9-1). Historically, the raw wastewater discharge to the lagoon system originated from the Camp García area. This consisted of a steel pipe approximately 6 inches in diameter that ran into the northeastern-most lagoon, approximately 80 ft from the berm, as shown on Figure 9-2. Effluent from the final two polishing lagoons was then chlorinated in a chlorine contact chamber (now part of AOC G). The 1988 and 1995 RFAs indicated that the effluent from the final lagoons was discharged to the land (Kearney, 1988; PREQB, 1995). ERI (2000) noted probable piping leading from the chlorination building to a series of linear ground scars and ditches (Figure 9-1). However, the Current Conditions Report indicates effluent from the final polishing lagoons was chlorinated in the chlorine contact chamber and then discharged to the sea (CH2M HILL, 2001).

In 1974, after the level of activity and associated domestic wastewater generation rate significantly decreased at Camp García, the treatment lagoons were lined using a 2-ft compacted clay and plastic liner to create a no-discharge system. The lagoons were then utilized as evaporation lagoons until the new no-discharge lagoon was constructed in September 2000 immediately northwest from the old lagoons as shown in Figure 9-3. No historical information has been found that suggests the lagoons were covered with soil fill once they became inactive. The new lagoon encompassed an area of approximately 40,000 ft^2, and was constructed with a clay and plastic liner and used only as an evaporation lagoon. This lagoon received only liquid sanitary waste; solids were removed in a settling tank prior to effluent discharge to the lagoon. The new lagoon was decommissioned and the area filled in with soil from the berms when the property transfer occurred in May 2003, and all sanitary effluent was discontinued from Camp Garcia at that time.

During the February 2000 site inspection in which the EPA and Navy inspected the consent order sites, it was noted that the four old lagoons were not active (CH2M HILL, 2001). During the January 2004 PA/SI field effort, it was noted that the new lagoon area was abandoned and no sign of the lagoon was present. No known releases of hazardous constituents have occurred at this site (PREQB, 1995). The action recommended by both RFA reports (Kearney, 1988; PREQB, 1995) was stated as follows:

> "Further review of facility practices or sampling and analysis of the waste should be conducted to determine if hazardous constituents may be present in the waste. Additional sampling and analyses of soil, etc. may be suggested based upon review of this information."

No historical evidence has been found that wastewater was discharged to the land south of the lagoons. This information was corroborated by an interview with the former Water Program Manager, NAPR Environmental Division.

9.1.2 Physical Setting

The description of the site's physical setting is based on information from the RFAs (Kearney, 1988; PREQB, 1995), the 2000 site visit, and the 2004 site visit, as well as on regional information.

As discussed above, the SWMU 10 site consists of four former lagoons. A former chlorine contact chamber, which is part of AOC G, was located on the southwest corner of the lagoons. The site sits at approximately 26 ft amsl and the topography slopes gently to the southeast. The site resides in the geologic unit KTd, which comprises plutonic rocks, largely granodiorite and quartz diorite. More detailed description of geologic conditions within the east Vieques study area is provided in Section 14.6. Bedrock at the site is between approximately 25 and 20 ft bgs. Groundwater occurs at approximately 35 ft bgs in the bedrock and appears to be under semi-confined conditions because water levels in the wells stabilized 3 to 10 ft above where groundwater was first observed during drilling. The site geology and hydrogeology are depicted in Figure 9-4. Figure 9-5 illustrates that the groundwater appears to flow radially away from the lagoons.

There are no surface water bodies at or adjacent to the site. The closest surface water body is Bahia Tapon, which is approximately 1,500 ft south of SWMU 10.

9.2 Sampling Approach and Chemical Constituents Identified

In June 2000, as part of the Phase I Environmental Assessment field work, four surface soil samples and four subsurface soil samples were collected in each of the four lagoons (SS/SB-01 through SS/SB-04, as shown in Figure 9-2). Additionally, one water sample (including a duplicate) was collected from a crack in the rusted pipe leading to the northeastern-most lined basin (presumably the influent pipe to the facility). During the 2004 investigation, no water was dripping from the rusted pipe.

The soil samples were collected to determine whether the lagoon material would be classified as characteristic hazardous waste and were, therefore, analyzed for TCLP VOCs, SVOCs, and metals. The subsurface soil samples were also analyzed for those Appendix IX

VOCs, SVOCs, and metals that are on the TCLP list, as well as TPH. The TCLP analytical results for these samples are presented in Tables 9-1 (surface soil) and 9-2 (subsurface soil), which show that none of the constituent concentrations exceeds its corresponding TCLP limit. Further, no TCLP VOCs or SVOCs were detected. Therefore, the material would not have been classified as a characteristic hazardous waste. Table 9-3 summarizes the constituents detected in the water sample collected from the rusted pipe.

In January 2004, as presented in the Phase I RFI Work Plan (CH2M HILL, 2003c), a soil sampling location was established in each quadrant of each lagoon, for a total of four soil sampling locations per lagoon (i.e., 16 total soil sampling locations, as shown in Figure 9-2). At each location, a surface soil and subsurface soil sample were collected. The surface soil samples were collected from lagoon sludge material at a depth interval of approximately 0 to 8 inches bls (i.e., the approximate length of a hand auger bucket), and subsurface soil samples were collected immediately below the liner to determine if there was contamination below the liner. The depths of the subsurface soil samples were dependent on the depth to the liner and varied by location from approximately 0.5 ft to 3.6 ft bls. The black plastic liner was encountered at all 16 soil boring locations, identified by small pieces brought up in the hand auger cuttings. Once the samples were collected, the soil borings were grouted with a cement grout to eliminate the openings made in the liner.

All soil samples collected during the PA/SI were analyzed for Appendix IX VOCs, SVOCS, pesticides, herbicides, PCBs, and metals; and explosives, including perchlorate. Seven of the surface soil samples (SS06, SS07, SS10, SS11, SS13, SS15, and SS19) and four of the subsurface samples (SS06, SS11, SS13, and SS19) were also analyzed for cyanide, sulfide and dioxins. Although historical information for SWMU 10 did not indicate munitions or explosives-related constituents would be related to potential releases at the site, explosives were included in the sample analyses to confirm that supposition. Tables 9-4 and 9-5 summarize the constituents detected in SWMU 10 surface soil samples and subsurface soil samples, respectively, collected during the PA/SI and identify screening criteria exceedances. Table 9-5 also summarizes the VOC and metals data for the subsurface soil samples collected during the 2000 Phase I Environmental Assessment.

Five monitoring wells were installed at SMWU 10 during the PA/SI. One monitoring (MW01) was installed in the presumed upgradient direction of the lagoons and four wells were installed within the bermed area of the four lagoons, as shown in Figure 9-2. Refer to Section 2 for well construction, development, and sampling details. As noted in Section 9.1.2, groundwater-level measurements indicated the presence of an apparent radial groundwater flow pattern in the vicinity of the lagoons, which means that well MW01 is not likely upgradient and may not be representative of background conditions. Therefore, as a conservative measure, the well MW01 was included with the other site wells for the purposes of screening. The background well at PAOC N, which is hydraulically upgradient of SWMU 10, was used as the background well for comparison purposes.

All groundwater samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, PCBs, and metals; and explosives, including perchlorate. Two samples (from wells MW04 and MW05) were also analyzed for cyanides, sulfide and dioxins. Table 9-6 summarizes the constituents detected in SWMU 10 groundwater samples collected during the PA/SI and identifies screening criteria exceedances. Raw analytical data for all samples collected at SWMU 10 are provided in Appendix O.

9.3 SWMU 10 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the PA/SI detection tables (Tables 9-4, 9-5, and 9-6).

Appendix N, Section N.9 discusses the evaluation of the SWMU 10 data quality. As detailed in Section N.9, the SWMU 10 data are acceptable (with the possible exception of thallium) for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at SWMU 10, which is done in Steps 1 through 5 below. The uncertainty associated with the thallium data is due to probability of the thallium results being falsely elevated because of the analytical method used. To address this uncertainty, additional data collection for thallium analysis (using an updated method) will be performed, as defined in Section 9.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was former sewage treatment lagoons. Based on the nature of historical activities, the potential presence of hazardous substances could not be confidently ruled out without sample collection. Sample collection took place during the 2000 Phase I Environmental Site Assessment and 2004 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

<u>Surface Soil</u>

- VOCs: none detected
- SVOCs: 4-bromophenyl-phenylether, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, di-n-butylphthalate, fluoranthene, pyrene
- Pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin
- Herbicides: none detected
- PCBs: none detected
- Dioxins: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin, octachlorodibenzo-p-dioxin, total heptachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin, total pentachlorodibenzo-p-dioxin, total tetrachlorodibenzo-p-dioxin
- Explosives: none detected
- Inorganics above background UTLs: lead, mercury, selenium, silver, thallium, zinc

<u>Subsurface Soil</u>

- VOCs: m- and p-xylenes, total xylenes, toluene

- SVOCs: bis(2-ethylhexyl)phthalate, di-n-buylphthalate
- Pesticides: 4,4'-DDE, 4,4'-DDT
- Herbicides: none detected
- PCBs: none detected
- Dioxins: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin, octachlorodibenzo-p-dioxin, total heptachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin, total tetrachlorodibenzo-p-dioxin
- Explosives: none detected
- Total petroleum hydrocarbons (TPH)
- Inorganics above background UTLs: arsenic, barium, beryllium, copper, selenium, thallium, vanadium, zinc

Groundwater

- VOCs: toluene
- SVOCs: none detected
- Pesticides: none detected
- Herbicides: none detected
- PCBs: none detected
- Dioxins: none detected
- Explosives: none detected
- Inorganics above background well (EPAN-MW02): antimony, arsenic, barium, chromium, cobalt, copper, mercury, nickel, selenium, silver, thallium, vanadium, zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Because there are no known records of exactly what was in the sewage discharged to the SWMU-10 lagoons, it is possible that the VOCs, SVOCs, and inorganics detected in SWMU-10 media are attributable to historic CECRLA-related releases. Therefore, these constituents are considered further in the decision analysis process.

The pesticides detected at this site are the same pesticides and of similar concentrations detected at other sites across east Vieques. This information, coupled with the history of the site, suggests the pesticides are present due to normal pesticide use, not a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1). Therefore, pesticides are not considered further in the decision analysis process.

Similarly, dioxins are not likely associated with sewage. Further, as shown in Table A-3, the highest dioxin concentration at SWMU 10 (in TEQ) is approximately 2.7 ppt, which is more than two orders of magnitude below the residential remediation level (i.e., 1,000 ppt) cited

by EPA. The other dioxin concentrations at SWMU 10 are even lower. Therefore, dioxins are not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Surface Soil

- Selenium: seven detections (samples SS05, SS08, SS10, SS16 to SS18, SS20) at concentrations (0.524 mg/kg to 1.04 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF 1 (0.3 mg/kg), and background UTL (0.51 mg/kg)
- Thallium: ten detections (samples SS06, SS07, SS09 to SS15, SS19) at concentrations (0.556 mg/kg to 1.02 mg/kg) above the adjusted PRG (0.52 mg/kg), ecological screening value (1 mg/kg, only for sample SS10), SSL at a DAF 1 (0.036 mg/kg), and background UTL (0.13 mg/kg)
- Zinc: six detections (samples SS05, and SS08 to SS12) at concentrations (135 mg/kg to 281 mg/kg) above the ecological screening value (120 mg/kg) and background UTL (32 mg/kg)

Subsurface Soil

- Arsenic: one detection (sample SB03) at a concentration (2.9 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Barium: four detections (samples SB01 to SB04) at concentrations (167 mg/kg to 241 mg/kg) above SSL at a DAF 1 (82 mg/kg) and background UTL (147 mg/kg)
- Copper: four detections (samples SB02 to SB04, SB06) at concentrations (66.2 mg/kg to 74.2 mg/kg) above the SSL at a DAF 1 (46 mg/kg) and background UTL (66 mg/kg)
- Selenium: eight detections (samples SB01 to SB05, SB12, SB16, SB20) at concentrations (0.52 mg/kg to 1.3 mg/kg) above the SSL at a DAF 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)
- Thallium: ten detections (samples SB06, SB07, SB09 to SB15, SB19) at concentrations (0.725 mg/kg to 1.62 mg/kg) above the adjusted PRG (0.52 mg/kg), SSL at a DAF 1 (0.036 mg/kg), and background UTL (0.13 mg/kg)
- Vanadium: one detection (sample SB15) at a concentration (157 mg/kg) above the adjusted PRG (7.8 mg/kg) and background UTL (144 mg/kg)

Groundwater

- Antimony (dissolved): two detections (wells MW04 and MW05) at concentrations (3.26 μg/L and 2.66 μg/L, respectively) above the adjusted tap water PRG (1.5 μg/L) background concentration (1.25 μg/L)

- Arsenic (total): one detection (well MW02) at a concentration (12 μg/L) above the tap water PRG (0.045 μg/L) and MCL (10 μg/L)
- Selenium (dissolved): one detection (MW02) at a concentration (19 μg/L) above the adjusted tap water PRG (18 μg/L).
- Thallium (total): one detection (well MW02) at a concentration (17.3 μg/L) above the adjusted tap water PRG (0.24 μg/L) and MCL (2 μg/L)
- Thallium (dissolved): two detections (wells MW02 and MW03) at concentrations (15.1 μg/L and 2.76 μg/L, respectively) above the adjusted tap water PRG (0.24 μg/L) and MCL (2 μg/L)
- Vanadium (total): one detection (well MW03) at a concentration (17.1 μg/L) above the adjusted tap water PRG (3.6 μg/L) and background concentration (15.2 μg/L)
- Vanadium (dissolved): two detections (wells MW03 and MW05) at concentrations (16.3 μg/L and 11.7 μg/L respectively) above the adjusted tap water PRG (3.6 μg/L) and background concentration (10.5 μg/L)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Soil

Only one constituent was detected in surface soil above the human health screening level and background UTL. Thallium was detected in 10 surface soil samples above background and its human health screening level (0.52 mg/kg based on an HQ=0.1), at a maximum concentration of 1.02 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 5.2 mg/kg (HQ=1). Based on the relatively low maximum detected concentration and the EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for thallium would be within acceptable levels and thallium would not be identified as a risk driver. The only other constituents detected above human health screening criteria and background UTL were a single detection of arsenic, a single detection of vanadium, and 10 detections of thallium in subsurface soil (see Subsurface Soil below). The non-cancer target organs/critical effects associated with these three constituents are skin and vascular effects (arsenic), increased mortality (vanadium), and liver effects (thallium). Therefore, there is no concern for cumulative human health effects from multiple constituents in soil.

The concentrations of three inorganics (selenium, thallium, and zinc) exceed ecological screening values and background in at least one surface soil sample. None of these constituents likely poses an unacceptable risk to ecological receptors on a site-wide basis based upon the following:

- The site is overgrown with vegetation, with no signs of stressed vegetation.
- Selenium exceeds the ecological screening value (0.52 mg/kg) in 7 of 16 samples. The screening value, however, is based on potential impacts to plants. The site is overgrown with vegetation and there is no sign of stress. The maximum concentration is less than ecological screening values based on other receptors (e.g., 4.10 mg/kg for soil invertebrates). Further, the mean selenium concentration (0.48 mg/kg) is less than the ecological screening value.
- Thallium exceeds the ecological screening value (1 mg/kg) in only 1 of 16 samples, at a HQ of 1.02. Further, the mean thallium concentration (approximately 0.48 mg/kg) is less than the ecological screening value.
- Zinc concentrations exceed ecological screening values in 6 of 16 surface soil samples. The HQ based on the mean zinc concentration (100 mg/kg) is less than the screening value (120 mg/kg). Thus, zinc has a low potential for unacceptable risks on a site-wide basis.

Two constituents, selenium and thallium, were detected at concentrations above the SSL at a DAF of 1. However, selenium was not detected in groundwater above its tap water PRG (180 μg/L). Further, thallium was detected in only two of the five wells above the tap water PRG (2.4 μg/L) and MCL (2 μg/L). However, the thallium analytical method utilized for these samples was prone to falsely elevated results. The absence of selenium and the majority of thallium detections above PRGs or MCL suggests the SSL at a DAF of 1 is not a representative predictor of leaching of these constituents to groundwater.

Subsurface Soil

Arsenic was detected in one subsurface soil sample above background and its human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR), at a concentration of 2.9 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ, acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the relatively low maximum detected concentration and the low EPC that would be used in risk calculations (based on a UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver. See the discussion under Surface Soil regarding other constituents exceeding the human health screening criteria. It is also notable that although the arsenic background UTL is 1.6 mg/kg, arsenic concentrations up to 5 mg/kg were detected during the east Vieques background soil inorganics investigation (CH2M HILL, 2007b). Although concentrations above 1.6 mg/kg were considered outliers for the purposes of establishing a background UTL, those concentrations may very well be representative of true background arsenic concentrations. The highest concentration of arsenic detected at SWMU 10 was 2.9 mg/kg.

Thallium was detected in 10 subsurface soil samples above background and its human health screening level (0.52 mg/kg based on an HQ=0.1), at a maximum concentration of 1.62 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 5.2 mg/kg (HQ=1). Based on the relatively low maximum detected concentration and the EPC that would be used in risk calculations

(based on a calculated UCL of the mean concentration), risk estimates for thallium would be within acceptable levels and thallium would not be identified as a risk driver.

Vanadium was detected in one subsurface soil sample above background and its human health screening level (7.8 mg/kg based on an HQ=0.1), at a concentration of 157 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 78 mg/kg (HQ=1). However, the background concentration of vanadium (144 mg/kg) exceeds the screening level and is the major contributor to the exceedance of the acceptable HQ. The potential site contribution to the HQ (157-144=13 mg/kg) is small and therefore an insignificant contributor to the unacceptable HQ. See the discussion under Surface Soil regarding other constituents exceeding the human health screening criteria.

Like surface soil, selenium and thallium were detected in subsurface soil above the SSL at a DAF of 1. See the discussion under Surface Soil above regarding the SSL exceedances for these two constituents. In addition to selenium and thallium, arsenic, barium, and copper exceeded the SSL at a DAF of 1 in at least one subsurface soil sample. However, neither barium nor copper was detected in groundwater above its respective PRG or MCL. In addition, arsenic was detected in only one groundwater sample above its PRG and MCL. However, the result was for the "total metals" analysis. Dissolved arsenic was not detected in groundwater. Like for surface soil, the SSLs at a DAF of 1 are not likely representative predictors of leaching to groundwater.

Groundwater

Antimony (dissolved) was detected in two wells above its human health screening level (1.5 µg/L based on an HQ=0.1), at a maximum concentration of 3.26 µg/L. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 15 µg/L (HQ=1). Most importantly, all antimony concentrations detected in soil were below the background UTL. Therefore, the presence of antimony in groundwater is likely attributable to background.

Arsenic (total) was detected in only one well (12 µg/L), and the concentration was above its screening level (0.045 µg/L based on 1×10^{-6} ELCR). However, arsenic was not detected in the dissolved fraction. This information, coupled with the absence of arsenic in all other wells, indicates that arsenic is not present in groundwater as the result of a release. Further, the soil data for arsenic suggest its presence in soil at SWMU 10 is likely attributable to background.

Selenium (dissolved) was detected in one well above its screening level (18 µg/L based on an HQ=0.1), at a concentration of 19 µg/L. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 180 µg/L. Because all detected concentrations are an order of magnitude less than the tap water PRG, a relatively low EPC would be used in risk calculations, and risk estimates for selenium would be within acceptable levels.

Thallium (total) was detected in two wells above its screening level (0.24 µg/L based on an HQ=0.1), at a maximum concentration of 17.3 µg/L (the maximum detected concentration of dissolved thallium was 15.1 µg/L, detected in one well). Based on the acceptable non-

cancer HQ, the acceptable risk-based concentration for tap water is 2.4 μg/L (HQ=1). Further, the MCL is 2 μg/L. Therefore, the thallium concentrations detected in two wells exceed the tap water PRG and MCL. However, as stated previously, the analytical method used to analyze samples for thallium was prone to falsely elevated results.

Vanadium (total) was detected above its human health screening level (3.6 μg/L based on an HQ=0.1) in all wells. The maximum detected concentrations of vanadium (total) and vanadium (dissolved) were 17.1 μg/L and 16.3 μg/L, respectively. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 36 μg/L (HQ=1). Because all detected concentrations are less than the acceptable tap water screening level, a relatively low EPC would be used in risk calculations, and risk estimates for vanadium would be within acceptable levels. Further, the soil data for vanadium suggest its presence in soil at SWMU 10 is likely attributable to background.

As indicated above, five constituents were detected in groundwater at concentrations above human health screening levels. The risk-based PRGs for these five constituents are based on the following target organs/critical effects: decreased longevity, decreased blood glucose, and altered blood cholesterol levels (antimony), cancer risk (arsenic), liver effects (thallium), integument effects (hair loss, nail loss, nail abnormalities, skin lesions); dental effects; decreased hemoglobin; central nervous system effects (selenium), and increased mortality (vanadium). A second PRG is available for arsenic based on non-cancer effects (hyperpigmentation, keratosis, and vascular effects). Since only one of these constituents is a potential carcinogen and the non-cancer effects for the five constituents are based on different target organs or critical effects, potential cumulative effects from multiple chemicals in groundwater are not a concern.

Summary

The more realistic evaluation above suggests the concentrations of thallium may need further evaluation, but are suspect as falsely elevated due to the analytical method used. Therefore, the decision analysis process continues to Step 5a.

Step 5a: Would additional source area data permit more realistic evaluations?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases at SWMU 10 are the former lagoons. Based on this information, multiple soil and groundwater samples were collected within and downgradient of each of these areas, the spatial distribution and resulting data of which indicate they likely have been sufficiently characterized. Because the five monitoring wells provide good spatial coverage of the site, especially with respect to the suspected source areas, the groundwater data suggest there is not wide-spread groundwater contamination at the site. However, the potential for falsely elevated thallium results lead to uncertainty in the conclusions drawn regarding thallium, especially considering it was detected above screening levels in both soil and groundwater. It is possible that additional thallium data, analyzed using the current thallium technique that has not been shown to provide falsely elevated results, will help resolve the uncertainty. It is, however, noted that it is likely that the thallium data represent an anomaly rather than a site-related release because all of the other data collected suggest domestic sewage was likely the only component of the waste in the lagoons and that there has not been a release that warrants further action.

9.4 Conclusions and Recommendations

Table 9-7 summarizes the results of the decision analysis for SWMU 10, which indicates there has not likely been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors, leaching concern for groundwater, or MCL exceedance. This evaluation applies to a domestic sewage treatment lagoon system that operated for nearly 50 years, approximately 20 years of which were as unlined lagoons. Anything that discharged to a potential former discharge area would have come from the lagoons. Therefore, if the historical and proposed samples confirm that the lagoon area warrants no further action, then sampling in the potential discharge area south of the lagoons would not be warranted.

For a similar rationale, the no-discharge lagoon constructed in 2000 does not warrant sampling. The purpose of and origin of waste for the no-discharge lagoon constructed in 2000 was essentially the same as those of the previous lagoons. Because the previous lagoons operated for approximately 50 years and the sampling data from them suggest no releases resulted in contamination that would pose potentially unacceptable risks, it is very likely the same is true for the no-discharge lagoon that operated for less than 3 years. In addition, as shown in Figure 9-5, well MW-01 is likely downgradient of the 2000 lagoon; the data from this well support the supposition that releases of hazardous constituents posing a potentially unacceptable risk did not occur from the lagoon.

In addition to the above, pesticide detections at the site are consistent with normal pesticide application associated with human occupancy of the historical facilities present at the site. Similarly, dioxin detections at the site are not likely associated with potential CERCLA-related releases and are nevertheless below risk-based screening levels.

Although the site likely warrants NFA, there is uncertainty associated with the thallium concentrations in soil and groundwater. Therefore, additional sampling is proposed to eliminate this uncertainty.

<u>Rationale</u>

Thallium was detected in soil and groundwater above screening levels that were associated with an analytical method prone to providing falsely elevated results. Therefore, additional soil and groundwater thallium data using current thallium analytical methods may eliminate this uncertainty.

<u>Objective</u>

Eliminate uncertainty in historic thallium results by:

- Collecting two surface and subsurface soil samples per lagoon (eight surface and subsurface soil samples total, as shown in Figure 9-6) and analyzing them for TAL thallium
- Re-developing the monitoring wells and collecting a round of groundwater samples from each and analyzing them for TAL thallium (total and dissolved)

Decision Analysis

Return to Step 5 to re-evaluate the data, excluding the historical thallium results if the new data confirm lower thallium concentrations.

TABLE 9-1
SWMU 10 Surface Soil TCLP Raw Analytical Results
Preliminary Assessment/Site Ispection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID		CGWWTPSS001	CGWWTPSS002	CGWWTPSS003	CGWWTPSS004
Sample ID	**TCLP Criteria**	NDD001	NDD002	NDD003	NDD004
Sample Date		06/07/00	06/07/00	06/07/00	06/07/00
Chemical Name					
TCLP Volatile Organic Compounds (mg/L)					
No Detections					
TCLP Semi-volatile Organic Compounds (mg/L)					
No Detections					
TCLP Metals (mg/L)					
Arsenic	5	0.05 U	0.05 U	0.05 U	0.05 U
Barium	100	0.577 J	1.25 J	1.62 J	0.897 J
Cadmium	1	0.01 U	0.01 U	0.01 U	0.01 U
Chromium	5	0.02 U	0.02 U	0.02 U	0.02 U
Lead	5	0.025 J	0.02 U	0.02 U	0.02 U
Mercury	0.2	0.002 U	0.002 U	0.002 U	0.002 U
Selenium	1	0.05 U	0.05 U	0.05 U	0.05 U
Silver	5	0.01 U	0.01 U	0.01 U	0.01 U

Notes:
mg/L - Milligrams per Liter
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected

TABLE 9-2
SWMU 10 Subsurface Soil TCLP Raw Analytical Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID		CGWWTPSB001	CGWWTPSB002	CGWWTPSB003	CGWWTPSB004
Sample ID	**TCLP Criteria**	NDD005	NDD006	NDD008	NDD007
Sample Date		06/07/00	06/07/00	06/07/00	06/07/00
Chemical Name					
TCLP Volatile Organic Compounds (mg/L)					
No Detections					
TCLP Semi-volatile Organic Compounds (mg/L)					
No Detections					
TCLP Metals (mg/L)					
Arsenic	5	0.05 U	0.05 U	0.05 U	0.05 U
Barium	100	1.43 J	1.19 J	1.85 J	1.79 J
Cadmium	1	0.01 U	0.01 U	0.01 U	0.01 U
Chromium	5	0.02 U	0.02 U	0.02 U	0.02 U
Lead	5	0.02 U	0.02 U	0.02 U	0.02 U
Mercury	0.2	0.002 U	0.002 U	0.002 U	0.002 U
Selenium	1	0.05 U	0.05 U	0.05 U	0.05 U
Silver	5	0.01 U	0.01 U	0.01 U	0.01 U

Notes:
mg/L - Milligrams per Liter
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected

TABLE 9-3
SWMU 10 Water Detection Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	CGWWTPWW001	CGWWTPWW001
Sample ID	NDD016	NDD017FD1
Sample Date	6/7/00	6/7/00
Chemical Name		
Volatile Organic Compounds (µg/L)		
Toluene	2	1
Semivolatile Organic Compounds (µg/L)		
No Detections		
Total Metals (µg/L)		
Cyanide	11.6	10 U
Barium	54.8 J	49.2 J
Copper	13.4 J	10 J
Lead	2 U	2.6 J
Zinc	77.4 J	56.9 J
Wet Chemistry (mg/L)[1]		
Nitrate/Nitrite	0.109	0.1 U
Sulfate	23.3	18.1
Sulfide	3.32	3.53
Total Petroleum Hydrocarbons (mg/L)		
Petroleum hydrocarbons	3.9 J	3.9

Notes:
µg/L - Micrograms per Liter
mg/L - Milligrams per Liter
NA - Not analyzed
U - Analyte not detected
J - Analyte present; reported value may or may not be accurate or precise
[1] Wet Chemistry includes nitrate/nitrite, sulfate/sulfide, and cyanide

TABLE 9-4
SWMU 10 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Ispection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone KTd SS**	CGW10SS05	CGW10SS06	CGW10SS07	CGW10SS08	CGW10SS09	CGW10SS10	CGW10SS11	CGW10SS12		CGW10SS13	CGW10SS14
Sample ID					CGW10SS05-R01	CGW10SS06-R01	CGW10SS07-R01	CGW10SS08-R01	CGW10SS09-R01	CGW10SS10-R01	CGW10SS11-R01	CGW10SS12-R01	CGW10FD01P-R01	CGW10SS13-R01	CGW10SS14-R01
Sample Date					1/22/04	1/20/04	1/20/04	1/22/04	1/20/04	1/20/04	1/20/04	1/20/04	1/20/04	1/20/04	1/20/04
Chemical Name															
Volatile Organic Compounds (µg/kg)															
No Detections															
Semivolatile Organic Compounds (µg/kg)															
4-Bromophenyl-phenylether	--	2900*	--	--	348 J	400 U	392 U	401 U	375 U	404 U	374 U	361 U	363 U	376 U	382 U
Benzo(a)anthracene	80	620	--	--	372 U	69.4 J	392 U	401 U	375 U	404 U	374 U	361 U	363 U	376 U	382 U
Benzo(a)pyrene	400	62	100	--	50.7 J	45 J	392 U	401 U	375 U	404 U	374 U	361 U	363 U	376 U	382 U
Benzo(k)fluoranthene	2,000	6,200	--	--	372 U	48.3 J	392 U	401 U	375 U	404 U	374 U	361 U	363 U	376 U	382 U
Chrysene	8,000	62,000	--	--	372 U	76.8 J	392 U	401 U	375 U	404 U	374 U	361 U	363 U	376 U	382 U
Di-n-butylphthalate	270,000	610,000	200,000	--	100 J	400 U	392 U	401 U	375 U	404 U	374 U	361 U	363 U	391	330 J
Fluoranthene	210,000	230,000	100	--	372 U	47.5 J	392 U	401 U	375 U	404 U	374 U	361 U	363 U	376 U	382 U
Pyrene	210,000	230,000	100	--	372 U	53.6 J	392 U	401 U	375 U	404 U	374 U	361 U	363 U	376 U	382 U
Pesticide/Polychlorinated Biphenyls (µg/kg)															
4,4'-DDD	800	2,400	10	--	0.26 J	0.19 J	3.9 U	0.3 J	11 J	0.44 J	0.5 J	0.6 J	0.56 J	3.8 U	3.8 U
4,4'-DDE	3,000	1,700	10	--	110 J	74 J	28 J	47 J	120 J	70 J	100 J	40 J	20 J	5.8 J	12 J
4,4'-DDT	2,000	1,700	10	--	0.92 J	0.97 J	3.9 U	4 U	3.8 U	4 U	3.7 U	3.6 U	3.6 U	3.8 U	3.8 U
Dieldrin	0.2	30	0.5	--	3.7 U	4 U	3.9 U	4 U	0.37 J	4 U	3.7 U	0.74 J	3.6 U	3.8 U	3.8 U
Herbicides (µg/kg)															
No Detections															
Dioxin/Furans (pg/g)															
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	**	--	--	NA	49.5	70.5	NA	NA	154	67.3	NA	NA	2.6	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	**	--	--	NA	2.5 U	2.5 U	NA	NA	3.1	2.5 U	NA	NA	2.5 U	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	**	--	--	NA	2.5 U	2.5 U	NA	NA	4	2.7	NA	NA	2.5 U	NA
Octachlorodibenzo-p-dioxin	--	**	--	--	NA	464	838	NA	NA	1,410	687	NA	NA	23.4	NA
Total heptachlorodibenzo-p-dioxin	--	**	--	--	NA	96.8	160	NA	NA	364	147	NA	NA	5.4	NA
Total hexachlorodibenzo-p-dioxin	--	**	--	--	NA	14.7	24	NA	NA	50.9	25.8	NA	NA	2.5 U	NA
Total pentachlorodibenzo-p-dioxin	--	**	--	--	NA	3	1 U	NA	NA	2	5	NA	NA	1 U	NA
Total tetrachlorodibenzo-p-dioxin	--	**	--	--	NA	7	1 U	NA	NA	80.6	25.4	NA	NA	1 U	NA
	--	**	--	--											
Explosives (µg/kg)															
No Detections															
Total Metals (mg/kg)															
Antimony	0.3	3.1	78	3.6	0.437 J	0.946 J	0.834 J	0.354 J	0.899 J	1.2 J	1 J	0.781 J	0.892 J	0.469 J	0.593 J
Arsenic	1	0.39	18	1.6	0.24 J	0.533 J	0.36 J	0.214 J	0.368 J	0.355 J	0.404 J	0.37 J	0.4 J	0.48 J	0.429 J
Barium	82	1,600	330	147	71.4	51.8	53.8	83.2	94.1	92.7	69.9	61.8	68.6	59.6	72.2
Beryllium	3	15	40	0.27	0.192 J	0.234 J	0.236 J	0.24 J	0.247 J	0.273 J	0.231 J	0.161 J	0.169 J	0.228 J	0.255 J
Cadmium	0.4	3.7	32	2.2	0.234 J	0.0112 U	0.0377 J	0.566 J	0.299 J	0.348 J	0.103 J	0.175 J	0.204 J	0.00961 U	0.00991 U
Chromium	2	210	0.4	72	13.6 J	14.4	15.4	16 J	16.5	19.4	16.4	14.7	19.8	16.3	16.9
Cobalt	33	140	13	16	9.33 J	9.16	9.51	10.7 J	10.4	12.1	10.3	8.06	8.36	9.34	11.4
Copper	46	300	70	66	39.7	36.2	39.4	49.4	50.5	60	44.3	37.2	38.3	47.8	51.3
Cyanide	--	120	1	0.89	NA	0.16 U	0.162 U	NA	NA	0.158 U	0.152 U	NA	NA	0.378 J	NA
Lead	14	400	120	5.4	10.1	4.2	3.77	7.63	5.88	7.48	4.99	8.01	8.29	1.34	2.05
Mercury	0.1	2.3	0.1	0.057	0.0398	0.0325 J	0.0171 J	0.0432	0.0654	0.0519	0.0403	0.0595	0.0513	0.011 J	0.0105 J
Nickel	7	160	38	22	5.24 J	4.95 J	5.37 J	6.06 J	6.29 J	7.46 J	6.02 J	5.36 J	5.74 J	6.41 J	6.85 J
Selenium	0.3	39	0.52	0.51	0.743 J	0.181 J	0.268 J	1.04	0.354 J	0.76	0.378 J	0.412 J	0.166 J	0.344 J	0.313 J
Silver	2	39	560	0.22	0.248 J	0.1 J	0.161 J	0.291 J	0.263 J	0.393 J	0.251 J	0.514 J	0.493 J	0.0573 J	0.0614 J
Thallium	0.036	0.52	1	0.13	0.128 U	0.795 J	0.763 J	0.125 U	0.701 J	1.02 J	0.769 J	0.71 J	0.556 J	0.759 J	0.732 J
Tin	--	4,700	--	NA	4.93 J	2.13 J	2.63 J	9.19	6.22 J	9.46	4.5 J	9.38	9.42	0.272 J	0.36 J
Vanadium	300	7.8	2	144	75.1	76.8	83.5	84.5	79	98.8	91.2	77	82.2	93.1	99.1
Zinc	620	2,300	120	32	137	55.3	90.5	234	206	281	135	204	216	24.5	31.6
Wet Chemistry (mg/kg)[1]															
Sulfide	--	--	--	--	NA	8 U	8 U	NA	NA	15.7 J	8 U	NA	NA	15.4 J	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996b
Vieques HHRA SO - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs)
* Bis(2-Chloro)isopropyl ether PRG value used as surrogate.
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, cyanide) from Ministry of Housing, Spacial Planning and Enviornment, 2000.
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) from Efroymson, 1997a.
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, fluoranthene, pyrene, dieldren) from Beyer, 1990
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, silver, thallium, vanadium, zinc) from Efroymson, 1997b.
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) from EPA, 2005
[1] Wet Chemistry consists of sulfide and cyanide (cyanide is included in the TAL Metals list of this table)
** See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 9-4
SWMU 10 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Ispection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	CGW10SS15	CGW10SS16	CGW10SS17	CGW10SS18	CGW10SS19	CGW10SS20
Sample ID					CGW10SS15-R01	CGW10SS16-R01	CGW10SS17-R01	CGW10SS18-R01	CGW10SS19-R01	CGW10SS20-R01
Sample Date					1/20/04	1/22/04	1/22/04	1/22/04	1/20/04	1/22/04
Chemical Name										
Volatile Organic Compounds (µg/kg)										
No Detections										
Semivolatile Organic Compounds (µg/kg)										
4-Bromophenyl-phenylether	--	2900*	--	--	379 U	387 U	390 U	391 U	384 U	371 U
Benzo(a)anthracene	80	620	--	--	379 U	387 U	390 U	391 U	384 U	371 U
Benzo(a)pyrene	400	62	100	--	379 U	387 U	390 U	391 U	384 U	371 U
Benzo(k)fluoranthene	2,000	6,200	--	--	379 U	387 U	390 U	391 U	384 U	371 U
Chrysene	8,000	62,000	--	--	379 U	387 U	390 U	391 U	384 U	371 U
Di-n-butylphthalate	270,000	610,000	200,000	--	238 J	90.4 J	80.6 J	76.6 J	384 U	71.6 J
Fluoranthene	210,000	230,000	100	--	379 U	387 U	390 U	391 U	384 U	371 U
Pyrene	210,000	230,000	100	--	379 U	387 U	390 U	391 U	384 U	371 U
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDD	800	2,400	10	--	0.23 J	3.8 U	10 J	0.16 J	0.54 J	0.33 J
4,4'-DDE	3,000	1,700	10	--	17 J	4.8 J	73 J	19 J	66 J	20 J
4,4'-DDT	2,000	1,700	10	--	3.8 U	0.3 J	84	0.39 J	3.8 U	0.44 J
Dieldrin	0.2	30	0.5	--	3.8 U	3.8 U	3.8 U	3.9 U	3.8 U	3.7 U
Herbicides (µg/kg)										
No Detections										
Dioxin/Furans (pg/g)										
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	**	--	--	44.9	NA	NA	NA	33.1	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	**	--	--	2.5 U	NA	NA	NA	2.5 U	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	**	--	--	2.5 U	NA	NA	NA	2.5 U	NA
Octachlorodibenzo-p-dioxin	--	**	--	--	435	NA	NA	NA	381	NA
Total heptachlorodibenzo-p-dioxin	--	**	--	--	90.5	NA	NA	NA	107	NA
Total hexachlorodibenzo-p-dioxin	--	**	--	--	18.3	NA	NA	NA	13.5	NA
Total pentachlorodibenzo-p-dioxin	--	**	--	--	1	NA	NA	NA	1	NA
Total tetrachlorodibenzo-p-dioxin	--	**	--	--	4	NA	NA	NA	3	NA
	--	**	--	--						
Explosives (µg/kg)										
No Detections										
Total Metals (mg/kg)										
Antimony	0.3	3.1	78	3.6	0.729 J	0.253 J	0.488 J	0.508 J	0.756 J	0.647 J
Arsenic	1	0.39	18	1.6	0.463 J	0.381 J	0.404 J	0.464 J	0.508 J	0.587 J
Barium	82	1,600	330	147	104	65.8	49.4	61.8	57.7	62.8
Beryllium	3	15	40	0.27	0.238 J	0.23 J	0.166 J	0.232 J	0.201 J	0.238 J
Cadmium	0.4	3.7	32	2.2	0.00933 U	0.154 J	0.161 J	0.2 J	0.00896 U	0.256 J
Chromium	2	210	0.4	72	15.7	15 J	12.1 J	13.5 J	14.8	12.5 J
Cobalt	33	140	13	16	11	10.6 J	6.59 J	8.36 J	8.65	9.31 J
Copper	46	300	70	66	45.1	46.8	28.7	34.3	40.6	36
Cyanide	--	120	1	0.89	0.154 U	NA	NA	NA	0.157 U	NA
Lead	14	400	120	5.4	2.15	3.54	5.4	5.11	4.56	6.21
Mercury	0.1	2.3	0.1	0.057	0.0113 J	0.0118 J	0.0146 J	0.0174 J	0.0159 J	0.0165 J
Nickel	7	160	38	22	6.21 J	5.95 J	3.48 J	4.5 J	5.1 J	4.71 J
Selenium	0.3	39	0.52	0.51	0.343 J	0.551 J	0.524 J	0.704 J	0.23 J	0.829 J
Silver	2	39	560	0.22	0.0842 J	0.0233 U	0.0412 J	0.0671 J	0.0504 J	0.0819 J
Thallium	0.036	0.52	1	0.13	0.786 J	0.118 U	0.125 U	0.12 U	0.299 J	0.128 U
Tin	--	4,700	--	NA	0.574 J	0.216 U	0.625 J	1.1 J	0.351 J	0.791 J
Vanadium	300	7.8	2	144	86.8	86.4	58.7	66	77.2	65.5
Zinc	620	2,300	120	32	32.7	19.2	31.2	42.6	32.3	33.1
Wet Chemistry (mg/kg)[1]										
Sulfide	--	--	--	--	8 U	NA	NA	NA	8 U	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Technical Background Document, 1996b
Vieques HHRA SO - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs)
* Bis(2-Chloro)isopropyl ether PRG value used as surrogate.
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, cyanide) from Ministry of Housing, Spacial Planning and Enviornment, 2000.
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) from Efroymson, 1997a.
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, fluoranthene, pyrene, dieldren) from Beyer, 1990
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, silver, thallium, vanadium, zinc) from Efroymson, 1997b.
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) from EPA, 2005
[1] Wet Chemistry consists of sulfide and cyanide (cyanide is included in the TAL Metals list of this table)
** See Section 1.1.1.2 for dioxin screening.

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 9-5
SWMU 10 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	CGWWTPSB001	CGWWTPSB002	CGWWTPSB003		CGWWTPSB004	CGW10SB05	CGW10SB06	CGW10SB07	CGW10SB08
Sample ID				NDD009	NDD010	NDD012	NDD013FD1	NDD011	CGW10SB05-R01-5	CGW10SB06-R01-5	CGW10SB07-R01-5	CGW10SB08-R01-5
Sample Date				6/7/00	6/7/00	6/7/00	6/7/00	6/7/00	1/22/04	1/20/04	1/20/04	1/22/04
Chemical Name												
Volatile Organic Compounds (µg/kg)												
m- and p-Xylene	10,000	27000*	--	1 J	0.4 J	2 UJ	2 U	2 U	NA	NA	NA	NA
Toluene	600	630,000	--	1 U	0.5 J	1 UJ	1 U	1 U	11.4 U	9.2 U	9.3 U	10.4 U
Xylene, total	10,000	27,000	--	1 J	0.4 J	2 UJ	2 U	2 U	11.4 U	9.2 U	9.3 U	10.4 U
Semivolatile Organic Compounds (µg/kg)												
bis(2-Ethylhexyl)phthalate	--	35,000	--	NA	NA	NA	NA	NA	402 U	174 J	386 U	118 J
Di-n-butylphthalate	270,000	610,000	--	NA	NA	NA	NA	NA	402 U	383 U	386 U	85.8 J
Pesticide/Polychlorinated Biphenyls (µg/kg)												
4,4'-DDE	3,000	1,700	--	NA	NA	NA	NA	NA	140 J	2.9 J	12 J	6.1 J
4,4'-DDT	2,000	1,700	--	NA	NA	NA	NA	NA	44 U	3.8 U	3.9 U	3.9 UJ
Herbicides (µg/kg)												
No Detections												
Dioxin/Furans (pg/g)												
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	**	--	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA
Octachlorodibenzo-p-dioxin	--	**	--	NA	NA	NA	NA	NA	NA	12.4	NA	NA
Total heptachlorodibenzo-p-dioxin	--	**	--	NA	NA	NA	NA	NA	NA	3.2	NA	NA
Total hexachlorodibenzo-p-dioxin	--	**	--	NA	NA	NA	NA	NA	NA	2.5 U	NA	NA
Total tetrachlorodibenzo-p-dioxin	--	**	--	NA	NA	NA	NA	NA	NA	1 U	NA	NA
Explosives (µg/kg)												
No Detections												
Total Metals (mg/kg)												
Antimony	0.3	3.1	3.3	NA	NA	NA	NA	NA	0.085 UJ	0.685 J	0.525 J	0.136 J
Arsenic	1	0.39	1.6	0.56 UJ	0.54 U	2.9	0.89 J	0.69 J	0.315 J	0.248 J	0.34 J	0.189 J
Barium	82	1,600	147	171	167	241	99.6	168 J	85.3	99.2 J	94.7 J	48.7
Beryllium	3	15	0.27	NA	NA	NA	NA	NA	0.289 J	0.214 J	0.219 J	0.243 J
Cadmium	0.4	3.7	2.2	0.11 U	0.11 U	0.11 U	0.14 U	0.11 U	0.137 J	0.00938 U	0.01 U	0.0768 J
Chromium	2	210	72	19.2	24.3	19.3	15.6	16.6	13.9 J	14.2	15.7	12.1 J
Cobalt	33	140	16	NA	NA	NA	NA	NA	11.1 J	10.6	8.37	5.93 J
Copper	46	310	66	60.9	73.9	74.2	71.6	71.7	48.1	66.2	38.5	32.7
Lead	14	400	3.3	1.5	1.1	2.4	1.2	1.4	2.81	0.836	2.2	1.91
Mercury	0.1	2.3	0.057	0.01 U	0.01 U	0.01 U	0.01 U	0.01 U	0.0237 J	0.00912 J	0.0209 J	0.0118 J
Nickel	7	160	22	8.2 J	9	14.4	8 J	7.8 J	6.05 J	8.27 J	5.64 J	4.31 J
Selenium	0.3	39	0.51	1.1	1.1 J	1 J	1.3 J	0.87 J	0.818	0.239 J	0.29 J	0.231 J
Silver	2	39	0.22	0.11 U	0.11 U	0.11 U	0.14 U	0.11 U	0.0447 J	0.0178 U	0.0886 J	0.0569 J
Thallium	0.036	0.52	0.13	NA	NA	NA	NA	NA	0.109 U	0.725 J	0.729 J	0.112 U
Tin	--	4,700	NA	NA	NA	NA	NA	NA	0.199 U	0.314 J	1.33 J	0.605 J
Vanadium	300	7.8	144	NA	NA	NA	NA	NA	80.7	84.4	75.1	52.9
Zinc	620	2,300	32	92.6 J	91.6 J	91.7 J	89.9 J	95.6 J	21.6	26.8	61.8	28.3
Wet Chemistry (mg/kg)[1]												
Sulfide	--	--	--	NA	NA	NA	NA	NA	NA	9.06 U	NA	NA
Total Petroleum Hydrocarbons (mg/kg)												
Petroleum hydrocarbons	--	--	--	4.4 UJ	4.2 U	4.4 UJ	27 J	4.3 U	NA	NA	NA	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
* Total xylene PRG value used as surrogate.
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
[1] Wet Chemistry consists of sulfide and cyanide
** See Section 1.1.1.2 for dioxin screening.

Exceeds Background and HHRA criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria

TABLE 9-5
SWMU 10 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	CGW10SB09	CGW10SB10	CGW10SB11	CGW10SB12	CGW10SB13	CGW10SB14	CGW10SB15	CGW10SB16	
Sample ID				CGW10SB09-R01-5	CGW10SB10-R01-5	CGW10SB11-R01-5	CGW10SB12-R01-5	CGW10SB13-R01-5	CGW10SB14-R01-5	CGW10SB15-R01-5	CGW10SB16-R01-5	CGW10FD02P-R01
Sample Date				1/20/04	1/20/04	1/20/04	1/20/04	1/20/04	1/20/04	1/20/04	1/22/04	1/22/04
Chemical Name												
Volatile Organic Compounds (µg/kg)												
m- and p-Xylene	10,000	27000*	--	NA	NA	NA	NA	NA	NA	NA	NA	NA
Toluene	600	630,000	--	10.1 U	9.4 U	9.6 U	9.8 U	10.3 U	9 U	9.1 U	11.9 U	9.4 U
Xylene, total	10,000	27,000	--	10.1 U	9.4 U	9.6 U	9.8 U	10.3 U	9 U	9.1 U	11.9 U	9.4 U
Semivolatile Organic Compounds (µg/kg)												
bis(2-Ethylhexyl)phthalate	--	35,000	--	376 U	382 U	373 U	383 U	394 U	365 U	369 U	386 U	146 J
Di-n-butylphthalate	270,000	610,000	--	376 U	382 U	373 U	383 U	394 U	365 U	369 U	386 U	96.1 J
Pesticide/Polychlorinated Biphenyls (µg/kg)												
4,4'-DDE	3,000	1,700	--	13 J	18 J	2.4 J	9.4 J	0.076 J	2 J	1.4 J	2.5 J	0.21 J
4,4'-DDT	2,000	1,700	--	3.8 U	3.8 U	3.7 U	3.8 U	4 U	3.6 U	3.7 U	41 U	4 U
Herbicides (µg/kg)												
No Detections												
Dioxin/Furans (pg/g)												
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	**	--	NA	NA	7.4	NA	2.5 U	NA	NA	NA	NA
Octachlorodibenzo-p-dioxin	--	**	--	NA	NA	76.1	NA	5 U	NA	NA	NA	NA
Total heptachlorodibenzo-p-dioxin	--	**	--	NA	NA	16.7	NA	2.5 U	NA	NA	NA	NA
Total hexachlorodibenzo-p-dioxin	--	**	--	NA	NA	2.8	NA	2.5 U	NA	NA	NA	NA
Total tetrachlorodibenzo-p-dioxin	--	**	--	NA	NA	2	NA	1 U	NA	NA	NA	NA
Explosives (µg/kg)												
No Detections												
Total Metals (mg/kg)												
Antimony	0.3	3.1	3.3	0.641 J	1.02 J	0.454 J	0.606 J	0.461 J	0.508 J	0.793 J	0.0986 J	0.0886 UJ
Arsenic	1	0.39	1.6	0.327 J	0.456 J	0.234 J	0.426 J	0.422 J	0.367 J	0.18 J	0.135 U	0.385 J
Barium	82	1,600	147	70.5 J	64.1 J	58.2 J	78.1 J	95.9 J	109 J	55.6 J	91.4	89.4
Beryllium	3	15	0.27	0.212 J	0.261 J	0.197 J	0.224 J	0.308 J	0.157 J	0.178 J	0.282 J	0.275 J
Cadmium	0.4	3.7	2.2	0.00978 U	0.0102 U	0.00978 U	0.00968 U	0.0108 U	0.00941 U	0.00895 U	0.0123 U	0.0849 J
Chromium	2	210	72	15.2	18.6	16.1	17.5	23	13.7	25	16.8 J	12.3 J
Cobalt	33	140	16	10.6	9.82	8.21	9.78	10.5	8.71	9.86	13.9 J	13.8 J
Copper	46	310	66	37.6	44.7	34.4	41	43.7	34	43.7	47.6	37.4
Lead	14	400	3.3	1.19	2.08	1.21	1.38	1.93	0.905	0.134 U	2.16	2.3
Mercury	0.1	2.3	0.057	0.0129 J	0.0167 J	0.0104 J	0.0103 J	0.00223 J	0.00447 J	0.00246 J	0.00236 U	0.00207 U
Nickel	7	160	22	5.69 J	6.64 J	5.43 J	6.43 J	7.3 J	6.09 J	6.57 J	7.49	6.34 J
Selenium	0.3	39	0.51	0.312 J	0.244 J	0.237 J	0.52 J	0.169 U	0.204 J	0.14 U	0.436 J	0.625 J
Silver	2	39	0.22	0.0579 J	0.082 J	0.0588 J	0.0407 J	0.0661 J	0.0277 J	0.0323 J	0.0627 J	0.034 J
Thallium	0.036	0.52	0.13	0.927 J	1.31 J	0.876 J	1.16 J	1.29 J	1.29	1.62	0.118 U	0.113 U
Tin	--	4,700	NA	0.172 U	1.16 J	0.599 J	0.308 J	0.19 U	0.165 U	0.157 U	0.306 J	0.208 U
Vanadium	300	7.8	144	86.5	89.2	81.2	88.3	104	85	157	103	81.3
Zinc	620	2,300	32	20.2	47.1	28.8	22.9	32.1	16	20.8	21.7	15.8
Wet Chemistry (mg/kg)[1]												
Sulfide	--	--	--	NA	NA	38.6 J	NA	15 J	NA	NA	NA	NA
Total Petroleum Hydrocarbons (mg/kg)												
Petroleum hydrocarbons	--	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
* Total xylene PRG value used as surrogate.
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
[1] Wet Chemistry consists of sulfide and cyanide
** See Section 1.1.1.2 for dioxin screening.

Exceeds Background and HHRA criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria

TABLE 9-5
SWMU 10 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	CGW10SB17	CGW10SB18	CGW10SB19	CGW10SB20	
Sample ID				CGW10SB17-R01-5	CGW10SB18-R01-5	CGW10SB19-R01-5	CGW10SB20-R01-5	CGW10FD04P-R01
Sample Date				1/22/04	1/22/04	1/20/04	1/22/04	1/22/04
Chemical Name								
Volatile Organic Compounds (µg/kg)								
m- and p-Xylene	10,000	27000*	--	NA	NA	NA	NA	NA
Toluene	600	630,000	--	9.1 U	9.5 U	8.6 U	8.9 U	8.6 U
Xylene, total	10,000	27,000	--	9.1 U	9.5 U	8.6 U	8.9 U	8.6 U
Semivolatile Organic Compounds (µg/kg)								
bis(2-Ethylhexyl)phthalate	--	35,000	--	132 J	353 U	479	380 U	146 J
Di-n-butylphthalate	270,000	610,000	--	102 J	73 J	367 U	83 J	94.8 J
Pesticide/Polychlorinated Biphenyls (µg/kg)								
4,4'-DDE	3,000	1,700	--	4.6 J	4.5 J	2.2 J	0.87 J	1.5 J
4,4'-DDT	2,000	1,700	--	0.31 J	3.7 U	3.7 U	3.8 U	3.8 UJ
Herbicides (µg/kg)								
No Detections								
Dioxin/Furans (pg/g)								
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	**	--	NA	NA	2.9	NA	NA
Octachlorodibenzo-p-dioxin	--	**	--	NA	NA	29.3	NA	NA
Total heptachlorodibenzo-p-dioxin	--	**	--	NA	NA	6	NA	NA
Total hexachlorodibenzo-p-dioxin	--	**	--	NA	NA	2.5 U	NA	NA
Total tetrachlorodibenzo-p-dioxin	--	**	--	NA	NA	1 U	NA	NA
Explosives (µg/kg)								
No Detections								
Total Metals (mg/kg)								
Antimony	0.3	3.1	3.3	0.184 J	0.214 J	0.517 J	0.0815 UJ	0.0816 UJ
Arsenic	1	0.39	1.6	0.487 J	0.164 J	0.304 J	0.454 J	0.251 J
Barium	82	1,600	147	98.9	76.3	77.8 J	82.2	75.1
Beryllium	3	15	0.27	0.268 J	0.141 J	0.214 J	0.221 J	0.207 J
Cadmium	0.4	3.7	2.2	0.141 J	0.0106 U	0.00924 U	0.16 J	0.126 J
Chromium	2	210	72	15.2 J	9.75 J	14.4	12.1 J	12.8 J
Cobalt	33	140	16	11.1 J	8.43 J	9.06	10.4 J	9.14 J
Copper	46	310	66	43.6	38.1	36.9	37.9	40.5
Lead	14	400	3.3	2.04	1.81	1.1	1.83	1.7
Mercury	0.1	2.3	0.057	0.00709 J	0.00525 J	0.00366 J	0.00261 J	0.00212 U
Nickel	7	160	22	5.94	4.36 J	5.54 J	5.61 J	5.46 J
Selenium	0.3	39	0.51	0.438 J	0.167 U	0.419 J	0.386 J	0.542 J
Silver	2	39	0.22	0.041 J	0.0239 J	0.0175 U	0.0206 U	0.026 J
Thallium	0.036	0.52	0.13	0.103 U	0.102 U	0.965 J	0.104 U	0.104 U
Tin	--	4,700	NA	0.189 U	0.187 U	0.162 U	0.191 U	0.191 U
Vanadium	300	7.8	144	108	68.8	89.9	77.2	77.7
Zinc	620	2,300	32	17.8	20.7	18.9	17.8	18.9
Wet Chemistry (mg/kg)[1]								
Sulfide	--	--	--	NA	NA	8.98 U	NA	NA
Total Petroleum Hydrocarbons (mg/kg)								
Petroleum hydrocarbons	--	--	--	NA	NA	NA	NA	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
* Total xylene PRG value used as surrogate.
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
[1] Wet Chemistry consists of sulfide and cyanide
** See Section 1.1.1.2 for dioxin screening.

Exceeds Background and HHRA criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria

TABLE 9-6
SWMU 10 Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Vieques HHRA GW**	**MCL - GW**	**PAOC-N EPAN-MW02 Background**	CGW10MW01	CGW10MW01	CGW10MW02	CGW10MW03	CGW10MW04	CGW10MW05
Sample ID				CGW10GW01-R01	CGW10FD03P-R01	CGW10GW02-R01	CGW10GW03-R01	CGW10GW04-R01	CGW10GW05-R01
Sample Date				2/11/04	2/11/04	2/10/04	2/10/04	2/9/04	2/9/04
Chemical Name									
Volatile Organic Compounds (µg/L)									
Toluene	230	1,000	NA	0.52 J	0.51 J	0.26 J	1 U	1 U	1 U
Semivolatile Organic Compounds (µg/L)									
No Detections									
Pesticide/Polychlorinated Biphenyls (µg/L)									
No Detections									
Herbicides (µg/L)									
No Detections									
Dioxin/Furans (pg/L)									
No Detections									
Explosives (µg/L)									
No Detections									
Total Metals (µg/L)									
Arsenic	0.045	10	--	2.04 U	2.04 U	12 J	2.04 U	2.04 U	2.04 U
Barium	730	2,000	200	364	365	204 J	146 J	372	405
Chromium	11	100	3.6 J	10.2	7.3 J	2.99 J	3.06 J	1.06 J	2.17 J
Cobalt	73	--	--	1.83 J	1.42 J	6.59 J	0.569 U	0.569 U	0.707 J
Copper	150	1,300	--	5.6 J	4.95 J	6.34 J	1.86 J	2.35 J	1.17 U
Mercury	1.1	2	--	0.0162 U	0.0162 U	0.453	0.0162 U	0.0162 U	0.0162 U
Nickel	73	--	2.4 J	11.1 J	9.93 J	8.8 J	6 J	4.43 J	5.04 J
Selenium	18	50	--	4.14 J	2.1 U	10.9 J	4.37 J	2.61 J	2.48 J
Thallium	0.24	2	--	2.54 U	2.54 U	17.3 J	2.54 U	2.54 U	2.54 U
Vanadium	3.6	--	--	15.2 J	13.5 J	3.09 J	17.1 J	10.2 J	12.6 J
Dissolved Metals (µg/L)									
Antimony	1.5	6	--	2.5 U	2.5 U	12.5 U	2.5 U	3.26 J	2.66 J
Barium	730	2,000	--	357	359	203 J	139 J	367	416
Chromium	11	100	--	2.84 J	2.39 J	3.12 J	1.31 J	0.661 J	1.88 J
Cobalt	73	--	--	0.921 J	0.696 J	7.91 J	0.569 U	0.569 U	0.569 U
Copper	150	1,300	--	3.73 J	3.56 J	5.85 U	2.18 J	2.96 J	1.33 J
Cyanide	73	200	N/A	N/A	N/A	NA	NA	3.73 U	4.79 J
Mercury	1.1	2	--	0.0162 U	0.0162 U	0.245	0.0162 U	0.0215 J	0.0162 U
Nickel	73	--	--	7.57 J	7.87 J	8.32 J	6.51 J	3.87 J	4.48 J
Selenium	18	50	--	2.1 U	2.21 J	19 J	2.64 J	3.49 J	3.76 J
Silver	18	--	--	0.472 U	0.42 U	2.36 U	0.472 U	0.472 U	0.585 J
Thallium	0.24	2	--	2.54 U	2.54 U	15.1 J	2.76 J	2.54 U	2.54 U
Tin	2,200	--	N/A	0.994 U	0.994 U	5.01 J	4.97 U	0.994 U	0.994 U
Vanadium	3.6	--	--	10.5 J	10.4 J	4.05 J	16.3 J	9.53 J	11.7 J
Zinc	1100	--	--	2.04 U	2.04 U	2.04 U	0.607 J	0.409 U	0.409 U
Wet Chemistry (µg/L)[1]									
No Detections									

Notes:
µg/L - Micrograms per Liter
pg/L - Picograms per Liter
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007), and listed below (as modified by Table 1-1)
Vieques HHRA GW - Screening values from the October 2004 Region IX Preliminary Remediation Goals (PRGs)
GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards
[1] Wet Chemistry consists of sulfide and cyanide (cyanide is shown with the TAL Metals in this table)
* - represents a value of half the detection limit

Exceeds Background and HHRA criteria
Exceeds Background, HHRA and MCL Criteria

TABLE 9-7
SWMU 10 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 5a Additional Source Area Data Beneficial?
Surface Soil	Yes					Additional source area data may help confirm suspicion that thallium results are falsely elevated.
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Dioxins	No	N/A	N/A	
		Inorganics	Yes	Se > ECO, SSL, BKG	ECO based on plants; no sign of stress to plants; mean concentration < ECO; < ECO for soil invertebrates; detected in groundwater below PRG (unadjusted) and MCL	
				Tl > PRG, ECO, SSL, BKG	acceptable HH risk level; mean concentration < ECO; thallium results suspected of being falsely elevated	
				Zn > ECO, BKG	mean concentration < ECO for invertebrates	
Subsurface Soil	Yes					Additional source area data may help confirm suspicion that thallium results are falsely elevated.
		VOCs	Yes	No	N/A	
		SVOCs	Yes	No	N/A	
		TPH	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Dioxins	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; not detected in groundwater (dissolved)	
				Ba > SSL, BKG	detected in groundwater below PRG and MCL	
				Cu > SSL, BKG	detected in groundwater below PRG and MCL	
				Se > SSL, BKG	detected in groundwater below PRG (unadjusted) and MCL	
				Tl > PRG, SSL, BKG	acceptable HH risk level; thallium results suspected of being falsely elevated	
				V > PRG, BKG	Primarily attributable to background	
Groundwater	Yes					Additional source area data may help confirm suspicion that thallium results are falsely elevated.
		VOCs	Yes	No	N/A	
		Inorganics	Yes	Sb (diss.) > PRG, BKG	< MCL; attributable to background	
				As (total) > PRG, MCL	not detected in dissolved fraction; detected in only one well; likely attributable to background	
				Tl (tot.) > PRG, MCL	thallium results suspected of being falsely elevated	
				Tl (diss.) > PRG, MCL	thallium results suspected of being falsely elevated	
				V (tot.) > PRG, BKG	acceptable HH risk level; likely attributable to background	
				V (diss.) > PRG, BKG	acceptable HH risk level; likely attributable to background	

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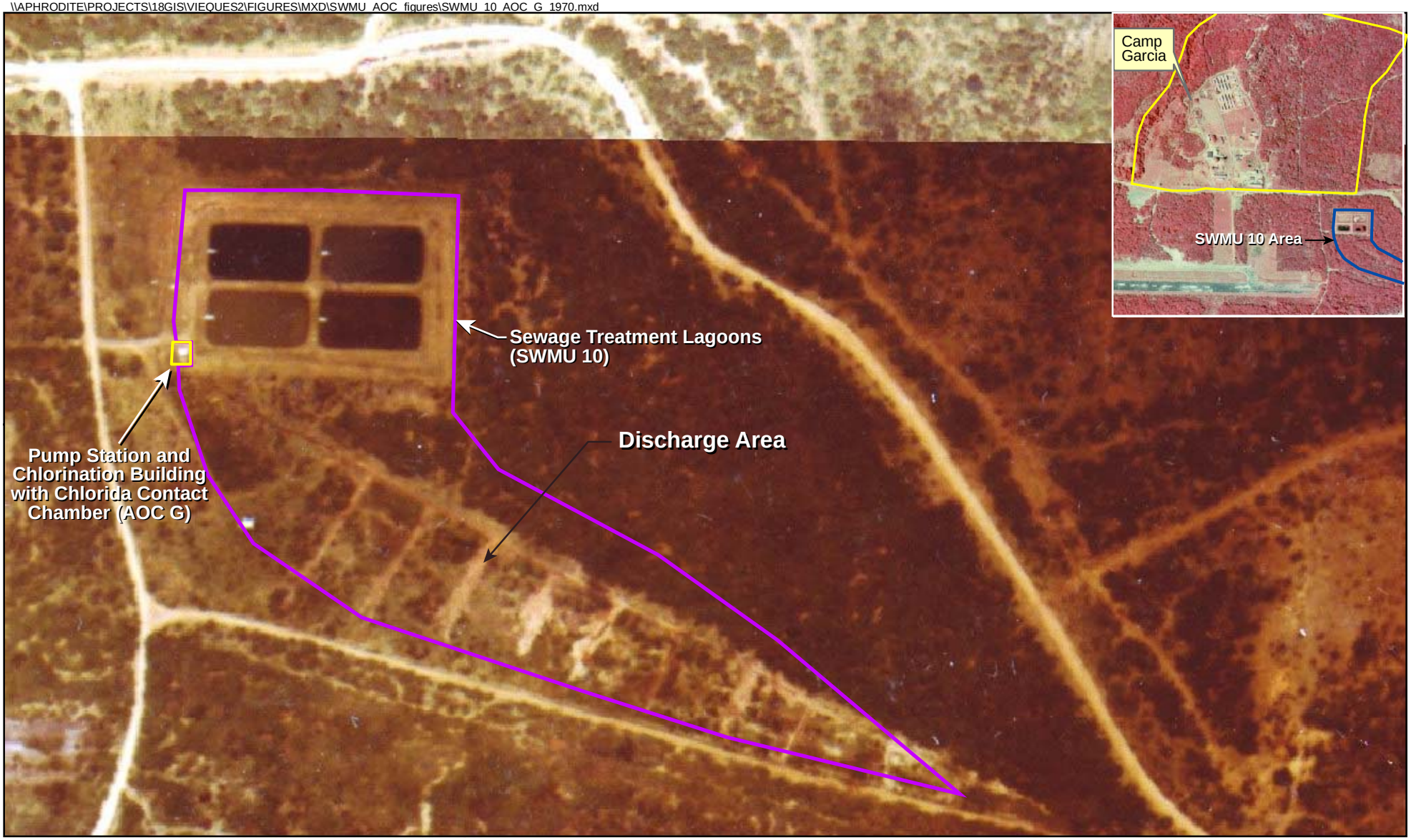

Legend

- SWMU 10 Area
- AOC G Area

N
W E
S

0 125 250 500 Feet

Figure 9-1
1970 Aerial Photograph of the SWMU 10 and AOC G Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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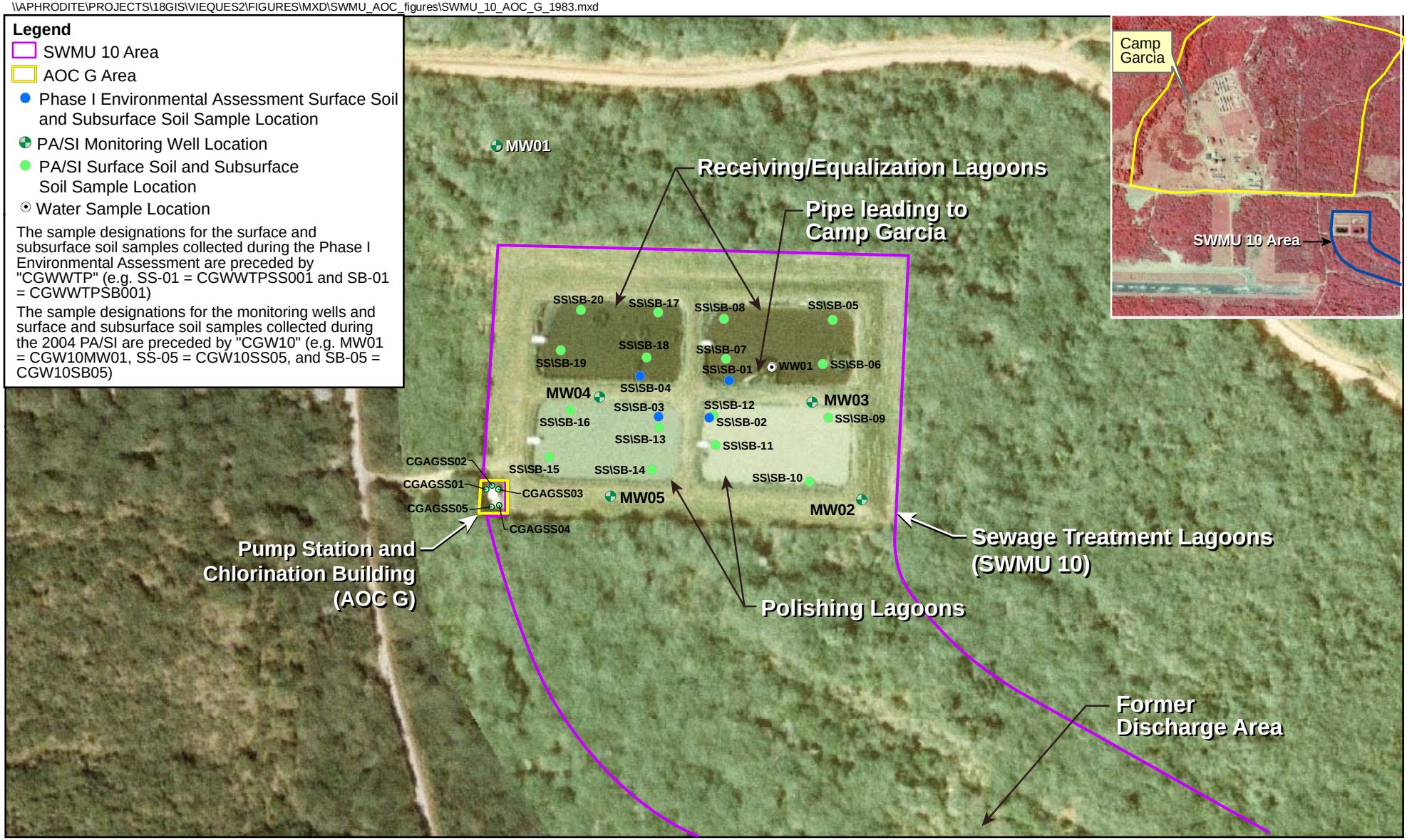

Figure 9-2
1983 Aerial Photograph of the SWMU 10 and AOC G Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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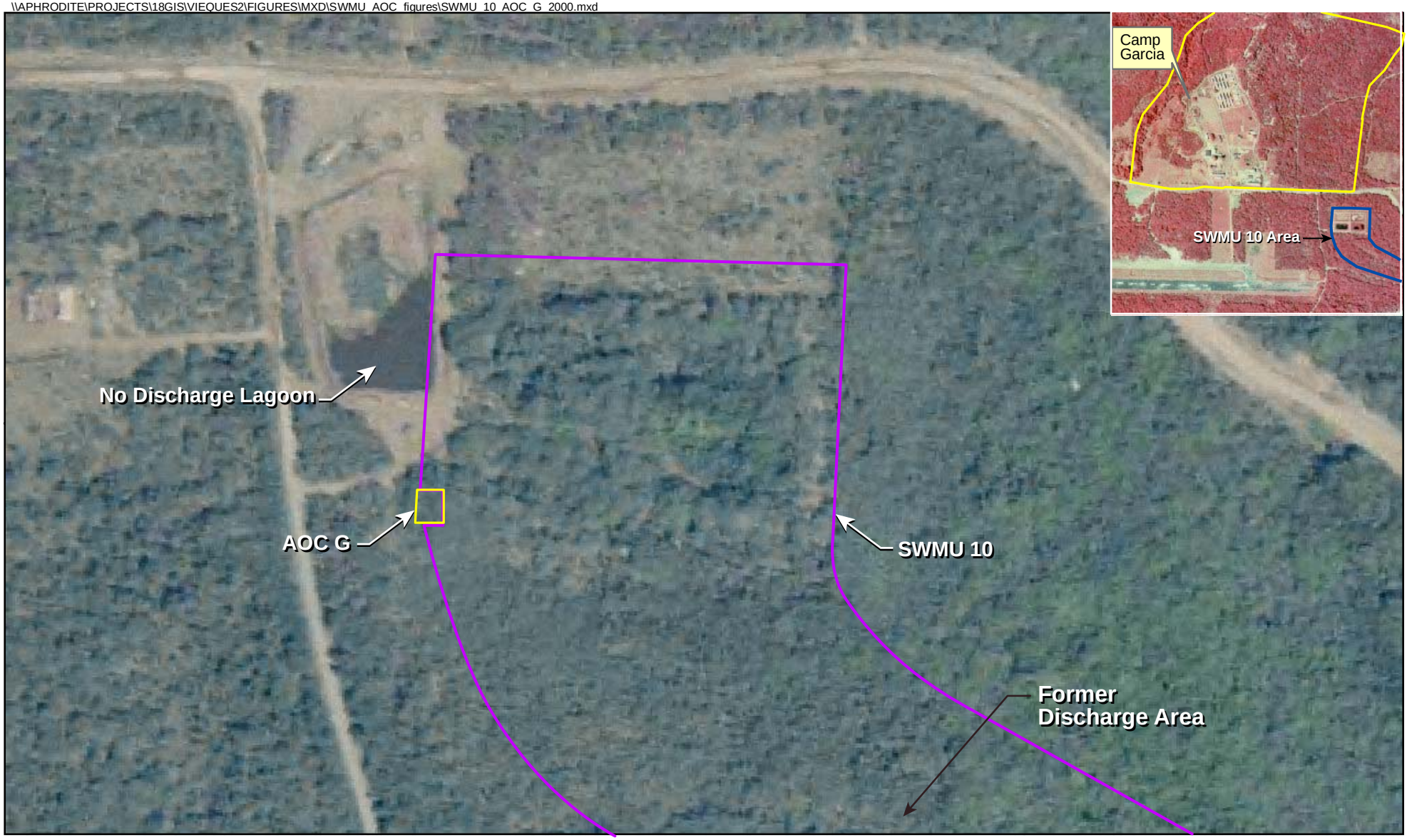

Legend

- SWMU 10 Area
- AOC G Area

N
W E
S

0 100 200 400 Feet

Figure 9-3
2000 Aerial Photograph of SWMU 10 and AOC G Areas and No Discharge Lagoon
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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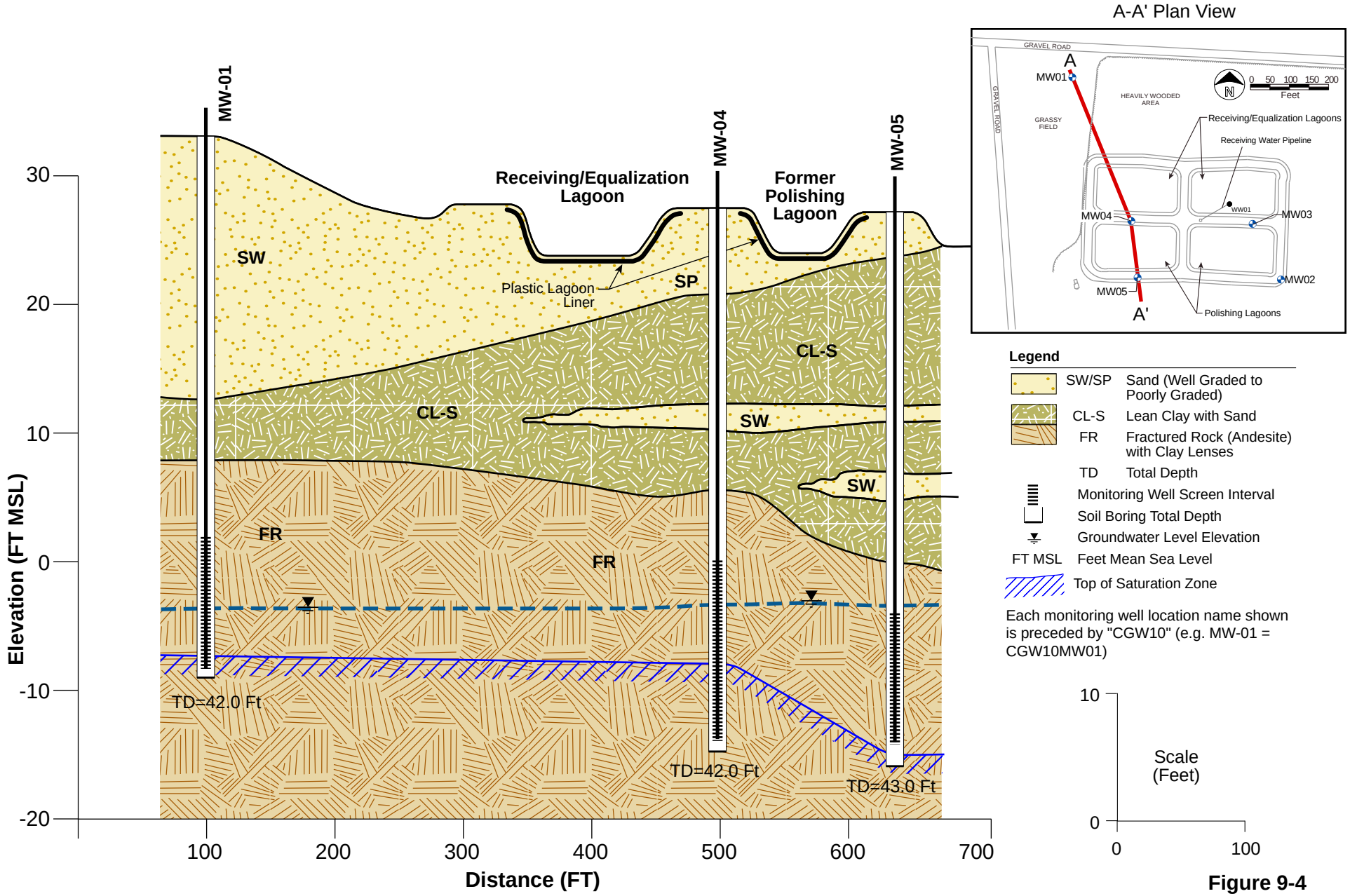
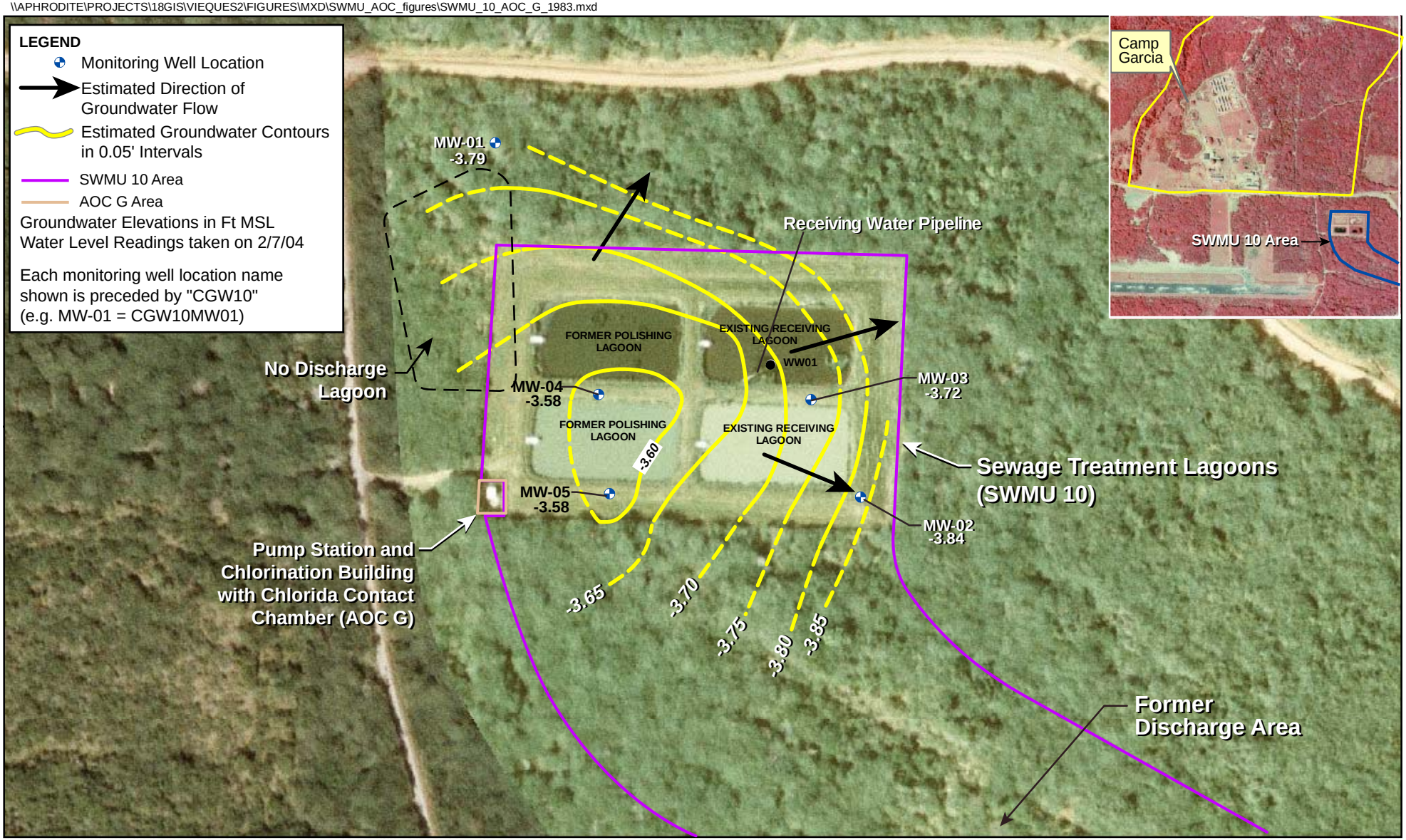


Figure 9-4
Geologic Cross Section A-A', SWMU 10
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\SWMU_10_AOC_G_1983.mxd



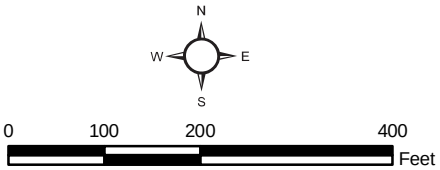


Figure 9-5
Groundwater Flow Map, SWMU 10
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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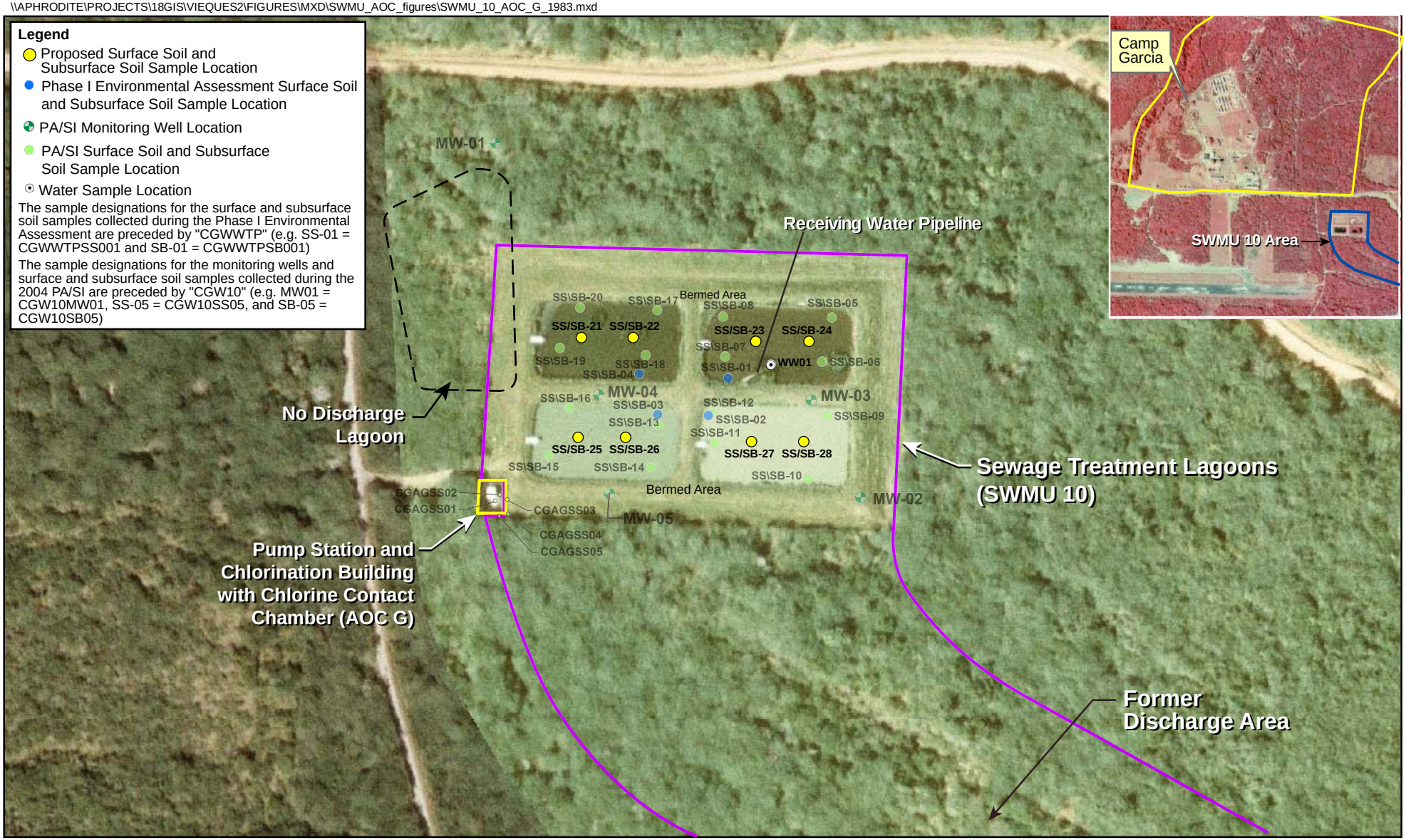

Figure 9-6
Proposed Surface and Subsurface Soil Sample Locations at SWMU 10
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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SECTION 10

SWMU 12—Solid Waste Collection Unit Area

This section presents the results of the PA/SI performed at SWMU 12, a solid waste collection unit area.

10.1 Conceptual Site Model

The CSM for SWMU 12 is based on review of historical information such as records, site inspection documentation, and interviews, as well as site-specific data collection.

10.1.1 Site History and Potential Sources of Release

SWMU 12 is located on an access road that leads to OP-1 (Figure 1-2 and 6-1). This area was referred to as AOC B in the 1988 RFA (Kearney, 1988), but in accordance with the Consent Order, this area was designated a waste management unit and identified as SWMU 12.

The solid waste collection unit area served as a solid waste staging area, prior to pickup of the domestic solid waste (indicative of galley or barracks waste) for disposal at the Vieques Island landfill. Containers used to store solid wastes collected at the site included wooden boxes, wooden trailers, metal dumpsters, and metal cans. The two RFA reports (Kearney, 1988; PREQB, 1995) suggested NFA for this site was necessary because no known hazardous constituents were staged there, which is why the material could be disposed of at the Vieques Island landfill. The visual inspection in February 2000, when the EPA and Navy representatives visited the consent order sites, identified two trailers potentially used for staging of domestic waste from OP-1 prior to transport to the Vieques Island landfill. Figure 10-1 presents a photograph of SWMU 12 taken during the 2000 visual inspection. During the 2004 PA/SI sampling event, no trailers or any signs of waste were present at SWMU 12. The trailers had previously been removed as part of the Navy's closure of VNTR in 2003.

10.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted during the February 2000 EPA and Navy site visit to all Consent Order sites (CH2M HILL, 2001) and during the 2004 PA/SI, as well as on regional information.

The site was a cleared gravelly area just off the side of a dirt road leading to OP-1. The site encompassed an area approximately 30 ft by 30 ft, at an elevation of approximately 240 ft amsl with a steep drop off to the east. The soil in the first 8 inches consists of well graded sand with silt and gravel. SWMU 12 lies within the Kv formation, which comprises sandstone, siltstone, conglomerate, lava, tuff, and tuffaceous breccia. For more information on the bedrock geology, see Section 1.4.6.

No surface water bodies are present at the site. The closest surface water body is the ocean, located approximately ½ mile to the south and southeast. Based on the depth to

groundwater encountered at other locations significantly above sea level (see Figure 1-9 and 1-10), groundwater beneath the OP-1 area is estimated to be more than 100 feet bls.

10.2 Sampling Approach and Chemical Constituents Identified

In accordance with the Phase I RFI Work Plan (CH2M HILL, 2003c), five surface soil samples around the waste collection units were collected in the former waste staging area (Figure 10-2). Samples were analyzed for Appendix IX VOCs, SVOCS, pesticides, herbicides, and metals; and explosives, including perchlorate. One surface soil sample, collected at station CGW12SS05, was also analyzed for cyanide, sulfide, and dioxins. Although historical information for SWMU 12 did not indicate munitions or explosives-related constituents would be related to potential releases at the site, explosives were included in the sample analyses because the site is located within the safety fan of the artillery firing positions in the EMA.

Table 10-1 summarizes the constituents detected in SWMU 12 surface soil samples collected during the PA/SI and identifies screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O.

10.3 SWMU 12 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection table (Table 10-1).

Appendix N, Section N.10 discusses the evaluation of the SWMU 12 data quality. As detailed in Section N.9, the SWMU 12 data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at SWMU 12, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was used to stage domestic waste prior to disposal at the Vieques landfill. Although both RFAs recommended NFA because no known or likely hazardous waste or hazardous constituents were staged at the site, sampling was required during the 2004 PA/SI because the site was a Consent Order site. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected:

<u>Surface Soil</u>

- VOCs: none detected
- SVOCs: di-n-butylphthalate
- Pesticides: none detected

- Herbicides: none detected
- Dioxins: octachlorodibenzo-p-dioxin
- PCBs: none detected
- Explosives: none detected
- Inorganics: arsenic, beryllium, selenium, thallium, zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

As noted in Section 10.1.1, the site was used to stage non-hazardous domestic waste on portable trailers and no evidence of releases were observed during the visual inspection or sampling event. However, the site was identified in the Consent Order and, therefore, required sampling. Therefore, it is conservatively assumed that the one SVOC and inorganics detected above the background UTLs are potentially attributable to a CERCLA-related release. These constituents are considered further in the decision analysis process. Conversely, dioxins are not likely associated with the material stored at this site. Further, as shown in Table A-3, the dioxin concentration at SWMU 12 (in TEQ) is approximately 0.002 ppt, which is almost six orders of magnitude less than the residential remediation level (i.e., 1,000 ppt) cited by EPA. Therefore, dioxins are not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection table. Those constituents that exceed one or more criteria (and background for inorganics) are listed below.

<u>Surface Soil</u>

- SVOCs: no exceedances
- Arsenic: five detections (samples SS01 through SS05) at concentrations (5.23 mg/kg to 14.6 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Selenium: five detections (samples SS01 through SS05) at concentrations (0.529 mg/kg to 1.39 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF 1 (0.3 mg/kg), and background UTL (0.51 mg/kg)
- Thallium: five detections (samples SS01 through SS05) at concentrations (0.438 mg/kg to 1.57 mg/kg) above the adjusted PRG (0.52 mg/kg; only by samples SS01 through SS04), ecological screening value (1 mg/kg; only by samples SS02 through SS04), SSL at a DAF 1 (0.036 mg/kg), and background UTL (0.13 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

At the five locations sampled, arsenic was detected in surface soil above background and its human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR), at a maximum concentration of 14.6 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ, acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the maximum detected concentration, risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver.

Thallium was detected in surface soil at four of the five locations sampled above background and its human health screening level (0.52 mg/kg based on an HQ=0.1), at a maximum concentration of 1.57 mg/kg. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 5.2 mg/kg (HQ=1). Based on the low maximum detected concentration (relative to the acceptable risk-based concentration) that would be used in risk calculations, risk estimates for thallium would be acceptable and thallium would not be identified as a risk driver. Further, the thallium concentrations in the samples collected at SWMU 12 are suspect because the analytical method utilized was prone to providing falsely elevated results. This supposition is supported by the fact that at several PI/PAOC sites where samples were analyzed for thallium using both the older method and the newer method (e.g., PAOC U), the thallium concentrations of the samples analyzed with the newer method are lower.

As noted above, there are only two constituents (arsenic and thallium) detected in soil at concentrations above human health screening levels and background UTLs. Vanadium was also detected above the adjusted PRG, but concentrations do not exceed the background UTL. Only the soil PRG for arsenic is based on potential carcinogenic effects. A second PRG is available for arsenic based on non-cancer skin and vascular effects, while the PRGs for thallium and vanadium are based on liver effects and increased mortality, respectively. Therefore, there is no concern for cumulative human health effects from multiple constituents in soil.

Two inorganics (selenium and thallium) exceed ecological screening values and background in at least one surface soil sample. Neither one of these constituents likely poses an unacceptable risk to ecological receptors on a site-wide basis based upon the following:

- The site is very small, is adjacent to a road, and has gravel at the ground surface. Therefore, the habitat is limited, especially compared to the surroundings, and potential exposures are not likely significant ecologically.
- Selenium exceeds the ecological screening value (0.52 mg/kg) in all five samples, at a maximum HQ of 2.67. Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at SWMU 12 (maximum of 1.39 mg/kg; 0.9 mg/kg in the field duplicate of this sample) may be within the range of background, especially considering that other data collected for the site do not suggest a CERCLA-related release has occurred. Further, all selenium concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for

soil invertebrates). Thus, selenium has a low potential for unacceptable risks, especially given the very low potential for exposure.

- Thallium exceeds the ecological screening value (1 mg/kg) in three of five samples, at a maximum HQ of 1.47 (note that the field duplicate concentration for this sample is less than the screening value). Further, the mean thallium soil concentration (0.95 mg/kg) is less than the ecological screening value. Also, as stated above, the thallium concentrations are suspected of being falsely elevated.

The concentrations of three inorganics (arsenic, selenium, and thallium) exceeded the SSL at a DAF 1. However, the former solid waste collection area (i.e., potential source area) was relatively small. Therefore, an SSL at a higher DAF is likely to be more realistic, as discussed in Section 1.1.2. This supposition is supported by data from site SWMU 1 (also located in the Kv zone), where SSLs at a DAF of 1 were shown to be unrealistic predictors of leaching to groundwater. At SWMU 1, arsenic, selenium, and thallium were all detected above the SSL at a DAF of 1; however, arsenic was not detected in groundwater and selenium was detected in groundwater below screening criteria. Further, as noted previously, the thallium results are suspected of being falsely elevated. The presumed depth to groundwater of more than about 100 feet at this location further supports a higher DAF. At SWMU 12, none of the concentrations of arsenic exceeds the SSL at a DAF of 15 and none of the selenium concentrations exceeds the SSL at a DAF of 5.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, photographs, interviews, site inspections) indicates a CERCLA-related release has not likely occurred at SWMU 12 due to the nature of the waste staged (i.e., non-hazardous), the fact that it was staged in containers, the fact that no evidence of releases was observed, and that constituents other than inorganics were generally not detected. Based on this information, the spatial distribution of samples and resulting data indicate the site has been sufficiently characterized.

10.4 Conclusions and Recommendations

Table 10-2 summarizes the results of the decision analysis for SWMU 12, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Further, the dioxin concentration detected at the site is not likely associated with potential CERCLA-related releases and is nevertheless below risk-based screening levels. The site was used to temporarily stage domestic waste from OP-1 prior to transfer to the Vieques Island landfill. There is no information (including the analytical data) to suggest SWMU 12 was used to stage anything other than non-hazardous domestic waste. In fact, other areas were used specifically for staging of waste that was not domestic in nature and potentially hazardous (e.g., SWMU 5 and SWMU 8) at OP-1. Therefore, it is recommended that a NFA decision document be prepared for SWMU 12.

TABLE 10-1
SWMU 12 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone Kv SS	CGW12SS01	CGW12SS02	CGW12SS03		CGW12SS04	CGW12SS05
Sample ID					CGW12SS01-R01	CGW12SS02-R01	CGW12SS03-R01	CGW12FD01P-R01	CGW12SS04-R01	CGW12SS05-R01
Sample Date					1/19/04	1/19/04	1/19/04	1/19/04	1/19/04	1/19/04
Chemical Name										
Volatile Organic Compounds (µg/kg)										
No Detections										
Semivolatile Organic Compounds (µg/kg)										
Di-n-butylphthalate	270,000	610,000	200,000	--	352 U	83.7 J	346 U	337 U	57.5 J	349 U
Pesticide/Polychlorinated Biphenyls (µg/kg)										
No Detections										
Herbicides (µg/kg)										
No Detections										
Dioxin/Furans (pg/g)										
Octachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	NA	NA	8
Explosives (µg/kg)										
No Detections										
Total Metals (mg/kg)										
Antimony	0.3	3.1	78	3.6	0.532 J	0.425 J	0.39 J	0.378 J	0.375 J	1.01 J
Arsenic	1	0.39	18	1.6	7.11	5.23	10.9	14.6	10.6	9.2
Barium	82	1600	330	212	86.7	107	148	139	153	102
Beryllium	3	15	40	0.27	0.275 J	0.388 J	0.285 J	0.28 J	0.27 J	0.304 J
Chromium	2	210	0.4	72	11.5 J	5.12 J	14.4 J	21.9 J	12 J	9.17 J
Cobalt	33	140	13	26	10.7 J	11 J	15.5 J	14.1 J	15.4 J	13.1 J
Copper	46	310	70	94	22.8	15.6	50.7	47.7	53.8	23.3
Lead	14	400	120	5.4	2.17 J	0.53 J	2.19 J	2.03 J	0.945 J	0.173 U
Mercury	0.1	2.3	0.1	0.057	0.0236 J	0.0227 J	0.0206 J	0.0238 J	0.0181 J	0.0569
Nickel	7	160	38	41	5.1 J	3.92 J	8 J	15.4 J	7.97 J	6.6 J
Selenium	0.3	39	0.52	0.51	0.818 J	0.632 J	1.39	0.9	0.575 J	0.529 J
Silver	2	39	560	0.22	0.149 J	0.122 J	0.166 J	0.151 J	0.14 J	0.118 J
Thallium	0.036	0.52	1	0.13	0.802 J	1.24 J	0.438 J	1.57 J	1.2 J	0.516 J
Vanadium	300	7.8	2	144	53	52.5	76.1	76.2	91.1	69.6
Zinc	620	2,300	120	32	67.9	91.4	82.8	81.1	93.9	89
Wet Chemistry (mg/kg)[1]										
No Detections										

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, silver, thallium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[1] Wet Chemistry consists of sulfide and cyanide
* See Section 1.1.1.2 for dioxin screening.

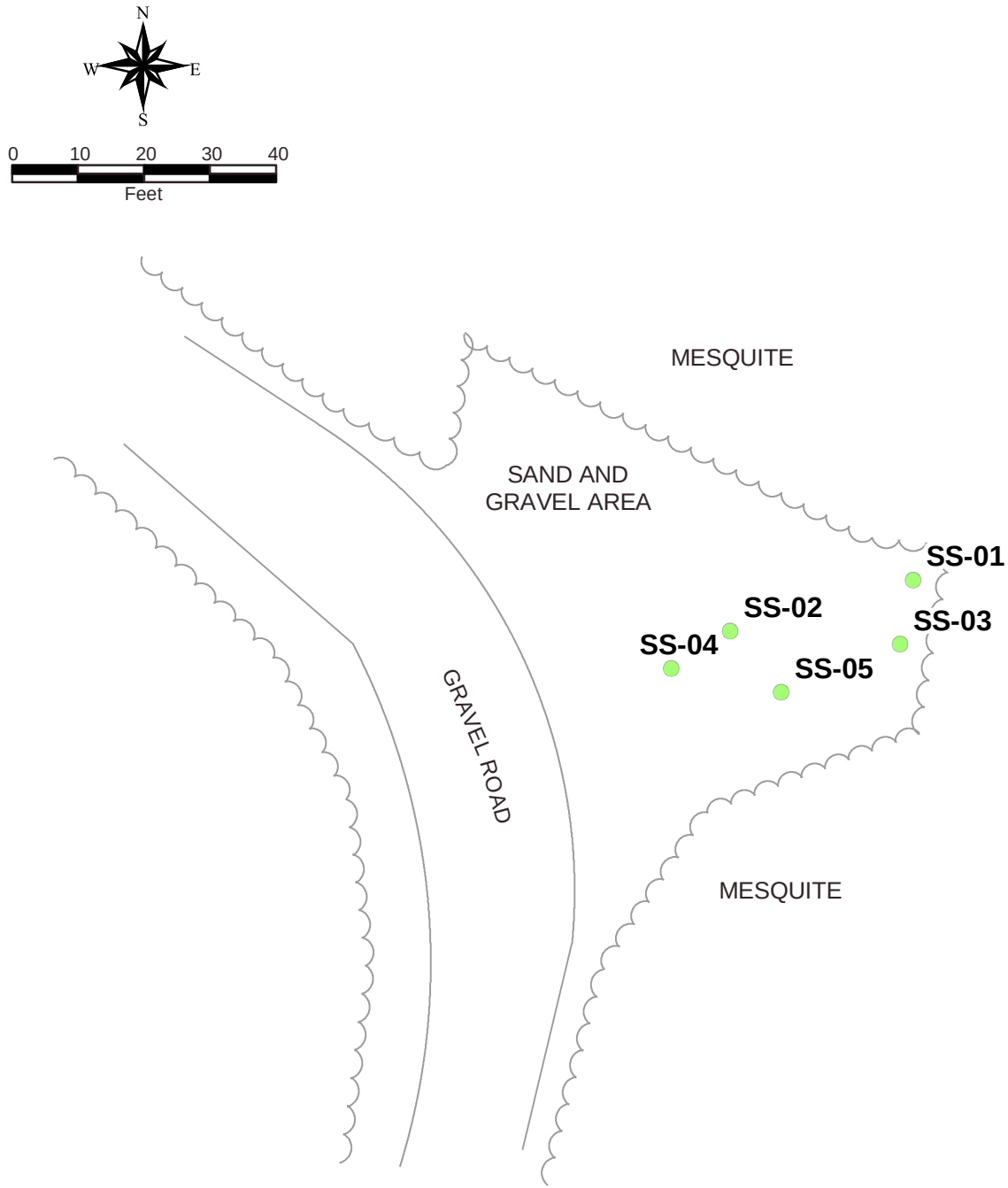
Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, and DAF Criteria

TABLE 10-2
SWMU 12 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		SVOCs	Yes	No	N/A	
		Dioxins	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH limits; < SSL at a DAF of 15	
				Se > ECO, SSL, BKG	ECO based on plants; no plants on site; mean concentration similar to ECO; < ECO for soil invertebrates; < SSL at a DAF of 5	
				Th > PRG, ECO, SSL, BKG	acceptable HH risk level; mean concentration < Eco; thallium results suspected of being falsely elevated	

Photograph taken February 3, 2000

Figure 10-1
SWMU 12 Solid Waste Collection Unit Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico



Location Map

Legend

Surface Soil Sample Location

Each sampling location shown is preceded by "CGW12" (e.g. SS-01 = CGW12SS01)

Figure 10-2
Surface Soil Sample Location Map, SWMU 12
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 11

AOC A—Diesel Fuel Fill Pipe Area

This section presents the results of the PA/SI performed at AOC A—Diesel Fuel Fill Pipe Area at OP-1 on the former VNTR.

11.1 Conceptual Site Model

The CSM for AOC A is based on review of historical information such as records, site inspection documentation, and interviews, as well as site-specific data collection.

11.1.1 Site History and Potential Sources of Release

AOC A is located in the SIA at OP-1 on the southeast corner of a fenced area that surrounds OP-1 (Figure 1-2 and 6-1). According to the 1988 RFA Report (Kearney, 1988), this area contained the fuel fill pipe for the 15,000-gallon diesel fuel UST located at OP-1 in the Cerro Matías area of the former VNTR. The UST was located 25 ft southwest and downgradient of the fill pipe, as shown in Figure 11-1.

The UST and fuel fill pipe entered service in approximately 1978. The 1995 RFA Report (PREQB, 1995) stated that the soil surrounding the fill pipe was stained, apparently as a result of fuel releases that had occurred during tank refueling. The total stained area was observed to be approximately 6 ft by 6 ft. However, ongoing fuel releases from leakage were observed, but no release controls were found at this site (PREQB, 1995). The 1995 RFA Report stated the following:

> *"Given the limited amount of fuel spilled to the soil, sampling and analysis of soil is not suggested at this time. A general cleanup of the area, however, would help reduce the potential of a release."*

The 15,000-gallon diesel fuel UST, associated piping including the fill pipe, and some surrounding soil were excavated and removed for disposal in 1997. After removal of the UST and surrounding soil, four confirmatory soil samples were collected from the excavation and analyzed for petroleum-related constituents (benzene, ethylbenzene, toluene, and xylenes [BTEX] and total recoverable petroleum hydrocarbons [TRPH]). No petroleum-related constituents were detected in any of the four soil samples. The closure report indicated that the four samples were collected after the lines and tank were removed, but does not include sample collection depths or actual collection locations. The closure report was finalized in April 2000 after comments were received from PREQB (IT, 2000).

A new UST was installed in 1997 following removal of the existing UST. The UST installed in 1997 was removed in 2003 in response to the closure of VNTR and the transfer the property to the DOI. Upon removal, confirmatory soil samples were collected, the data from which are discussed in Section 11.2 and included in the decision analysis.

11.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted during the removal of the USTs in 1997 and 2003, as well as on regional information.

The site resides in a relatively flat area and is overgrown with high grass. The site sits at an elevation of approximately 453 ft amsl, with a drop off of approximately 240 ft to the south toward the coastline. Although bedrock was not encountered during site activities, it appears to be very shallow because outcrops were observed around the site. The soil at the site consists of well-graded sand with silt and gravel, based on observations made at adjacent SWMU 5. AOC A lies within the Kv formation, which comprises sandstone, siltstone, conglomerate, lava, tuff, and tuffaceous breccia. For more information on the bedrock geology see Section 1.4.6.

No surface water bodies are present at the site. The closest surface water body is the ocean, located approximately ½ mile to the south and southeast. Based on the depth to groundwater encountered at other locations significantly above sea level (see Figure 1-9 and 1-10), groundwater beneath the OP-1 area is estimated to be more than 100 feet bls.

11.2 Sampling Approach and Chemical Constituents Identified

Soil samples were collected from 10 locations following removal of the UST and associated piping in April 2003: six locations around the former tank (two at the bottom of the excavation and one on each of the four sides of the excavation), and four locations along the length of the bottom of the former fuel line that connected the tank to the generator (Figure 11-1). The samples around the side walls of the tank excavation were collected from approximately 4 ft to 5 ft bls, while samples from the bottom of the tank excavation were collected from approximately 8 ft to 10 ft bls. Samples from the former fuel line excavation were collected from approximately 2 ft bls. The soil samples were analyzed for BTEX and methyl tert-butyl ether (MTBE), TPH diesel range organics (DROs), naphthalene, and lead.

Table 11-1 summarizes the constituents detected in AOC A subsurface soil samples collected during the 2003 UST removal and identifies screening criteria exceedances. Raw analytical data for the samples are provided in Appendix O.

11.3 AOC A Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection table (Table 11-1).

Appendix N, Section N.11 discusses the evaluation of the AOC A data quality. As detailed in Section N.11, the AOC A data are acceptable for use in evaluating whether a release of petroleum-related constituents warranting further action occurred at AOC A, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a diesel UST and associated fuel fill pipe. While petroleum constituents are generally exempt from CERCLA and RCRA, the site was

identified in the Consent Order and sampled as part of the UST removal. Further, the Navy and EPA have agreed to further address the site under CERCLA. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected in April 2003 following the UST removal, the following inorganics above the background UTLs and non-inorganics were detected:

Subsurface Soil

- BTEX: m- and p-xylene, o-xylene, total xylene
- MTBE and naphthalene: none detected
- Lead
- TPH-DRO

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

As noted previously, petroleum hydrocarbons are exempt from CERCLA. However, because the site was included in the Consent Order and agreed upon by the Navy and EPA to address under RCRA (now CERCLA in accordance with the NPL listing of Vieques), the detected constituents are considered to be associated with CERCLA-related releases and are therefore considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection table. Those constituents that exceed one or more criteria (and background for inorganics) are listed below.

Subsurface Soil

- Xylenes: no exceedances
- Lead: no exceedances
- TPH-DRO: four detections (SB07 through SB10) at concentrations (121 mg/kg to 2,040 mg/kg) above the PREQB corrective action criterion (100 mg/kg)

As shown above, there are exceedances of the PREQB screening criterion for TPH-DRO. Therefore, decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

The data suggest that the soil removal associated with the UST excavation was sufficient. All constituents analyzed for in the samples associated with the UST were either not

detected or were detected below screening criteria. However, TPH-DRO concentrations in the subsurface soil beneath the former piping from the UST to the generator exceed the PREQB corrective action criterion, which indicates additional soil removal may be warranted.

Step 5a: Would additional source area data permit more realistic evaluations?

Additional data below the former piping would not alter the fact that TPH concentrations above the PREQB corrective action criterion are present in the soil. Therefore, in accordance with the decision tree, additional soil removal is warranted, followed by additional confirmatory soil sampling.

11.4 Conclusions and Recommendations

Table 11-2 summarizes the results of the decision analysis for AOC A, which indicates there has been a release at the site that has resulted in contamination of soil above the PREQB UST corrective action criterion. Therefore, additional soil removal and confirmatory soil sampling is recommended as outlined below.

Rationale

Soil data associated with the former piping excavation show TPH-DRO concentrations are above the PREQB UST corrective action criterion.

Objective

To remove soil with TPH-DRO concentrations above the PREQB UST corrective action criterion as follows:

- Perform additional soil excavation within the area where the TPH exceedances were identified (i.e., along the former fill pipe length, as shown in Figure 11-1).
- Collect confirmatory soil samples along the side-walls (at a depth of approximately 2 ft bls) and bottom of the excavated area. Collect samples at the frequency of one set of three (each sidewall and bottom) per 5 linear ft (lf) of excavation. Sidewall sample depths will be from 0-ft to 1-ft bgs because of the nature of past releases (i.e., to ground surface).
- Analyze all samples for TPH-DRO

Decision Analysis

If the concentrations of the new soil samples are below the PREQB UST corrective action criterion of 100 mg/kg, then the excavation will be backfilled and NFA will be necessary at the site.

- or -

If any single soil sample is above the PREQB UST corrective action criterion, a case-by-case evaluation will be performed in order to determine if EQB concurs with the Navy's recommendation for "No Further Action."

Otherwise, additional excavation will be performed in order to meet at least one of the above condition.

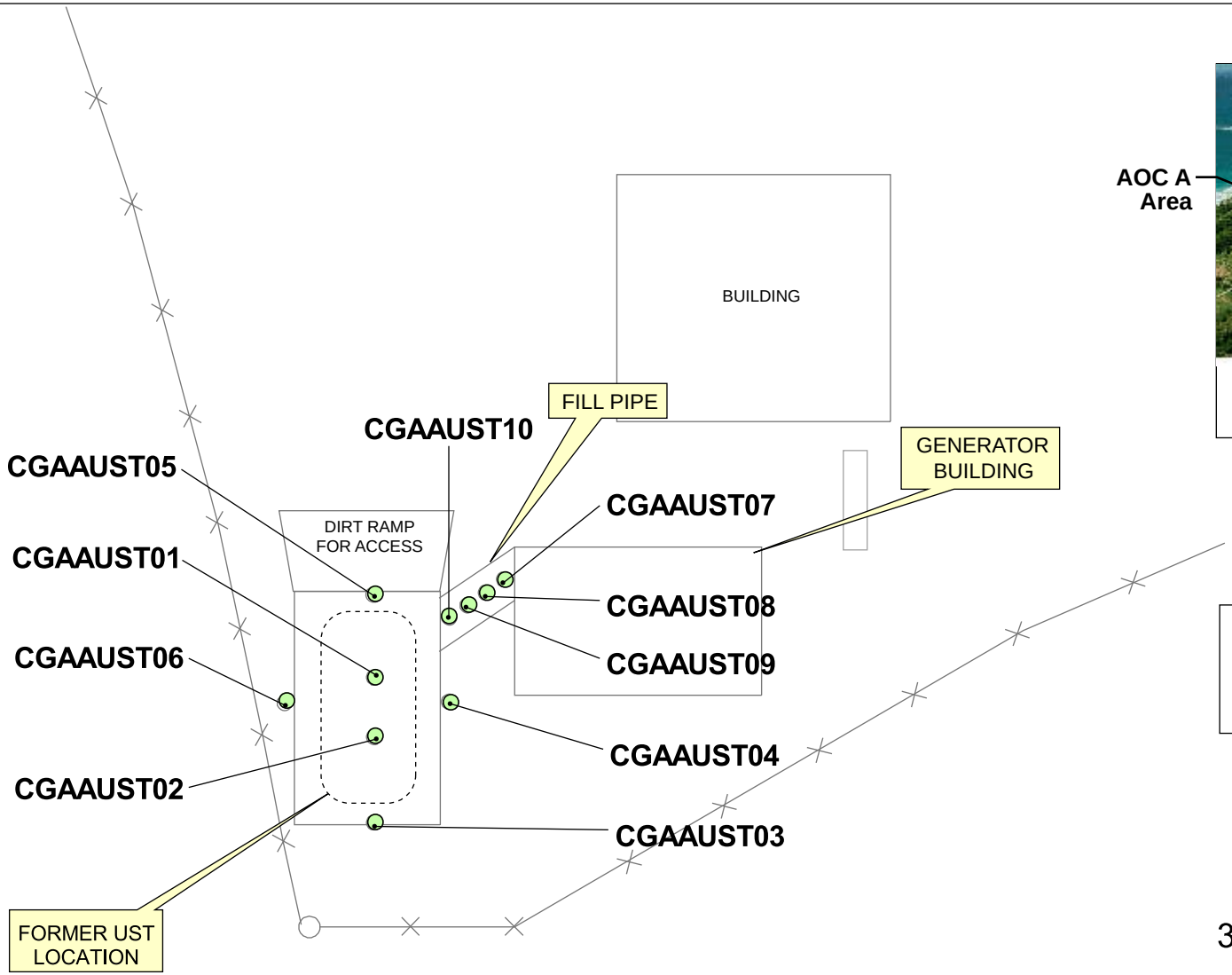
TABLE 11-1
AOC A Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**PREQB UST Corrective Action Criteria**	**Vieques HHRA SO**	**Vieques (East) Background Zone Kv SS**	CGAAUST01	CGAAUST02	CGAAUST03	CGAAUST04	CGAAUST05	CGAAUST06	CGAAUST07	CGAAUST07	CGAAUST08	CGAAUST09	CGAAUST10
Sample ID					001	002	003	004	005	006	007	FD1	008	009	010
Sample Date					4/14/03	4/14/03	4/14/03	4/14/03	4/14/03	4/14/03	4/14/03	4/14/03	4/14/03	4/14/03	4/14/03
Chemical Name															
BTEX (µg/kg)															
m- and p-Xylene	10,000	10,000	27000*	--	5.6 U	5.3 U	5.5 U	5.5 U	4.6 U	5.1 U	4.9 U	5.2 U	3 J	5.2 U	4.9 U
o-Xylene	10,000	10,000	27,000	--	5.6 U	5.3 U	5.5 U	5.5 U	4.6 U	5.1 U	4.9 U	5.2 U	7	4.5 J	0.46 J
Xylene, total	10,000	10,000	27,000	--	5.6 U	5.3 U	5.5 U	5.5 U	4.6 U	5.1 U	4.9 U	5.2 U	10	4.5 J	4.9 U
MTBE and Napthalene (µg/kg)															
No Detections															
Lead (mg/kg)															
Lead	14	50	400	5.4	2.04	1.57	1.94	2.94	2.09	1.79	6.87	3.82	4.06	3.1	2.96
Total Petroleum Hydrocarbons - DRO (mg/kg)															
TPH-DRO	--	100	--	--	50.1	4.3 U	15.6	11.4	2 J	1.6 J	121	177	976	2,040	440

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
PREQB UST Corrective Action Criteria - Puerto Rico Regulations, Office of the Governor, EQB, "Underground Storage Tank Regulations" State file number #4362. (PREQB, 1990)
* Total xylene PRG value used as surrogate
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Exceeds Background and UST criteria

TABLE 11-2
AOC A Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 5a Additional Source Area Data Beneficial?
Subsurface Soil	Yes					Characterization indicates additional soil removal beneath former piping is warranted.
		Xylenes	Yes	No	N/A	
		Lead	Yes	No	N/A	
		TPH-DRO	Yes	Yes	No	



Location Map

Legend

Samples:

- Subsurface Soil Sample Location
- Chain Link Fence

N
W E
S

30 0 30 Feet

Figure 11-1
Subsurface Soil Sample Location Map, AOC A
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 12

AOC F—Rock Quarry (Camp García)

This section presents the results of the PA/SI performed at AOC F - the Camp Garcia rock quarry.

12.1 Conceptual Site Model

The CSM for AOC F is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews, as well as site-specific data collection.

12.1.1 Site History and Potential Sources of Release

The AOC F rock quarry is located southwest of the former Camp Garcia landfill (Figures 1-2 and 1-3). This site was historically used by the Navy as a source of gravel for road construction and other projects, and is still being used as a gravel source for road construction activities. The 1995 RFA Report noted that used tires and some paper waste were visible at this location (PREQB, 1995). The two RFA reports prepared for this site recommended NFA (Kearney, 1988; PREQB, 1995).

During the February 2000 site inspection in which the EPA and Navy visited the Consent Order sites, no tires or other waste were observed at the quarry, and the quarry was not active. No additional historical usage information is known for this AOC.

Based on the information above, there is no known or suspected source of CERCLA-related releases at the rock quarry.

12.1.2 Physical Setting

The description of the site's physical setting is based on site inspections in February 2000 and June 2000 (CH2M HILL, 2001), as well as on regional information. The site consists of bare soil overlying bedrock with sparse trees; the southern and eastern sides of the site are bordered by a dirt road. Rock outcrops are visible, with low lying areas between the higher rock formations, as shown in the 1962 aerial photograph (Figure 12-1). The site sits at approximately 60 ft amsl, with the surface topography sloping gradually to the southeast. There are no surface water bodies at or adjacent to the site, but Bahia Tapon is located less than ¼ mile to the southwest. The soil at the site consists of lean clay with gravel and poorly graded sand with clay. AOC F lies primarily within the Kv formation, which consists of sandstone, siltstone, conglomerate, lava, tuff, and tuffaceous breccia. The far eastern and western ends of the quarry lie within the Qa formation, which consists of alluvial deposits of gravel, sand, silt, and clay. For more information on the bedrock geology see Section 1.4.6.

12.2 Sampling Approach and Chemical Constituents Identified

A surface soil sampling investigation referred to as the Phase I Environmental Assessment was conducted in June 2000 as part of the transfer of Navy Public Works operations from west Vieques to east Vieques. Following this transfer, the rock quarry was used for road maintenance activities. Five surface soil samples were collected from the portion of the quarry within the Kv formation at sampling locations illustrated in Figure 12-2**.** The samples were analyzed for Appendix IX VOCs, SVOCS, pesticides, herbicides, PCBs, and metals.

Table 12-1 summarizes the constituents detected in AOC F surface soil samples collected during the 2000 Phase I Environmental Assessment and identifies screening criteria exceedances. Raw analytical data for the samples are provided in Appendix O.

Composite samples of the rock material to be used for road repair were collected in 2007 at the request of EPA. The results of these samples are discussed in Step 4 of the decision analysis in Section 12.3 below.

12.3 AOC F Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection table (Table 12-1).

Appendix N, Section N.12 discusses the evaluation of the AOC F data quality. As detailed in Section N.12, the AOC F data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at AOC F, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was used as a quarry. There is no evidence or historical data that suggests hazardous waste or materials were disposed of at the site. However, the site was identified in the Consent Order and subsequently sampled as part of the Environmental Assessment. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For samples collected during the 2000 Environmental Assessment, the following inorganics above background UTLs and non-inorganics were detected by medium:

<u>Surface Soil</u>

- VOCs: none detected
- SVOCs: none detected
- Pesticides: delta-BHC
- Herbicides: 2,4,5-T
- PCBs: none detected
- Inorganics above background UTLs: arsenic, barium, beryllium, cobalt, selenium

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Although there are no known or suspected CERCLA-related activities at the rock quarry that could have released hazardous constituents or waste, the inorganics are conservatively considered further in the decision analysis process.

The concentrations of the pesticide and herbicide detected at AOC F are similar to the concentrations detected at other sites across east Vieques. Consequently, the pesticide and herbicide are likely attributable to normal pesticide use, not to a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1) and are, therefore, not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection table. Those constituents that exceed one or more criteria (and background for inorganics) are listed below.

<u>Surface Soil</u>

- Arsenic: five detections (samples SS01 through SS05) at a concentrations (2.1 mg/kg to 4.2 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Barium: three detections (samples SS02, SS03, SS05) at concentrations (218 mg/kg to 268 mg/kg) above the SSL at a DAF 1 (82 mg/kg) and background UTL (212 mg/kg)
- Cobalt: one detection (sample SS03) at a concentration (25.9 mg/kg) above the ecological screening value (13 mg/kg) and background UTL (25.5 mg/kg)
- Selenium: five detections (samples SS01 through SS05) at concentrations (0.84 mg/kg to 1.4 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF 1 (0.3 mg/kg), and background UTL (0.51 mg/kg)

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Arsenic was detected above background and its human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR), at a maximum concentration of 4.2 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (which is based on skin and vascular effects), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the relatively low maximum detected concentration (relative to the acceptable risk-based range) that would be used in risk calculations, risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver.

Although vanadium was detected in soil above the adjusted residential PRG, its PRG is based on increased mortality, so there is no concern about potential cumulative human

health effects from multiple constituents in site soil. Further, all vanadium concentrations are below the background UTL.

In addition to the above, although the arsenic UTL is 1.6 mg/kg, arsenic concentrations up to 5 mg/kg were detected during the east Vieques background soil inorganics investigation (CH2M HILL, 2007b). Although concentrations above 1.6 mg/kg were considered outliers for the purposes of establishing a background UTL, those concentrations may very well be representative of true background arsenic concentrations. This information, together with the above information, indicates the arsenic concentrations detected at AOC F (i.e., maximum of 4.2 mg/kg) may be representative of background.

Cobalt and selenium concentrations exceed ecological screening values and background in at least one surface soil sample collected at the site. These constituents do not likely pose an unacceptable risk to ecological receptors based upon the following:

- The area is an active quarry, with surficial material being periodically reworked and removed. Thus, the quarry provides limited habitat and, therefore, potential exposures to ecological receptors are likely minimal.
- Only one cobalt concentration exceeds the ecological screening value and background UTL. However, the concentration (25.9 mg/kg) is only slightly above the background UTL (25.5 mg/kg).
- Although selenium exceeds the background UTL of 0.51 mg/kg, the relative uniformity of the concentrations (0.84 to 1.4 mg/kg) suggests that selenium may be present at background concentrations Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at AOC F (maximum of 1.40 mg/kg) may be within the range of background, especially considering that other data collected for the site do not suggest a CERCLA-related release has occurred. Further, all selenium concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Given these factors, and the low quality habitat (bare dirt and rock with sparse vegetation), no unacceptable risks to ecological receptors are likely for exposure to selenium.

The concentrations of three constituents (arsenic, barium, and selenium) exceed the SSL at a DAF of 1 and background UTL. However, data from other sites suggest SSLs at a DAF of 1 are not realistic predictors of leaching to groundwater. For example, at SWMU 1, arsenic and selenium were detected in soil above the SSL at a DAF of 1; however, arsenic was not detected in groundwater and selenium was detected in groundwater below screening criteria. At AOC F, none of the arsenic, barium, or selenium concentrations exceeds the SSL at a DAF of 5.

As noted above, the arsenic concentrations may be representative of background, especially considering the arsenic concentrations detected in the crushed rock samples collected at the quarry (see Table 12-2 and the discussion below regarding the quarry rock samples). In addition, although three barium concentrations exceed the background UTL and SSL at a DAF of 1, the magnitude of background exceedances is relatively low. Similar to arsenic, barium concentrations up to 292 were detected during the background soil inorganics

investigation. Therefore, it is possible that the barium concentrations detected in the quarry soil samples are representative of background (maximum concentration of 268 mg/kg). In addition, there is no likely CERCLA-related source of barium at AOC F. Barium is most commonly used in drilling muds, and can be a component in bricks, ceramics, glass, and rubber.

In addition to the above information, crushed rock samples were collected from the rock quarry at the request of EPA to support use of the rock quarry material for road repair. The results of the comparison of the rock quarry sample data to typical screening criteria (i.e., east Vieques soil background data and risk-based screening criteria) provide not only the rationale for why the data support that the material should be acceptable for use as road repair material, but that the material has not likely been affected by a release. The Technical Memorandum summarizing this information is provided in Appendix P.

In accordance with the *Operational Plan for Removal of Rock Material from AOC F to be Used as Roadbed Materials* (CH2M HILL, 2005), composite rock quarry samples were collected at a rate of 1 grab sample per 100 cubic yards of material removed from the rock quarry. At the request of EPA (EPA, 2005), the samples were analyzed for TAL metals to assess the use of the material as roadbed material. The analytical results of the samples are provided in Table 12-2.

The samples collected at AOC F were crushed stone collected from piles created by a bulldozer scraping up rock and weathered rock from the quarry. The photographs taken during sample collection suggest the piles were primarily rock, with some weathered rock interspersed. The samples were pulverized by the laboratory in order to perform the required analyses. Therefore, while comparison to east Vieques soil background data is a logical first step in evaluation of the quarry sample data, it is reasonable that this comparison alone may not be sufficient to make a determination of whether the quarry samples are representative of background because constituent concentrations in soil may differ from those in rock due to their different physical forms and chemical characteristics.

Table 12-2 shows the screening criteria comparison performed for the rock quarry samples. Because the rock quarry lies within the Kv and Qa geologic zones, the rock quarry data were initially screened against the background soil UTLs for these two zones. Any constituent concentration that exceeded the higher of the two background soil UTLs was then compared to the residential PRG. Results of this screening show that only three constituents from the rock quarry samples had concentrations above both the background soil UTLs and the residential PRGs (noting that calcium does not have a PRG, but its background UTL was exceeded). These three constituents are arsenic, calcium, and iron. There is no known anthropogenic source of arsenic, calcium, or iron contamination at the AOC.

The highest calcium concentration detected in the rock quarry samples was 30,800 mg/kg, which exceeds the background calcium UTL of 11,900 mg/kg. The presence of calcium above the background soil UTL is most likely due to the presence of limestone and calcite deposits in the rock fractures. Limestone is part of Kv (and surely Qa because of the nature of this formation) and white "veins" were observed in the quarry samples collected. In addition, the calcium concentrations detected in the AOC F quarry samples are within the range of calcium concentrations (2,000- 38,000 mg/kg) of the background bedrock samples collected on west Vieques (CH2M HILL, 2002). Based on this information, the presence of

calcium in the AOC F samples is indicative of background rock concentrations and not a "calcium release."

The highest arsenic concentration detected in the rock quarry samples was 7.2 mg/kg, which was one of only two arsenic concentrations (the other being 5.7 mg/kg) detected in rock quarry samples above the range of arsenic concentrations detected during the east Vieques background study (including outliers, where arsenic concentrations up to 5 mg/kg were detected). For arsenic, the PRG of 0.39 mg/kg is based on a cancer risk of 1×10^{-6}. Given that EPA defines the acceptable risk range to be 1×10^{-4} to 1×10^{-6}, only 3 of the 41 arsenic concentrations exceed the PRG based on 1×10^{-5} (i.e., 3.9 mg/kg), and none exceed the PRG based on 1×10^{-4} (i.e., 39 mg/kg). The mean arsenic concentration (approximately 2.6 mg/kg) is less than the 1×10^{-5} PRG (i.e., 3.9 mg/kg). It is important to note that all arsenic concentrations detected in the quarry samples are at the lower end of the range of arsenic concentrations (i.e., 0.96 to 36 mg/kg) and below the mean of arsenic concentration (i.e., 8.91 mg/kg) reported by ATSDR for Vieques (ATSDR, 2003). Arsenic is common in marine deposits, primarily associated with iron sulfides (in reducing depositional environments) and iron oxyhydroxides (in oxidizing depositional environments). Further, arsenic concentrations between 5 and 40 mg/kg have been measured in uncontaminated marine sediments (Neff, 1997).

The highest iron concentration detected in the AOC F rock quarry samples was 46,800 mg/kg, which exceeds the background UTL of 38,100 mg/kg. However, only 2 of the 41 iron concentrations within the rock quarry samples exceeded both the PRG and background screening values. Furthermore, none of the iron concentrations detected in the quarry samples exceeds the mean iron concentration (54,200 mg/kg) detected in samples from the Kv lithology analyzed by ATSDR (ATSDR, 2003).

Based on the information above, it is very likely that all quarry sample constituent concentrations are representative of background rock concentrations in that area. Furthermore, for those constituents above soil background UTLs and residential PRGs, a comparison of the data to acceptable screening criteria suggests the exceedances would not pose an unacceptable risk to human receptors over that of background.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

Historical information regarding the rock quarry indicates there is no likely CERCLA-related source of release at the site. In addition, because both the soil and rock data were collected and both sets of data suggest the constituent concentrations are likely attributable to background, the site has been sufficiently characterized.

12.4 Conclusions and Recommendations

Table 12-3 summarizes the results of the decision analysis for AOC F, which indicates inorganic constituent concentrations detected are likely attributable to background and that there has not likely been a CERCLA-related release at the site. Further, the pesticide and herbicide detections at the site are likely associated with normal pesticide use, not a CERCLA-related release. Therefore, NFA is recommended.

TABLE 12-1
AOC F Surface Soil Detection and Exceedance Results
Preliminary Asssessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone Kv SS**	CGAOCFSS001	CGAOCFSS002	CGAOCFSS003	CGAOCFSS004	CGAOCFSS005	
Sample ID					NDD044	NDD045	NDD046	NDD047	NDD048	NDD049FD1
Sample Date					6/14/00	6/14/00	6/14/00	6/14/00	6/14/00	6/14/00
Chemical Name										
Volatile Organic Compounds (µg/kg)										
No Detections										
Semivolatile Organic Compounds (µg/kg)										
No Detections										
Pesticide/Polychlorinated Biphenyls (µg/kg)										
delta-BHC	0.1	440	--	--	1.8 UJ	1.5 UJ	2.1 UJ	1.7 UJ	2 UJ	0.73 J
Herbicides (µg/kg)										
2,4,5-T	--	61,000	--	--	79 UJ	67 UJ	5.2 J	75 UJ	86 UJ	73 UJ
Total Metals (mg/kg)										
Arsenic	1	0.39	18	1.6	2.1	2.9	4.2	3	3.1	4.2
Barium	82	1600	330	212	160	268	238	61.8	218	165
Beryllium	3	15	40	0.27	0.34	0.32	0.53	0.37	0.37	0.37
Chromium	2	210	0.4	72	8.1	9.8	21.5	10.4	20.2	14.9
Cobalt	33	140	13	25.5	16.7	20	25.9	15.2	22.7	20.5
Copper	46	310	70	94.2	9.2	19.2	34.7	29.4	30.7	27.7
Lead	14	400	120	5.4	1.6	2.2	3.2	2.7	2.4	2.6
Mercury	0.1	2.3	0.1	0.057	0.05 J	0.012 UJ	0.022 UJ	0.015 UJ	0.017 UJ	0.013 UJ
Nickel	7	160	38	41	4.9 J	4.5 J	10.9	3.7 J	9.7	7.4
Selenium	0.3	39	0.52	0.51	0.84 J	1.1 J	1.4 J	0.86 J	1.3 J	1.2 J
Vanadium	300	7.8	2	144	73.8	81.5	118	96.9	99.7	116
Zinc	620	2,300	120	32	18.1	15.3	17.7	10.5	13.9	14.5

Notes:
- mg/kg - Milligrams per kilogram
- µg/kg - Micrograms per kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will and Suter, 1997)
Vieques Eco SO - Screening values for compounds (nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (arsenic, barium, beryllium, cobalt, lead) (EPA, 2005b)

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

Table 12-2
AOC F Gravel Analytical Results, May 2007
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Soil Bkg Criteria - Zone Kv	Soil Bkg Criteria - Zone Qa	Vieques HHRA SO	VEAF-G2D3I4		VEAF-G2D3I5		
Sample ID				VEAF-G2D3I4-08-0507	VEAF-G2D3I4-09-0507	VEAF-G2D3I5-10-0507	VEAF-G2D3I5-10P-0507	VEAF-G2D3I5-11-0507
Sample Date				05/03/07	05/03/07	05/03/07	05/03/07	05/03/07
Chemical Name								
Total Metals (MG/KG)								
Aluminum	35,000	35,000	7600	14,700 D	15,900 D	16,200 D	18,600 D	24,300 D
Antimony	NA	NA	3.1	24.5 U	24.5 U	24.7 U	25 U	25.3 U
Arsenic	1.6	1.6	0.39	2.3 JD	3.8 JD	1.6 JD	2 JD	2.4 JD
Barium	212	212	1600	16.5 JD	21.4 JD	23.5 JD	27.4 JD	45.7 JD
Beryllium	0.27	0.27	15	0.26 JD	0.29 JD	2.1 U	0.29 JD	0.35 JD
Calcium	8,840	11,900		7,000 D	6,980 D	9,170 D	10,600 D	14,800 D
Chromium	72	72	210	4.1 U	4.8 D	5.2 D	3.6 JD	5.9 D
Cobalt	25.5	15.8	140	26.9 D	26 D	24 D	24.5 D	30.6 D
Copper	94.2	52.8	310	106 D	44.2 D	80.8 D	77.4 D	82.3 D
Iron	43,200	38,100	2400	31,400 D	35,600 D	31,400 D	36,100 D	39,100 D
Lead	5.4	5.4	400	0.97 JD	2.6 JD	0.71 JD	4.2 U	2.2 JD
Magnesium	22,200	22,200		9,310 D	10,200 D	12,500 D	14,500 D	14,800 D
Manganese	1,630	1,630	180	393 D	404 D	416 D	477 D	583 D
Mercury	0.057	0.057	2.3	0.1 U	0.1 U	0.1 U	0.1 U	0.013 J
Nickel	41	22.2	160	3.5 JD	3.6 JD	4.9 JD	4.6 JD	5.3 JD
Potassium	5,270	5,270		576 JD	718 JD	942 JD	930 JD	1,650 JD
Selenium	0.51	0.51	39	14.3 U	14.3 U	14.4 U	14.6 U	14.8 U
Silver	0.22	0.22	39	7 D	8.5 D	6.7 D	8 D	7.5 D
Sodium	1,590	1,590		2,040 U	2,040 U	2,060 U	2,080 U	2,110 U
Vanadium	144	144	7.8	74.9 D	84.7 D	84.4 D	85.4 D	98.3 D
Zinc	32	32	2300	13 JD	10.7 JD	9.5 JD	14.9 JD	20.7 JD
Wet Chemistry (MG/KG)								
Cyanide	0.33	0.33	120	0.068 J	0.071 J	2.6 U	2.6 U	2.6 U
% Solids	NA	NA	NA	98.1	97.8	97.2	96.1	94.9

Notes:

D - Diluted Result
J - Below Detection Limit

N - Spiked sample recovery not within control limits
U - Analyte not detected
NA - Not Applicable
% - Percent
mg/Kg - Milligrams per Kilogram
Exceeds background and HHRA

Table 12-2
AOC F Gravel Analytical Results, May 2007
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Soil Bkg Criteria - Zone Kv	Soil Bkg Criteria - Zone Qa	Vieques HHRA SO	VEAF-G2D3J3					
Sample ID				VEAF-G2D3J3-01-0507	VEAF-G2D3J3-03-0507	VEAF-G2D3J3	VEAF-G2D3J3-04-0507	VEAF-G2D3J3-05-0507	VEAF-G2D3J3-06-0507
Sample Date				05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07
Chemical Name									
Total Metals (MG/KG)									
Aluminum	35,000	35,000	7600	12,900 D	17,900 D	15,400 D	15,900 D	16,200 D	9,850 D
Antimony	NA	NA	3.1	25.4 U	25 U	25.5 U	25.2 U	24.9 U	24.8 U
Arsenic	1.6	1.6	0.39	3.3 JD	3.1 JD	3 JD	2 JD	1.9 JD	1.7 JD
Barium	212	212	1600	24.1 JD	27.2 JD	28.5 JD	27.4 JD	26.3 JD	20.5 JD
Beryllium	0.27	0.27	15	2.1 U	2.1 U	0.24 JD	0.24 JD	2.1 U	2.1 U
Calcium	8,840	11,900		5,320 D	5,740 D	6,800 D	6,850 D	7,730 D	5,020 D
Chromium	72	72	210	3.8 JD	4.7 D	3.9 JD	4.6 D	3.9 JD	2.3 JD
Cobalt	25.5	15.8	140	23.1 D	35.3 D	27.4 D	29.9 D	29.3 D	18.5 JD
Copper	94.2	52.8	310	48.6 D	34.6 D	49.2 D	42.4 D	35.8 D	32.2 D
Iron	43,200	38,100	2400	27,700 D	37,700 D	30,600 D	32,800 D	33,100 D	19,200 D
Lead	5.4	5.4	400	1.4 JD	4.2 U	4.3 U	1.2 JD	4.2 U	4.1 U
Magnesium	22,200	22,200		7,910 D	12,800 D	7,940 D	9,540 D	10,100 D	5,400 D
Manganese	1,630	1,630	180	309 D	384 D	447 D	463 D	419 D	268 D
Mercury	0.057	0.057	2.3	0.11 U	0.1 U	0.11 U	0.11 U	0.1 U	0.1 U
Nickel	41	22.2	160	2.9 JD	3.2 JD	3.3 JD	3.3 JD	3.1 JD	1.6 JD
Potassium	5,270	5,270		471 JD	1,850 JD	422 JD	564 JD	572 JD	344 JD
Selenium	0.51	0.51	39	14.8 U	14.6 U	14.9 U	14.7 U	14.6 U	14.5 U
Silver	0.22	0.22	39	6.1 D	9.1 D	6 D	7.2 D	7.3 D	4.1 U
Sodium	1,590	1,590		2,120 U	2,090 U	2,130 U	2,100 U	2,080 U	2,070 U
Vanadium	144	144	7.8	69.1 D	95.8 D	73.4 D	78.5 D	82.5 D	45.3 D
Zinc	32	32	2300	7.1 JD	11.7 JD	16.7 JD	13.3 JD	22.5 JD	4.6 JD
Wet Chemistry (MG/KG)									
Cyanide	0.33	0.33	120	0.12 J	2.6 U	2.7 U	2.6 U	2.6 U	2.6 U
% Solids	NA	NA	NA	94.5	95.9	94	95.2	96.2	96.6

Notes:

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% - Percent
mg/Kg - Milligrams per Kilogram
Exceeds background and HHRA

Table 12-2
AOC F Gravel Analytical Results, May 2007
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Soil Bkg Criteria - Zone Kv	Soil Bkg Criteria - Zone Qa	Vieques HHRA SO	VEAF-G2D3J4							
Sample ID				VEAF-G2D3J4-07-0507	VEAF-G2D3J4-14-0507	VEAF-G2D3J4-15-0507	VEAF-G2D3J4-16-0507	VEAF-G2D3J4-17-0507	VEAF-G2D3J4-18-0507	VEAF-G2D3J4-19-0507	VEAF-G2D3J4-20-0507
Sample Date				05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07
Chemical Name											
Total Metals (MG/KG)											
Aluminum	35,000	35,000	7600	13,000 D	16,100 D	15,000 D	16,400 D	12,500 D	9,970 D	6,720 D	15,700 D
Antimony	NA	NA	3.1	24.8 U	24.4 U	24.7 U	24.2 U	24.1 U	24.1 U	12.1 U	24.2 U
Arsenic	1.6	1.6	0.39	1.4 JD	1.8 JD	2 JD	2.3 JD	3.2 JD	2.2 JD	1.9 JD	3.3 JD
Barium	212	212	1600	28.3 JD	23.3 JD	11.9 JD	69.7 JD	15.8 JD	10.8 JD	8.9 JD	22.3 JD
Beryllium	0.27	0.27	15	2.1 U	0.26 JD	0.31 JD	0.27 JD	2 U	2 U	0.14 JD	0.43 JD
Calcium	8,840	11,900		5,200 D	12,900 D	8,000 D	5,460 D	9,940 D	9,660 D	7,900 D	11,700 D
Chromium	72	72	210	3.2 JD	3.1 JD	4.1 U	4.4 D	11.4 D	3.2 JD	4.6 D	5.7 D
Cobalt	25.5	15.8	140	35.8 D	22.9 D	20.2 JD	21.5 D	18.6 JD	23.7 D	10.9 D	20.7 D
Copper	94.2	52.8	310	30.9 D	50.4 D	295 D	34.1 D	23.5 D	142 D	12.2 D	30.3 D
Iron	43,200	38,100	2400	25,900 D	31,200 D	36,100 D	31,600 D	33,200 D	22,600 D	18,200 D	35,300 D
Lead	5.4	5.4	400	4.1 U	4.1 U	0.86 JD	4 U	0.97 JD	4 U	0.39 JD	1.2 JD
Magnesium	22,200	22,200		8,270 D	11,800 D	10,300 D	10,400 D	8,750 D	9,280 D	5,860 D	13,800 D
Manganese	1,630	1,630	180	413 D	457 D	263 D	741 D	358 D	257 D	229 D	460 D
Mercury	0.057	0.057	2.3	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	41	22.2	160	2.4 JD	2.8 JD	4.5 JD	3.2 JD	12.3 JD	2.6 JD	2.5 JD	3.9 JD
Potassium	5,270	5,270		346 JD	1,010 JD	424 JD	802 JD	642 JD	386 JD	272 JD	805 JD
Selenium	0.51	0.51	39	14.4 U	14.2 U	14.4 U	14.1 U	14.1 U	14 U	7.1 U	14.1 U
Silver	0.22	0.22	39	5.6 D	6.1 D	8.5 D	6.7 D	7.6 D	5 D	3.7 D	6.6 D
Sodium	1,590	1,590		2,060 U	2,030 U	2,060 U	2,020 U	2,010 U	2,010 U	1,010 U	2,020 U
Vanadium	144	144	7.8	63.5 D	74.7 D	85.6 D	75.4 D	70.9 D	49.7 D	39 D	73.9 D
Zinc	32	32	2300	11.6 JD	21.6 JD	7.8 JD	8.3 JD	10 JD	7.6 JD	5.8 JD	11.9 JD
Wet Chemistry (MG/KG)											
Cyanide	0.33	0.33	120	2.6 U	2.5 U	2.6 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U
% Solids	NA	NA	NA	96.9	98.4	97.2	99.2	99.6	99.7	99	99.1

Notes:

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N - Spiked sample recovery not within control limits
U - Analyte not detected
NA - Not Applicable
% - Percent
mg/Kg - Milligrams per Kilogram
Exceeds background and HHRA

Table 12-2
AOC F Gravel Analytical Results, May 2007
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Soil Bkg Criteria - Zone Kv	Soil Bkg Criteria - Zone Qa	Vieques HHRA SO	VEAF-G2D3J4		VEAF-G2D3J5	
Sample ID				VEAF-G2D3J4-20P-0507	VEAF-G2D3J4-21-0507	VEAF-G2D3J5-12-0507	VEAF-G2D3J5-13-0507
Sample Date				05/03/07	05/03/07	05/03/07	05/03/07
Chemical Name							
Total Metals (MG/KG)							
Aluminum	35,000	35,000	7600	20,300 D	14,700 D	15,200 D	13,100 D
Antimony	NA	NA	3.1	30.6 U	24.5 U	24.2 U	24.3 U
Arsenic	1.6	1.6	0.39	2.7 JD	2.3 JD	2.6 JD	1.3 JD
Barium	212	212	1600	20.2 JD	23.2 JD	26.9 JD	8.7 JD
Beryllium	0.27	0.27	15	0.33 JD	0.26 JD	0.32 JD	2 U
Calcium	8,840	11,900		10,600 D	11,400 D	18,000 D	4,240 D
Chromium	72	72	210	6.6 D	5.1 D	3.5 JD	2.6 JD
Cobalt	25.5	15.8	140	22.7 JD	17.4 JD	23 D	19.4 JD
Copper	94.2	52.8	310	43.1 D	14.1 D	18.5 D	71.7 D
Iron	43,200	38,100	2400	39,500 D	31,200 D	27,700 D	26,800 D
Lead	5.4	5.4	400	5.1 U	4.1 U	4 U	4.1 U
Magnesium	22,200	22,200		14,500 D	10,800 D	10,300 D	11,900 D
Manganese	1,630	1,630	180	464 D	420 D	476 D	289 D
Mercury	0.057	0.057	2.3	0.1 U	0.013 J	0.1 U	0.1 U
Nickel	41	22.2	160	4.1 JD	3.2 JD	2.8 JD	3.1 JD
Potassium	5,270	5,270		1,190 JD	664 JD	627 JD	479 JD
Selenium	0.51	0.51	39	17.9 U	14.3 U	14.1 U	14.2 U
Silver	0.22	0.22	39	8.1 D	5 D	4.7 D	6.2 D
Sodium	1,590	1,590		2,550 U	2,040 U	2,010 U	2,030 U
Vanadium	144	144	7.8	83.8 D	67.2 D	59.9 D	53.9 D
Zinc	32	32	2300	26.4 JD	20.3 JD	12.5 JD	9.4 JD
Wet Chemistry (MG/KG)							
Cyanide	0.33	0.33	120	2.6 U	2.6 U	2.5 U	2.5 U
% Solids	NA	NA	NA	97.9	97.8	99.3	98.7

Notes:

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% - Percent
mg/Kg - Milligrams per Kilogram
Exceeds background and HHRA

Table 12-2
AOC F Gravel Analytical Results, May 2007
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Soil Bkg Criteria - Zone Kv	Soil Bkg Criteria - Zone Qa	Vieques HHRA SO	VEAF-G2E3A3							
Sample ID				VEAF-G2E3A3-37-0507	VEAF-G2E3A3-38-0507	VEAF-G2E3A3-39-0507	VEAF-G2E3A3-40-0507	VEAF-G2E3A3-40P-0507	VEAF-G2E3A3-41-0507	VEAF-G2E3A3-42-0507	VEAF-G2E3A3-42P-0507
Sample Date				05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07
Chemical Name											
Total Metals (MG/KG)											
Aluminum	35,000	35,000	7600	15,500 D	19,400 D	16,300 D	15,600 D	16,400 D	15,900 D	14,700 D	15,200 D
Antimony	NA	NA	3.1	24.6 U	60.6 U	24.4 U	24.3 U	1.3 JD	24.6 U	1.4 JD	24.6 U
Arsenic	1.6	1.6	0.39	5.7 D	7.2 JD	4.2 D	2.8 JD	2.5 JD	2 JD	2.5 JD	2.8 JD
Barium	212	212	1600	58.5 JD	40.5 JD	31.5 JD	24.6 JD	28.9 JD	35.7 JD	26.1 JD	25.3 JD
Beryllium	0.27	0.27	15	0.38 JD	0.62 JD	0.37 JD	0.32 JD	0.33 JD	0.32 JD	0.35 JD	0.35 JD
Calcium	8,840	11,900		5,880 D	15,600 D	15,600 D	10,300 D	10,200 D	9,410 D	10,500 D	9,780 D
Chromium	72	72	210	4 JD	5.8 JD	6.1 D	4.2 D	4.8 D	3.9 JD	5 D	4.3 D
Cobalt	25.5	15.8	140	39.6 D	49.8 JD	33.6 D	41.7 D	31.4 D	33 D	29.2 D	27 D
Copper	94.2	52.8	310	52.5 D	115 D	104 D	84 D	87.1 D	52.9 D	57.6 D	44.2 D
Iron	43,200	38,100	2400	38,300 D	46,800 D	38,000 D	35,100 D	36,600 D	39,800 D	35,600 D	34,000 D
Lead	5.4	5.4	400	2.1 JD	10.1 U	0.92 JD	0.94 JD	4.1 U	4.1 U	0.91 JD	4.1 U
Magnesium	22,200	22,200		11,900 D	15,300 D	13,000 D	12,100 D	13,200 D	14,300 D	12,300 D	13,500 D
Manganese	1,630	1,630	180	533 D	735 D	631 D	506 D	524 D	635 D	522 D	456 D
Mercury	0.057	0.057	2.3	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	41	22.2	160	3.6 JD	4.8 JD	5.2 JD	3.8 JD	3.9 JD	4.3 JD	3.9 JD	4 JD
Potassium	5,270	5,270		936 JD	933 JD	1,150 JD	877 JD	1,020 JD	1,050 JD	782 JD	827 JD
Selenium	0.51	0.51	39	14.3 U	35.4 U	14.2 U	14.2 U	14.2 U	14.4 U	14.3 U	1.3 JD
Silver	0.22	0.22	39	7.4 D	8.7 JD	5.9 D	6.5 D	6.8 D	7.4 D	6.2 D	6 D
Sodium	1,590	1,590		695 JD	5,050 U	2,030 U	2,020 U	2,030 U	294 JD	2,050 U	2,050 U
Vanadium	144	144	7.8	81.5 D	94 D	77.8 D	76.5 D	75.1 D	77.2 D	75.1 D	68.9 D
Zinc	32	32	2300	22.6 JD	13.9 JD	19.3 JD	21 JD	22.6 JD	16 JD	12.7 JD	17.3 JD
Wet Chemistry (MG/KG)											
Cyanide	0.33	0.33	120	2.6 U	2.5 U	2.5 U	2.5 U	2.5 U	2.6 U	2.6 U	2.6 U
% Solids	NA	NA	NA	97.6	99	98.5	98.9	98.4	97.5	97.7	97.4

Notes:

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Exceeds background and HHRA

Table 12-2
AOC F Gravel Analytical Results, May 2007
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Soil Bkg Criteria - Zone Kv	Soil Bkg Criteria - Zone Qa	Vieques HHRA SO	VEAF-G2E3A4							
Sample ID				VEAF-G2E3A4-22-0507	VEAF-G2E3A4-23-0507	VEAF-G2E3A4-24-0507	VEAF-G2E3A4-25-0507	VEAF-G2E3A4-26-0507	VEAF-G2E3A4-34-0507	VEAF-G2E3A4-35-0507	VEAF-G2E3A4-36-0507
Sample Date				05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07
Chemical Name											
Total Metals (MG/KG)											
Aluminum	35,000	35,000	7600	13,300 D	17,300 D	20,600 D	20,800 D	18,200 D	13,100 D	14,500 D	17,300 D
Antimony	NA	NA	3.1	24.4 U	24.1 U	24.3 U	30.3 U	1.2 JD	24.4 U	24.3 U	25.1 U
Arsenic	1.6	1.6	0.39	2.9 JD	2 JD	2.3 JD	3.1 JD	2.7 JD	3.2 JD	2.8 JD	1.8 JD
Barium	212	212	1600	13.7 JD	38.6 JD	41.3 JD	49.4 JD	57.4 JD	18.1 JD	19.8 JD	55.4 JD
Beryllium	0.27	0.27	15	0.26 JD	0.32 JD	0.38 JD	0.33 JD	0.4 JD	0.31 JD	0.29 JD	0.29 JD
Calcium	8,840	11,900		7,830 D	11,700 D	13,800 D	14,700 D	10,800 D	7,910 D	12,100 D	11,400 D
Chromium	72	72	210	13.7 D	4.6 D	4.5 D	4 JD	4.4 D	3.9 JD	3.2 JD	3.4 JD
Cobalt	25.5	15.8	140	40 D	35.7 D	39.8 D	42.2 D	26.4 D	42.2 D	33 D	30.4 D
Copper	94.2	52.8	310	30.8 D	93.9 D	71.6 D	77.1 D	29.7 D	160 D	23.4 D	46.8 D
Iron	43,200	38,100	2400	27,900 D	38,600 D	39,900 D	45,800 D	39,300 D	29,100 D	32,400 D	37,200 D
Lead	5.4	5.4	400	1.3 JD	0.71 JD	1.4 JD	1.1 JD	4 U	0.74 JD	4.1 U	1.8 JD
Magnesium	22,200	22,200		7,540 D	13,500 D	15,500 D	15,200 D	14,600 D	13,300 D	14,300 D	14,000 D
Manganese	1,630	1,630	180	362 D	600 D	678 D	687 D	588 D	428 D	503 D	492 D
Mercury	0.057	0.057	2.3	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	41	22.2	160	4.1 JD	4.2 JD	4.5 JD	4.5 JD	4.1 JD	3.8 JD	3.9 JD	4 JD
Potassium	5,270	5,270		467 JD	1,090 JD	1,740 JD	1,580 JD	1,150 JD	532 JD	712 JD	1,240 JD
Selenium	0.51	0.51	39	14.2 U	14.1 U	14.2 U	17.7 U	14.2 U	14.2 U	14.2 U	14.7 U
Silver	0.22	0.22	39	5.3 D	6.2 D	6.7 D	7.6 D	6.8 D	5.2 D	5.4 D	6.4 D
Sodium	1,590	1,590		2,030 U	2,010 U	179 JD	2,530 U	2,020 U	2,030 U	2,030 U	2,090 U
Vanadium	144	144	7.8	69.6 D	74.1 D	79.5 D	86.5 D	87.3 D	60.3 D	60.4 D	66.6 D
Zinc	32	32	2300	31.5 D	13.6 JD	27.9 D	29.2 JD	33.5 D	11 JD	25.3 D	21.5 JD
Wet Chemistry (MG/KG)											
Cyanide	0.33	0.33	120	0.078 J	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.5 U	2.6 U
% Solids	NA	NA	NA	98.5	99.4	98.8	98.9	98.8	98.3	98.6	95.5

Notes:

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Exceeds background and HHRA

Table 12-2
AOC F Gravel Analytical Results, May 2007
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Soil Bkg Criteria - Zone Kv	Soil Bkg Criteria - Zone Qa	Vieques HHRA SO	VEAF-G2E3A5		VEAF-G2E3B4		VEAF-G2E3B5			
Sample ID				VEAF-G2E3A5-27-0507	VEAF-G2E3A5-28-0507	VEAF-G2E3B4-32-0507	VEAF-G2E3B4-33-0507	VEAF-G2E3B5-29-0507	VEAF-G2E3B5-30-0507	VEAF-G2E3B5-30P-0507	VEAF-G2E3B5-31-0507
Sample Date				05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07	05/03/07
Chemical Name											
Total Metals (MG/KG)											
Aluminum	35,000	35,000	7600	16,600 D	20,100 D	11,900 D	15,900 D	18,600 D	16,400 D	13,700 D	19,100 D
Antimony	NA	NA	3.1	24.5 U	24.3 U	24.3 U	24.8 U	24.4 U	1.4 JD	24.3 U	24.6 U
Arsenic	1.6	1.6	0.39	3.4 JD	2.2 JD	1.8 JD	3.2 JD	2.5 JD	2.3 JD	2.5 JD	2.4 JD
Barium	212	212	1600	28.4 JD	70.3 JD	22.7 JD	30.3 JD	48.4 JD	17 JD	17.3 JD	18.3 JD
Beryllium	0.27	0.27	15	0.42 JD	0.36 JD	0.25 JD	0.32 JD	0.3 JD	0.33 JD	0.3 JD	0.36 JD
Calcium	8,840	11,900		30,800 D	18,100 D	5,400 D	9,710 D	13,600 D	7,530 D	6,080 D	7,990 D
Chromium	72	72	210	4.8 D	4.5 D	3.5 JD	8 D	4.2 D	5.1 D	4.9 D	6.1 D
Cobalt	25.5	15.8	140	37.3 D	43.9 D	17.4 JD	35.8 D	33.6 D	46.2 D	49 D	25.3 D
Copper	94.2	52.8	310	17.7 D	78.2 D	18.5 D	84.5 D	89.9 D	136 D	153 D	15.2 D
Iron	43,200	38,100	2400	38,900 D	39,100 D	26,100 D	37,900 D	37,500 D	39,900 D	36,200 D	39,100 D
Lead	5.4	5.4	400	4.1 U	1.1 JD	2 JD	4.1 U	4.1 U	4 U	4 U	4.1 U
Magnesium	22,200	22,200		14,500 D	14,800 D	10,400 D	14,000 D	15,600 D	15,700 D	13,800 D	16,400 D
Manganese	1,630	1,630	180	577 D	917 D	317 D	523 D	551 D	382 D	384 D	473 D
Mercury	0.057	0.057	2.3	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U	0.1 U
Nickel	41	22.2	160	4.3 JD	3.9 JD	3 JD	4 JD	4 JD	5 JD	4.5 JD	4.8 JD
Potassium	5,270	5,270		853 JD	2,120 D	768 JD	1,010 JD	1,920 JD	777 JD	703 JD	1,420 JD
Selenium	0.51	0.51	39	14.3 U	14.2 U	14.2 U	14.5 U	14.2 U	14.1 U	14.2 U	14.3 U
Silver	0.22	0.22	39	4.9 D	5.2 D	4.7 D	7 D	6.7 D	7.7 D	7.2 D	7.5 D
Sodium	1,590	1,590		2,040 U	2,030 U	340 JD	328 JD	2,030 U	350 JD	410 JD	1,070 JD
Vanadium	144	144	7.8	84.1 D	73.6 D	54.6 D	70.1 D	65.4 D	80.3 D	69.9 D	87 D
Zinc	32	32	2300	29.2 D	38.3 D	9.7 JD	11.7 JD	31 D	25.9 D	11.6 JD	21.8 JD
Wet Chemistry (MG/KG)											
Cyanide	0.33	0.33	120	0.16 J	0.12 J	0.08 J	0.066 J	2.5 U	2.5 U	0.15 J	2.6 U
% Solids	NA	NA	NA	97.9	98.6	98.9	96.8	98.5	99	98.9	97.6

Notes:

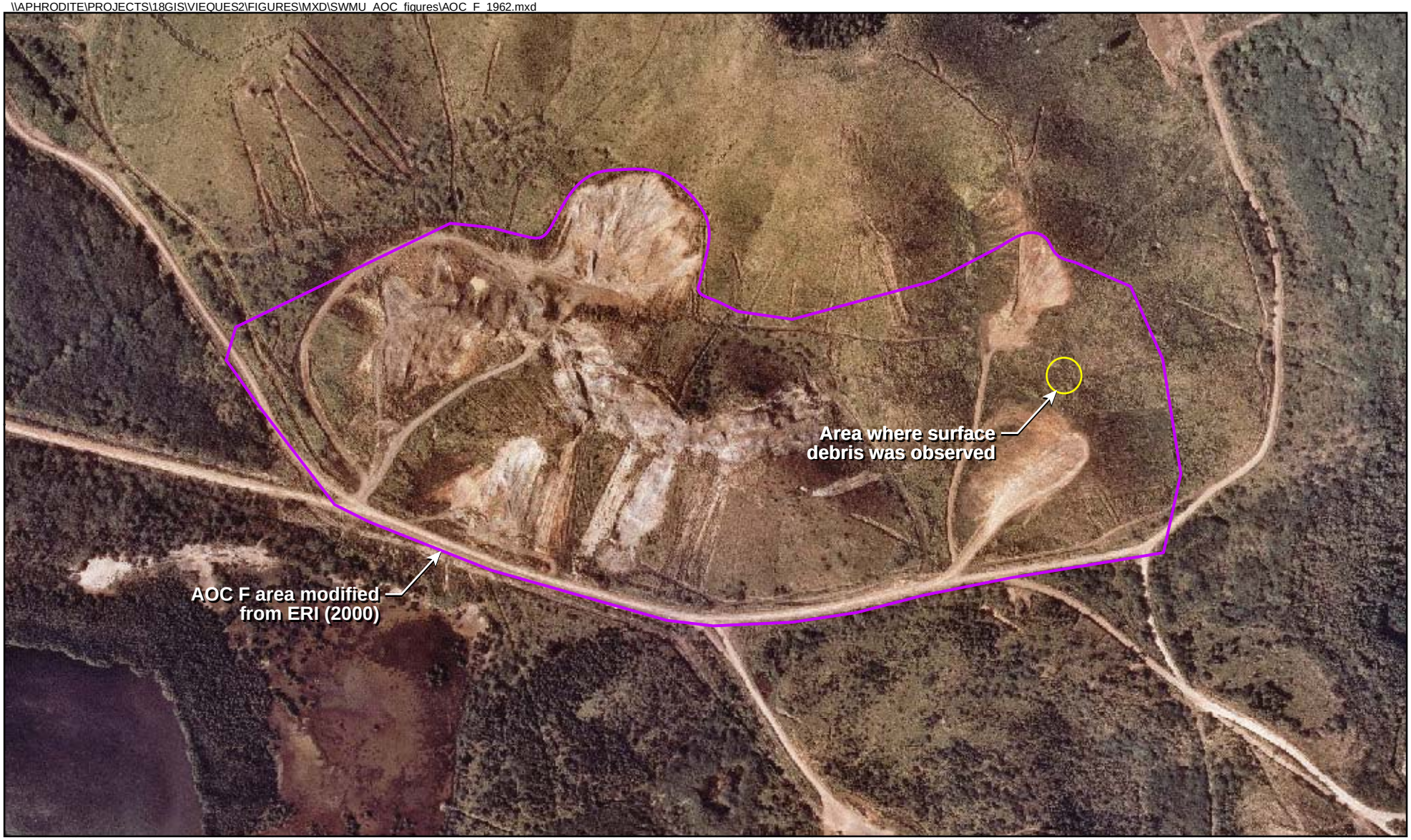
D - Diluted Result
J - Below Detection Limit

N - Spiked sample recovery not within control limits
U - Analyte not detected
NA - Not Applicable
% - Percent
mg/Kg - Milligrams per Kilogram
Exceeds background and HHRA

TABLE 12-3
AOC F Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		Pesticide	No	N/A	N/A	
		Herbicide	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; < SSL at a DAF of 5; concentrations likely attributable to background	
				Ba > SSL, BKG	< SSL at a DAF of 4; concentrations likely attributable to background; no likely release source	
				Co > ECO, BKG	only one exceedance of BKG (by 0.4 mg/kg)	
				Se > ECO, SSL, BKG	< ECO for soil invertebrates	
Rock	Yes					Medium sufficiently characterized; no further action for medium
		Inorganics	Yes	As > PRG, BKG	within acceptable HH risk range; < concentrations reported for Vieques by ATSDR	
				Fe > PRG, BKG	acceptable HH risk level; < concentrations reported for Vieques by ATSDR	

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\AOC_F_1962.mxd



Legend

- AOC F Area modified from the ERI (2000)
- Area where surface debris was observed

N
W E
S

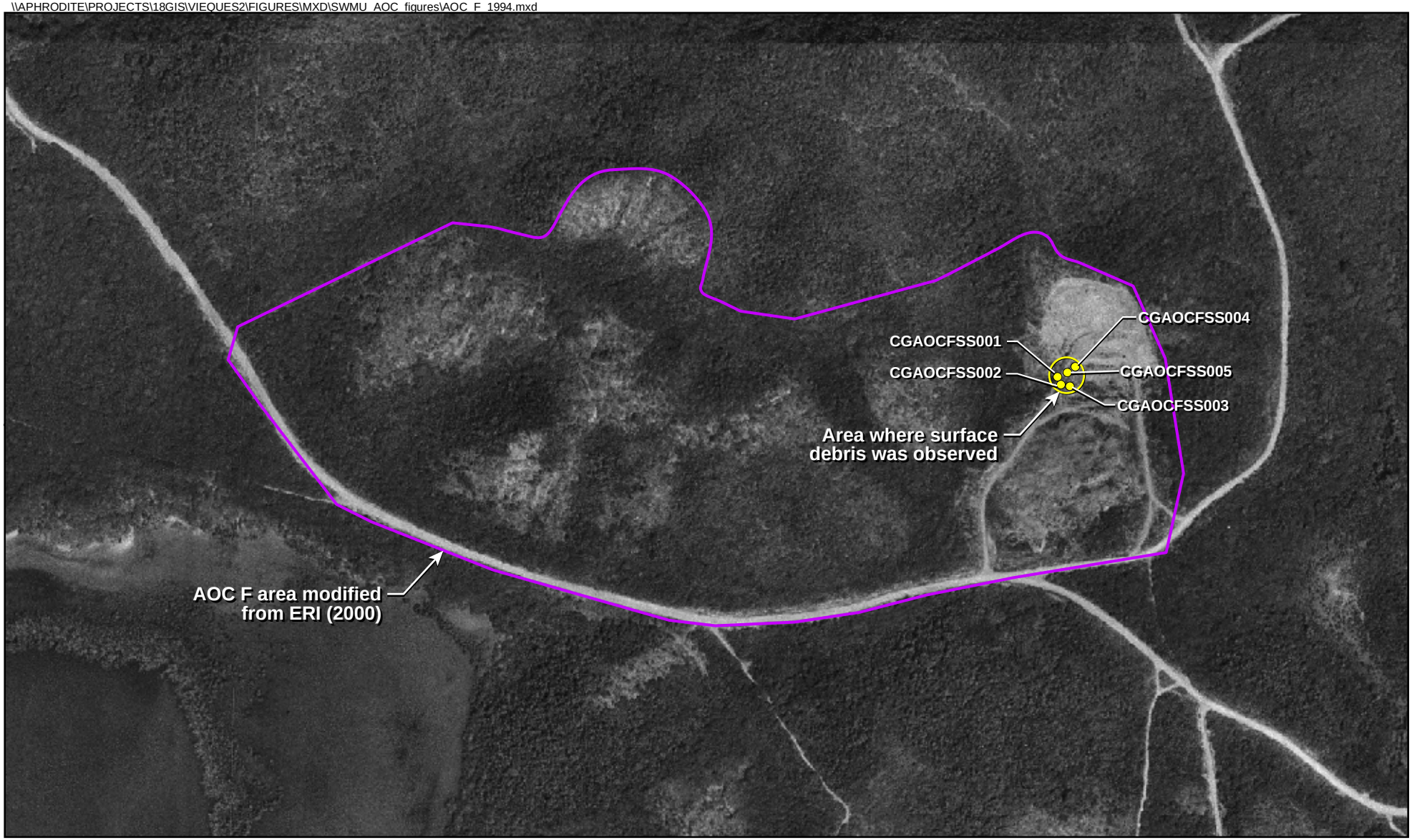
0 250 500 1,000 Feet

Figure 12-1
1962 Aerial Photograph of the AOC F Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

ES062007002TPA

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\SWMU_AOC_figures\AOC_F_1994.mxd



Legend

- AOC F Area modified from the ERI (2000)
- Area where surface debris was observed
- Phase I Environmental Assessment Surface Soil Sample Locations

N
W E
S

0 250 500 1,000 Feet

Figure 12-2
1994 Aerial Photograph of the AOC F Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

ES062007002TPA

SECTION 13

AOC G—Pump Station and Chlorination Building at Sewage Lagoons (Camp García)

This section presents the results of the PA/SI performed at AOC G—Pump Station and Chlorination Building at Sewage Lagoons at Camp García.

13.1 Conceptual Site Model

The CSM for AOC G is based on review of historical information such as records, site inspection documentation, and interviews, as well as site-specific data collection.

13.1.1 Site History and Potential Sources of Release

AOC G is located adjacent to the sewage treatment lagoons (SWMU 10) at Camp García (Figures 1-2, 1-3, and 9-1). The site consists of a building that housed a pump station and chlorination equipment used for the chlorination of the lagoon system effluent. These facilities were placed into operation in the 1950s. Operations ceased in 1978, but the building that housed the pump station and the chlorination contact chamber are still present at the site. The pump station and chlorination contact chamber are shown in Figure 13-1.

The building was constructed of concrete, and was built partially below grade. During the 1988 RFA, stains were reportedly visible on the concrete floor in the building, indicating that wastewater might have overflowed. However, no signs of vegetation stress or staining were apparent in the grassy area surrounding the building at the time of the RFA. The 1988 and 1995 RFA reports both recommended NFA for this site (Kearney, 1988; PREQB, 1995).

In February 2000, EPA and the Navy inspected AOC G as part of site visits made to the Consent Order sites. During this visit, no staining was observed in the chlorination building, and the site was inactive and overgrown with vegetation. Site conditions during the January 2004 PA/SI sampling event were the same as those observed in February 2000.

13.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 1988 and 1995 RFA (Kearney, 1988; PREQB, 1995) and the 2000 site visit (CH2M HILL, 2001), as well as on regional information.

The site consists of the pump station building and a contact chamber adjacent to the building that contained concrete partitions to slow down the water flow and increase the retention time that water could be treated. The site is currently overgrown with trees and tall grass. The site sits at approximately 26 ft amsl, and the topography slopes gently to the southeast. The site resides in the geologic unit KTd, which comprises plutonic rocks, largely granodiorite and quartz diorite. More detailed description of geologic conditions within the east Vieques study area is provided in Section 14.6.

Groundwater occurs at approximately 35 ft bgs in the bedrock and appears to be under semi-confined conditions. There are no surface water bodies at or adjacent to the site. The closest surface water body is Bahia Tapon, which is approximately 1,500 ft south of AOC G.

13.2 Sampling Approach and Chemical Constituents Identified

As presented in the Phase I RFI Work Plan (CH2M HILL, 2003c), five surface soil samples were collected in the area of the chlorination building and the nearby chlorine contact chamber, as shown in Figure 9-2. All soil samples were analyzed for Appendix IX VOCs, SVOCS, metals, pesticides, herbicides, and PCBs; and explosives, including perchlorate. One sample, collected from station CGAGSS04, was also analyzed for cyanide, sulfide, and dioxins. Although historical information for AOC G did not indicate munitions or explosives-related constituents would be related to potential releases at the site, explosives were included in the sample analyses to confirm that supposition.

Table 13-1 summarizes the constituents detected in AOC G surface soil samples collected during the PA/SI and identifies screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O.

13.3 AOC G Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Table 13-1).

Appendix N, Section N.13 discusses the evaluation of the AOC G data quality. As detailed in Section N.13, the AOC G data are acceptable for use in evaluating aspects of environmental conditions at AOC G, which is done in Steps 1 through 5 below. However, it is recognized that sufficient data have not been collected to draw conclusions regarding potential releases with adequate confidence, as discussed in Step 6 below. Therefore, additional data collection will be performed, as defined in Section 13.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was former pump house and chlorination tank for sanitary sewage. Based on the nature of historical activities, the potential presence of hazardous substances could not be confidently ruled out without sample collection. Sample collection took place during the 2004 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected:

<u>Surface Soil</u>

- VOCs: none detected

- SVOCs: benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, indeno(1,2,3-cd)pyrene, kepone, pyrene
- Pesticides: 4,4′-DDD, 4,4′-DDE, 4,4′-DDT
- Herbicides: none detected
- Dioxins: 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin, 1,2,3,6,7,8-hexachlorodibenzo-p-dioxin, 1,2,3,7,8,9-hexachlorodibenzo-p-dioxin, octachlorodibenzo-p-dioxin, total heptachlorodibenzo-p-dioxin, total hexachlorodibenzo-p-dioxin, total pentachlorodibenzo-p-dioxin
- PCBs: none detected
- Explosives: none detected
- Inorganics above background UTLs: copper, lead, mercury, selenium, zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Although there are no known records of a release from AOC G, because the unit was a pump house, it is assumed that the SVOCs and inorganics are potentially attributable to CERCLA-related releases at the site and are, therefore, further evaluated in the decision analysis process.

Dioxins are not likely associated with the former pump house and chlorination unit, especially considering no waste incineration occurred at the site. Further, as shown in Table A-3, the dioxin concentration at AOC G (in TEQ) is approximately 2.3 ppt, which is more than two orders of magnitude below the residential remediation level (i.e., 1,000 ppt) cited by EPA. Therefore, dioxins are not considered further in the decision analysis process.

The concentrations of 4,4′-DDD, 4,4′-DDE, and 4,4′-DDT detected at this site are comparable to concentrations of these pesticides detected at other sites across east Vieques. Consequently, these pesticides are likely attributable to normal pesticide use when the facility was active, not to a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1) and are, therefore, not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection table. Those constituents that exceed one or more criteria (and background for inorganics) are listed below.

<u>Surface Soil</u>

- Kepone: one detection (sample SS01) at a concentration (956 µg/kg) above the PRG (61 µg/kg)

- Copper: one detection (sample SS04) at a concentration (70.7 mg/kg) above the ecological screening value (70 mg/kg), SSL at a DAF 1 (46 mg/kg), and background UTL (66 mg/kg)
- Mercury: two detections (samples SS02 and SS05) at concentrations (0.14 mg/kg and 0.114 mg/kg, respectively) above the ecological screening value (0.1 mg/kg), SSL at a DAF of 1 (0.1 mg/kg), and background UTL (0.057 mg/kg)
- Selenium: four detections (samples SS01, SS02, SS04, SS05) at concentrations (0.591 mg/kg to 0.763 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Kepone was detected in one of five surface soil samples above its screening level (61 µg/kg based on 1×10^{-6} ELCR), at a concentration of 956 µg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (1.0, based on kidney effects), acceptable risk-based concentrations for a residential scenario range from 61 µg/kg (1×10^{-6} ELCR) to 6,100 µg/kg (1×10^{-4} ELCR). Based on the only detected concentration (the exposure point concentration that would be used in risk calculations), risk estimates for kepone would be within acceptable levels and kepone would not be identified as a risk driver.

Arsenic and vanadium are the only other constituents detected in soil above human health screening criteria. However, neither constituent was detected above background. Although arsenic has a PRG based on carcinogenic effects, the maximum concentration of arsenic detected at AOC G is 0.94 µg/kg, which is toward the lower end of the acceptable risk-based concentration range for a residential scenario (0.39 mg/kg [1×10^{-6} ELCR] to 22 mg/kg [HQ=1]). Therefore, the cumulative carcinogenic effects of kepone and arsenic would be within acceptable levels.

As indicated above, only three constituents (kepone, arsenic, and vanadium) were detected in soil above human health screening levels. A second PRG is available for both kepone and arsenic based on non-cancer effects (i.e., kidney effects for kepone; skin and vascular effects for arsenic). The PRG for vanadium is based on increased mortality. Because the non-cancer effects listed above are different for each constituent, potential cumulative human health effects from multiple non-carcinogenic constituents in soil are not a concern.

Copper, mercury, and selenium concentrations exceed ecological screening values and background in at least one surface soil sample collected at the site. These constituents do not likely pose an unacceptable risk to ecological receptors based upon the following:

- The site is overgrown with vegetation, with no signs of stressed vegetation.
- Copper exceeds the background UTL and ecological screening value in only one sample, with an HQ of 1.04. Further, the mean copper concentration (49.7 mg/kg) is below the screening value (70 mg/kg).

- Mercury exceeds the ecological screening value and background UTL in two of five samples, with a maximum HQ of 1.4. However, the mean mercury concentration (0.077 mg/kg) is less than the screening value (0.10 mg/kg).
- Selenium concentrations exceed the ecological screening value and background UTL in four of the five surface soil samples. The screening value (0.52 mg/kg), however, is based on potential impacts to plants. As indicated above, the site has become overgrown with vegetation and there were no signs of stress during the site visit. All selenium concentrations are less than ecological screening values based on other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable ecological risks.

Copper, mercury, and selenium were detected at concentrations above the SSLs at a DAF of 1. The former pump house and chlorination unit (i.e., potential source area) is relatively small. Therefore, SSLs at a higher DAF are likely to be more realistic, as discussed in Section 1.1.2. This supposition is supported by the data collected at SWMU 10 (see Section 9). No copper, mercury, or selenium concentration detected at AOC G exceeds the SSL at a DAF of 3.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases are the former pump house and chlorination contact basin areas. Based on this information, multiple soil samples were collected, the spatial distribution and resulting data of which indicate the surface soil has been sufficiently characterized.

Section 13.1.1 indicates that the building was partially below grade and that staining potentially attributable to wastewater overflows was observed on the floor during the RFA. Because this wastewater would have been the same material managed in the adjacent lagoons (SWMU 10), the data for the SWMU 10 soil samples, which were collected within the former lagoons, are likely representative of any potential subsurface releases of wastewater from the pump house, especially considering a release from inside the building was unlikely or, at a minimum, likely to be less extensive than what is represented by the lagoon data. As discussed in Section 9, the data for the SWMU 10 soil indicate the constituent concentrations do not pose an unacceptable risk to potential human or ecological receptors. This information, together with the information above, indicates the potential source area at AOC G likely has been sufficiently characterized. However, because there were pumps inside the building that surely underwent periodic maintenance during the more than 25 years of operation, it is possible that fluids generated during the maintenance operations were spilled or discharged adjacent to the building (although there is no record of this taking place). Therefore, soil sampling is warranted to ensure the potential source area is sufficiently characterized.

13.4 Conclusions and Recommendations

Table 13-2 summarizes the results of the decision analysis for AOC G, which indicates there likely has not been a CERCLA-related release at the site that has resulted in contamination

of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Further, pesticide detections (other than kepone) at the site are consistent with normal pesticide application associated with maintenance of the historical facilities present at the site. Additionally, the dioxins present are not likely associated with potential CERCLA-related releases at the site and are nevertheless below the risk-based screening level. However, there is uncertainty regarding whether the source area has been sufficiently characterized due to the potential that pump maintenance fluids were discharged to the ground surface adjacent to the building. To address this uncertainty it is recommended that this additional data collection be conducted via an expanded SI, as described below.

Rationale

Additional information is necessary to provide adequate spatial data in order to determine whether a CERCLA-related release has occurred. The objective, approach, and decision analysis for the additional data collection will be detailed in an Expanded SI work plan, but they are briefly discussed below.

Objective and Approach

Sufficiently characterize the potential source areas by:

- Collecting two co-located surface/subsurface soil samples near building door in an area where fluids would most likely have been spilled or otherwise discharged. Samples will be submitted to the laboratory for analysis of TCL VOCs and SVOCs, and TAL metals.

Decision Analysis

Evaluate newly collected and relevant historical data using 6-step decision analysis process (Figure 1-4).

TABLE 13-1
AOC G Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	CGAGSS01	CGAGSS02	CGAGSS03	CGAGSS04	CGAGSS05	
Sample ID					CGAGSS01-R01	CGAGSS02-R01	CGAGSS03-R01	CGAGSS04-R01	CGAGSS05-R01	CGAGSSFD01P-R01
Sample Date					1/22/04	1/22/04	1/22/04	1/22/04	1/22/04	1/22/04
Chemical Name										
Volatile Organic Compounds (µg/kg)										
No Detections										
Semivolatile Organic Compounds (µg/kg)										
Benzo(a)pyrene	400	62	100	--	367 U	37.3 J	402 U	382 U	376 UJ	387 U
Benzo(b)fluoranthene	200	620	--	--	367 U	88.8 J	402 U	382 U	376 UJ	387 U
Benzo(g,h,i)perylene	210,000	2,300,000	--	--	367 U	39.9 J	402 U	382 U	376 UJ	387 U
Benzo(k)fluoranthene	2,000	6,200	--	--	367 U	58.6 J	402 U	382 U	376 UJ	387 U
Chrysene	8,000	62,000	--	--	367 U	58.3 J	402 U	382 U	376 UJ	387 U
Indeno(1,2,3-cd)pyrene	700	620	--	--	367 U	43 J	402 U	382 U	376 UJ	387 U
Kepone	--	61	--	--	956	370 U	402 U	382 U	376 UJ	387 U
Pyrene	210,000	230,000	100	--	367 U	43.1 J	402 U	382 U	376 UJ	387 U
Pesticide/Polychlorinated Biphenyls (µg/kg)										
4,4'-DDD	800	2,400	10	--	0.17 J	0.31 J	0.33 J	0.93 J	0.72 J	0.56 J
4,4'-DDE	3,000	1,700	10	--	13 J	5.8 J	9.2 J	31 J	12 J	15 J
4,4'-DDT	2,000	1,700	10	--	2.4 J	1.4 J	1.4 J	2 J	1.2 J	0.96 J
Herbicides (µg/kg)										
No Detections										
Dioxin/Furans (pg/g)										
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	123	NA	NA
1,2,3,6,7,8-Hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	3.1	NA	NA
1,2,3,7,8,9-Hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	3.6	NA	NA
Octachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	1,400	NA	NA
Total heptachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	257	NA	NA
Total hexachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	39.9	NA	NA
Total pentachlorodibenzo-p-dioxin	--	*	--	--	NA	NA	NA	2	NA	NA
Explosives (µg/kg)										
No Detections										
Total Metals (mg/kg)										
Antimony	0.3	3.1	78	3.6	0.36 J	0.114 J	0.289 J	0.289 J	0.254 J	0.371 J
Arsenic	1	0.39	18	1.6	0.937 J	0.768 J	0.696 J	0.935 J	0.718 J	0.46 J
Barium	82	1,600	330	147	62.7	59.8	76.4	83.4	110	65.7
Beryllium	3	15	40	0.27	0.207 J	0.204 J	0.216 J	0.254 J	0.231 J	0.213 J
Cadmium	0.4	3.7	32	2.2	0.362 J	0.267 J	0.366 J	0.355 J	0.334 J	0.202 J
Chromium	2	210	0.4	72	13.2 J	13.1 J	13.9 J	15.3 J	14.3 J	18.3 J
Cobalt	33	140	13	16	9.64 J	8.47 J	9.14 J	12.9 J	12.9 J	10.9 J
Copper	46	310	70	66	51.4	42.4	40.7	70.7	41.9	44.9
Cyanide	--	120	1	0.89	NA	NA	NA	0.307 J	NA	NA
Lead	14	400	120	5.4	10.9	11.9	5.04	8.23	6.32	6.06
Mercury	0.1	2.3	0.1	0.057	0.0946	0.14	0.0258	0.0235	0.114	0.0895
Nickel	7	160	38	22	5.97 J	5.09 J	5.63 J	6.69 J	6 J	5.86 J
Selenium	0.3	39	0.52	0.51	0.591 J	0.605 J	0.201 J	0.73 J	0.763 J	0.407 J
Silver	2	39	560	0.22	0.0386 J	0.0245 U	0.053 J	0.0285 J	0.0306 J	0.0518 J
Tin	--	4,700	--	NA	0.479 J	0.311 J	0.212 U	0.538 J	0.53 J	0.288 J
Vanadium	300	7.8	2	144	72.1	66.8	76.2	84.1	79.7	86.1
Zinc	620	2,300	120	32	76.3	88.3	41.2	59.2	79.8	82.3
Wet Chemistry (mg/kg)[1]										
Sulfide	--	--	--	--	NA	NA	NA	27.2 J	NA	NA

Notes:
mg/kg - Milligrams per kilogram
µg/kg - Micrograms per kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: User's Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (nickel, selenium, silver, vanadium, zinc) (Efroymson et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
[1] Wet Chemistry consists of sulfide and cyanide (cyanide is included with the TAL Metals on this table)
* See Section 1.1.1.2 for dioxin screening.

Exceeds Background and HHRA criteria
Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 13-2
AOC G Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					With respect to potential releases associated with wastewater from SWMU 10, medium sufficiently characterized. With respect to potential releases associated with wastewater from SWMU 10, surface and subsurface soil data for adjacent SWMU 10 sufficient for AOC G subsurface soil. However, surface soil and subsurface soil not sufficiently characterized for potential releases associated with pump maintenance activities.
		SVOCs	Yes	Kepone > PRG	within acceptable HH risk range	
		Pesticides	No	N/A	N/A	
		Dioxins	No	N/A	N/A	
		Inorganics	Yes	Cu > ECO, SSL, BKG	mean concentration < ECO; < SSL at a DAF of 2	
				Hg > ECO, SSL, BKG	mean concentration < ECO; < SSL at a DAF of 2	
				Se > ECO, SSL, BKG	ECO based on plants; no sign of stress to plants; < ECO for soil invertebrates; < SSL at a DAF of 3	

Photographs taken February 3, 2000

Figure 13-1
AOC G Chlorination Contact Chamber and Building
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 14

PI 4—Former Helicopter Maintenance Area, Trenched Area, Disturbed Area, and Bermed Areas used for Fuel Bladder Storage

This section presents the results of the PA/SI performed at PI 4—Former Helicopter Maintenance Area, Trenched Area, and Bermed Areas used for Fuel Bladder Storage.

14.1 Conceptual Site Model

The CSM for PI-4 is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews; as well as site-specific data collection.

14.1.1 Site History and Potential Sources of Release

PI-4 is located on the south side of the main access road leading from the main gate of Camp García (Figures 1-2 and 1-3). It was identified in an aerial photography study completed by ERI (ERI, 2000). The EBS identifies the site as a series of trenches and disturbed ground, active between 1959 and 1964 (NAVFACENGCOM, 2003). The trenches, visible in the 1959 aerial photograph (Figure 14-1), are reported in the EBS to have been covered by 1962, which is evident in 1962 aerial photograph (Figure 14-2). An area of disturbed ground (other than that of the trenches) is visible in the 1962 aerial photograph just south of the former helicopter maintenance area (Figure 14-2). Two rectangular bermed areas, identified during interviews conducted during the EBS as having been formerly used for fuel bladder storage, are also visible in the 1962 aerial photograph, as is the helicopter maintenance area. An area of disturbed ground appears in the southeast corner of the trenched area in the 1964 photograph (Figure 14-3). The interviews and records also indicate that barracks and a mess hall were present at PI-4 (NAVFACENGCOM, 2003), although no buildings are currently present at the site. Based on the configuration of the trenches and the presence of the concrete slabs and vault in the area of the trenches, it is possible the trenches were associated with a sanitary leach field for the barracks and mess.

There is no known historical information suggesting release(s) of hazardous waste or hazardous constituents occurred at PI-4. Further, during the 2001 site inspection of PI sites and 2002 EBS site inspection, no physical evidence of a release was noted. However, as a conservative measure, five potential sources of a release were identified for PA/SI sampling based on historical activities at the site: (1) former trenches, (2) area of disturbed ground south of the helicopter maintenance area, (3) fuel bladder storage area, (4) former helicopter maintenance area, and (5) disturbed area in the southeast part of trenched area. Each of these areas is identified in Figures 14-1, 14-2, and 14-3.

14.1.2 Physical Setting

The description of the sites physical setting is based on site inspections conducted in 2001 (recon of PI sites), 2002 (EBS), and in 2006 (PA/SI), as well as on regional information.

The site slopes gently to the southeast with elevations dropping from about 45 ft amsl to approximately 30 ft amsl. The land around PI-4 was at one time maintained as cleared, but has become re-vegetated since operations ceased. No federally protected species or preferred habitats were identified in the area. For more information on the ecological survey, see Appendix M.

Soil borings at PI-4 encountered primarily dry sands and dry silty sands. For more details on the unconsolidated material overlying bedrock, see the site-specific boring logs in Appendix D. PI-4 lies within the KTd formation, which is characterized by plutonic rocks, largely granodiorite and quartz diorite. Bedrock cores for MW04 and MW02 encountered granite and some fine grained volcanic rock. Bedrock boreholes for MW05 and MW03 encountered granodiorite. Bedrock was encountered in the monitoring well borings at between 17 and 28 ft bgs. For more information on the bedrock geology see Section 1.4.6.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Tapon along the coast, approximately ½ mile southeast of the site. Based on water level readings from PI-4 monitoring wells, groundwater flows as a subdued replica of the topography, through the fractured bedrock aquifer toward the southeast (Figure 14-4).

During the 2001 site inspection of PI sites, several man-made structures, including three 20-ft wide by 50-ft long concrete pads that may be relics of the foundations of historical buildings (Figure 14-5, Photo 1), were identified at PI-4. The easternmost pad had several sections of 48-inch-diameter reinforced concrete pipe (RCP) and pre-cast square manhole access sections stored on it (Figure 4-5, Photo 2). A concrete vault, approximately 10-ft long by 6-ft wide by 5-ft deep, with the entrance covered by plywood was noted approximately 10 feet east of the concrete pads (Figure 14-5, Photo 3). Stagnant water was observed inside the vault, which was sampled during the PA/SI. A second concrete vault box, approximately 2-ft wide by 4-ft long by 3 feet deep, was found approximately 100 ft south of the aforementioned vault (Figure 14-5, Photo 4). Several openings (4-inch diameter) were noted at the bottom of the south-facing side of the manhole. As noted previously, these vaults may have been associated with a sanitary septic system for the barracks and mess potentially located at this site.

14.2 Sampling Approach and Chemical Constituents Identified

As part of the EBS, two surface soil samples were collected at PI-4 within the two rectangular bermed areas formerly used for fuel bladder storage (Figure 14-1). Both samples were analyzed for TPH-DRO and TPH-gasoline range organics (GRO).

As presented in the PA/SI Work Plan (CH2M HILL, 2006), surface soil and subsurface soil samples were collected from 15 boring locations and groundwater samples were collected from the five monitoring wells installed as part of the PA/SI (Figure 14-1). In addition to the soil and groundwater samples, a grab water sample was collected from the concrete septic

vault box. No FID readings significantly above background (see Soil Boring Logs, Appendix D) were observed in the soil borings; therefore, subsurface soil samples were collected at default depths in accordance with the work plan (see Table 2-1 for subsurface soil sample depths).

Of the 15 soil boring locations, six surface and subsurface soil samples were collected in the trenched area (TCL VOCs, SVOCs, pesticides, and PCBs; and TAL inorganics); two surface and subsurface soil samples were collected from the bermed area (TCL VOCs, SVOCs; and TAL inorganics); one surface and subsurface soil sample was collected from each of the four sides and in the center of the location of former Building 949 (helicopter maintenance area, mess hall, and barracks), for a total of five surface and subsurface soil samples (TCL VOCs, SVOCs, and pesticides; and TAL inorganics); and two surface and subsurface soil samples were collected from the disturbed area south of the former helicopter maintenance area (TCL VOCs, SVOCs, and pesticides; and TAL inorganics).

Five monitoring wells were installed at PI 4: one south of the helicopter maintenance area (MW-02), one within the trenched area (MW-04), one downgradient of the trenched area (MW-05), one south of the bermed area used for fuel bladder storage (MW-03), and one in the southern portion of the disturbed area south of the helicopter maintenance area (MW-01). All groundwater samples were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs; and TAL inorganics. In addition to the soil and groundwater samples, a grab water sample was collected from the concrete septic vault box.

All surface and subsurface soil and groundwater samples collected during the PA/SI were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs; and TAL inorganics. The grab water sample was analyzed for these same parameters as the groundwater samples plus explosives.

Tables 14-1, 14-2, 14-3, and 14-4 summarize the constituents detected in PI-4 surface soil samples, subsurface soil samples, groundwater samples, and vault water sample, respectively, and identify screening criteria exceedances. Raw analytical data for the EBS and PA/SI samples are provided in Appendix O. Note that the groundwater data from the background well for PAOC N (EPAN-MW02) was used for initial background comparison for the groundwater data collected at PI-4. PI-4 is located in the same geologic unit as PAOC N.

14.3 PI-4 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 14-1 through 14-4).

Appendix N, Section N.14 discusses the evaluation of the PI-4 data quality. As detailed in Section N.14, the PI-4 data are acceptable for use in evaluating aspects of environmental conditions at PI-4, which is done in Steps 1 through 5 below. However, it is recognized that sufficient data have not been collected to draw conclusions regarding potential releases with adequate confidence, as discussed in Step 6 below. Therefore, additional data collection will be performed, as defined in Section 14.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former helicopter maintenance area, trenched area, disturbed area, and bermed area for storage of fuel bladders. Although there are no records of past releases at the site and there was no evidence of past releases observed during the site visits, the potential presence of CERCLA hazardous substances could not be confidently ruled out without sample collection due to the nature of the historical activities at the site. Sample collection took place during the 2002 EBS and 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the EBS and PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

Surface Soil

- VOCs: acetone, carbon disulfide
- SVOCs: bis(2-ethylhexyl)phthalate
- Pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan I, delta-BHC, gamma-chlordane
- PCBs: aroclor-1260
- TPH-DRO: none detected
- TPH-GRO: none detected
- Inorganics above background UTLs: arsenic, barium, calcium, lead, magnesium, selenium, zinc

Subsurface Soil

- VOCs: none detected
- SVOCs: none detected
- Pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin aldehyde, gamma-chlordane
- PCBs: none detected
- Inorganics above background UTLs: calcium, copper, lead, magnesium, selenium, zinc

Groundwater

- VOCs: chloroform, cis-1,2-DCE, PCE, toluene, trichloroethene (TCE)
- SVOCs: none detected
- Pesticides: none detected
- PCBs: none detected

- Total and dissolved inorganics above background (EPAN MW02): all inorganics detected (see Table 14-3)

Vault Water

- VOCs: cis-1,2-DCE
- SVOCs: none detected
- Pesticides: none detected
- PCBs: none detected
- Explosives: none detected
- Total and dissolved inorganics: all inorganics detected (see Table 14-4) because there is no "background" vault water

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Because there are no known records of what the trenches and disturbed area were used for, and because the site was also the location of a former helicopter maintenance area, it is possible that the constituents detected in PI-4 media are attributable to historic CERCLA-related releases even though no visual observations of releases were noted during any of the site visits. However, as discussed in Section 1, the pesticides detected in the surface and subsurface soil are at relatively similar concentrations across the site and are comparable to the type and concentrations of pesticides detected at other sites across east Vieques. Consequently, the pesticides are likely attributable to normal pesticide use when the facility was active, not to a CERCLA-related release and are, therefore, not considered further in the decision analysis process. However, all other detected constituents (i.e., VOCs, SVOCs, PCBs, and inorganics) are further considered in the decision analysis process. With respect to the vault water sample (Table 14-4), it is important to note that the vault has been removed since the sample was taken, so any potential exposure pathway has been eliminated. Therefore, the vault water is not further evaluated in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Surface Soil

- VOCs: no exceedances
- SVOCs: no exceedances
- PCBs: no exceedances

- Arsenic: one detection (sample SS01) at a concentration (3.2 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Barium: one detection (sample SS14) at a concentration (168 mg/kg) above the SSL at a DAF of 1 (82 mg/kg) and background UTL (147 mg/kg)
- Lead: one detection (sample SS01) at a concentration (29 mg/kg) above the SSL at a DAF of 1 (14 mg/kg) and background UTL (5.4 mg/kg)
- Selenium: seven detections (samples SS03, SS06, SS08, SS11, SS12, SS13, SS14) at concentrations (0.54 mg/kg to 0.78 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

Subsurface Soil

- Copper: one detection (sample SB11) at concentration (111 mg/kg) above the SSL at a DAF of 1 (46 mg/kg) and background UTL (66 mg/kg)
- Selenium: five detections (samples SB04, SB10, SB11, SB14, SB15) at concentrations (0.54 mg/kg to 0.74 mg/kg) above the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

Groundwater

- Chloroform: two detections (wells MW-2 and MW-4) at concentrations (0.99 μg/L and 0.50 μg/L, respectively) above the tap water PRG (0.17 μg/L)
- PCE: one detection (well MW-5) at a concentration (0.17 μg/L) above the tap water PRG (0.1 μg/L)
- TCE: two detections (wells MW-5 and MW-1) at concentrations (9.3 μg/L and 0.48 μg/L, respectively) above the tap water PRG (0.028 μg/L) and, in the case of the detection in MW-5, above the MCL (5 μg/L)
- Chromium (total): two detections (wells MW-4 and MW-5) at concentrations (22 μg/L and 12 μg/L, respectively) above the adjusted tap water PRG (11 μg/L)
- Iron (total): one detection (well MW-5) at a concentration (1,280 μg/L) above the adjusted tap water PRG (1,100 μg/L)
- Vanadium (total and dissolved): detected in all wells (dissolved) and MW-1 (total) at concentrations (between approximately 14 μg/L and 25 μg/L) above the adjusted tap water PRG (3.6 μg/L)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Soil

Arsenic is the only constituent detected in a PI-4 soil sample above the PRG and the background UTL. However, it was detected in only 1 of 15 surface soil samples (and 1 of 30 surface and subsurface soil samples) above background and its human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR), at a concentration of 3.2 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ (which is based on skin and vascular effects), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the low maximum detected concentration and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver. Although aluminum, iron, manganese, and vanadium were detected in soil above the adjusted PRGs, their PRGs are based on neurotoxicity in offspring (aluminum), gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

In surface soil, there was one detection of arsenic (SS01), barium (SS14), and lead (SS01) above the SSL at a DAF of 1. However, none of these constituents was detected in the subsurface soil at the same location above the SSL. Further, neither arsenic nor lead was detected in groundwater at this location (MW-1), and barium was detected immediately downgradient (MW-3) below its adjusted tap water PRG and MCL. Also in surface soil, selenium was detected at seven locations above the SSL at a DAF of 1. However, at five of the seven locations, it was not detected in the associated subsurface sample at a concentration above the SSL. Further, selenium was not detected in groundwater above its adjusted tap water PRG or MCL. The only other inorganic constituent detected at a concentration above its SSL at a DAF of 1 is copper, in one subsurface sample (SB11). Similar to the other inorganics, copper was not detected in groundwater above its adjusted tap water PRG or MCL. The above information indicates that the SSLs at a DAF of 1 for the inorganic constituents detected at PI-4 are not representative predictors of leaching to groundwater.

Selenium concentrations exceed the ecological screening value and background UTL in several surface soil samples collected at the site. Selenium does not likely pose an unacceptable risk to ecological receptors based upon the following:

- The site is overgrown with vegetation, with no signs of stressed vegetation.
- Selenium concentrations exceed the ecological screening value and background UTL in 7 of the 15 surface soil samples, at a maximum HQ of 1.50. The screening value (0.52 mg/kg), however, is based on potential impacts to plants. As indicated above, the site has become overgrown with vegetation and there were no signs of stress. All selenium concentrations are less than ecological screening values based on other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable ecological risks.

Groundwater

Three organic constituents (chloroform, PCE, and TCE) were detected in groundwater at concentrations (0.5 and 0.99 μg/L, 0.17 μg/L, and 0.48 μg/L and 9.3 μg/L, respectively) above the tap water PRGs (0.17 μg/L, 0.1 μg/L, and 0.028 μg/L, respectively). However, TCE is the only constituent detected above its MCL (5 μg/L). PCE and TCE were detected only in well MW-05. Three wells (MW-02, MW-03, and MW-04) located within several hundred ft in the general upgradient direction from well MW-05 (Figure 14-4) did not contain either of these two constituents. Further, even though there were several detections of VOCs at concentrations above their respective PRGs, the relatively low concentrations of detected constituents (relative to exceedance criteria) across the site suggests any release to groundwater has been minor, as discussed below.

The PRGs for chloroform, PCE, and TCE are based on potential carcinogenic effects. Based on the maximum detected concentrations of these three constituents in relation to PRGs (derived using a target risk of 1×10^{-6}), the estimated risks would be 6×10^{-6} for chloroform, 2×10^{-6} for PCE, and 3×10^{-4} for TCE, yielding a cumulative risk from the three potential carcinogens of approximately 3×10^{-4} for tap water. Based on the EPCs that would be used in risk calculations, risk estimates would exceed acceptable levels and these three constituents would be identified as risk drivers, primarily due to TCE.

Chromium (total) was detected in all five wells. The maximum detected concentration (22.3 μg/L) is above the screening level for hexavalent chromium (11 μg/L based on an HQ=0.1). Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 110 μg/L (HQ=1). Because all detected concentrations are less than the acceptable risk-based concentration, and an EPC less than the acceptable risk-based concentration would be used in risk calculations, risk estimates for chromium would be within acceptable levels and chromium would not be identified as a risk driver. Further, the maximum detected concentration is less than the MCL (100 μg/L). Additionally, all chromium detections in soil are below the background UTL, which indicates the presence of chromium in groundwater is attributable to background.

Iron (total) was detected in three of the five wells. The maximum detected concentration (1,280 μg/L) is above its screening level (1,100 μg/L based on an HQ=0.1). Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 11,000 μg/L (HQ=1), which is approximately an order of magnitude above the maximum detected concentration at PI-4. Because all detected concentrations are less than the acceptable risk-based concentration, and an EPC less than the acceptable risk-based concentration would be used in risk calculations, risk estimates for iron would be within acceptable levels and iron would not be identified as a risk driver. Further, all iron detections in soil are below the background UTL, which indicates the presence of iron in groundwater is attributable to background.

Vanadium (total and/or dissolved) was detected above its screening level (3.6 μg/L based on an HQ=0.1) in all five wells. The maximum detected concentrations of vanadium (total) and vanadium (dissolved) are 22.1 μg/L and 25.2 μg/L, respectively. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 36 μg/L (HQ=1), which is above the maximum concentrations detected. Because all detected concentrations are less than the acceptable risk-based concentration, and an EPC less than

the acceptable risk-based concentration would be used in risk calculations, risk estimates for vanadium would be within acceptable levels and vanadium would not be identified as a risk driver. Additionally, all vanadium detections in soil are below the background UTL, which indicates the presence of vanadium in groundwater is attributable to background.

As noted above, three inorganic constituents (chromium, iron, vanadium) were detected in groundwater above their respective adjusted tap water PRGs and background. No other constituents were detected at concentrations above the adjusted tap water PRGs. Chromium, iron, and vanadium act on different target organs, so there is no concern for cumulative human health effects from multiple constituents in groundwater. The PRGs are based on respiratory system effects (chromium), gastrointestinal effects (iron), and increased mortality (vanadium).

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases are the former trenched areas, the former fuel bladder storage areas, the formerly visibly disturbed area, and the former helicopter maintenance area. Based on this information, multiple soil and groundwater samples were collected at each/downgradient of these areas, the spatial distribution and resulting data of which indicate they likely have been sufficiently characterized. However, several VOCs (chloroform, toluene, PCE, TCE, cis-1,2-DCE) were detected in groundwater that were not detected in any of the soil samples. It is important to note, though, that the concentrations of each of these VOCs were low (with respect to the screening criteria). Only one detected VOC concentration (9.3 μg/L of TCE in well MW-5) is above 1 μg/L and an MCL. Because the five monitoring wells provide good spatial coverage of the site, especially with respect to the suspected source areas, the groundwater data suggest there is not wide-spread groundwater contamination at the site. However, to confirm this supposition, additional data collection is recommended, as discussed in Section 14.4.

14.4 Conclusions and Recommendations

Table 14-5 summarizes the results of the decision analysis for PI-4, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Although several inorganic and non-inorganic constituents were detected in surface and subsurface soil, all but one detection of arsenic in surface soil are below human health and ecological screening criteria. Further, pesticide detections at the site are consistent with normal pesticide application associated with maintenance of the historical facilities present at the site. Therefore, NFA is recommended for soil at the site, pending the additional groundwater data collection (see below).

As stated in Step 6 of the decision analysis presented in Section 14.3, low (with respect to screening criteria) concentrations of VOCs were detected in groundwater. Although these levels likely indicate that releases to groundwater have been minor and that groundwater contamination is not widespread or at appreciable concentrations, additional data collection

is proposed to confirm this supposition, primarily because of the MCL exceedance. The rationale, objective, and decision analysis for additional groundwater data collection are provided below:

Rationale

Initial groundwater data suggest only low levels (with respect to screening criteria) are present in groundwater, but one VOC was detected in groundwater above its MCL.

Objective

Confirm the groundwater VOC concentrations are low (primarily with respect to MCLs) by:

- Collecting a round of synoptic water level measurements across the site to confirm groundwater flow direction.
- Installing an additional well approximately 200 ft upgradient and an additional well approximately 200 feet downgradient of MW-5 (see Figure 14-6), the well in which the TCE concentration exceeds the MCL, based on the results of the synoptic water-level measurements
- Collecting a round of groundwater samples from all existing PI-4 wells and the newly installed wells and analyzing the samples for VOCs

Decision Analysis

If the concentrations of all VOCs are generally consistent with the concentrations detected in the initial (2006) round of sampling, but still above MCL(s), additional groundwater monitoring may be necessary, the duration and frequency of which would be determined through inter-agency discussions. If the concentrations of all VOCs are inconsistent (i.e., either higher or all below MCLs) with those detected in the initial round (by well), collect a third round of groundwater samples approximately 6 months later (to help account for temporal variability).

If the concentrations of VOCs in the newly installed well are inconsistent (greater by an order-of-magnitude) with those in well MW-05, propose additional soil data collection to determine if there is a yet unknown source. Depending on the results of the soil data collection, determine if additional well(s) are necessary.

TABLE 14-1
PI 4 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	EPI04-SO01	EPI04-SO02	EPI04-SO03	EPI04-SO04	EPI04-SO05		EPI04-SO06	EPI04-SO07	EPI04-SO08		EPI04-SO09
Sample ID					EPI04-SS01-0001	EPI04-SS02-0001	EPI04-SS03-0001	EPI04-SS04-0001	EPI04-SS05-0001	EPI04-SS05P-0001	EPI04-SS06-0001	EPI04-SS07-0001	EPI04-SS08-0001	EPI04-SS08P-0001	EPI04-SS09-0001
Sample Date					01/26/06	01/26/06	01/26/06	01/26/06	01/26/06	01/26/06	01/26/06	01/25/06	01/25/06	01/25/06	01/24/06
Chemical Name															
Volatile Organic Compounds (UG/KG)															
Acetone	800	1,400,000	--	--	13 U	10 U	28 J	12 U	11 U	11 U	10 U	10 U	10 U	11 U	10 U
Carbon disulfide	2,000	36,000	--	--	13 U	10 U	10 J	12 U	11 U	11 U	10 U	10 U	10 U	11 U	10 U
Semi-volatile Organic Compounds (UG/KG)															
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	370 UJ	360 U	350 U	350 U	350 U	350 U	360 U	370 U	350 U	350 U	370 U
Pesticide/Polychlorinated Biphenyls (UG/KG)															
4,4'-DDD	800	2,400	10	--	3.7 U	3.6 U	3.5 U	3.5 U	3.5 U	3.5 U	2.1 J	3.1 J	3.5 U	3.5 U	3.7 U
4,4'-DDE	3,000	1,700	10	--	3.8	2.2 J	12	1.2 J	2.7 J	4.7	620	36	29	27	9.1
4,4'-DDT	2,000	1,700	10	--	1.4 J	3.6 U	3.1 J	3.5 U	1.4 J	27	100	7.8	3.1 J	5.3	1.4 J
Aroclor-1260	--	110	40,000	--	NA	NA	NA	35 U	NA	NA	NA	NA	35 U	35 U	37 U
Endosulfan I	900	37,000	0.01	--	1.9 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	3.7 U	1.9 U	1.8 U	1.8 U	1.9 U
delta-BHC	0.1	440	--	--	1.9 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	0.75 J	1.9 U	1.8 U	1.8 U	1.9 U
gamma-Chlordane	500	1,600	--	--	0.69 J	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1 J	1.9 U	1.8 U	1.8 U	0.79 J
Total Metals (MG/KG)															
Aluminum	55,000	7,600	--	35,000	5,720 J	9,040 J	7,450 J	8,220	6,770 J	6,930 J	6,100 J	8,540 J	12,200	12,300	9,970 J
Antimony	0.3	3.1	78	3.6	6.7 U	6.5 U	6.4 U	6.4 U	6.4 U	6.4 U	6.6 U	6.7 U	0.62 J	0.75 J	6.8 U
Arsenic	1	0.39	18	1.6	3.2 J	1.1 U	1.1 U	0.35 J	1.1 U	1.1 U	1.1 U	1.1 U	0.58 J	0.39 J	1.1 U
Barium	82	1,600	330	147	33 J	45.4 J	52.1 J	55.7	52.7 J	53.3 J	52.1 J	50.9 J	57.4	58.3	64.9 J
Beryllium	3	15	40	0.27	0.55 U	0.54 U	0.53 U	0.53 U	0.53 U	0.53 U	0.55 U	0.56 U	0.039 J	0.53 U	0.56 U
Cadmium	0.4	3.7	32	2.24	0.55 U	0.54 U	0.53 U	0.53 U	0.53 U	0.53 U	0.55 U	0.56 U	0.15 J	0.53 U	0.56 U
Calcium	--	--	--	8,840	171,000 J	15,400 J	7,200 J	2,770	2,700 J	2,850 J	4,610 J	7,410 J	5,290	6,860	10,000 J
Chromium	2	210	0.4	72	14.1 J	12.7 J	10.1 J	9.1	9 J	8.8 J	10.2 J	10 J	7.2	8.3	11.8 J
Cobalt	33	140	13	15.8	5.6 U	8.3 J	9 J	9.7	9.1 J	9.8 J	8.3 J	9.1 J	13.2	12.5	9.6 J
Copper	46	310	70	65.5	19.9 J	43.5 J	32.1 J	33.2	37.1 J	37.6 J	39.3 J	38.8 J	34.9	36.2	43 J
Cyanide	--	120	1	0.89	0.54 J	2.7 U	2.7 U	0.72 J	2.7 U	2.7 U	2.7 U	2.8 U	2.6 U	2.7 U	2.8 U
Iron	276	2,300	--	38,100	14,200 J	16,100 J	15,000 J	13,600	14,100 J	14,200 J	14,400 J	16,000 J	24,700	24,100	17,300 J
Lead	14	400	120	5.4	28.8 J	7.3 J	4.1 J	2.7 J	3.2 J	2.7 J	7.6 J	6.8 J	5	2.9	3.5 J
Magnesium	--	--	--	3,710	27,000 J	5,030 J	1,770 J	1,510	1,430 J	1,540 J	1,380 J	2,070 J	8,730	7,820	4,000 J
Manganese	57	180	220	1,630	265 J	444 J	567 J	584	572 J	573 J	514 J	365 J	549	540	432 J
Nickel	7	160	38	22.2	5.3 J	7.2 J	4.3 U	4.3 U	4.3 U	4.2 U	4.4 U	4.5 U	4.3 J	4.7 J	5.6 J
Potassium	--	--	--	5,270	805 J	950 J	849 J	1,150 J	1,040 J	1,030 J	753 J	823 J	1,500 J	1,630 J	1,030 J
Selenium	0.3	39	0.52	0.51	7.8 U	3.8 UJ	0.55 J	3.7 U	0.38 J	0.45 J	0.54 J	0.44 J	0.59 J	3.7 U	4 UJ
Vanadium	300	7.8	2	144	37.9 J	49.7 J	56.1 J	49.5	51 J	50.7 J	55.5 J	57.5 J	64.7	63.8	63.8 J
Zinc	620	2,300	120	32	23.9 J	27.3 J	16.7 J	16.7 J	19.5 J	18 J	38.7 J	22.7 J	28.6	28.6	18.7 J
Total Petroleum Hydrocarbons (MG/KG)															
TPH GRO															
No Detections					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH DRO															
No Detections					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- NA - Not Analyzed
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan I, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (aroclor-1260, nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set.
-- Regulatory standard not promulgated

Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, and DAF 1 Criteria
Exceeds Background and Eco Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 14-1
PI 4 Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques Eco SO**	**Vieques (East) Background Zone KTd SS**	EPI04-SO10	EPI04-SO11	EPI04-SO12	EPI04-SO13	EPI04-SO14	EPI04-SO15	VNTR-PI4-1	VNTR-PI4-2
Sample ID					EPI04-SS10-0001	EPI04-SS11-0001	EPI04-SS12-0001	EPI04-SS13-0001	EPI04-SS14-0006	EPI04-SS15-0006	EBS PI4-1	EBS PI4-2
Sample Date					01/24/06	01/25/06	01/24/06	01/25/06	01/31/06	01/31/06	12/17/02	12/17/02
Chemical Name												
Volatile Organic Compounds (UG/KG)												
Acetone	800	1,400,000	--	--	10 U	11 U	10 U	12 U	14 U	14 U	NA	NA
Carbon disulfide	2,000	36,000	--	--	10 U	11 U	10 U	12 U	14 U	14 U	NA	NA
Semi-volatile Organic Compounds (UG/KG)												
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	360 U	360 U	360 U	370 U	130 J	360 U	NA	NA
Pesticide/Polychlorinated Biphenyls (UG/KG)												
4,4'-DDD	800	2,400	10	--	3.6 U	3.6 U	3.6 U	3.7 U	NA	NA	NA	NA
4,4'-DDE	3,000	1,700	10	--	84	26	180	5.9	NA	NA	NA	NA
4,4'-DDT	2,000	1,700	10	--	2.8 J	3.6	22	3.7 U	NA	NA	NA	NA
Aroclor-1260	--	110	40,000	--	36 U	36 U	28 J	37 U	NA	NA	NA	NA
Endosulfan I	900	37,000	0.01	--	0.44 J	1.8 U	1.8 U	1.9 U	NA	NA	NA	NA
delta-BHC	0.1	440	--	--	1.8 U	1.8 U	1.8 U	1.9 U	NA	NA	NA	NA
gamma-Chlordane	500	1,600	--	--	1.8 U	1.8 U	1.8 U	0.57 J	NA	NA	NA	NA
Total Metals (MG/KG)												
Aluminum	55,000	7,600	--	35,000	8,820 J	10,800	8,290	8,590 J	13,300	14,400	NA	NA
Antimony	0.3	3.1	78	3.6	6.5 U	0.82 J	0.58 J	6.6 U	6.6 U	6.6 U	NA	NA
Arsenic	1	0.39	18	1.6	1.1 U	1.1 U	1.1 U	1.1 U	0.83 J	0.86 J	NA	NA
Barium	82	1,600	330	147	57.3 J	80.5	62.9	63.1 J	168	99.1	NA	NA
Beryllium	3	15	40	0.27	0.54 U	0.54 U	0.07 J	0.55 U	0.55 U	0.55 U	NA	NA
Cadmium	0.4	3.7	32	2.24	0.54 U	0.54 U	0.11 J	0.55 U	0.55 U	0.55 U	NA	NA
Calcium	--	--	--	8,840	10,900 J	11,200	6,060	11,000 J	21,100	12,500	NA	NA
Chromium	2	210	0.4	72	11.9 J	13	9.6	13 J	14.3	13.6	NA	NA
Cobalt	33	140	13	15.8	9.2 J	11.4	9.1	11.7 J	14.9	10	NA	NA
Copper	46	310	70	65.5	34 J	42.1	32.4	31.9 J	52.8	51	NA	NA
Cyanide	--	120	1	0.89	2.7 U	2.7 U	2.7 U	2.8 U	0.23 J	2.7 U	NA	NA
Iron	276	2,300	--	38,100	15,900 J	19,200	15,900	16,900 J	20,100	20,200	NA	NA
Lead	14	400	120	5.4	3.9 J	6.6	2.8	3.4 J	2.3 J	2 J	NA	NA
Magnesium	--	--	--	3,710	2,910 J	3,720	2,720	2,870 J	4,590	4,600	NA	NA
Manganese	57	180	220	1,630	501 J	638	536	707 J	968	427	NA	NA
Nickel	7	160	38	22.2	4.7 J	5.7 J	4.6 J	5.2 J	8.2	7.1	NA	NA
Potassium	--	--	--	5,270	1,120 J	1,540 J	1,030 J	1,110 J	2,420 J	1,590 J	NA	NA
Selenium	0.3	39	0.52	0.51	3.8 U	0.56 J	0.68 J	0.61 J	0.78 J	3.8 U	NA	NA
Vanadium	300	7.8	2	144	62.3 J	73	54.2	68.5 J	86.1	78.4	NA	NA
Zinc	620	2,300	120	32	19.4 J	27	20.4	13.8 J	24.8 J	26.5 J	NA	NA
Total Petroleum Hydrocarbons (MG/KG)												
TPH GRO												
No Detections					NA	NA	NA	NA	NA	NA		
TPH DRO												
No Detections					NA	NA	NA	NA	NA	NA		

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- NA - Not Analyzed
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endosulfan I, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (aroclor-1260, nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set.
-- Regulatory standard not promulgated

Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, and DAF 1 Criteria
Exceeds Background and Eco Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 14-2
PI 4 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico
Validated Subsurface
Soil Detects 2006

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPI04-SO01	EPI04-SO02	EPI04-SO03	EPI04-SO04	EPI04-SO05	EPI04-SO06	EPI04-SO07
Sample ID				EPI04-SB01-0406	EPI04-SB02-0406	EPI04-SB03-0406	EPI04-SB04-0406	EPI04-SB05-0406	EPI04-SB06-0406	EPI04-SB07-0406
Sample Date				01/26/06	01/26/06	01/26/06	01/26/06	01/26/06	01/26/06	01/25/06
Chemical Name										
Volatile Organic Compounds (UG/KG)										
No Detections										
Semi-volatile Organic Compounds (UG/KG)										
No Detections										
Pesticide/Polychlorinated Biphenyls (UG/KG)										
4,4'-DDD	800	2,400	--	3.5 U	3.4 U	3.5 U	3.8 U	3.5 U	3.7 U	1.2 J
4,4'-DDE	3,000	1,700	--	3.5 U	3.4 U	1.5 J	3.8 U	3.5 U	2.7 J	1.1 J
4,4'-DDT	2,000	1,700	--	3.5 U	3.4 U	3.5 U	3.8 U	3.5 U	2.2 J	3.7 U
Endrin aldehyde	50	1,800	--	3.5 U	3.4 U	3.5 U	3.8 U	3.5 U	3.7 U	3.7 U
gamma-Chlordane	500	1,600	--	0.49 J	0.45 J	1.8 U	2 U	0.65 J	0.5 J	0.48 J
Total Metals (MG/KG)										
Aluminum	55,000	7,600	35,000	9,060 J	6,660 J	7,240 J	7,350	7,370 J	12,400 J	8,380 J
Antimony	0.3	3.1	3.3	6.4 U	6.3 U	6.3 U	6.9 U	6.3 U	6.7 U	6.7 U
Arsenic	1	0.39	1.6	1.1 U	1 U	1.1 U	1.2 U	1 U	1.1 U	1.1 U
Barium	82	1,600	147	46.9 J	42.4 J	44.7 J	51.8	44.4 J	84.3 J	55.8 J
Beryllium	3	15	0.27	0.53 U	0.52 U	0.52 U	0.58 U	0.53 U	0.56 U	0.56 U
Cadmium	0.4	3.7	2.24	0.53 U	0.52 U	0.52 U	0.58 U	0.53 U	0.56 U	0.56 U
Calcium	--	--	8,840	14,100 J	2,050 J	3,180 J	2,760	2,310 J	3,040 J	2,550 J
Chromium	2	210	72	16.2 J	10.8 J	11.3 J	10.6	11.4 J	11.6 J	11.2 J
Cobalt	33	140	15.8	7.9 J	8.1 J	7.5 J	7.7	7.4 J	11.1 J	9.3 J
Copper	46	310	65.5	45 J	39.3 J	44.9 J	41.7	48.8 J	57.5 J	48.4 J
Cyanide	--	120	0.89	2.7 U	2.6 U	2.6 U	2.9 U	2.6 U	2.8 U	2.8 U
Iron	276	2,300	38,100	21,400 J	15,000 J	17,100 J	15,700	16,800 J	20,500 J	18,500 J
Lead	14	400	3.34	1.6 J	1.1 J	2.3 J	1.4 J	1 U	1.4 J	1.5 J
Magnesium	--	--	3,710	4,890 J	2,580 J	2,360 J	2,510	2,930 J	3,250 J	3,080 J
Manganese	57	180	1,630	308 J	322 J	309 J	395	374 J	504 J	594 J
Nickel	7	160	22.2	6.6 J	5.8 J	4.5 J	5	5.9 J	9.7 J	6.7 J
Potassium	--	--	2,000	531 U	523 U	526 U	577 U	527 U	555 U	556 U
Selenium	0.3	39	0.51	3.7 U	3.7 U	3.7 U	0.54 J	3.7 U	0.49 J	3.9 U
Sodium	--	--	2,250	470 J	523 U	526 U	577 U	527 U	555 U	556 U
Vanadium	300	7.8	144	99.4 J	60.3 J	65.6 J	61.7	62.7 J	70.3 J	75.3 J
Zinc	620	2,300	32	18.7	13.9 J	15 J	15.7 J	18.3 J	17.4 J	17.2 J

Notes:

mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)

Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set.
-- Regulatory standard not promulgated

Exceeds Background and DAF 1 Criteria

TABLE 14-2
PI 4 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico
Validated Subsurface
Soil Detects 2006

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPI04-SO08		EPI04-SO09	EPI04-SO10	EPI04-SO11	EPI04-SO12	EPI04-SO13
Sample ID				EPI04-SB08-0406	EPI04-SB08P-0406	EPI04-SB09-0406	EPI04-SB10-0406	EPI04-SB11-0406	EPI04-SB12-0406	EPI04-SB13-0406
Sample Date				01/25/06	01/25/06	01/24/06	01/24/06	01/25/06	01/24/06	01/25/06
Chemical Name										
Volatile Organic Compounds (UG/KG)										
No Detections										
Semi-volatile Organic Compounds (UG/KG)										
No Detections										
Pesticide/Polychlorinated Biphenyls (UG/KG)										
4,4'-DDD	800	2,400	--	3.5 U	3.5 U	0.89 J	3.6 U	3.8 U	3.5 U	3.8 U
4,4'-DDE	3,000	1,700	--	71	47	44	50	0.79 J	220	3.8 U
4,4'-DDT	2,000	1,700	--	8.5	11	56	1.9 J	3.8 U	6.1	3.8 U
Endrin aldehyde	50	1,800	--	1.5 J	3.5 U	3.5 U	3.6 U	3.8 U	3.5 U	3.8 U
gamma-Chlordane	500	1,600	--	1.8 U	1.8 U	1.8 U	1.1 J	1.9 U	1.8 U	2 U
Total Metals (MG/KG)										
Aluminum	55,000	7,600	35,000	8,620	8,000	12,000	12,200 J	16,700	9,980	10,100 J
Antimony	0.3	3.1	3.3	0.52 J	0.44 J	0.61 J	6.5 U	0.79 J	0.6 J	6.9 U
Arsenic	1	0.39	1.6	0.54 J	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.2 U
Barium	82	1,600	147	47.3	42.3	61.1	75.1 J	106	57.6	68.6 J
Beryllium	3	15	0.27	0.53 U	0.53 U	0.54 U	0.54 U	0.56 U	0.034 J	0.58 U
Cadmium	0.4	3.7	2.24	0.53 U	0.53 U	0.54 U	0.54 U	0.56 U	0.079 J	0.58 U
Calcium	--	--	8,840	2,980	2,970	4,750	9,410 J	5,060	2,810	4,530 J
Chromium	2	210	72	9.6	11	11.7 J	13.1 J	18.1	14	12.4 J
Cobalt	33	140	15.8	9.3	8	10.2 J	9.5 J	15.8	10.8	11.5 J
Copper	46	310	65.5	39.3	40.2	43.5	39.4 J	111	44.2	56.3 J
Cyanide	--	120	0.89	2.6 U	2.7 U	2.7 U	2.7 U	2.8 U	2.7 U	2.9 U
Iron	276	2,300	38,100	17,600	17,600	17,800	18,300 J	30,000	18,700	18,700 J
Lead	14	400	3.34	1.2	1.1	4.3 J	1.6 J	1.8	1.5	1.5 J
Magnesium	--	--	3,710	4,020	3,330	3,900	3,110 J	7,810	2,930	4,900 J
Manganese	57	180	1,630	382	368	441	445 J	730	499	626 J
Nickel	7	160	22.2	4.6 J	4.4 J	5.9 J	5.3 J	11.5 J	6.7 J	8.8 J
Potassium	--	--	2,000	805 J	715 J	858 J	1,050 J	806 J	670 J	883 J
Selenium	0.3	39	0.51	3.7 U	3.7 U	3.8 U	0.59 J	0.74 J	3.8 U	4 U
Sodium	--	--	2,250	528 U	532 U	538 U	542 U	565 U	540 U	636 J
Vanadium	300	7.8	144	59.3	61.8	61.9	67 J	113	72.7	76.2 J
Zinc	620	2,300	32	14.2	13.7	17.6 J	16.6 J	38.2	16.7	22.8 J

Notes:

mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)

Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set.
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 14-2
PI 4 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico
Validated Subsurface
Soil Detects 2006

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPI04-SO14		EPI04-SO15
Sample ID				EPI04-SB14-0406	EPI04-SB14P-0406	EPI04-SB15-0406
Sample Date				02/14/06	02/14/06	02/14/06
Chemical Name						
Volatile Organic Compounds (UG/KG)						
No Detections						
Semi-volatile Organic Compounds (UG/KG)						
No Detections						
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDD	800	2,400	--	NA	NA	NA
4,4'-DDE	3,000	1,700	--	NA	NA	NA
4,4'-DDT	2,000	1,700	--	NA	NA	NA
Endrin aldehyde	50	1,800	--	NA	NA	NA
gamma-Chlordane	500	1,600	--	NA	NA	NA
Total Metals (MG/KG)						
Aluminum	55,000	7,600	35,000	6,820	6,950	11,900
Antimony	0.3	3.1	3.3	0.2 J	0.27 J	0.32 J
Arsenic	1	0.39	1.6	1 U	1 U	1.1 U
Barium	82	1,600	147	52.4 J	45.9 J	62.6 J
Beryllium	3	15	0.27	0.52 U	0.52 U	0.54 U
Cadmium	0.4	3.7	2.24	0.52 U	0.52 U	0.54 U
Calcium	--	--	8,840	3,080	3,900	3,740
Chromium	2	210	72	10.2 J	9.1 J	10.5 J
Cobalt	33	140	15.8	7.6 J	7.6 J	11.3 J
Copper	46	310	65.5	41.1 J	41.5 J	65.9 J
Cyanide	--	120	0.89	2.6 U	2.6 U	0.21 J
Iron	276	2,300	38,100	14,600	13,900	18,100
Lead	14	400	3.34	1 J	1.2 J	1.4 J
Magnesium	--	--	3,710	2,340	2,450	3,550
Manganese	57	180	1,630	367 J	328 J	507 J
Nickel	7	160	22.2	4.6 J	4.5 J	6 J
Potassium	--	--	2,000	521 U	519 U	742
Selenium	0.3	39	0.51	0.54 J	0.57 J	0.71 J
Sodium	--	--	2,250	521 U	519 U	539 U
Vanadium	300	7.8	144	55.8 J	51.3 J	61.3 J
Zinc	620	2,300	32	19.6 J	17.1 J	20.2 J

Notes:

mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)

Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set.
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 14-3
PI 4 Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Vieques HHRA GW**	**MCL - GW**	**PAOC-N EPAN-MW02 Background**	EPI04-MW01	EPI04-MW02	EPI04-MW03	EPI04-MW04	EPI04-MW05
Sample ID				EPI04-GW01-06B	EPI04-GW02-06B	EPI04-GW03-06B	EPI04-GW04-06B	EPI04-GW05-06B
Sample Date				04/04/06	04/04/06	04/04/06	04/05/06	04/05/06
Chemical Name								
Volatile Organic Compounds (UG/L)								
Chloroform	0.17	80	NA	0.5 U	0.99	0.5 U	0.5	0.5 U
Tetrachloroethene	0.1	5	NA	0.5 U	0.5 U	0.5 U	0.5 U	0.17 J
Toluene	230	1,000	NA	0.12 J	0.5 U	0.5 U	0.11 J	0.5 U
Trichloroethene	0.028	5	NA	0.48 J	0.5 U	0.5 U	0.5 U	9.3
cis-1,2-Dichloroethene	6.1	70	NA	0.5 UJ	0.5 U	0.5 UJ	0.5 U	0.19 J
Semi-volatile Organic Compounds (UG/L)								
No Detections								
Pesticide/Polychlorinated Biphenyls (UG/L)								
No Detections								
Total Metals (UG/L)								
Aluminum	3,600	--	263	200 U	265	200 U	200 U	794
Barium	730	2,000	200	200 U	200 U	200 U	200 U	272
Calcium	--	--	144,000	110,000	111,000	80,500	146,000	416,000
Chromium	11	100	3.6 J	1.3 J	1.3 J	1.8 J	22.3	11.7
Cobalt	73	--	--	50 U	0.41 J	0.41 J	50 U	2.6 J
Copper	150	1,300	--	11.7 J	25 U	25 U	25 U	25 U
Iron	1,100	--	198	100 U	205	100 U	213	1,280
Magnesium	--	--	75,600	86,800	83,800	51,500	169,000	346,000
Manganese	88	--	8 J	86.9	21.2	8.1 J	64.6	62.6
Nickel	73	--	2.4 J	1.7 J	1.3 J	1.6 J	18.1 J	7.2 J
Potassium	--	--	1780 J	2,260 J	5,000 U	5,000 U	5,000 U	5,000 U
Selenium	18	50	--	2.7 J	2.1 J	2.3 J	2.8 J	35 U
Sodium	--	--	323,000	260,000	273,000	245,000	344,000	477,000
Vanadium	3.6	--	--	22.1 J	50 U	50 U	50 U	50 U
Dissolved Metals (UG/L)								
Aluminum	3,600	--	--	200 U	235	200 U	200 U	200 U
Barium	730	2,000	--	56.7 J	87.2 J	91.1 J	191 J	273
Cadmium	1.8	5	--	5 U	0.15 J	5 U	5 U	5 U
Calcium	--	--	139,000	114,000	120,000	82,100	151,000	422,000
Chromium	11	100	--	0.88 J	0.81 J	0.77 J	2.4 J	1.2 J
Cobalt	73	--	--	50 U	0.49 J	50 U	50 U	50 U
Copper	150	1,300	--	8.8 J	25 U	25 U	25 U	25 U
Iron	1,100	--	--	100 U	118	100 U	100 U	66.6 J
Magnesium	--	--	73,400	89,200	90,200	53,000	177,000	358,000
Manganese	88	--	0.82	79.2	18.8	4.1 J	31.4	13.3 J
Mercury	1.1	2	--	0.2 U	0.051 J	0.2 U	0.2 U	0.2 U
Nickel	73	--	--	1.6 J	1.2 J	1 J	5.7 J	3.1 J
Potassium	--	--	1,710 J	2,310 J	2,510 J	1,380 J	1,620 J	3,260 J
Selenium	18	50	--	3.6 J	3.2 J	1.9 J	35 U	35 U
Sodium	--	--	311,000	262,000	285,000	248,000	355,000	493,000
Vanadium	3.6	--	--	22.4 J	19 J	25.2 J	14.3 J	13.5 J
Wet Chemistry (MG/L)								
Total dissolved solids (TDS)	--	--	NA	1,370	1,380	1,100	1,980	4,560

Notes:
- mg/L - Milligrams per Liter
- ug/L - Micrograms per Liter
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
- NA - Not Applicable

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Vieques HHRA GW - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards (40 Code of Federal Regulations [CFR] 141)
-- Not detected in background well
-- Regulatory standard not promulgated

Exceeds Background and HHRA criteria
Exceeds HHRA and MCL Criteria

TABLE 14-4
PI 4 Surface Water Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	EPI04-SW01
Sample ID	EPI04-SW1-06A
Sample Date	03/17/06
Chemical Name	
Volatile Organic Compounds (UG/L)	
cis-1,2-Dichloroethene	0.13 J
Semi-volatile Organic Compounds (UG/L)	
No Detections	
Pesticide/Polychlorinated Biphenyls (UG/L)	
No Detections	
Explosives (UG/L)	
No Detections	
Total Metals (UG/L)	
Aluminum	844
Barium	9.8 J
Calcium	17,200
Chromium	0.97 J
Cobalt	1 J
Copper	3.5 J
Cyanide	6.6 J
Iron	893
Magnesium	719 J
Manganese	52.4
Nickel	1 J
Potassium	12,900
Silver	0.99 J
Sodium	37,700
Vanadium	4.8 J
Dissolved Metals (UG/L)	
Aluminum	238 J
Barium	7.4 J
Calcium	15,600 J
Chromium	0.51 J
Cobalt	0.49 J
Iron	263 J
Magnesium	607 J
Manganese	20.8 J
Nickel	1.2 J
Potassium	13,700 J
Silver	0.5 J
Sodium	38,100 J

Notes:

ug/L - Micrograms per Liter

J - Analyte present; reported value may or may not be accurate or precise

TABLE 14-5
PI-4 Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable a CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized pending additional well installation and groundwater sampling
		VOCs	Yes	No	N/A	
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		PCB	Yes	No	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; < SSL in subsurface soil; not detected in groundwater	
				Ba > SSL, BKG	< SSL in subsurface soil; < PRG and MCL in groundwater	
				Pb > SSL, BKG	< SSL in subsurface soil; not detected in groundwater	
				Se > ECO, SSL, BKG	ECO based on plants; no sign of stress to plants; < ECO for soil invertebrates; < PRG and MCL in groundwater	
Subsurface Soil	Yes					Medium sufficiently characterized pending additional well installation and groundwater sampling
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Cu > SSL, BKG	< PRG and MCL in groundwater	
				Se > SSL, BKG	< PRG and MCL in groundwater	
Groundwater	Yes					See Section 14.4 - No further action for inorganics. Install additional wells and collect more data for VOCs due to MCL exceedance for TCE
		VOCs	Yes	Chloroform > PRG	individual HH risk acceptable; cumulative risk above acceptable level; < MCL	
				PCE > PRG	individual HH risk acceptable; cumulative risk above acceptable level; < MCL	
				TCE > PRG, MCL	individual and cumulative risk above acceptable level; just above	
		Inorganics	Yes	Cr > PRG, BKG	acceptable HH risk level	
				Fe > PRG, BKG	acceptable HH risk level	
				V > PRG, BKG	acceptable HH risk level	
Vault Water	Yes					Medium sufficiently characterized; vault has been removed
		VOC	Yes	N/A	N/A	
		Inorganics	Yes	N/A	N/A	

PHOTO DATE 1959

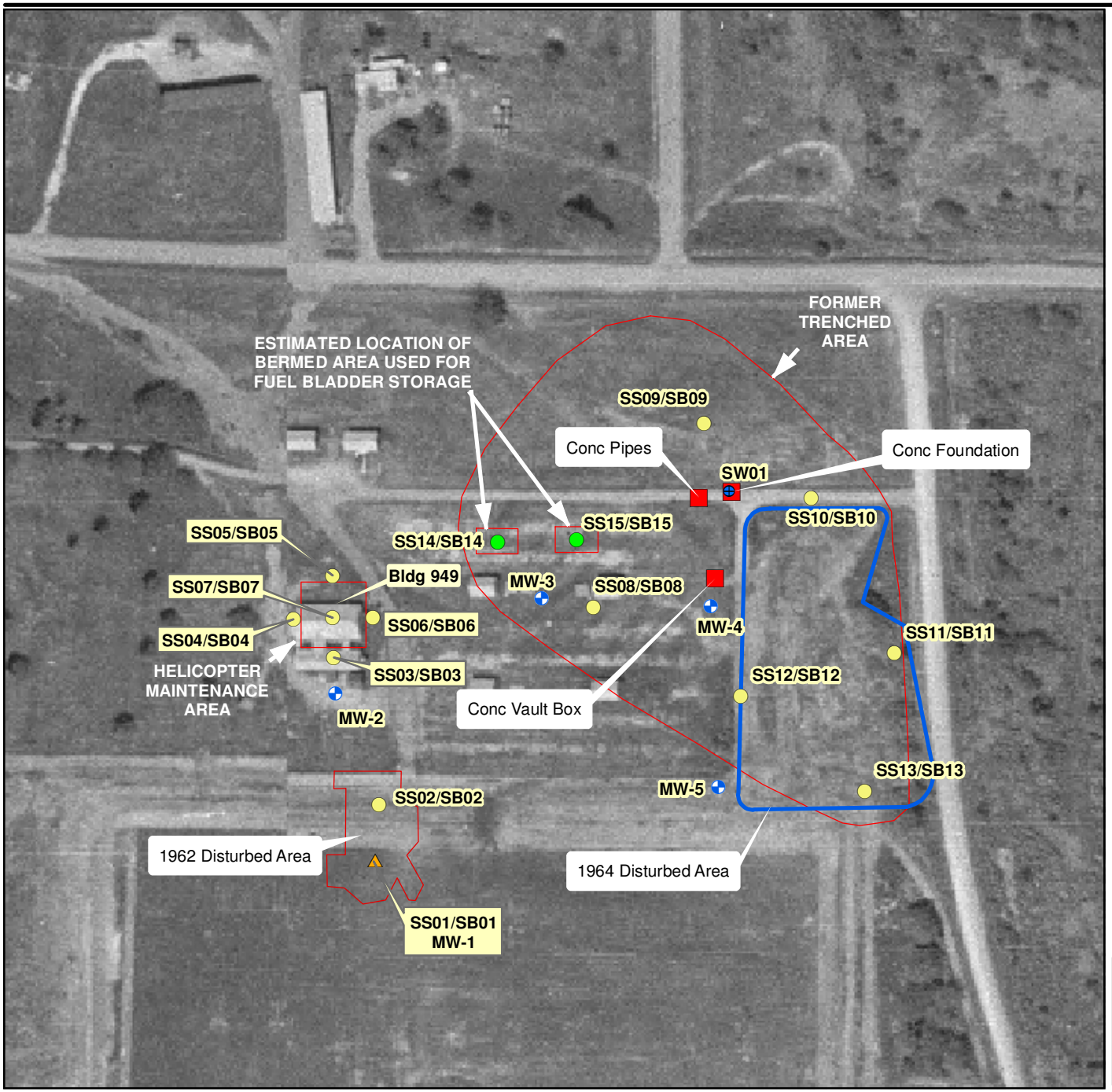
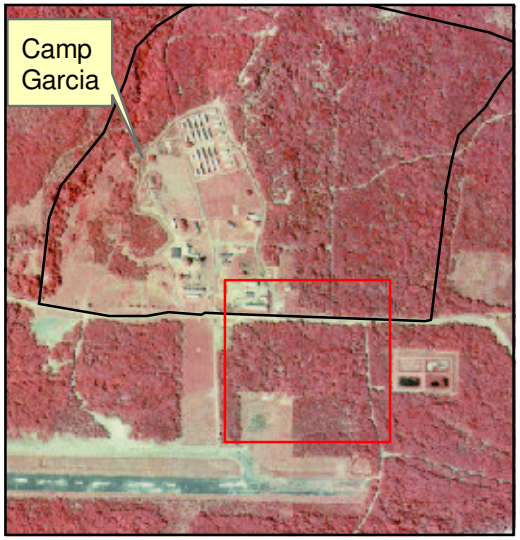


PHOTO DATE 1985



LEGEND

- PA/SI Monitoring Well Location
- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location
- PA/SI Surface and Subsurface Soil Sample Location Co-located with EBS Surface Soil Sample Location
- PA/SI Surface Water Sample Location
- Concrete Pipes/Foundation Slab/Vault Box
- Feature visible in 1962 Aerial Photograph
- Feature visible in 1964 Aerial Photograph

Note:
Each sampling location shown is preceded by "EPI04" (e.g. SS02/SB02 = EPI04-SS02 and EPI04-SB02, and MW-1 = EPI04-MW01)

N

0 100 200 Feet

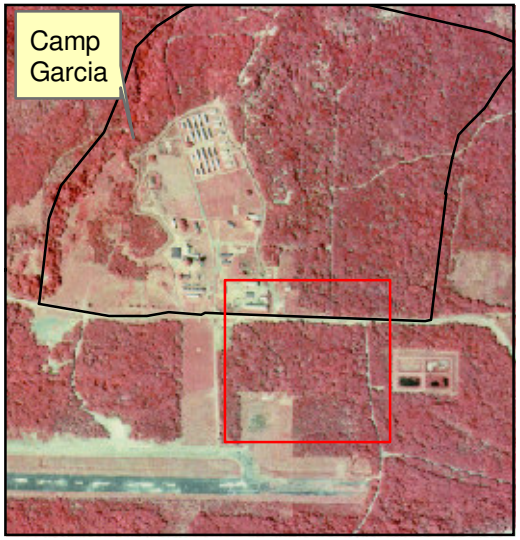
FIGURE 14-1
1959 Aerial Photograph of the PI 4 Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\Figure_14_1_1959_Aerial_Photo_PI_4.mxd

PHOTO DATE 1962

PHOTO DATE 1985



LEGEND

- PA/SI Monitoring Well Location
- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location
- PA/SI Surface and Subsurface Soil Sample Location Co-located with EBS Surface Soil Sample Location
- PA/SI Surface Water Sample Location
- Concrete Pipes/Foundation Slab/Vault Box
- Feature visible in 1964 Aerial Photograph

Note:
Each sampling location shown is preceded by "EPI04" (e. g. SS02/SB02 = EPI04-SS02 and EPI04-SB02, and MW-1 = EPI04-MW01)

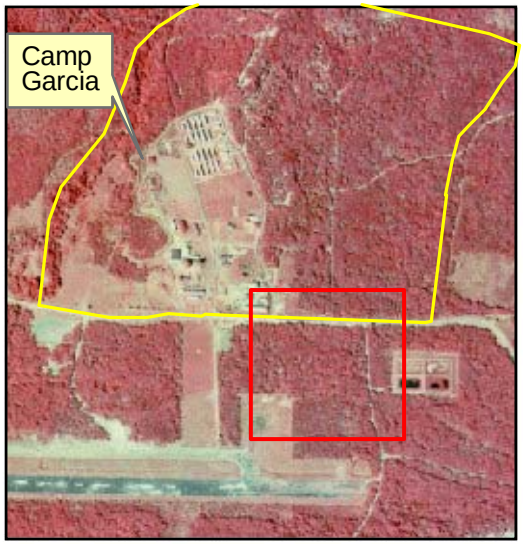
N

0 100 200 Feet

Figure 14-2
1962 Aerial Photograph of the PI 4 Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\Figure_14_2_1962_Aerial_Photo_PI_4.mxd



LEGEND

Disturbed area identified in ERI (2000)

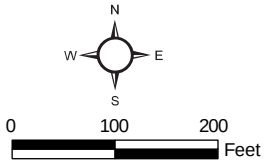


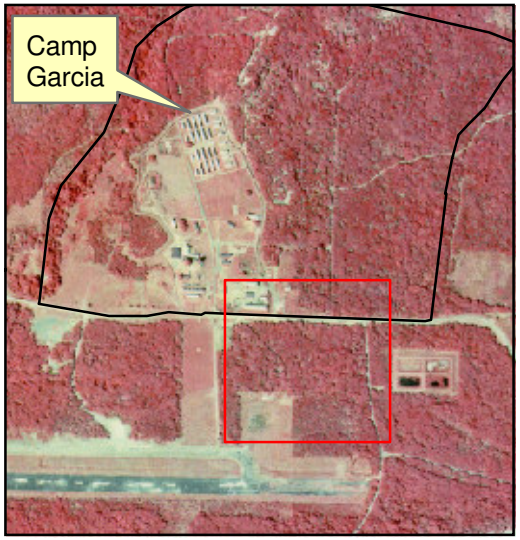
Figure 14-3
1964 Aerial Photograph of the PI 4 Area

Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

PHOTO DATE 1962

PHOTO DATE 1985



LEGEND

- PA/SI Monitoring Well Location With Water Elevation, Feet Above Mean Sea Level
- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location With Water Elevation, Feet Above Mean Sea Level
- PA/SI Surface and Subsurface Soil Sample Location Co-located with EBS Surface Soil Sample Location
- PA/SI Surface Water Sample Location
- Concrete Pipes/Foundation Slab/Vault Box
- Estimated Peizometric Contours (dashed where inferred)
- Feature visible in 1964 Aerial Photograph

Note: Each sampling location shown is preceded by "EPI04" (e.g. SS02/SB02=EPI04-SS02 and EPI04-SB02, and MW-1=EPI04-MW01)

N

0 100 200 Feet

Figure 14-4
PI 4 Piezometric Surface Elevation
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\Figure_14_4_PI_4_PiezometricSurface.mxd

Photo 1: PI 4 Concrete Foundation slab
Source: DRAFT FINAL EBS, 2003

Photo 2: PI 4 Concrete Pipe
Source: CH2M HILL site visit, 2001

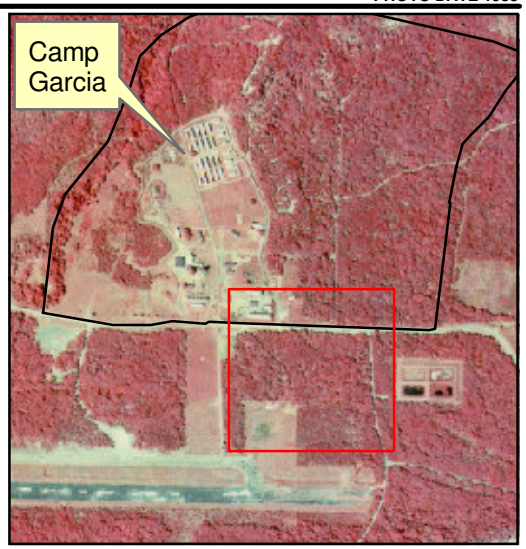
Photo 3: PI-4 Concrete vault and location of surface water sample.
Source: DRAFT FINAL EBS, 2003

Photo 4: PI 4 Concrete vault box south of concrete slabs
Source: DRAFT FINAL EBS, 2003

Figure 14-5
PI 4 Photos
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

PHOTO DATE 1962

PHOTO DATE 1985



LEGEND

- PA/SI Monitoring Well Location With Water Elevation, Feet Above Mean Sea Level
- Proposed Monitoring Well Location
- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location
- PA/SI Surface and Subsurface Soil Sample Location Co-located with EBS Surface Soil Sample Location
- PA/SI Surface Water Sample Location
- Concrete Pipes/Foundation Slab/Vault Box
- Estimated Peizometric Contours (dashed where inferred)
- Feature visible in 1964 Aerial Photograph

N

0 100 200 Feet

Figure 14-6
PI 4 Proposed Monitoring Well
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\Figure_14_6_PI_4_Proposed_MW.mxd

SECTION 15

PI-7 Former Quarry, Tar Drum Disposal Area, and Radar Communication Area

This section presents the results of the PA/SI performed at PI-7 Former Quarry, Tar Drum Disposal Area, and Radar Communication Area.

15.1 Conceptual Site Model

The CSM for PI-7 is based on review of historical information such as records, aerial photographs, interviews, site inspection documentation, as well as site-specific data.

15.1.1 Site History and Potential Sources of Release

PI-7 is located approximately ¼-mile west of the western boundary of Camp Garcia (Figures 1-2 and 1-3). Results of the aerial photography study completed by ERI in August 2000 showed that from 1959 through 1994, persistent ground scarring was evident at this location (NAVFACENGCOM, 2003).

PI-7 is divided into distinct subsections based on interviews, records, and site visits. The north subsection, believed to be associated with a radar communication facility (Figure 15-1); the center subsection, formerly a quarry (Figure 15-2); and the southern subsection, which contains drums, is believed to be a former tar drum disposal area (Figure 15-3).

The northern subsection of PI-7 is located between two hills, one to the southwest, and one to the southeast. In September 2001, a site reconnaissance of the northern subsection was performed to visually identify surface features and get a better understanding of the site. A concrete slab was observed and photographed during the reconnaissance (see Figure 15-4, Photo 2).

A site visit to the central subsection (former quarry) was conducted in 2002 as part of the EBS (NAVFACENGCOM, 2003). Various debris items, such as utility poles, scrap metal, a rubber pipe, and concrete were observed during this site visit (see Figure 15-4, Photos 1 and 3).

In August 2005, a more detailed site reconnaissance was completed on the northern, central, and southern subsections of PI-7. The objectives of the 2005 site reconnaissance were to identify the locations of surface debris by visual inspection, identify subsurface metallic anomalies in the central and southern subsections using a metal detector, and verify the subsurface metallic anomalies in order to select appropriate PA/SI sampling locations. Based on the results of the 2005 site reconnaissance, the area for subsequent reconnaissance was expanded in 2006 to cover areas east of the 2005 central subsection reconnaissance, and to cover the area between the central quarry subsection and the southern tar drum disposal area, as well as an approximate 100-foot-wide strip along the west side of the north-south

road adjacent to the southern tar disposal area and central quarry subsection (Figures 15-3 and 15-4). The findings of the various site reconnaissance activities are summarized below.

As stated previously, historical information and site reconnaissance of the northern subsection of PI-7 suggest it is the location of a former radar station. The large, irregular area outlined in Figure 15-1 is the boundary identified by the aerial photo analysis (ERI, 2000). During the August 2005 site reconnaissance, this area was searched, but the only object identified within the boundary was a telephone pole, whose location is shown on Figure 15-1. Further, the area identified by ERI was very hilly, which did not appear conducive for a radar communication facility. Because the area identified by ERI did not appear to be the location of any former structure, the field team expanded the site reconnaissance in an attempt to find the former radar communication facility. During this reconnaissance, it was determined that the former radar facility was actually located several hundred ft to the southeast of the area identified by ERI, as shown by the small rectangular area in Figure 15-1. At this location, rebar anchor loops and three 5-ft by 10-ft slabs of concrete were found at the locations identified in Figure 15-1. One of the concrete slabs is shown in Figure 15-4, Photo 2.

Approximately 7.1 acres in the central subsection (quarry) of PI-7 were visually observed with the aid of a metal detector during the August 2005 site reconnaissance, as shown in Figure 15-2. The reconnaissance included areas outside the boundary identified by ERI because a subsurface anomaly was identified along both the southwestern and northwestern boundaries. Within the area evaluated, the reconnaissance team found 11 metallic subsurface anomalies, 4 surface debris items, and two empty 55-gallon drums, as shown in Figure 15-2. All subsurface metallic anomalies were unearthed with a shovel. None were identified to be potential sources of contamination. They were primarily iron-bearing rocks and small pieces of metal such as wire. Among the identified metallic debris were a drill bit, communication wire, steel wire, and two ordnance related scrap (M212 40mm cartridge cases from a M781 40mm practice grenade round).

Also during the 2005 site reconnaissance, the southern subsection of PI-7 was visually observed with the aid of a metal detector to confirm the presence of drums previously observed. The area reconnoitered and the items found are shown in Figure 15-3. Three debris piles were found in the center of the site. These piles consisted of approximately 10, 10, and 40 rusted 55-gallon drums along with other metal debris. Two smaller piles, consisting of approximately 2 and 5 drums and other metal debris, were also identified near the larger debris piles. In addition, 18 subsurface metallic anomalies found. All subsurface metallic anomalies were unearthed with a shovel. Like the central subsection, none were identified to be potential sources of contamination.

Based on the results of the 2005 site reconnaissance, a second site reconnaissance was conducted in March 2006. This reconnaissance expanded the area evaluated in 2005, as shown in Figures 15-2 and 15-3. Twenty-nine pieces of mostly metallic surface debris were identified, four of which were rusted drums (two drums together, and two individual drums, as shown in Figure 15-3). The majority of the debris consisted of metallic plates, sheets, mats, and pipes. No additional subsurface anomalies were identified during the expanded reconnaissance, likely because: 1) the soil cover was greater, keeping the metal detector farther away from the ferrous rocks that caused false detections and/or 2) the intent of the survey was to find drums and potential sources of contaminant release, so

using lessons learned from the first survey, the sensitivity of the metal detector was decreased just enough to no longer pick up ferrous rocks as had been the case in the quarry, or small bits of wire and bottle caps. In addition, both sides of the north-south road adjacent to the western side of the site, including the 100-foot-wide strip west of the road, were visually inspected for evidence of drums. No drums were observed.

As discussed above, miscellaneous surface debris, drums, and approximately 29 subsurface anomalies (11 in the central subsection and 18 in the southern subsection) were identified during the August 2005 reconnaissance. These locations were marked with a flag and GPS coordinates of each were taken. All subsurface anomalies were later dug up with a shovel by UXO trained personnel to identify the anomaly source. None of the subsurface items found, which consisted mainly of metal wire, screws, and rocks, were suspected of being a potential contaminant source. The 2006 reconnaissance identified additional, mostly metallic surface debris and four more drums. Other than the drums found within the former quarry and tar drum disposal area, none of the surface debris was suspected of being a potential contaminant source. Therefore, based on the above information, the primary potential sources of contamination identified for PA/SI sampling were the drums. In addition, as a conservative measure, the former radar communication facility and the area near the southern boundary of the central subsection (i.e., EBS sample location PI7-3) were identified as potential source areas for PA/SI sampling. For details on the 2005 and 2006 site reconnaissance activities, see Appendix Q.

15.1.2 Physical Setting

The description of the sites physical setting is based on site reconnaissance activities conducted in 2001 (brief recon of 23 PI sites), 2002 (EBS), 2005 and 2006 (site reconnaissance for the PA/SI), as well as on regional information.

The site is hilly, sloping generally to the south and dropping approximately 250 ft from the northern subsection to the southern subsection. No federally protected species or preferred habitats are present at the site. For more information on the ecological survey, see Appendix M.

Soils overlying bedrock encountered in soil borings consist mostly of fine sand and silty sand. For more details on the unconsolidated material overlying bedrock, see the site-specific boring logs in Appendix D. Bedrock was encountered at approximately 14 ft to 17 ft bls in the southern subsection and at approximately 10 ft bls in the central subsection. PI-7 lies within the KTd formation, which consists of plutonic rocks, largely granodiorite and quartz diorite. The bedrock encountered in the well boreholes was granodiorite, with few fractures. For more information on the bedrock geology see Section 1.4.6.

There are no surface water bodies at or immediately adjacent to PI-7. There is an ephemeral stream about 2,000 ft south (in the downhill direction) of the southern subsection of PI-7. Regional groundwater flow is generally to the south (USGS, 1989) toward the Caribbean Sea, which is located approximately 1 mile to the south at Puerto Ferro.

15.2 Sampling Approach and Chemical Constituents Identified

Four surface soil samples (0 to 6 inches bls) were collected during the EBS in the vicinity of the debris observed in the former quarry area (PI7-1 through PI7-4 in Figure 15-2) and analyzed for Appendix IX VOCs, SVOCS, metals, herbicides, pesticides, and PCBs; explosives including perchlorate; cyanide, and sulfide. PI7-1 and PI7-2 were also analyzed for TPH-DRO and TPH-GRO. Surface soil sample locations were chosen because they were at the base of the slope near the edge of the site (as it was delineated in 2002).

As presented in the PA/SI Work Plan (CH2M HILL, 2006) and also in accordance with the field reconnaissance protocol, 22 surface soil samples and 18 subsurface soil samples were collected for analysis at PI 7 during the PA/SI. No FID readings significantly above background were observed in the soil borings (see Soil Boring Logs, Appendix D); therefore, subsurface soil samples were collected at default depths (or refusal, whichever was encountered first) in accordance with the work plan (see Table 2-1 for subsurface soil sample depths). For the northern subsection (former radar communication facility), one surface soil sample and one subsurface soil sample were collected at each of the three surficial feature areas identified during the August 2005 site reconnaissance, as shown in Figure 15-1.

For the central subsection (former quarry), two surface and two subsurface soil samples were collected at the location of the two empty 55-gallon drums identified during the August 2005 site reconnaissance (SS/SB15 and SS/SB16 in Figure 15-2). The more southern of these two borings was completed as a monitoring well (EPI07-MW03). Four surface soil samples and two subsurface samples (SS/SB11, SS12, SS13, and SS/SB14 in Figure 15-2) were collected around EBS sample PI7-3 to further delineate the extent of constituents previously detected at this location. Two additional subsurface samples (SB12 and SB13) were planned, but bedrock was encountered in these two borings at 1 ft bgs. One additional surface and subsurface soil sample (SS/SB21) was collected adjacent to the individual empty drum identified in the second (2006) reconnaissance.

Based on the descriptions of the debris identified south of the former quarry, 10 surface and subsurface soil samples (SS/SB01 through SS/SB10 in Figure 15-3) were collected around the debris areas. In addition, because of the number of drums found in the area, two of the soil borings were completed as monitoring wells (EPI07-MW01 and EPI07-MW02). The remaining two surface soil samples (SS20 and SS22 in Figure 15-3) were taken alongside individual rusted empty drums identified during the second (2006) reconnaissance. All surface and subsurface soil and groundwater samples were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs; and TAL inorganics.

Table 15-1 summarizes the constituents detected in PI-7 surface soil samples collected during the EBS and PA/SI and identifies screening criteria exceedances. EBS samples are prefaced by EBS in the sample name. Similar to Table 15-1, Tables 15-2 and 15-3 summarize the constituents detected in PI-7 subsurface soil and groundwater samples, respectively, as well as identify screening criteria exceedances. Subsurface soil and groundwater samples were collected during the PA/SI. Raw analytical data for the EBS and PA/SI samples are provided in Appendix O. Note that the groundwater data from the upgradient well at

PAOC N (EPAN-MW02), which is also within the KTd formation, was used for initial background comparison for the groundwater data collected at PI-7.

15.3 Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 15-1 through 15-3).

Appendix N, Section N.15 discusses the evaluation of the PI-7 data quality. As detailed in Section N.15, the PI-7 data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at PI-7, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former radar communication area, former quarry, and former tar drum disposal area. Based on this information, the potential for the presence of CERCLA hazardous substances could not be confidently ruled out without sample collection, which was conducted during the 2002 EBS and 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the EBS and PA/SI, the following inorganics above background UTLs and non-inorganics were detected by medium:

Northern Subsection (former radar communication facility)

Surface Soil (samples SS17 through SS19)

- VOCs: none detected
- SVOCs: di-n-octylphthalate
- Pesticides: 4,4'-DDE, 4,4'-DDT
- PCBs: none detected
- Inorganics above background UTLs: copper, lead, zinc

Subsurface Soil (samples SB17 through SB19)

- VOCs: none detected
- SVOCs: none detected
- Pesticides: 4,4'-DDE, 4,4'-DDT
- PCBs: none detected
- Inorganics above background UTLs: copper, magnesium, potassium, selenium, zinc

Central Subsection (former quarry)

Surface Soil (samples PI7-1 through PI7-4, SS11 through SS16, SS21)

- VOCs: none detected
- SVOCs: fluoranthene, benzo(b)fluoranthene, pyrene, chrysene, benzo(a)pyrene, benzo(a)anthracene, bis(2-ethylhexyl)phthalate, benzo(k)fluoranthene, benzo(g,h,i)perylene, ideno(1,2,3-cd)pyrene
- Pesticides: 4,4'-DDE, endrin, beta-BHC
- Herbicides: none detected
- PCBs: none detected
- Inorganics above background UTLs: arsenic, barium, copper, magnesium, selenium, thallium, zinc
- TPH GRO: none detected
- TPH DRO: none detected

Subsurface Soil (samples SB11, SB14 through SB16, SB21)

- VOCs: none detected
- SVOCs: di-n-octylphthalate, bis(2-ethylhexyl)phthalate
- Pesticides: none detected
- PCBs: none detected
- Inorganics above background UTLs: barium, calcium, copper, magnesium, selenium, zinc

Groundwater (well MW03)

- VOCs: carbon disulfide, chloromethane
- SVOCs: none detected
- Pesticides: delta-BHC
- PCBs: none detected
- Total inorganics above background UTLs: barium, calcium, chromium, cobalt, manganese, nickel, potassium, selenium
- Dissolved inorganics above background UTLs: barium, calcium, chromium, cobalt, manganese, mercury, nickel, potassium, vanadium

Southern Subsection (former tar drum disposal area)

Surface Soil (samples SS01 through SS10, SS20, SS22)

- VOCs: none detected

- SVOCs: none detected
- Pesticides: 4,4′-DDE, 4,4′-DDT, delta-BHC
- PCBs: none detected
- Inorganics above background UTLs: calcium, copper, cyanide, magnesium, selenium, zinc

Subsurface Soil (samples SB01 through SB10)

- VOCs: none detected
- SVOCs: none detected
- Pesticides: 4,4'-DDE
- PCBs: none detected
- Inorganics above background UTLs: arsenic, barium, calcium, magnesium, selenium

Groundwater (MW01 and MW02)

- VOCs: chloroform, tetrachloroethene (PCE)
- SVOCs: none detected
- Pesticides: delta-BHC
- PCBs: none detected
- Total inorganics above background UTLs: barium, manganese, nickel
- Dissolved inorganics above background UTLs: barium, chromium, cobalt, manganese, mercury, nickel, potassium, selenium, vanadium

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Drums were found within the former quarry and the former tar drum disposal area south of the former quarry. Some other debris was found in the quarry area as well. As such, it is possible that the SVOCs and inorganics detected in the central and southern subsections of PI 7 soil and VOCs and inorganics detected in groundwater are attributable to historic CERCLA-related releases. Further, although no evidence of a release was observed at the former radar communication area and there is no known source of hazardous material or constituents in this area, the single SVOC and inorganics are conservatively assumed to be potentially attributable to historic CERCLA-related releases.

As discussed in Section 1, the pesticides detected at this site are the same pesticides and of similar concentrations detected at other sites across east Vieques. This information, coupled with the history of the site, suggests the pesticides are present due to normal pesticide use, not a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1). Therefore, pesticides are not considered further in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Northern Subsection (former radar communication facility)

Surface Soil (samples SS17 through SS19)

- SVOCs: no exceedances
- Copper: three detections (SS17, SS18, SS19) at concentrations (85 mg/kg to 119 mg/kg) above the ecological screening value (70 mg/kg), the SSL at a DAF of 1 (46 mg/kg), and the background UTL (65 mg/kg)

Subsurface Soil (samples SB17 through SB19)

- Copper: three detections (SB17, SB18, SB19) at concentrations (118 mg/kg to 185 mg/kg) above the SSL at a DAF of 1 (46 mg/kg) and the background UTL (65 mg/kg).
- Selenium: one detection (SB18) at a concentration (0.69 mg/kg) above the SSL at DAF of 1 (0.3 mg/kg) and the background UTL (0.51 mg/kg).

Central Subsection (former quarry)

Surface Soil (samples PI7-1 through PI7-4, SS11 through SS16, SS21)

- Fluoranthene: one detection (PI7-3) at a concentration (2,580 μg/kg) above the ecological screening value (100 μg/kg)
- Benzo(b)fluoranthene: one detection (PI7-3) at a concentration (2,480 μg/kg) above the PRG (620 μg/kg) and SSL at a DAF of 1 (200 μg/kg)
- Pyrene: one detection (PI7-3) at a concentration (2,470 μg/kg) above the ecological screening value (100 μg/kg)
- Benzo(a)pyrene: one detection (PI7-3) at a concentration (1,710 μg/kg) above the PRG (62 μg/kg), the SSL at a DAF of 1 (400 μg/kg), and the ecological screening value (100 μg/kg)
- Benzo(a)anthracene: one detection (PI7-3) at a concentration (1,670 μg/kg) above the PRG (620 μg/kg) and the SSL at a DAF of 1 (80 μg/kg)
- Indeno(1,2,3-cd)pyrene: one detection (PI7-3) at a concentration (945 μg/kg) above the PRG (620 μg/kg) and the SSL at a DAF of 1 (700 μg/kg)
- Arsenic: one detection (PI7-3) at a concentration (12 mg/kg) above the PRG (0.39 mg/kg), the SSL at a DAF of 1 (1 mg/kg), and the background UTL (1.6 mg/kg)
- Barium: one detection (SS21) at a concentration (200 mg/kg) above the SSL at a DAF of 1 (82 mg/kg) and the background UTL (147 mg/kg)

- Copper: one detection (SS13) at a concentration (83 mg/kg) above the ecological screening value (70 mg/kg), the SSL at a DAF of 1 (46 mg/kg), and the background UTL (65 mg/kg)
- Selenium: three detections (SS11, SS16, SS21) at concentrations (0.56 mg/kg, 0.84 mg/kg, and 0.6 mg/kg, respectively) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and the background UTL (0.51 mg/kg)
- Thallium: three detections (PI7-1, PI7-2, PI7-4) at concentrations (1 mg/kg to 1.4 mg/kg) above the adjusted PRG (0.52 mg/kg), the SSL at a DAF of 1 (0.036 mg/kg), the background UTL (0.13 mg/kg), and (except for PI7-4) the ecological screening value (1 mg/kg)

Subsurface Soil (samples SB11, SB14 through SB16, SB21)

- SVOCs: no exceedances
- Barium: one detection (SB21) at a concentration (181 mg/kg) above the SSL at a DAF of 1 (82 mg/kg) and the background UTL (147 mg/kg)
- Copper: one detection (SB16) at a concentration (72 mg/kg) above the SSL at a DAF of 1 (46 mg/kg) and the background UTL (65 mg/kg)
- Selenium: three detections (SB14, SB15, SB16) at concentrations (0.72 mg/kg, 0.64 mg/kg, and 0.53 mg/kg, respectively) above the SSL at DAF of 1 (0.3 mg/kg) and the background UTL (0.51 mg/kg)

Groundwater (well MW03)

- VOCs: no exceedances
- Vanadium (dissolved): detected at a concentration (4.7 µg/L) above the adjusted tap water PRG (3.6 µg/L) and background (non-detect)

Southern Subsection (former tar drum disposal area)

Surface Soil (samples SS01 through SS10, SS20, SS22)

- Copper: two detections (SS09, SS22) at concentrations (71.2 and 70.5 mg/kg, respectively) above the ecological screening value (70 mg/kg), the SSL at a DAF of 1 (46 mg/kg), and the background UTL (65mg/kg)
- Cyanide: one detection (SS02) at a concentration (1.3 mg/kg) above the ecological screening value (1 mg/kg) and the background UTL (0.89 mg/kg)
- Selenium: six detections (SS01, SS02, SS03, SS05, SS06, and SS09) at concentrations (0.57 mg/kg to 1.1 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and the background UTL (0.51 mg/kg)

Subsurface Soil (samples SB01 through SB10)

- Arsenic: one detection (SB08) at a concentration (2.6 mg/kg) above the PRG (0.39 mg/kg), the SSL at a DAF of 1 (1 mg/kg), and the background UTL (1.6 mg/kg)

- Barium: two detections (SB06, SB09) at concentrations (154 mg/kg and 163 mg/kg, respectively) above the SSL at a DAF of 1 (82 mg/kg) and the background UTL (147 mg/kg)
- Selenium: eight detections (SB01, SB02, SB03, SB05, SB06, SB07, SB09, SB10) at concentrations (0.59 mg/kg to 1 mg/kg) above the SSL at DAF of 1 (0.3 mg/kg) and the background UTL (0.51 mg/kg)

Groundwater (MW01 and MW02)

- PCE: one detection (MW02) at a concentration (0.2 μg/L) above the tap water PRG (0.1 μg/L)
- Vanadium (dissolved): detected in both wells at concentrations (11 μg/L and 8.3 μg/L) above the adjusted tap water PRG (3.6 μg/L) and background (non-detect)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Northern Subsection (former radar communication facility)

Soil

No constituents exceed human health screening criteria. Although aluminum, iron, manganese, and vanadium were detected in soil above their adjusted PRGs, all concentrations are below their background UTLs.

Copper exceeds the ecological screening value and background UTL in several surface soil samples collected around the former radar communication facility. This constituent does not likely pose an unacceptable risk to ecological receptors based upon the following:

- The site is very small (i.e., the remnants of the former radar structure were found in an area about 100 ft by 100 ft). Further, the site is well vegetated with no signs of stress.
- Copper exceeds the ecological screening value (70 mg/kg, which is based upon plants) and background UTL in the three surface soil samples collected in this area. These screening value exceedances are of relatively low magnitude, with an HQ based on the maximum copper concentration of 1.7. The maximum HQ for ecological screening values based upon other receptors (e.g., 80 mg/kg for soil invertebrates) is only 1.49. Based upon the mean copper concentration (97 mg/kg), the HQ is 1.2 to 1.4. Although the background UTL for copper in this soil type is 65.5 mg/kg, copper concentrations up to 102 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the copper concentrations detected at in this portion of PI-7 (85, 85.8, and 119 mg/kg) may be within the range of background. Thus, copper has a low potential for unacceptable risks.

The same three copper concentrations discussed above exceed the SSL at a DAF of 1 (46 mg/kg), as did the subsurface soil concentrations of copper at this location. However, as noted above, the area of the site is small. Therefore, an SSL at a higher DAF is likely to be

more representative of copper leaching through soil, as discussed in Section 1.1.2. None of the copper concentrations exceeds the SSL at a DAF of 4. Further, copper was not detected in any of the wells installed in the central and southern subsections of PI-7, which are in the approximate downgradient direction from the northern subsection.

Selenium was detected in one subsurface soil sample above the SSL at a DAF of 1 (0.3 mg/kg), but below the SSL at a DAF of 3. Further, selenium was either not detected or was detected at a concentration below screening criteria in the wells installed in the southern and central subsections of PI-7.

Central Subsection (former quarry)

Soil

Four PAHs and arsenic were detected in soil at concentrations exceeding human health screening values and background (for arsenic) at only one (PI7-3, collected in 2002) of the locations sampled within the former quarry area. However, five surface soil samples (SS-11 through SS-14 and SS-21 [Figure 15-2]) collected in 2006 around sample PI7-3 did not contain detectable SVOCs or arsenic. This suggests the PAHs and arsenic detected during the EBS were very localized around PI7-3 or are no longer present.

The PRGs for the four PAHs (i.e., benzo(b)fluoranthene, benzo(a)pyrene, benzo(a)anthracene, indeno(1,2,3-cd)pyrene) and arsenic are based on potential carcinogenic effects. Based on the maximum detected concentrations of these constituents relative to PRGs (derived using a target risk of 1×10^{-6}), the estimated risks would be 4×10^{-6} for benzo(b)fluoranthene, 3×10^{-5} for benzo(b)pyrene, 3×10^{-6} for benzo(a)anthracene, 2×10^{-6} for ideno(1,2,3-cd)pyrene, and 3×10^{-5} for arsenic, yielding a cumulative risk of approximately 7×10^{-5} for a residential scenario. Based on the relatively low maximum detected concentrations and the EPCs that would be used in risk calculations, risk estimates would be within acceptable levels and these constituents would not be identified as risk drivers. The single arsenic detection in surface soil at PI7-3 also exceeds the PRG based on non-cancer hazards (2.2 mg/kg at an HQ=0.1). Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 22 mg/kg (HQ=1); the arsenic concentration is below this level.

Thallium is the only other constituent detected above its human health screening level (0.52 mg/kg based on an HQ=0.1) and background UTL. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 5.2 mg/kg (HQ=1); all thallium concentrations are below this level. Further, all three of the thallium exceedances were for surface soil samples collected during the EBS. These thallium concentrations are suspect because the analytical method utilized tended to give falsely elevated results. This supposition is supported by the fact that none of the samples collected at PI-7 during the PA/SI contained thallium at elevated concentrations with respect to the various screening criteria.

As noted above, only two constituents with non-carcinogenic toxicity values (arsenic and thallium) were detected above PRGs and background. The non-carcinogenic PRG for arsenic is based on skin and vascular effects, while the PRG for thallium is based on liver effects. Although aluminum, iron, manganese, and vanadium were detected in soil above their adjusted PRGs, the PRGs are based on neurotoxicity in offspring (aluminum),

gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

Three PAHs (fluoranthene, pyrene, and benzo[a]pyrene) and three inorganics (copper, selenium, and thallium) exceed ecological screening values and background (for copper, selenium, and thallium) in at least one surface soil sample collected around the former quarry. None of these constituents likely poses an unacceptable risk to ecological receptors based upon the following:

- Although the concentrations of three PAHs (fluoranthene, pyrene, and benzo[a]pyrene) are elevated relative to individual ecological screening values (which are not toxicologically-based) in PI7-3, the total PAH concentration for detected constituents in sample PI7-3 (16,070 µg/kg) is less than the ecological screening value (eco-SSL) for total higher molecular-weight PAHs based upon exposures to soil invertebrates (18,000 µg/kg). In addition, the potential risks to more mobile ecological receptors (such as birds and mammals) would likely be acceptable because these potential receptors would use a much broader area as habitat, not be limited to the very small area at PI7-3, noting that the samples adjacent to PI7-3 did not contain detectable PAHs.
- Copper exceeds the ecological screening value (70 mg/kg) and background in 1 of 11 surface soil samples (SS13) collected within the former quarry area; the maximum HQ is only 1.18. However, the mean copper concentration (48 mg/kg) is less than the ecological screening value. Therefore, unacceptable ecological risks are unlikely.
- Selenium exceeds the ecological screening value (0.52 mg/kg) and background UTL in 3 of the 11 surface soil samples. The screening value (0.52 mg/kg), however, is based on potential impacts to plants. The site has become overgrown with vegetation and there were no signs of stress during the site visit. All selenium concentrations are less than ecological screening values based on other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable ecological risks.
- Thallium concentrations exceed the ecological screening value in only two surface soil samples (PI7-1 and PI7-2). The HQ based on the maximum concentration is 1.4. However, the HQ based on the mean concentration is less than 1. Thus, thallium does not likely pose an unacceptable ecological risk. Further, as discussed above, the thallium results are suspected of being artificially high.

None of the PAHs that exceed the SSLs at a DAF of 1 in surface soil sample PI7-3 were detected in any of the three subsurface samples (SB11, SB14, SB21) surrounding PI7-3 or in the groundwater samples collected downgradient of this area. This suggests the SSLs at a DAF of 1 are not realistic predictors of PAH leaching to groundwater. None of the PAHs exceeds its SSL at a DAF of about 20.

Five constituents (arsenic, barium, copper, selenium, and thallium) were detected in surface and/or subsurface soil above their SSLs at a DAF of 1. However, all but thallium were detected below their SSLs at a DAF of 12 and barium, copper, and selenium were detected below their SSLs at a DAF of 3. Further, arsenic was not detected in the surface soil or subsurface soil in any of the other samples collected in the vicinity of the single SSL

exceedance (PI7-3), nor was thallium detected in the subsurface soil above the SSL at a DAF of 1. In addition, arsenic, copper, thallium were not detected in groundwater at PI-7, and barium and selenium were detected below their respective MCLs and tap water PRGs. This information suggests that the SSLs at a DAF of 1 are not realistic predictors of leaching to groundwater within the former quarry area of PI-7.

Groundwater

PCE was detected in one of three groundwater samples, at a concentration of 0.2 μg/L, which is above its human health screening level (0.1 μg/L based on 1×10^{-6} ELCR). Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}), the acceptable risk-based concentrations range from 0.1 μg/L (1×10^{-6} ELCR) to 10 μg/L (1×10^{-4} ELCR). The detected concentration is toward the low end of the acceptable risk range.

Vanadium (dissolved) was detected above its screening level (3.6 μg/L based on an HQ=0.1) in the three wells. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for tap water is 36 μg/L (HQ=1), which is approximately three times the maximum detected concentration of 11.1 μg/L. Further, all concentrations of vanadium detected in soil at PI-7 are below the background UTL. This indicates that the vanadium present in groundwater is attributable to background.

As noted above, only two constituents (PCE and vanadium) were detected in groundwater at or downgradient of the former quarry at concentrations above tap water PRGs. Neither was detected above an MCL. The PRG for PCE is based on cancer risk. For vanadium, the PRG is based on increased mortality. Because no other constituent was detected above its adjusted tap water PRG, there is not a concern for cumulative non-cancer effects from multiple constituents in groundwater.

Southern Subsection (former tar drum disposal area)

Soil

Arsenic was detected in only one soil sample (subsurface soil sample SB08) within the former tar drum disposal area above the human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR) and background UTL. Further, it is the only constituent to exceed its human health screening level and background in soil in this area. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer hazard quotient (HQ), acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the low maximum detected concentration and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver. Although aluminum, iron, manganese, and vanadium were detected in soil above their adjusted PRGs, the PRGs are based on neurotoxicity in offspring (aluminum), gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

Three inorganics (copper, cyanide, and selenium) exceed ecological screening values and background in at least one surface soil sample collected around the former tar drum

disposal area. None of these constituents likely poses an unacceptable risk to ecological receptors based upon the following:

- The two ecological screening value exceedances for copper (SS9, SS22) in surface soil were scattered within the southern area of the site with no obvious spatial pattern. However, both detections exceed the screening value by less than 2 mg/kg; the HQs are 1.02 and 1.01, respectively. Further, the HQ based on the mean copper concentration (47 mg/kg) in this area is less than 1. This indicates that unacceptable ecological risks associated with copper are unlikely in this area.
- The only cyanide concentration in surface soil to exceed the ecological screening value and background is in sample SS02. This single exceedance is of low magnitude (HQ = 1.3), indicating that unacceptable ecological risks associated with cyanide are unlikely in this area.
- Selenium exceeds the ecological screening value, which is based upon plants, and the background UTL in 6 of 12 surface soil samples within the former tar drum disposal area. Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations of up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected in this portion of PI-7 (maximum of 1.1 mg/kg) may be within the range of background. Further, all selenium concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable risks.

Four constituents (arsenic, barium, copper, and selenium) were detected in surface and/or subsurface soil above their SSLs at a DAF of 1. However, none were detected above their SSLs at a DAF of 4. Further, arsenic was not detected in the surface soil or subsurface soil in any of the other samples collected in the vicinity of the single SSL exceedance (SB08). In addition, neither arsenic nor copper was detected in groundwater at PI-7, and barium and selenium were detected below their respective MCLs and tap water PRGs.

Groundwater

See groundwater discussion under “Central Subsection (former quarry)” above.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases are around the former radar communication structure to the north, and under and around the drums and debris piles in the quarry and to the south. Based on this information, multiple soil and groundwater samples were collected around (in the case of soil) and downgradient (in the case of groundwater) of these areas, the spatial distribution and resulting data of which indicate the potential source areas have been sufficiently characterized.

15.4 Conclusions and Recommendations

Tables 15-4, 15-5, and 15-6 summarize the results of the decision analysis for PI-7, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Although several organic and non-inorganic constituents were detected in surface and subsurface soil and groundwater, the detections were concluded to be within acceptable risk levels. Further, pesticide detections at the site are consistent with normal pesticide application associated with maintenance of the historical facilities present at the site.

Although soil and groundwater samples were collected within and immediately adjacent to the areas where drums were found, as a precautionary measure to ensure the drums do not pose a potential future source of contamination, it is recommended that they be removed and disposed of appropriately. If, during the removal of the drums, there is evidence of a release (i.e., visual or PID), the visually contaminated soil will be removed. Regardless of any evidence of contamination, following drum (and soil if any removed) removal, confirmatory surface soil samples will be collected from the area of drum removal. The confirmatory soil sample data will be used to determine if additional characterization, removal, or preparation of a NFA decision document is warranted.

The rationale, objective, and decision analysis for confirmatory soil data collection are provided below:

<u>Rationale</u>

To confirm whether releases occurred and, if so, whether further action is warranted.

<u>Objective</u>

Evaluate whether a release warranting further action took place from the drums by:

- Removing the drums
- Collecting 6-inch soil samples from where the drums were removed (one sample for piles of up to 5 drums; two samples for piles between 6 and 19 drums; three samples for piles of 20 or more drums)
- Analyzing all soil samples for TCL VOCs and SVOCs, and TAL inorganics

<u>Decision Analysis</u>

Evaluate newly collected and relevant historical data using 6-step decision analysis process (Figure 1-4).

TABLE 15-1
PI 7 Suface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	EPI07-SO01		EPI07-SO02	EPI07-SO03	EPI07-SO04	EPI07-SO05	EPI07-SO06	EPI07-SO07	EPI07-SO08	EPI07-SO09	EPI07-SO10	EPI07-SO11	EPI07-SO12	EPI07-SO13	EPI07-SO14	EPI07-SO15
Sample ID, prefaced with EBS if EBS data					EPI07-SS01-0001	EPI07-SS01-0001P	EPI07-SS02-0001	EPI07-SS03-0001	EPI07-SS04-0001	EPI07-SS05-0001	EPI07-SS06-0001	EPI07-SS07-0001	EPI07-SS08-0001	EPI07-SS09-0001	EPI07-SS10-0001	EPI07-SS11-0001	EPI07-SS12-0001	EPI07-SS13-0001	EPI07-SS14-0001	EPI07-SS15-0001
Sample Date					03/13/06	03/13/06	03/13/06	03/13/06	03/13/06	03/14/06	03/14/06	03/14/06	03/14/06	03/14/06	03/14/06	03/14/06	03/14/06	03/14/06	03/14/06	03/16/06
Chemical Name																				
Volatile Organic Compounds (UG/KG)																				
No Detections																				
Semi-volatile Organic Compounds (UG/KG)																				
Di-n-octylphthalate	10,000,000	240,000	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 UJ	350 UJ	340 U	350 UJ	350 UJ	340 U	340 U	340 U	350 U	360 UJ
Fluoranthene	210,000	230,000	100	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
Benzo(b)fluoranthene	200	620	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
Pyrene	210,000	230,000	100	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
Chrysene	8,000	62,000	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
Benzo(a)pyrene	400	62	100	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
Benzo(a)anthracene	80	620	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
Benzo(k)fluoranthene	2,000	6,200	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 U
Benzo(g,h,I)perylene	210,000	2,300,000	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 UJ	350 UJ	340 U	350 UJ	350 UJ	340 U	340 U	340 U	350 U	360 U
Ideno(1,2,3-cd)pyrene	700	620	--	--	350 U	350 U	370 U	360 U	340 U	350 U	350 U	350 U	340 U	350 U	350 U	340 U	340 U	340 U	350 U	360 UJ
Pesticide/Polychlorinated Biphenyls (UG/KG)																				
4,4'-DDE	3,000	1,700	10	--	7.5	6.4	4.9	12	3.4 U	22	13	1.7 J	3.4 U	1.7 J	6.6	0.9 J	3.4 U	3.4 U	3.5 U	3.6 U
4,4'-DDT	2,000	1,700	10	--	3.5 U	3.5 U	1.3 J	2.5 J	3.4 U	3.5 U	3.5 U	3.5 U	3.4 U	3.5 U	1.6 J	3.4 U	3.4 U	3.4 U	3.5 U	3.6 U
Endrin	50	1,800	0.04	--	3.5 U	3.5 U	3.7 U	3.6 U	3.4 U	3.5 U	3.5 U	3.5 U	3.4 U	3.5 U	3.5 U	3.4 U	3.4 U	3.4 U	3.5 U	3.6 U
beta-BHC	0.1	320	9	--	1.8 U	1.8 U	1.9 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	1.8 U	1.8 U	1.8 U
delta-BHC	0.1	440	--	--	1.8 U	1.8 U	1.9 U	0.41 J	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	1.8 U	1.8 U	1.8 U
gamma-Chlordane	500	1,600	--	--	1.8 U	1.8 U	1.9 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	1.8 U	1.8 U	1.8 U
Appendix IX Organophosphate Pesticides (UG/KG)																				
No Detections					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Appendix IX Herbicides (UG/KG)																				
No Detections					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total Metals (MG/KG)																				
Aluminum	55,000	7,600	--	35,000	8,800 J	10,200 J	10,200 J	11,100 J	9,300 J	14,000 J	12,200 J	15,200 J	10,600	15,300 J	9,010 J	10,300	10,100	11,600	13,700	12,700
Antimony	0.3	3.1	78	3.6	0.68 J	0.41 J	0.62 J	0.73 J	0.61 J	0.63 J	0.63 J	0.73 J	0.72 J	0.53 J	0.46 J	0.57 J	0.61 J	0.6 J	0.78 J	0.72 J
Arsenic	1	0.39	18	1.6	0.36 J	1.1 U	1.1 U	1.1 U	1 U	1.1 U	1.1 U	0.5 J	1 U	1.1 U	1.1 U	1 U	1 U	1 U	1.1 U	1.1 U
Barium	82	1,600	330	147	75.8 J	79.2 J	90.9 J	77.1 J	68.3 J	128 J	103 J	107 J	95.6	127 J	49.7 J	67.3	59.1	96	99.5	123
Calcium	--	--	--	8,840	5,930 J	4,870 J	7,520 J	5,550 J	4,570 J	3,610 J	4,290 J	25,500 J	4,540	5,980 J	4,520 J	5,500	7,210	4,600	5,960	3,690
Chromium	2	210	0.4	72	5.4	5.2	4.7	7.1	4.2	5.7	5.8	5.6	3.9	6	4.6	3.7	3.9	3.3	3.2	5.9 J
Cobalt	33	140	13	15.8	8 J	8.6 J	8.9 J	9.2 J	8.4 J	10.5 J	10.1 J	11 J	9.7	13.5 J	7.8 J	10.5	10.5	9.9	11.5	11.4 J
Copper	46	310	70	65.5	33.3	37.6	35.7	45.4	42.6	60.3	33.4	52.6	52.3	71.2	30.5	47	46	82.9	51.4	62.4
Cyanide	--	120	1	0.89	0.97 J	0.79 J	1.3 J	1 J	2.6 U	0.88 J	0.75 J	0.76 J	2.6 U	2.6 R	2.7 R	2.5 U	2.6 U	2.6 U	2.7 U	0.19 J
Iron	276	2,300	--	38,100	18,600 J	17,300 J	16,700 J	21,000 J	15,100 J	22,700 J	18,800 J	20,300 J	17,200	23,000 J	16,100 J	16,700	17,100	14,500	18,700	20,900
Lead	14	400	120	5.4	2.3	2.3	2.7	2.2	1.5	1.9	2.2	2.8	1.5	2.8	1.2	1.1	1 U	1.2	1.1	1.8
Magnesium	--	--	--	3,710	2,360 J	2,990 J	3,010 J	4,450 J	4,810 J	3,010 J	3,410 J	4,790 J	5,330	7,240 J	4,450 J	6,590	7,090	4,470	6,450	2,910 J
Manganese	57	180	220	1,630	604 J	604 J	658 J	556 J	435 J	745 J	629 J	773 J	550	708 J	395 J	535	554	481	623	807 J
Nickel	7	160	38	22.2	2.3 J	2.6 J	2.6 J	3.6 J	3 J	2.8 J	3.3 J	3.3 J	3.5 J	4.7 J	2.7 J	3.2 J	4.1 U	4.1 U	4.3 U	4.4 U
Potassium	--	--	--	5,270	1,650	2,000	2,120	2,170	956	1,230	1,960	2,250	1,100	1,410	869	831	574	514 U	779	2,420
Selenium	0.3	39	0.52	0.51	1 J	0.57 J	0.64 J	1.1 J	0.46 J	0.81 J	0.7 J	0.4 J	3.6 U	1.1 J	3.7 U	0.56 J	0.51 J	3.6 U	3.8 U	0.47 J
Thallium	0.036	0.52	1	0.13	0.53 U	0.52 U	0.56 U	0.54 U	0.52 U	0.54 U	0.53 U	0.53 U	0.52 U	0.53 U	0.53 U	0.51 U	0.51 U	0.51 U	0.54 U	0.54 U
Vanadium	300	7.8	2	144	58.2	51	49.1	61.4	36.3	67	53.9	59.2	37.3	55.9	46.6	38.3	38.2	35.2	42.2	60.9
Zinc	620	2,300	120	32	18.5	21.6	24.2	27.8	24.9	19.8	24.1	26.3	28	40.2	20.5	31.9	32.8	24.8	31.3	24
Total Petroleum Hydrocarbons (MG/KG)																				
TPH GRO																				
No Detections					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
TPH DRO																				
No Detections					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Wet Chemistry																				
Sulfide																				
No Detections					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- R - Unreliable result
- U - Analyte not detected
- NA - Not Analyzed
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

* EBS sample analyzed for technical chlordane, consisting of alpha and gamma chlordane, heptachlor, and other hydrocarbons.
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDE, 4,4'-DDT, endrin, beta-BHC, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper) (Efroymson, Will, and Suter,1997)
Vieques Eco SO - Screening values for compounds (fluoranthene, pyrene, benzo(a)pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (nickel, selenium, thallium, vanadium, zinc) (Efroymson, et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
EBS surface samples collected from 0 to 0.5 feet bgs.
-- Not part of background data set
-- Regulatory standard not promulgated

- Exceeds Background and Eco Criteria
- Exceeds Background and DAF 1 Criteria
- Exceeds Background, Eco, and DAF 1 Criteria
- Exceeds Background, HHRA, and DAF 1 Criteria
- Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 15-1
PI 7 Suface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	EPI07-SO16		EPI07-SO17	EPI07-SO18	EPI07-SO19	EPI07-SO20	EPI07-SO21	EPI07-SO22	VNTR-PI7-1	VNTR-PI7-2	VNTR-PI7-3	VNTR-PI7-4
Sample ID, prefaced with EBS if EBS data					EPI07-SS16-0001	EPI07-SS16P-0001	EPI07-SS17-0001	EPI07-SS18-0001	EPI07-SS19-0001	EPI07-SS20-0001	EPI07-SS21-0001	EPI07-SS22-0001	EBS PI7-1	EBS PI7-2	EBS PI7-3	EBS PI7-4
Sample Date					03/16/06	03/16/06	03/15/06	03/15/06	03/15/06	03/16/06	03/16/06	03/16/06	12/16/02	12/16/02	12/16/02	12/16/02
Chemical Name																
Volatile Organic Compounds (UG/KG)																
No Detections																
Semi-volatile Organic Compounds (UG/KG)																
Di-n-octylphthalate	10,000,000	240,000	--	--	350 UJ	350 UJ	340 U	81 J	340 U	350 UJ	350 UJ	350 UJ	333 U	333 U	333 U	333 U
Fluoranthene	210,000	230,000	100	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	2580	333 U
Benzo(b)fluoranthene	200	620	--	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	2480	333 U
Pyrene	210,000	230,000	100	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	2470	333 U
Chrysene	8,000	62,000	--	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	2080	333 U
Benzo(a)pyrene	400	62	100	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	1710	333 U
Benzo(a)anthracene	80	620	--	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	1670	333 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	1260	333 U
Benzo(k)fluoranthene	2,000	6,200	--	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	1150	333 U
Benzo(g,h,I)perylene	210,000	2,300,000	--	--	350 U	350 U	340 U	340 U	340 U	350 U	350 U	350 U	333 U	333 U	985	333 U
Ideno(1,2,3-cd)pyrene	700	620	--	--	350 UJ	350 UJ	340 U	340 U	340 U	350 UJ	350 UJ	350 UJ	333 U	333 U	945	333 U
Pesticide/Polychlorinated Biphenyls (UG/KG)																
4,4'-DDE	3,000	1,700	10	--	3.5 U	3.5 U	3.4 U	150	1.4 J	3.5 U	3.5 U	3.5 U	3.3 U	3.3 U	3.3 U	3.3 U
4,4'-DDT	2,000	1,700	10	--	3.5 U	3.5 U	3.4 U	31	1.7 J	3.5 U	3.5 U	3.5 U	3.3 U	3.3 U	3.3 U	3.3 U
Endrin	50	1,800	0.04	--	3.5 U	2.4 J	3.4 U	3.4 U	3.4 U	3.5 U	3.5 U	3.5 U	3.3 U	3.3 U	3.3 U	3.3 U
beta-BHC	0.1	320	9	--	1.8 U	1.9 J	1.7 U	1.8 U	1.7 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	1.7 U	1.7 U
delta-BHC	0.1	440	--	--	1.8 U	1.8 U	1.7 U	1.8 U	1.7 U	1.8 U	1.8 U	1.8 U	1.7 U	1.7 U	1.7 U	1.7 U
gamma-Chlordane	500	1,600	--	--	1.8 U	1.9 J	1.7 U	1.8 U	1.7 U	1.8 U	1.8 U	1.8 U	16.7* U	16.7* U	16.7* U	16.7* U
Appendix IX Organophosphate Pesticides (UG/KG)																
No Detections					NA	NA	NA	NA	NA	NA	NA	NA				
Appendix IX Herbicides (UG/KG)																
No Detections					NA	NA	NA	NA	NA	NA	NA	NA				
Total Metals (MG/KG)																
Aluminum	55,000	7,600	--	35,000	9,010	11,400	9,430	11,900	10,500	8,160	11,800	8,770	NA	NA	NA	NA
Antimony	0.3	3.1	78	3.6	0.58 J	0.63 J	0.83 J	0.77 J	0.68 J	0.4 J	0.56 J	0.43 J	5.2 U	5.8 U	5.7 U	4.7 U
Arsenic	1	0.39	18	1.6	1.1 U	1.1 U	1 U	1 U	1 U	1.1 U	1.1 U	1.1 U	0.86 U	0.96 U	11.9	0.78 U
Barium	82	1,600	330	147	116	140	59.6	64.1	68.6	71.4	200	91.5	56.8	52.8	36.4	60.6
Calcium	--	--	--	8,840	3,060	3,730	3,080	4,940	3,520	5,090	3,600	3,510	NA	NA	NA	NA
Chromium	2	210	0.4	72	3.8 J	4.4 J	2	3.8	4.8	3.6 J	3.2 J	2.3 J	4	4	8.3	7.1
Cobalt	33	140	13	15.8	8.5 J	10.3 J	9.8	9.2	8.3	7 J	9.5 J	5.9 J	7	6.9	5.6	6.9
Copper	46	310	70	65.5	45.2	56.8	85	85.8	119	35.5	52.3	70.5	33.1	42.6	30.2	33.1
Cyanide	--	120	1	0.89	2.7 U	2.7 U	2.6 U	2.6 U	2.6 U	2.7 U	2.7 U	2.7 U	1 U	1 U	1 U	1 U
Iron	276	2,300	--	38,100	15,000	18,100	12,800	13,800	11,800	10,800	16,800	10,500	NA	NA	NA	NA
Lead	14	400	120	5.4	1.2	1.5	1 U	8.2	2.6	1.5	2	3.8	1.8	1.7	0.88	1
Magnesium	--	--	--	3,710	2,990 J	3,990 J	3,610	3,710	3,320	4,100 J	3,830 J	2,900 J	NA	NA	NA	NA
Manganese	57	180	220	1,630	572 J	678 J	319	407	324	427 J	717 J	323 J	NA	NA	NA	NA
Nickel	7	160	38	22.2	4.3 U	4.3 U	2.4 J	2.6 J	3.1 J	4.3 U	2.6 J	1.9 J	3.45 U	3.85 U	3.77 U	4.9
Potassium	--	--	--	5,270	1,380	1,770	2,840	1,760	1,710	1,010	1,460	1,260	NA	NA	NA	NA
Selenium	0.3	39	0.52	0.51	3.8 U	0.84 J	0.39 J	3.6 U	3.6 U	3.7 U	0.6 J	3.7 U	0.86 U	0.96 U	0.94 U	0.78 U
Thallium	0.036	0.52	1	0.13	0.54 U	0.54 U	0.012 J	0.014 J	0.028 J	0.54 U	0.53 U	0.53 U	1.1	1.4	0.94 U	1
Vanadium	300	7.8	2	144	38.9	46	34.9	35.8	32.5	21.9	32.5	21.2	46.8	39.5	32.1	46.7
Zinc	620	2,300	120	32	19.2	25	29	53.8	27.7	20.2	21.1	20.8	23.3	26.1	20.3	21.2
Total Petroleum Hydrocarbons (MG/KG)																
TPH GRO																
No Detections					NA	NA	NA	NA	NA	NA	NA	NA			NA	NA
TPH DRO																
No Detections					NA	NA	NA	NA	NA	NA	NA	NA			NA	NA
Wet Chemistry																
Sulfide																
No Detections					NA	NA	NA	NA	NA	NA	NA	NA				

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- R - Unreliable result
- U - Analyte not detected
- NA - Not Analyzed
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

* EBS sample analyzed for technical chlordane, consisting of alpha and gamma chlordane, heptachlor, and other hydrocarbons.
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDE, 4,4'-DDT, endrin, beta-BHC, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper) (Efroymson, Will, and Suter,1997)
Vieques Eco SO - Screening values for compounds (fluoranthene, pyrene, benzo(a)pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (nickel, selenium, thallium, vanadium, zinc) (Efroymson, et al.,1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
EBS surface samples collected from 0 to 0.5 feet bgs.
-- Not part of background data set
-- Regulatory standard not promulgated

- Exceeds Background and Eco Criteria
- Exceeds Background and DAF 1 Criteria
- Exceeds Background, Eco, and DAF 1 Criteria
- Exceeds Background, HHRA, and DAF 1 Criteria
- Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 15-2
PI 7 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPI07-SO01	EPI07-SO02	EPI07-SO03	EPI07-SO04	EPI07-SO05	EPI07-SO06	EPI07-SO07	EPI07-SO08
Sample ID				EPI07-SB01-0406	EPI07-SB02-0406	EPI07-SB03-0406	EPI07-SB04-0406	EPI07-SB05-0406	EPI07-SB06-0406	EPI07-SB07-0406	EPI07-SB08-0406
Sample Date				03/13/06	03/13/06	03/13/06	03/13/06	03/14/06	03/14/06	03/14/06	03/14/06
Chemical Name											
Volatile Organic Compounds (UG/KG)											
No Detections											
Semi-volatile Organic Compounds (UG/KG)											
Di-n-octylphthalate	10,000,000	240,000	--	360 U	370 U	370 U	360 U	370 U	370 UJ	370 UJ	360 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	360 U	370 U	370 U	360 U	370 U	370 U	370 U	360 U
Pesticide/Polychlorinated Biphenyls (UG/KG)											
4,4'-DDE	3,000	1,700	--	3.6 U	4.2	3.7 U	3.6 U	0.98 J	3.7 U	3.7 U	130
4,4'-DDT	2,000	1,700	--	3.6 U	3.7 U	3.7 U	3.6 U	3.7 U	3.7 U	3.7 U	3.6 U
Total Metals (MG/KG)											
Aluminum	55,000	7,600	35,000	13,600 J	9,660 J	9,350 J	13,700 J	14,500 J	22,600 J	14,900 J	14,700
Antimony	0.3	3.1	3.3	0.71 J	0.5 J	0.79 J	0.88 J	0.95 J	0.7 J	0.5 J	0.74 J
Arsenic	1	0.39	1.6	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	2.6
Barium	82	1,600	147	109 J	72.5 J	86.9 J	135 J	97.8 J	154 J	81.3 J	52.4
Beryllium	3	15	0.27	0.55 U	0.5 U	0.56 U	0.55 U	0.56 U	0.56 U	0.56 U	0.55 U
Calcium	--	--	8,840	14,500 J	4,870 J	2,970 J	2,660 J	2,970 J	3,650 J	2,740 J	11,100
Chromium	2	210	72	5.6	5.1	4.1	6.2	7.6	6.7	4.3	14.5
Cobalt	33	140	15.8	9.1 J	7.1 J	7.7 J	9.4 J	8.3 J	9.5 J	10.4 J	12.1
Copper	46	310	65.5	43.3	30.5	38.2	48	29.4	51.4	42.9	30.5
Cyanide	--	120	0.89	2.7 U	0.56 J	0.38 J	2.7 U	0.19 J	0.4 J	2.8 R	2.8 U
Iron	276	2,300	38,100	19,500 J	15,600 J	14,800 J	26,300 J	30,600 J	28,600 J	18,900 J	21,500
Lead	14	400	3.34	2	2.6	1.9	1.3	1.1 U	1.8	1.2	1.7
Magnesium	--	--	3,710	4,830 J	2,510 J	2,290 J	4,470 J	2,950 J	3,880 J	3,250 J	10,000
Manganese	57	180	1,630	545 J	494 J	531 J	442 J	491 J	451 J	698 J	451
Nickel	7	160	22.2	2.9 J	2.3 J	2.1 J	3.2 J	2.6 J	3.4 J	2.6 J	10.9
Potassium	--	--	2,000	1,280	1,420	1,180	775	985	1,570	1,090	552 U
Selenium	0.3	39	0.51	0.92 J	0.62 J	0.59 J	0.51 J	0.63 J	0.84 J	0.89 J	0.4 J
Thallium	0.036	0.52	0.13	0.55 U	0.56 U	0.56 U	0.55 U	0.56 U	0.56 U	0.56 U	0.53 U
Vanadium	300	7.8	144	56.5	48.8	46.2	79.5	98.4	79.9	50.6	62.3
Zinc	620	2,300	32	25.1	17.8	21.8	25.4	18.2	23.8	18.9	17.5

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- R - Unreliable result
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA,1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, and DAF 1 Criteria

TABLE 15-2
PI 7 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPI07-SO09		EPI07-SO10	EPI07-SO11	EPI07-SO14	EPI07-SO15	EPI07-SO16	EPI07-SO17
Sample ID				EPI07-SB09-0406	EPI07-SB09P-0406	EPI07-SB10-0406	EPI07-SB11-0102	EPI07-SB14-0406	EPI07-SB15-0204	EPI07-SB16-0204	EPI07-SB17-0102
Sample Date				03/14/06	03/14/06	03/14/06	03/14/06	03/14/06	03/16/06	03/16/06	03/15/06
Chemical Name											
Volatile Organic Compounds (UG/KG)											
No Detections											
Semi-volatile Organic Compounds (UG/KG)											
Di-n-octylphthalate	10,000,000	240,000	--	370 UJ	360 UJ	370 UJ	340 U	350 U	360 UJ	270 J	340 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	370 U	360 U	370 U	340 U	180 J	360 U	370 U	340 U
Pesticide/Polychlorinated Biphenyls (UG/KG)											
4,4'-DDE	3,000	1,700	--	0.76 J	3.6 U	3.7 U	3.4 U	3.5 U	3.6 U	3.7 U	3.4 U
4,4'-DDT	2,000	1,700	--	3.7 U	3.6 U	3.7 U	3.4 U	3.5 U	3.6 U	3.7 U	3.4 U
Total Metals (MG/KG)											
Aluminum	55,000	7,600	35,000	19,200 J	18,300 J	15,500 J	10,400	12,100	12,500	17,500	9,650
Antimony	0.3	3.1	3.3	0.82 J	0.48 J	0.82 J	0.73 J	0.61 J	0.67 J	0.72 J	0.69 J
Arsenic	1	0.39	1.6	1.1 U	1.1 U	1.1 U	1 U	1.1 U	1.1 U	1.1 U	1 U
Barium	82	1,600	147	163 J	134 J	97.7 J	52	99.7	123	123	96.7
Beryllium	3	15	0.27	0.17 J	0.14 J	0.095 J	0.51 U	0.53 U	0.55 U	0.56 U	0.51 U
Calcium	--	--	8,840	2,680 J	2,660 J	2,830 J	6,720	13,100	3,340	3,220	3,380
Chromium	2	210	72	6.3	6.3	7.1	3.5	4.4	4.8 J	6.4 J	1.7
Cobalt	33	140	15.8	9.7 J	11.8 J	7.4 J	11.2	9.1	9.9 J	11.3 J	11.4
Copper	46	310	65.5	43	40.9	27.6	47.6	38.8	64.5	72.4	185
Cyanide	--	120	0.89	2.8 R	2.7 R	2.8 R	2.6 U	2.7 U	0.3 J	2.8 U	2.5 U
Iron	276	2,300	38,100	25,100 J	24,600 J	27,900 J	17,700	15,800	23,700	23,200	13,200
Lead	14	400	3.34	1.6	1.5	1.1 U	1 U	1.1	1.7	1.5	1 U
Magnesium	--	--	3,710	3,490 J	3,520 J	2,640 J	7,370	5,540	3,430 J	4,090 J	4,650
Manganese	57	180	1,630	648 J	780 J	422 J	560	715	538 J	636 J	343
Nickel	7	160	22.2	3.3 J	3.3 J	2.8 J	3.2 J	4.2 U	4.4 U	4.4 U	2.7 J
Potassium	--	--	2,000	1,280	1,210	914	521	821	1,260	1,680	2,720
Selenium	0.3	39	0.51	1 J	0.72 J	0.98 J	3.6 U	0.72 J	0.64 J	0.53 J	3.6 U
Thallium	0.036	0.52	0.13	0.56 U	0.54 U	0.56 U	0.51 U	0.017 J	0.55 U	0.56 U	0.043 J
Vanadium	300	7.8	144	64.8	65.3	85.8	39.7	36.1	70	56	34.6
Zinc	620	2,300	32	23.1	22.5	15.1	32.8	26	28.1	28	29.7

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- R - Unreliable result
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA,1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, and DAF 1 Criteria

TABLE 15-2
PI 7 Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPI07-SO18	EPI07-SO19	EPI07-SO21
Sample ID				EPI07-SB18-0204	EPI07-SB19-0204	EPI07-SB21-0103
Sample Date				03/15/06	03/15/06	03/16/06
Chemical Name						
Volatile Organic Compounds (UG/KG)						
No Detections						
Semi-volatile Organic Compounds (UG/KG)						
Di-n-octylphthalate	10,000,000	240,000	--	340 U	340 U	350 UJ
bis(2-Ethylhexyl)phthalate	--	35,000	--	340 U	340 U	350 U
Pesticide/Polychlorinated Biphenyls (UG/KG)						
4,4'-DDE	3,000	1,700	--	19	3.4 U	3.5 U
4,4'-DDT	2,000	1,700	--	2.2 J	3.4 U	3.5 U
Total Metals (MG/KG)						
Aluminum	55,000	7,600	35,000	10,700	11,200	13,200
Antimony	0.3	3.1	3.3	0.84 J	0.6 J	0.64 J
Arsenic	1	0.39	1.6	1 U	1 U	1.1 U
Barium	82	1,600	147	61	64.8	181
Beryllium	3	15	0.27	0.51 U	0.51 U	0.53 U
Calcium	--	--	8,840	4,700	3,920	3,570
Chromium	2	210	72	13.3	2.9	3.1 J
Cobalt	33	140	15.8	10.9	9.5	9.7 J
Copper	46	310	65.5	118	129	51.8
Cyanide	--	120	0.89	2.6 U	2.5 U	2.7 U
Iron	276	2,300	38,100	15,500	12,400	17,200
Lead	14	400	3.34	1 U	1.4	1.2
Magnesium	--	--	3,710	5,180	3,570	4,860 J
Manganese	57	180	1,630	461	380	583 J
Nickel	7	160	22.2	5.6	2.8 J	2.7 J
Potassium	--	--	2,000	750	509 U	627
Selenium	0.3	39	0.51	0.69 J	3.6 U	3.7 U
Thallium	0.036	0.52	0.13	0.016 J	0.011 J	0.53 U
Vanadium	300	7.8	144	46.3	33.2	35.9
Zinc	620	2,300	32	34.3	32.9	23.4

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- R - Unreliable result
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA,1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, and DAF 1 Criteria

TABLE 15-3
PI-7 Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Vieques HHRA GW	MCL - GW	PAOC-N EPAN-MW02 Background	EPI07-MW01	EPI07-MW02	EPI07-MW03
Sample ID				EPI07-GW01-06B	EPI07-GW02-06B	EPI07-GW03-06B
Sample Date				04/06/06	04/06/06	04/06/06
Chemical Name						
Volatile Organic Compounds (UG/L)						
Carbon disulfide	100	--	NA	0.5 U	0.5 U	0.11 J
Chloroform	0.17	80	NA	0.14 J	0.5 U	0.5 U
Chloromethane	16	--	NA	0.5 U	0.5 U	0.21 J
Tetrachloroethene	0.1	5	NA	0.5 U	0.2 J	0.5 U
Semi-volatile Organic Compounds (UG/L)						
No Detections						
Pesticide/Polychlorinated Biphenyls (UG/L)						
delta-BHC	0.052	--	NA	0.0051 J	0.01 U	0.012
Total Metals (UG/L)						
Barium	730	2,000	200	549	623	571
Calcium	--	--	144,000	116,000	117,000	147,000
Chromium	11	100	3.6 J	0.49 J	1.7 J	4.3 J
Cobalt	73	--	--	50 U	50 U	0.49 J
Magnesium	--	--	75,600	45,400	42,900	59,800
Manganese	88	--	8 J	43.5	46.6	79.1
Nickel	73	--	2.4J	1.3 J	2.8 J	6.2 J
Potassium	--	--	1,780 J	5,000 U	5,000 U	6,730 J
Selenium	18	50	--	35 U	35 U	1.9 J
Sodium	--	--	323,000	120,000	116,000	151,000
Dissolved Metals (UG/L)						
Barium	730	2,000	--	573	680	587
Calcium	--	--	139,000	119,000	122,000	145,000
Chromium	11	100	--	0.39 J	10 U	1 J
Cobalt	73	--	--	50 U	0.45 J	0.62 J
Magnesium	--	--	73,400	47,300	45,900	60,500
Manganese	88	--	--	34.6	44.5	75.8
Mercury	1.1	2	--	0.2 U	0.033 J	0.036 J
Nickel	73	--	--	0.91 J	2.3 J	5.4 J
Potassium	--	--	1,710 J	2,000 J	2,430 J	6,980 J
Selenium	18	50	--	35 U	2.3 J	35 U
Sodium	--	--	311,000	125,000	125,000	153,000
Vanadium	3.6	--	--	11.1 J	8.3 J	4.7 J
Wet Chemistry (MG/L)						
Total dissolved solids (TDS)	--	--	NA	882	786	1,050

Notes:

mg/L - Milligrams per Liter
ug/L - Micrograms per Liter
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
NA - Not Applicable

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Vieques HHRA GW - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards (40 Code of Federal Regulations [CFR] 141)
-- Not detected in background well
-- Regulatory standard not promulgated
Exceeds Background and HHRA criteria

TABLE 15-4
PI-7 Northern Subsection (Former Radar Communication Facility) Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Cu > ECO, SSL, BKG	small site, no vegetative stress; mean concentration just above ECO; < SSL at a DAF of 3; not detected in groundwater downgradient of area	
Subsurface Soil						Medium sufficiently characterized; no further action for medium
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Cu > SSL, BKG	< SSL at a DAF of 4; not detected in groundwater downgradient of area	
				Se > SSL, BKG	not detected or detected below PRG and MCL in groundwater downgradient of area; < SSL at a DAF of 3	

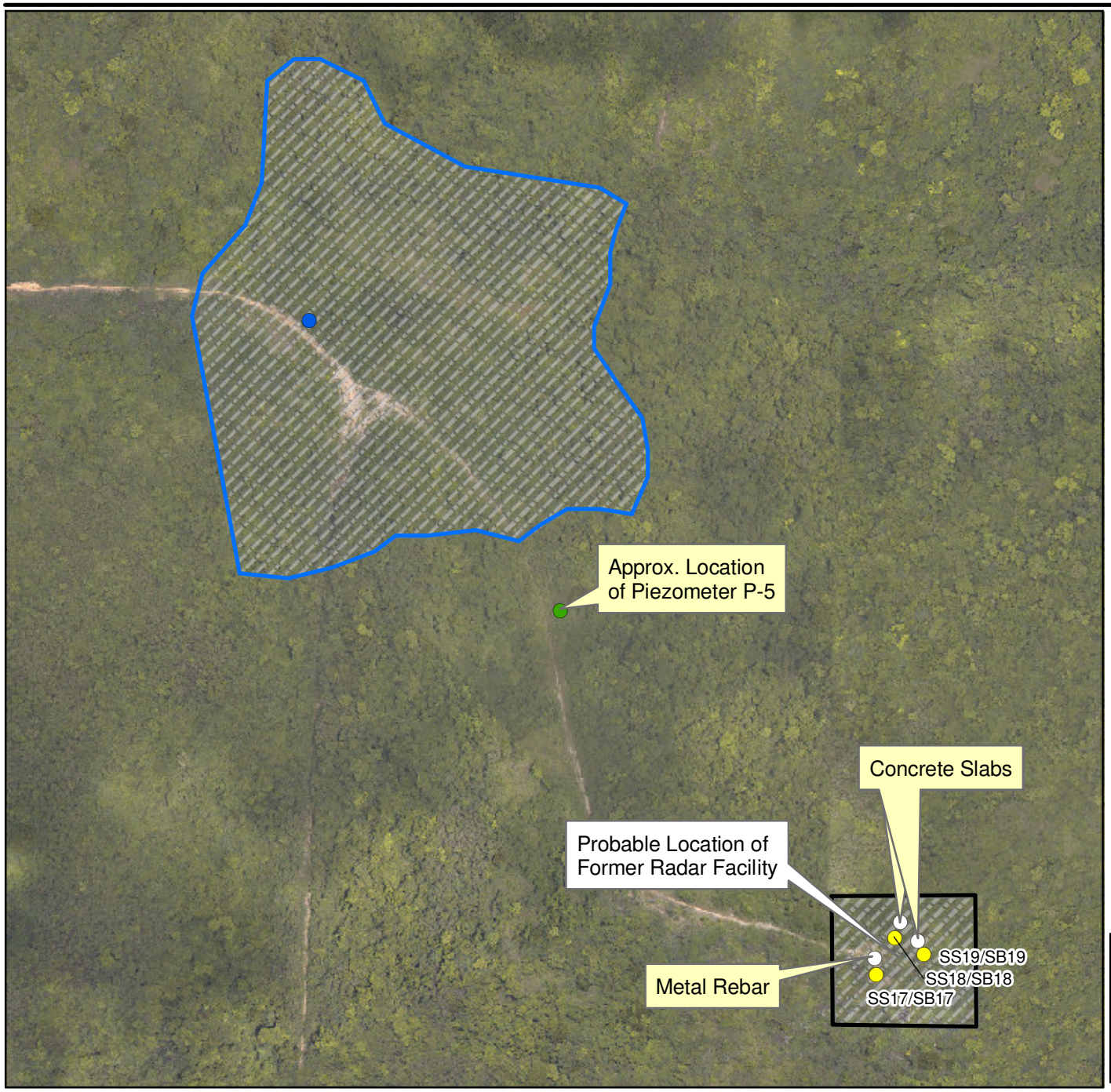
TABLE 15-5
PI-7 Central Subsection (Former Quarry) Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					As precautionary measure, remove drums and collect confirmatory soil samples. Otherwise, medium sufficiently characterized; no further action for medium pending confirmatory soil sample results.
		SVOCs	Yes	Fluoranthene > ECO	not detected in surrounding soil; total PAHs < ECO	
				Benzo(b)fluoranthene > PRG, SSL	individual and cumulative HH risk acceptable; not detected in surrounding soil or groundwater	
				Pyrene > ECO	not detected in surrounding soil; total PAHs < ECO	
				Benzo(a)pyrene > PRG, Eco, SSL	individual and cumulative HH risk acceptable; not detected in surrounding soil or groundwater; total PAHs < ECO	
				Benzo(a)anthracene > PRG, SSL	individual and cumulative HH risk acceptable; not detected in surrounding soil or groundwater	
				Ideno(1,2,3-cd)pyrene > PRG, SSL	individual and cumulative HH risk acceptable; not detected in surrounding soil or groundwater	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	< SSL in subsurface soil and surrounding surface soil; not detected in groundwater; hazard and individual and cumulative HH risk acceptable	
				Ba > SSL, BKG	detected in groundwater below PRG and MCL; < SSL at a DAF of 3	
				Cu > ECO, SSL, BKG	ECO risk likely acceptable; not detected in groundwater; < SSL at a DAF of 2	
				Se > ECO, SSL, BKG	ECO based on plants; no sign of stress to plants; < ECO for soil invertebrates; detected in groundwater below PRG and MCL; < SSL at a DAF of 3	
				Tl > PRG, ECO, SSL, BKG	acceptable HH risk level, < SSL in subsurface; not detected in groundwater; mean concentration < ECO; EBS results suspect	
Subsurface Soil						Medium sufficiently characterized other than confirmatory soil samples during drum removal.
		SVOCs	Yes	No	N/A	
		Inorganics	Yes	Ba > SSL, BKG	detected in groundwater below PRG and MCL; < SSL at a DAF of 3	
				Cu > SSL, BKG	not detected in groundwater; < SSL at a DAF of 3	
				Se > SSL, BKG	detected in groundwater below PRG and MCL; < SSL at a DAF of 3	
Groundwater						Medium sufficiently characterized; no further action for medium
		VOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	V > PRG, BKG	detected in groundwater below PRG (unadjusted); not detected in soil above background UTL	

TABLE 15-6
PI-7 Southern Subsection (Former Tar Drum Disposal Area) Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					As precautionary measure, remove drums and collect confirmatory soil samples. Otherwise, medium sufficiently characterized; no further action for medium pending confirmatory soil sample results.
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Cu > ECO, SSL, BKG	mean concentration < ECO; not detected in groundwater; < SSL at a DAF of 2	
				Cyanide > ECO, BKG	mean concentration < ECO	
				Se > ECO, SSL, BKG	< ECO for soil invertebrates; detected in groundwater below PRG and MCL; < SSL at a DAF of 4	
Subsurface Soil						Medium sufficiently characterized other than confirmatory soil samples during drum removal.
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; not detected in groundwater; < SSL at a DAF of 3	
				Ba > SSL, BKG	detected in groundwater below PRG and MCL; < SSL at a DAF of 3	
				Se > SSL, BKG	Detected in groundwater below PRG and MCL; < SSL at a DAF of 4	
Groundwater						Medium sufficiently characterized; no further action for medium
		VOCs	Yes	PCE > PRG	N/A	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	V > PRG, BKG	detected in groundwater below PRG (unadjusted); not detected in soil above background UTL	

PHOTO DATE 2005



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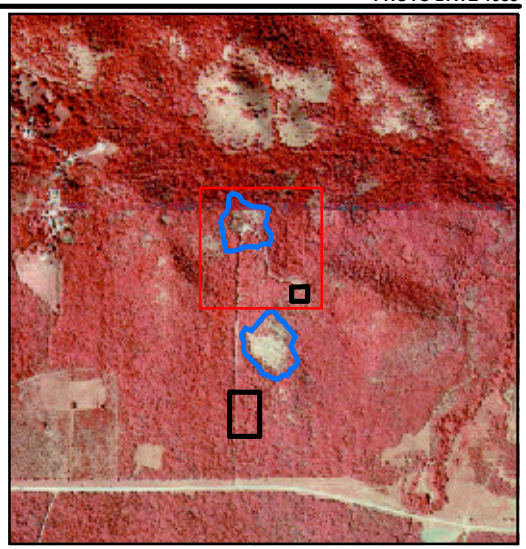

LEGEND

- PA/SI Surface and Subsurface Soil Sample Location
- Previously Installed Piezometer
- Telephone Pole
- Surface Debris Identified During 2005 Reconnaissance
- Area of August 2005 PA/SI Reconnaissance
- ERI Aerial Photo Analysis Area

Note:
Each sampling location shown is preceded by "EPI07" (e.g. SS02/SB02 = EPI07-SS02 and EPI07-SB02)

N

0 100 200 Feet

FIGURE 15-1
PI 7 Northern Subsection - Former Radar Communications Facility
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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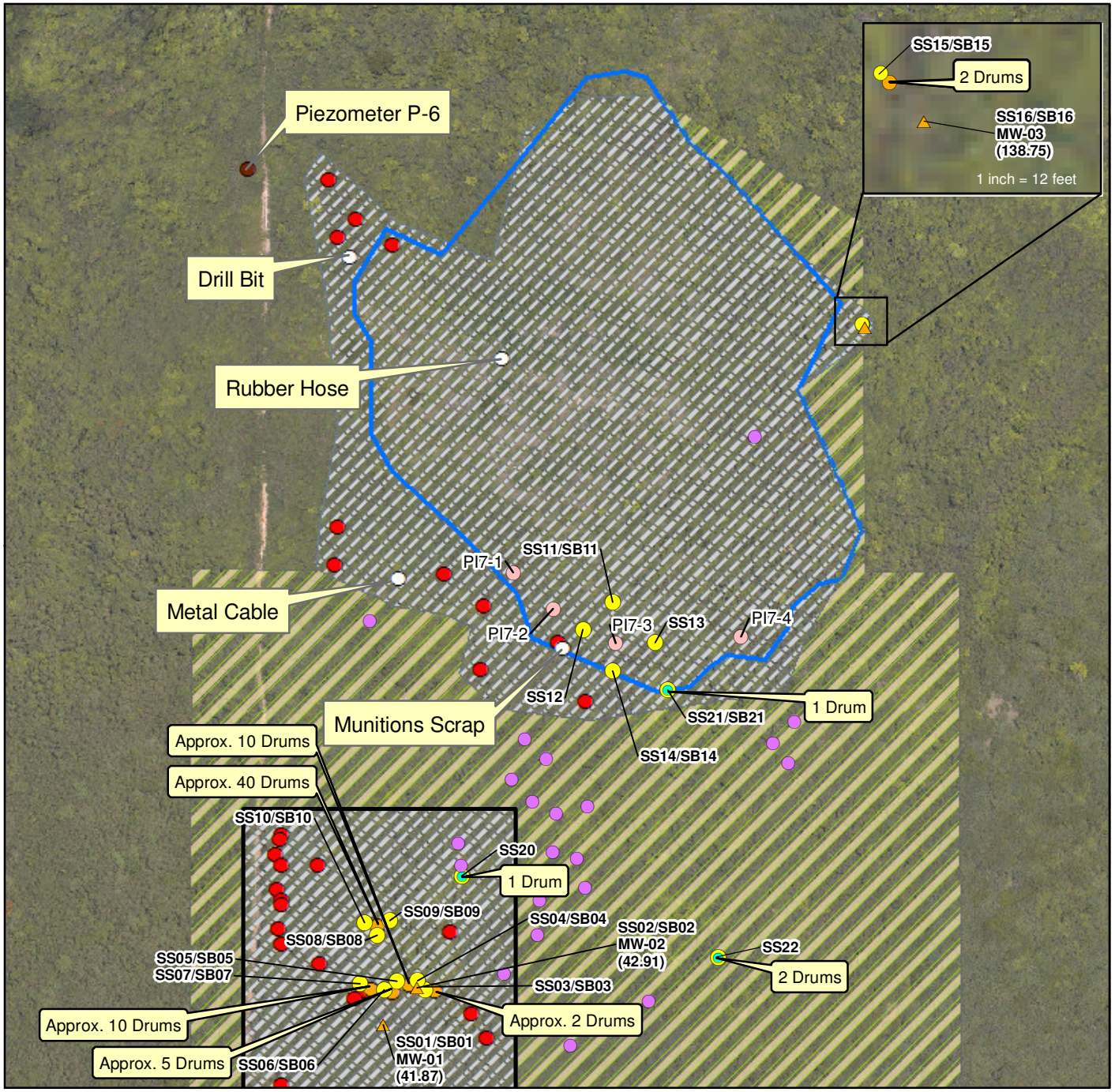
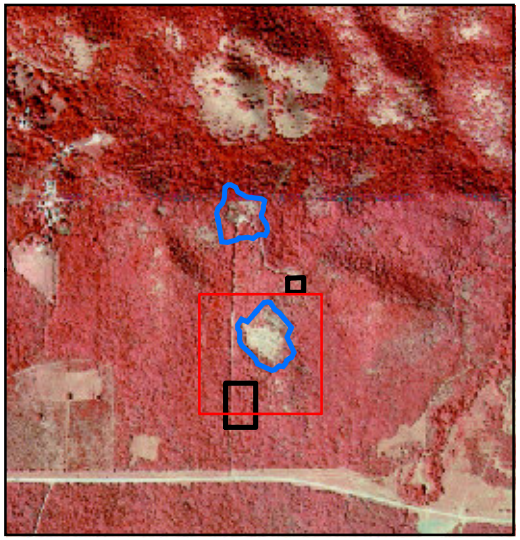
\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\Figure_15_1_SurfaceAnomalies_SamplingLocationsNorth.mxd

PHOTO DATE 2005

PHOTO DATE 1985





LEGEND

- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location With Water Elevation, Feet Above Mean Sea Level
- PA/SI Subsurface and/or Surface Soil Sample Location
- Previously Installed Piezometer
- EBS Surface Soil Sample Location
- Drums Identified During 2005 Reconnaissance
- Drums Identified During 2006 Reconnaissance
- Metallic Sub-surface Anomalies Identified During 2005 Reconnaissance
- Surface Debris Identified During 2005 Reconnaissance
- Surface Debris Identified During 2006 Reconnaissance
- Area of August 2005 PA/SI Reconnaissance
- Area of March 2006 PA/SI Reconnaissance
- ERI Aerial Photo Analysis Area

Note:
Each sampling location shown is preceded by "EPI07" (e.g. SS02/SB02 = EPI07-SS02 and EPI07-SB02, and MW-1 = EPI07-MW01)

N

0 100 200 Feet

FIGURE 15-2
PI7 Central Subsection - Former Quarry
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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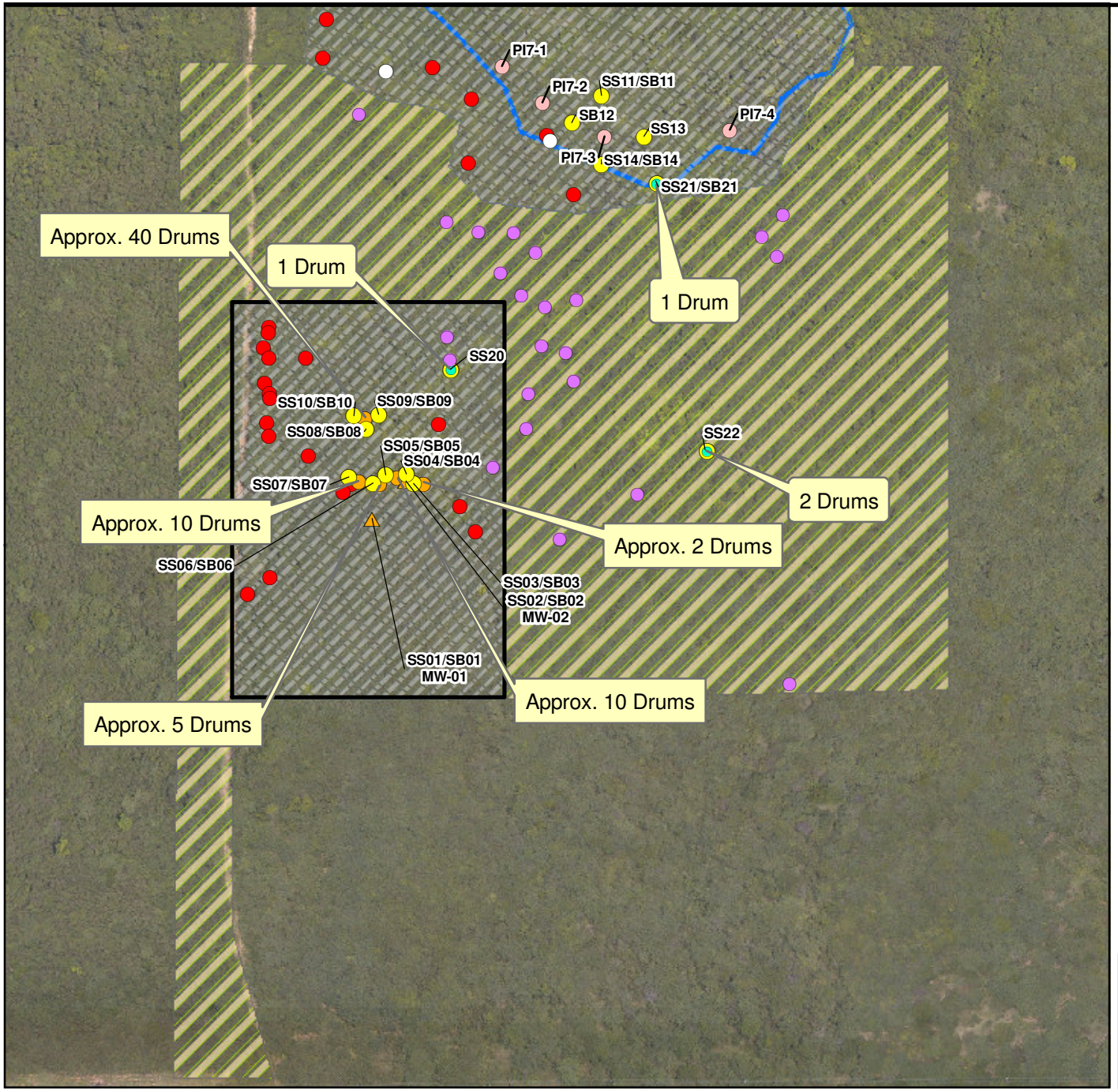
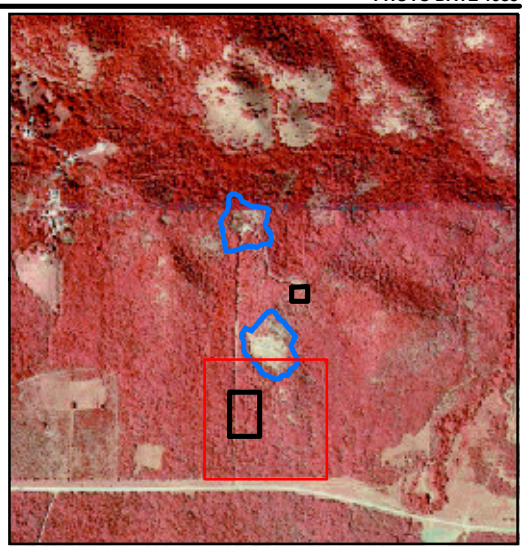
\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\Figure_15_2_PreviousSampleLocations.mxd

PHOTO DATE 2005

PHOTO DATE 1985





LEGEND

- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location
- PA/SI Subsurface and/ or Surface Soil Sample Location
- Drums Identified During 2005 Reconnaissance
- Drums Identified During 2006 Reconnaissance
- Metallic Sub-surface Anomalies Identified During 2005 Reconnaissance
- Surface Debris Identified During 2005 Reconnaissance
- Surface Debris Identified During 2006 Reconnaissance
- ERI Aerial Photo Analysis Area
- Area of August 2005 PA/SI Reconnaissance
- Area of March 2006 PA/SI Reconnaissance

Note:
Each sampling location shown is preceded by "EPI07" (e.g. SS02/SB02 = EPI07-SS02 and EPI07-SB02, and MW-1 = EPI07-MW01)

N

0 50 100 Feet

FIGURE 15-3
Former Tar Drum Disposal Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\Figure_15_3_PI_7_Debris_to_the_South_zoom_out.mxd

Photo 1. PI 7 Potential former quarry
Source: DRAFT FINAL EBS, 2003

Photo 2. PI 7 concrete slab
Source: CH2M HILL site visit, 2001

Photo 3. PI 7 Rubber Pipe
Source: DRAFT FINAL EBS, 2003

Figure 15-4
PI 7 Site Photographs
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 16

PAOC J—Former Vehicle Maintenance Area

This section presents the results of the PA/SI performed at PAOC J—Former Vehicle Maintenance Area.

16.1 Conceptual Site Model

The CSM for PAOC J is based on review of historical information such as records, aerial photographs, site inspection documentation, as well as site-specific data collection.

16.1.1 Site History and Potential Sources of Release

An interview conducted in June 2000 with an employee from NASD (CH2M HILL, 2001) indicated that a former vehicle maintenance area at Camp García existed immediately north of the main road at the location shown on Figures 1-2, 1-3, and 16-1. A review of the historical aerial photos indicates that all structures were demolished prior to 1980. The interviewee was not aware of any hazardous material or hazardous waste releases at the site. During the EBS VSI conducted in October 2002, there was no evidence of hazardous material, hazardous waste, petroleum, or munitions storage or disposal (NAVFACENGCOM, 2003). However, due to the past use of this site, implementation of a PA/SI was performed.

16.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 2001 (recon of PI sites), 2002 (EBS), and in 2005-2006 (PA/SI), as well as on regional information.

The site slopes very gently to the southwest, with the highest elevation at about 72 ft amsl. The land around PAOC J is cleared periodically as part of routine maintenance activities. No federally protected species or preferred habitats were identified at the site. For more information on the ecological survey, see Appendix M.

Soil borings at PAOC J encountered 12 ft to 16 ft of unsaturated silty or clayey sand and weathered rock overlying bedrock. For more details on the unconsolidated material overlying bedrock, see the site-specific boring logs in Appendix D. PAOC J lies within the KTd formation, which consists of plutonic rocks, largely granodiorite and quartz diorite. Bedrock borehole EPAJ-SO01 was drilled on the south side of PAOC J with the intent of installing a monitoring well. Bedrock (granodiorite) was encountered at 12 ft bgs. The borehole was continued to 100 ft bgs, in granodiorite for the entire bedrock boring. The borehole was video logged, and a few fractures were observed, but the borehole remained dry for 2 days, which indicates that beneath PAOC J, there is limited groundwater. For more information on the bedrock geology see Section 1.4.6.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon

along the coast, a little less than 1 mile to the south and southeast, respectively. Based on the borehole completed at EPAJ-SO01 and nearby wells, groundwater in this area exists within fractures in the bedrock, though transmissive fractures appear limited. Based on nearby wells, the topographic slope, and the regional groundwater flow mapped by the USGS (1989), groundwater is presumed to flow in a southerly direction toward the coast (approximately 1 mile south of the site), as described in Section 1.4.7.

16.2 Sampling Approach and Chemical Constituents Identified

As presented in the PA/SI Work Plan (CH2M HILL, 2006), six soil boring locations and one monitoring well location were selected for the PA/SI (Figure 16-1). At each of the six soil borings, one surface soil sample and one subsurface soil sample were collected. The locations of the borings were chosen to spatially cover the former vehicle maintenance area, and were placed on or adjacent to former structures identified on historical aerial photographs. No FID readings significantly above background were observed in the soil borings(see Soil Boring Logs, Appendix D); therefore, subsurface samples were collected at default depths (or refusal, whichever was encountered first) in accordance with the work plan (see Table 2-1 for subsurface soil sample depths). All surface soil and subsurface soil samples were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs; and TAL inorganics. As noted above, the monitoring well borehole installed at PAOC J was dry. Therefore, the borehole was grouted up on February 17, 2006.

Tables 16-1 and 16-2 summarize the constituents detected in PAOC J surface soil samples and subsurface soil samples, respectively, collected during the PA/SI. The tables also identify screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O.

16.3 PAOC J Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 16-1 and 16-2).

Appendix N, Section N.16 discusses the evaluation of the PAOC J data quality. As detailed in Section N.16, the PAOC J data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at PAOC J, which is done in Steps 1 through 5 below. To increase the level of confidence in this determination, however, additional regional data collection will be performed, as defined in Section 16.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former vehicle maintenance area. Although there are no records of past releases at the site and there was no evidence of past releases observed during the site visits, the potential presence of CERCLA hazardous substances could not be confidently ruled out without sample collection due to the nature of the historical activities at the site. Sample collection took place during the 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

Surface Soil

- VOCs: no detections
- SVOCs: no detections
- PCBs: no detections
- Pesticides: 4, 4'-DDD, 4, 4'-DDE, 4, 4'-DDT
- Inorganics above background UTLs: calcium, lead, magnesium, selenium, zinc

Subsurface Soil

- VOCs: no detections
- SVOCS: no detections
- PCBs : no detections
- Pesticides: 4, 4'-DDE, 4, 4'-DDT, beta-BHC
- Inorganics above background UTLs: calcium, magnesium, mercury, potassium, selenium

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

As noted previously, there is no history or visual evidence of releases at PAOC J. Further, the pesticides detected at this site are the same pesticides and of similar concentrations detected at other sites across east Vieques. This information, coupled with the history of the site, suggests the pesticides are present due to normal pesticide use, not a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1). Therefore, pesticides are not considered further in the decision analysis process. Because metals may be associated with historical vehicle maintenance, they are further considered in the decision analysis process, even though other constituents likely to be detected if there were releases associated with historical vehicle maintenance activities (e.g., SVOCs) were not present.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Surface Soil

- Lead: two detections (samples SS04, SS05) at concentrations (20 mg/kg and 16 mg/kg, respectively) above the SSL at a DAF of 1 (14 mg/kg) and background UTL (5.4 mg/kg)
- Selenium: four detections (samples SS01, SS02, SS05, SS06) at concentrations (0.54 mg/kg to 0.91 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

Subsurface Soil

- Selenium: four detections (samples SS02, SS03, SS04, SS05) at concentrations (0.55 mg/kg to 0.87 mg/kg) above the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Selenium was the only constituents detected in soil above background and human health or ecological screening values. Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at PAOC J (maximum of 0.91 mg/kg) may be within the range of background, especially considering that other data collected for the site do not suggest a CERCLA-related release has occurred. Further, the ecological screening value for selenium is based upon effects to plants, an endpoint that is not appropriate for the site given the cleared/mowed grass habitats present. All selenium concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable risks, especially given the very low potential for exposure based upon the limited habitat present.

Although aluminum, arsenic, iron, manganese, and vanadium were detected above human health screening criteria, none were detected at concentrations above background UTLs.

Lead and selenium slightly exceed the SSLs at a DAF of 1. However, lead was not detected above the SSL in the subsurface soil samples collected at the same locations, which suggests the SSL at a DAF of 1 is not a realistic predictor of lead leaching through soil. Also, only two of the four soil sampling locations where selenium was detected in the surface soil above the SSL had selenium in the subsurface soil above the SSL. Two additional subsurface soil samples contained selenium at concentrations above the SSL, but their corresponding surface soil samples did not. This information, coupled with the fact that constituents such as calcium and magnesium were detected above their background UTLs, suggests the selenium is likely part of innate background. This is supported by the fact that similar selenium concentrations were detected at adjacent sites PAOC K and PAOC L. In addition, a similar pattern of lead and selenium detections in the soil were observed at PI-4, which is in the same geologic unit as PAOC J. At PI-4, lead was not detected in groundwater and selenium was detected in groundwater below screening criteria. Therefore, the SSLs at a

DAF of 1 are not likely realistic predictors of leaching to groundwater at PAOC J. At a DAF of 3, none of the lead or selenium concentrations exceeds the SSL.

All of the above information, together with the fact that no non-inorganic contaminants were detected other than pesticides, suggests no CERCLA-related release has occurred at PAOC J or that any release has not resulted in constituent levels that likely pose an unacceptable risk over that of background.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely source of CERCLA-related releases at PAOC J is the former vehicle maintenance area. Based on this information, soil samples were collected across the area, the spatial distribution and resulting data of which indicate the potential source area has been sufficiently characterized.

16.4 Conclusions and Recommendations

Table 16-3 summarizes the results of the decision analysis for PAOC J, which indicates there has not been a CERCLA-related release at the site or if there has been a release, it did not result in contamination of soil at concentrations that would likely pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Although several inorganics were detected in surface and subsurface soil, their concentrations are below human health and ecological screening criteria. Further, pesticide detections at the site are consistent with normal pesticide application associated with maintenance of the historical facilities present at the site. Therefore, based on the above information, it is likely that NFA is warranted for PAOC J. However, to help confirm that from the sites within the western half of Camp Garcia (including PAOC J) there have not been releases that have adversely affected groundwater quality, a monitoring well will be installed just south of the western half of Camp Garcia, as shown in Figure 16-1. The actual location of the well will be based on a synoptic round of groundwater elevations collected from all Camp Garcia wells to ensure it is positioned in the downgradient flow direction from the western half of Camp Garcia. A groundwater sample will be collected from this well and analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL total and dissolved inorganics.

TABLE 16-1
PAOC J Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	EPAJ-SO01	EPAJ-SO02	EPAJ-SO03	EPAJ-SO04	EPAJ-SO05		EPAJ-SO06
Sample ID					EPAJ-SS01-0001	EPAJ-SS02-0001	EPAJ-SS03-0001	EPAJ-SS04-0001	EPAJ-SS05-0001	EPAJ-SS05P-0001	EPAJ-SS06-0001
Sample Date					03/02/06	03/01/06	03/01/06	03/01/06	03/02/06	03/02/06	03/01/06
Chemical Name											
Volatile Organic Compounds (UG/KG)											
No Detections											
Semi-volatile Organic Compounds (UG/KG)											
No Detections											
Pesticide/Polychlorinated Biphenyls (UG/KG)											
4,4'-DDD	800	2,400	10	--	2 J	3.6 U	4	6.8 J	3.5 U	3.6 U	3.8 U
4,4'-DDE	3,000	1,700	10	--	92	51	420	1,200	49	3 J	1.2 J
4,4'-DDT	2,000	1,700	10	--	28	8.5	46	990	11	21	1.7 J
Total Metals (MG/KG)											
Aluminum	55,000	7,600	--	35,000	8,920 J	8,630 J	7,760 J	6,730 J	8,590 J	8,080 J	8,630 J
Antimony	0.3	3.1	78	3.6	0.27 J	0.43 J	0.33 J	0.53 J	0.65 J	0.43 J	6.8 UJ
Arsenic	1	0.39	18	1.6	1.1 U	0.48 J	1 J	0.84 J	1.1 U	1.1 U	1.1 U
Barium	82	1,600	330	147	88 J	71.6 J	50.4 J	48.2 J	60.5 J	57.7 J	50.9 J
Beryllium	3	15	40	0.27	0.039 J	0.026 J	0.52 U	0.52 U	0.53 U	0.55 U	0.57 U
Cadmium	0.4	3.7	32	2.24	0.079 J	0.082 J	0.13 J	0.11 J	0.53 U	0.55 U	0.073 J
Calcium	--	--	--	8,840	12,900 J	5,410 J	88,800 J	18,400 J	19,600 J	13,300 J	24,500 J
Chromium	2	210	0.4	72	4.2	6	7.1	5	4.4	4.3	4.9
Cobalt	33	140	13	15.8	8.4 J	8.1 J	7 J	9.1 J	6.6 J	6.4 J	6.4 J
Copper	46	310	70	65.5	30.2	32	40.1	55.3	33.7	32.7	25.3
Iron	276	2,300	--	38,100	13,200 J	14,900 J	11,500 J	12,600 J	12,200 J	11,600 J	12,400 J
Lead	14	400	120	5.4	11.6	7.3	8.3	20	14.8	15.6	1.5
Magnesium	--	--	--	3,710	2,550 J	2,150 J	5,270 J	4,870 J	2,670 J	2,670 J	3,670 J
Manganese	57	180	220	1,630	601 J	546 J	357 J	298 J	370 J	381 J	349 J
Mercury	0.1	2.3	0.1	0.057	0.11 U	0.11 U	0.1 U	0.1 U	0.11 U	0.049 J	0.11 U
Nickel	7	160	38	22.2	4.3 U	4.4 U	4.2	4.2 U	4.3 U	4.4 U	4.5 U
Potassium	--	--	--	5,270	1,400	1,310	1,130	1,730	1,310	1,330	1,180
Selenium	0.3	39	0.52	0.51	0.91 J	0.87 J	3.6 U	0.5 J	0.54 J	3.9 U	0.56 J
Vanadium	300	7.8	2	144	42.7 J	52 J	35.9 J	34.1 J	39.7 J	36.9 J	50.6 J
Zinc	620	2,300	120	32	43.2	29.5	31.9	47.1	33.4	35.2	11.7

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, beryllium, cadmium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and DAF 1 Criteria
Exceeds Background and Eco Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 16-2
PAOC J Subsurface Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puertro Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPAJ-SO01	EPAJ-SO02	EPAJ-SO03	EPAJ-SO04	EPAJ-SO05		EPAJ-SO06
Sample ID				EPAJ-SB01-0405	EPAJ-SB02-0406	EPAJ-SB03-0406	EPAJ-SB04-0406	EPAJ-SB05-0406	EPAJ-SB05P-0406	EPAJ-SB06-0406
Sample Date				03/02/06	03/01/06	03/01/06	03/02/06	03/02/06	03/02/06	03/01/06
Chemical Name										
Volatile Organic Compounds (UG/KG)										
No Detections										
Semi-volatile Organic Compounds (UG/KG)										
No Detections										
Pesticide/Polychlorinated Biphenyls (UG/KG)										
4,4'-DDE	3,000	1,700	--	3.1 J	3.7 U	2.1 J	48	2.5 J	3.1 J	1.3 J
4,4'-DDT	2,000	1,700	--	1.7 J	3.7 U	3.5 U	27	1.3 J	1.3 J	27
beta-BHC	0.1	320	--	1.8 U	1.9 U	1.8 U	1.9 U	1.9 U	2.2 JN	1.8 U
Total Metals (MG/KG)										
Aluminum	55,000	7,600	35,000	7,340 J	9,340 J	8,400 J	15,400 J	10,100 J	9,560 J	8,410 J
Antimony	0.3	3.1	3.3	0.34 J	0.28 J	0.31 J	0.46 J	0.22 J	6.7 UJ	6.3 UJ
Barium	82	1,600	147	107 J	89.9 J	51 J	55 J	53.9 J	95.3 J	50.2 J
Beryllium	3	15	0.27	0.52 U	0.1 J	0.049 J	0.13 J	0.14 J	0.12 J	0.041 J
Cadmium	0.4	3.7	2.24	0.026 J	0.047 J	0.027 J	0.042 J	0.56 U	0.56 U	0.043 J
Calcium	--	--	8,840	1,720 J	17,800 J	4,570 J	1,880 J	2,850 J	2,850 J	10,500 J
Chromium	2	210	72	2.3	4.9	3.1	3.4	5	5	4.6
Cobalt	33	140	15.8	8 J	10.4 J	8.3 J	6.4 J	7.1 J	9.1 J	6.6 J
Copper	46	310	65.5	21.7	24.3	32.5	27.3	23.5	22.8	25.6
Iron	276	2,300	38,100	12,200 J	13,600 J	14,300 J	19,200 J	13,600 J	14,400 J	12,300 J
Lead	14	400	3.34	0.7 J	1.8	1.3	1.1	2	2	1.3
Magnesium	--	--	3,710	2,750 J	3,860 J	3,930 J	2,740 J	3,240 J	3,410 J	3,130 J
Manganese	57	180	1,630	222 J	710 J	260 J	163 J	522 J	729 J	372 J
Mercury	0.1	2.3	0.057	0.1 U	0.11 U	0.058 J	0.11 U	0.11 U	0.11 U	0.1 U
Nickel	7	160	22.2	1.7 J	4.4 U	4.3 U	4.4 U	4.5 U	4.5 U	4.2 U
Potassium	--	--	2,000	2,270	1,150	1,760	5,790	1,280	1,220	1,210
Selenium	0.3	39	0.51	3.7 U	0.55 J	0.7 J	0.87 J	0.69 J	0.68 J	3.7 U
Silver	2	39	0.22	0.07 J	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1 U
Sodium	--	--	2,250	522 U	778	534 U	554 U	563 U	562 U	524 U
Vanadium	300	7.8	144	37.7 J	59.8 J	53.9 J	62.6 J	44 J	53.4 J	52.1 J
Zinc	620	2,300	32	14.9	13.7	19.3	14.8	14.1	15	11.6

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- JN - Qualitative identification questionable due to poor resolution. Analyte presumptively present at approximate quantity
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

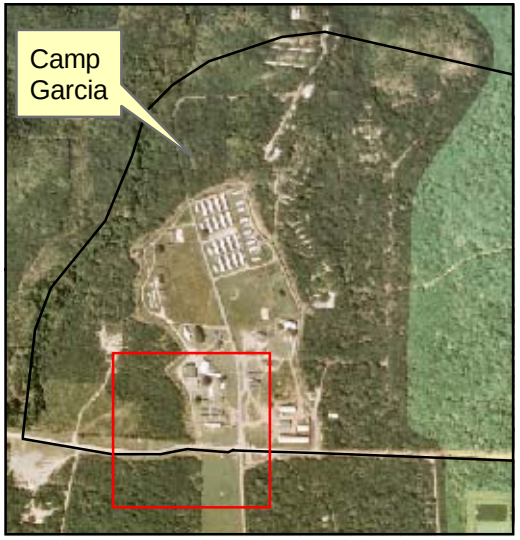
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 16-3
PAOC J Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Pb > SSL, BKG	< SSL in subsurface soil; < SSL at a DAF of 2	
				Se > ECO, SSL, BKG	ECO based on plants; no sign of stress to plants; maintained area; < ECO for soil invertebrates; not above SSL in all samples; other non-contaminants (calcium, magnesium, potassium) detected above background; if releases had occurred, other constituents indicative of a release likely would have been detected if there had been a release; < SSL at a DAF of 3	
Subsurface Soil	Yes					Medium sufficiently characterized; no further action for medium
		Pesticides	No	N/A		
		Inorganics	Yes	Se > SSL, BKG	See above	
Groundwater	Yes	Not applicable				No well installed (dry borehole); to increase confidence in site-specific determination, regional groundwater data are warranted.

PHOTO DATE 1962

PHOTO DATE 1983



LEGEND

- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location
- PA/SI Surface and Subsurface Soil Sample and Abandoned Bedrock Boring Location
- Former/ Current Location of Structure
- General Area, PAOC J
- Proposed Monitoring Well Location

N
W E
S

0 100 200 Feet

Figure 16-1
1962 Aerial Photograph of the PAOC J, K, and L Areas
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 17

PAOC K—Former Wash Rack

This section presents the results of the PA/SI performed at PAOC K—Former Wash Rack.

17.1 Conceptual Site Model

The CSM for PAOC K is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews; as well as site-specific data collection.

17.1.1 Site History and Potential Sources of Release

PAOC K was first identified in a site visit conducted in June 2000 with an employee from NSRR (CH2M HILL, 2001). The site is located in an area north of the main road of Camp García, adjacent to PAOCs J and L, as shown on Figure 16-1. Interviewees identified PAOC K as being a potential source of petroleum contamination from washing vehicles on the vehicle wash rack. The structure was demolished prior to 1980. During a site visit in October 2002, no evidence of hazardous materials, hazardous waste, petroleum, or munitions storage or disposal was observed at the site (NAVFACENGCOM, 2003). While there was no observable evidence of a release, a PA/SI was performed due to past vehicle washing activities at the site.

17.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 2001 (recon of PI sites), 2002 (EBS), 2005-2006 PA/SI, as well as on regional information. No federally protected species or preferred habitats were identified at the site. For more information on the ecological survey, see Appendix M.

The site slopes very gently to the southwest, with the highest elevation at about 72 ft amsl. The land around PAOC K is cleared periodically as part of routine maintenance activities.

Soil borings at PAOC K encountered mostly dry well graded sand, often with silt or clay or gravel. For more details on the unconsolidated material overlying bedrock, see the site-specific boring logs in Appendix D. No monitoring wells were drilled on PAOC K, but soil boring refusal depths at PAOC K were 10, 17, 11, 9, and 13 ft bgs, which corresponds to the approximate depth bedrock was encountered at adjacent PAOC L. This was confirmed in the bedrock monitoring well boring for EPAL-MW01. PAOC K lies within the KTd formation, which consists of plutonic rocks, largely granodiorite and quartz diorite. For more information on the bedrock geology, see Section 1.4.6.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon along the coast, a little less than 1 mile to the south and southeast, respectively. Based on nearby wells, the topographic slope, and the regional groundwater gradient determined by

the USGS (1989), groundwater in this area exists within fractures in the bedrock and is presumed to flow in a southerly direction toward the coast (approximately 1 mile south of the site), as described in Section 1.4.7. The 9 ft to 17 ft of soil and weathered rock that exists over bedrock at the site is unsaturated, based on the soil borings done during the PA/SI.

17.2 Sampling Approach and Chemical Constituents Identified

As presented in the PA/SI Work Plan (CH2M HILL, 2006), five soil borings were installed at the locations illustrated on Figure 16-1. At each of the five soil borings, one surface soil sample and one subsurface soil sample were collected. Four soil borings were installed around the perimeter of the former wash rack where runoff would most likely have occurred. In addition, one soil boring was completed in the center of where the former wash rack was located. No FID readings significantly above background were observed in the soil borings (see Soil Boring Logs, Appendix D); therefore, subsurface soil samples were collected at default depths in accordance with the work plan (see Table 2-1 for subsurface soil sample depths).The surface soil and subsurface soil samples collected from each of the six borings were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs; and TAL metals.

Tables 17-1 and 17-2 summarize the constituents detected in PAOC K surface soil samples and subsurface soil samples, respectively, collected during the PA/SI. The tables also identify screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O.

17.3 PAOC-K Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 17-1 and 17-2).

Appendix N, Section N.17 discusses the evaluation of the PAOC K data quality. As detailed in Section N.17, the PAOC K data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at PAOC K, which is done in Steps 1 through 5 below. To increase the level of confidence in this determination, however, additional regional data collection will be performed, as defined in Section 17.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former vehicle wash rack. Although there are no records of past releases at the site and there was no evidence of past releases observed during the site visits, the potential presence of CERCLA hazardous substances could not be confidently ruled out without sample collection due to the nature of the historical activities at the site. Sample collection took place during the 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above background UTLs and non-inorganics were detected by medium:

Surface Soil

- VOCs: none detected
- SVOCs: none detected
- PCBs: none detected
- Pesticides: 4,4′-DDD, 4,4′-DDE, 4,4′-DDT, gamma-chlordane
- Inorganics above background UTLs: arsenic, calcium, cobalt, copper, lead, magnesium, mercury, selenium, and zinc

Subsurface Soil

- VOCs: none detected
- SVOCs: none detected
- Pesticides: 4,4′-DDD, 4,4′-DDE, 4,4′-DDT, endrin ketone, gamma-chlordane
- PCBs: arochlor-1260
- Inorganics above background UTLs: arsenic, barium, calcium, lead, magnesium, potassium, selenium, and zinc

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

There is no history or visual evidence of releases at PAOC K. Further, the pesticides detected at this site are the same pesticides and of similar concentrations detected at other sites across east Vieques. This information, coupled with the history of the site, suggests the pesticides are present due to normal pesticide use, not a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1). Therefore, pesticides are not considered further in the decision analysis process. Because metals (and the single PCB detection) may be associated with historical vehicle washing, they are further considered in the decision analysis process, even though other constituents likely to be detected if there were releases associated with historical vehicle washing (e.g., SVOCs) were not present.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Surface Soil

- Arsenic: two detections (samples SS03 and SS05) at concentrations (2 and 1.7 mg/kg, respectively) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and background UTL (1.6 mg/kg)

- Cobalt: one detection (sample SS04) at a concentration (21.1 mg/kg) above the ecological screening value (13 mg/kg) and background UTL (15.8 mg/kg)
- Copper: one detection (sample SS04) at a concentration (113 mg/kg) above the ecological screening value (70 mg/kg), SSL at a DAF of 1 (46 mg/kg), and background UTL (65.5 mg/kg)
- Lead: three detections (samples SS01, SS03, SS04,) at concentrations (20.2 mg/kg to 60.6 mg/kg) above the SSL at a DAF of 1 (14 mg/kg) and background UTL (5.4 mg/kg)
- Selenium: three detections (samples SS01, SS02, and SS04) at concentrations (0.53 mg/kg to 0.59 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

Subsurface Soil

- PCBs: no exceedances
- Arsenic: one detection (sample SB04) at a concentration (2.3 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and background UTL (1.6 mg/kg)
- Barium: one detection (sample SB01) at a concentration (469 mg/kg) above the SSL at a DAF of 1 (82 mg/kg) and background UTL (147 mg/kg)
- Lead: one detection (sample SB04) at a concentration (20.8 mg/kg) above the SSL at a DAF of 1 (14 mg/kg) and background UTL (3.34 mg/kg)
- Selenium: four detections (samples SB01, SB03, SB04, and SB05) at concentrations (0.74 mg/kg to 1.1 mg/kg) above the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

In the surface soils, arsenic is the only constituent detected above its PRG and background UTL. Although it was detected at four of the five locations in surface soil and one of the five locations in subsurface soil, only the three highest concentrations (1.7 mg/kg, 2 mg/kg, and 2.3 mg/kg) were above the background UTL and the PRG (0.39 mg/kg based on 1×10^{-6} ELCR). Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and acceptable non-cancer HQ, acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the relatively low maximum detected concentration and the low EPC that would be used in risk calculations, risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver. Because no other chemicals were detected in soil above adjusted PRGs, there would be no potential cumulative health effect evaluation from multiple constituents in surface soil. the Although aluminum, iron, manganese, and vanadium were detected in soil above the adjusted PRGs, their PRGs are based on neurotoxicity in offspring (aluminum), gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health

effects from multiple constituents in site soil. Further, all aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

Three inorganics (cobalt, copper, and selenium) exceed ecological screening values in at least one surface soil sample collected from the site. None of these constituents likely poses an unacceptable risk to ecological receptors on a site-wide basis based upon the following:

- The site is very small and provides very limited habitat, especially considering the area is maintained by periodic mowing. Thus, the potential exposures to ecological receptors are minimal.
- Cobalt and copper each exceed their respective ecological screening values and the background UTL in one of five surface soil samples. In each case, the associated duplicate for the exceeding sample is less than the background UTL and comparable to, or less than, the ecological screening value. Additionally, the mean concentrations of both constituents are comparable to, or less than, the ecological screening values. Thus, no unacceptable ecological risks are likely associated with exposure to these two constituents.
- Selenium exceeds the ecological screening value and background UTL in three of the five surface soil samples. The HQ based on the maximum concentration is only 1.13. The screening value (0.52 mg/kg), however, is based upon potential impacts to plants. The site consists of periodically mowed grass, so plant endpoints are not likely representative of ecological exposures. None of the selenium concentrations exceeds ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at PAOC K (maximum of 0.59 mg/kg) may be within the range of background. Thus, selenium has a low potential for unacceptable risks, especially given the very low potential for exposure.

Five inorganics (arsenic, barium, copper, lead, and selenium) were detected in PAOC K soil above the SSLs at a DAF of 1. These same five inorganics were detected in PI-4 soil, which is in the same geologic unit as PAOC K, above the SSLs at a DAF of 1. As discussed in Section 14 for PI-4, the SSLs at a DAF of 1 are not likely representative predictors of leaching to groundwater because none of the constituents were detected in groundwater above screening criteria. At PAOC K, none of the five inorganics were detected at concentrations above SSLs at a DAF of 6.

All of the information above suggests no CERCLA-related release has occurred at PAOC K or that any release has not resulted in constituent levels that potentially pose an unacceptable risk over that of background.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely source of CERCLA-related releases at PAOC K is the former wash rack. Based on this information, soil samples were collected on each side of the former wash rack, and in

the center of the former location; the spatial distribution and resulting data indicate the potential source area has been sufficiently characterized.

17.4 Conclusions and Recommendations

Table 17-3 summarizes the results of the decision analysis for PAOC K, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Although several inorganics were detected in surface and subsurface soil and one PCB was detected in subsurface soil, their concentrations do not pose an unacceptable risk to human health or ecological receptors. Further, pesticide detections at the site are consistent with normal pesticide application associated with maintenance of the historical facilities present at the site. Therefore, based on the above information, it is likely that NFA is warranted for PAOC K. However, to help confirm that from the sites within the western half of Camp Garcia (including PAOC K) there have not been releases that have adversely affected groundwater quality, a monitoring well will be installed just south of the western half of Camp Garcia, as shown in Figure 16-1. The actual location of the well will be based on a synoptic round of groundwater elevations collected from all Camp Garcia wells to ensure it is positioned in the downgradient flow direction from the western half of Camp Garcia. A groundwater sample will be collected from this well and analyzed for TCL VOCs, SVOCs, pesticides, PCBs, and TAL total and dissolved inorganics.

SECTION 18

PAOC L—Former Paint and Transformer Storage Area

This section presents the results of the PA/SI performed at PAOC L—Former Paint and Transformer Storage Area.

18.1 Conceptual Site Model

The CSM for PAOC L is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews; as well as site-specific data collection.

18.1.1 Site History and Potential Sources of Release

PAOC L is located just east of PAOCs J and K in Camp Garcia, as shown in Figure 16-1. PAOC L was initially identified as a potential site in 2000 as part of the Description of Current Conditions site reconnaissance (CH2M HILL, 2001). Interviews and records indicate that the former storage structure was a small, single room concrete block building, as shown in Figure 18-1. While the site is no longer in use, the structure still exists. No evidence of PCBs, hazardous materials, hazardous waste, petroleum, or munitions storage or disposal was evident during the 2000 reconnaissance (Description of Current Conditions recon), the 2002 reconnaissance (EBS), or the 2006 sampling effort (PA/SI). While there was no observable evidence of a release, a PA/SI was performed due to past storage of paints and transformers.

18.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 2000, 2002, and 2006, as well as on regional information.

The site slopes very gently to the southwest, with the highest elevation at about 72 ft amsl. The land around PAOC L is cleared periodically as part of routine maintenance activities.

Soils at PAOC L consist mostly of silty sand with some gravel. For more details on the unconsolidated material overlying bedrock, see the site-specific boring logs in Appendix D. Bedrock at the site was encountered at approximately 14 ft bgs. Bedrock below PAOC L is of the KTd formation, which consists of plutonic rocks, largely granodiorite and quartz diorite. This was confirmed in the bedrock monitoring well boring for EPAL-MW01. For more information on the bedrock geology, see Section 1.4.6.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon along the coast, a little less than 1 mile to the south and southeast, respectively. Based on the well at PAOC L and other nearby wells, the topographic slope, and the regional

groundwater gradient determined by the USGS (1989), groundwater in this area exists within fractures in the bedrock and is presumed to flow in a southerly direction toward the coast (approximately 1 mile south of the site), as described in Section 1.4.7. The 14 ft of soil and weathered rock that exists over bedrock at the site is unsaturated, based on the soil borings done during the PA/SI and the depth to water in the monitoring well (24.7 ft bgs).

18.2 Sampling Approach and Chemical Constituents Identified

As presented in the PA/SI Work Plan (CH2M HILL, 2006), four soil borings were installed at the locations shown on Figure 16-1. At each of the four soil boring locations, one surface soil sample and one subsurface soil sample were collected. The four soil borings were located around the perimeter of the building, less than 5 ft from the outer wall of the building, halfway between each corner. No FID readings significantly above background were observed in the soil borings (see Soil Boring Logs, Appendix D); therefore, subsurface soil samples were collected at default depths (or refusal, whichever was encountered first) in accordance with the work plan (see Table 2-1 for subsurface soil sample depths).The southernmost soil boring was completed as a monitoring well (EPAL-MW01), as shown in Figure 16-1. The surface soil and subsurface soil samples collected from each of the four borings were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs; and TAL metals. Groundwater samples were analyzed for TCL VOCs, SVOCs, pesticides, and PCBs; and TAL metals.

Tables 18-1, 18-2, and 18-3 summarize the constituents detected in PAOC L surface soil samples, subsurface soil samples, and groundwater samples, respectively, collected during the PA/SI. The tables also identify screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O. Note that the groundwater data from the background well for PAOC N (EPAN-MW02) was used for initial background comparison for the groundwater data collected at PAOC L. PAOC N is located several hundred ft east of PAOC L.

18.3 PAOC L Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 18-1 through 18-3).

Appendix N, Section N.18 discusses the evaluation of the PAOC L data quality. As detailed in Section N.18, the PAOC L data are acceptable for use in evaluating aspects of environmental conditions at PAOC L, which is done in Steps 1 through 5 below. However, it is recognized that sufficient data have not been collected to draw conclusions regarding potential releases with adequate confidence, as discussed in Step 6 below. Therefore, additional data collection will be performed, as defined in Section 18.4.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former paint and transformer storage building. Although there are no records of past releases at the site and there was no evidence of past releases observed during the site visits, the potential presence of CERCLA hazardous substances could not be confidently ruled out without sample collection due to

the nature of the historical activities at the site. Sample collection took place during the 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above background UTLs and non-inorganics were detected by medium:

Surface Soil

- VOCs: acetone
- SVOCs: acetophenone, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, fluoranthene, pyrene
- Pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endrin
- PCBs: none detected
- Inorganics above background UTLs: calcium, copper, lead, magnesium, selenium, and zinc

Subsurface Soil

- VOCs: none detected
- SVOCs: none detected
- Pesticides: 4,4'-DDE, 4,4'-DDT, Endosulfan 1
- PCBs: none detected
- Inorganics above background UTLs: calcium, lead, magnesium, potassium, selenium, and zinc

Groundwater

- VOCs: chloroform, TCE
- SVOCs: none detected
- Pesticides: none detected
- PCBs: none detected
- Total inorganics above background (EPAN MW02): aluminum, chromium, cobalt, copper, iron, manganese, nickel, potassium, and selenium
- Dissolved inorganics above background (EPAN MW02): barium, cobalt, manganese, nickel, potassium, selenium, and vanadium

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Although each constituent of the various chemical groups may not be associated with the paint historically stored at PAOC L, the constituent groups VOCs, SVOCs, and inorganics are associated with paints. Therefore, they are considered further in the decision analysis process as potentially being associated with a CERCLA-related release.

Pesticides are very common at sites across east Vieques where samples have been collected for pesticide analysis. As discussed in *Pesticides and Herbicides* under Section 1.1.1, pesticides legally applied for normal pest control are not CERCLA-related releases and are, therefore, not subject to CERCLA regulation. Further, as indicated in DoD guidance, concentrations of pesticides should not be used to conclude whether a pesticide release has occurred (USACE, 2004). While the pesticide concentrations at a particular site are not used to draw this conclusion for the site, the pesticide concentrations at a site relative to all the other sites where pesticides were detected are used, in part, to help draw this conclusion. Pesticide data collected across Vieques suggest normal pesticide use resulted in residual pesticide concentrations in soil in the range of less than 1 µg/kg to several hundred µg/kg. At PAOC L, however, the pesticide concentrations detected in several soil samples were up to more than an order of magnitude higher than those generally found in samples at other sites.

In addition to the above information, the building's use was taken into consideration in determining whether the presence of pesticides in the soil is the result of a release or normal pesticide application. As stated in Section 18.1.1, the building was a small structure historically used to store chemicals. Even though historical information indicates the chemicals were paints, that the building was used to store chemicals, coupled with the pesticide data discussed above, suggests it is possible that pesticides could have been stored and subsequently released (e.g., spilled) at the site. Therefore, it is assumed that a pesticide release at PAOC L potentially occurred. Therefore, the pesticide concentrations at PAOC L are further considered in the decision analysis process as potentially being associated with a CERCLA-related release.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

<u>Surface Soil</u>

- VOCs: no exceedances
- Benzo(a)pyrene: one detection (sample SS01) at a concentration (73 µg/kg) above the PRG (62 µg/kg)
- Fluoranthene: two detections (samples SS01 and SS03) at concentrations (120 µg /kg and 110 µg/kg, respectively) above the ecological screening value (100 µg/kg)

- Pyrene: two detections (samples SS01 and SS03) at concentrations (120 μg/kg and 110 μg/kg, respectively) above the ecological screening value (100 μg/kg)
- 4,4′-DDD: two detections (samples SS01 and SS04) at concentrations (24 μg/kg and 940 μg/kg respectively) above the ecological screening value (10 μg/kg), and in the case of SS04, above the SSL at a DAF of 1 (800 μg/kg)
- 4,4′-DDE: all four detections at concentrations (670 μg /kg to 3,400 μg/kg) above the ecological screening value (10 μg/kg), and in the case of SS02 and SS04, above the PRG (1,700 μg/kg), and in the case of SS02, above the SSL at a DAF of 1 (3,000 μg/kg)
- 4,4′-DDT: all four detections at concentrations (300 μg/kg to 67,000 μg/kg) above the ecological screening value (10 μg/kg), and in the case of SS01 and SS04, above the PRG (1,700 μg/kg) and the SSL at a DAF of 1 (2,000 μg/kg)
- Dieldrin: one detection (SS03) at a concentration (0.79 μg/kg) above the ecological screening value (0.5 μg/kg) and the SSL at a DAF of 1 (0.2 μg/kg)
- Endrin: one detection (SS01) at a concentration (0.78 μg/kg) above the ecological screening value (0.04 μg/kg)
- Copper: one detection (sample SS01) at a concentration (70.2 mg/kg) above the ecological screening value (70 mg/kg), the SSL at a DAF of 1 (46 mg/kg) and background UTL (65.5 mg/kg)
- Lead: two detections (samples SS01 and SS04) at concentrations (14.9 mg/kg to 38 mg/kg) above the SSL at a DAF of 1 (14 mg/kg) and background UTL (5.4 mg/kg)
- Selenium: four detections (samples SS01, SS02, SS03, and SS04) at concentrations (0.54 mg/kg to 0.81 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)
- Zinc: one detection (sample SS01) at concentrations (258 mg/kg; 215 mg/kg in the field duplicate) above the ecological screening value (120 mg/kg) and background UTL (32 mg/kg)

<u>Subsurface Soil</u>

- Pesticides: no exceedances
- Lead: three detections (sample SB02, SB03, and SB04) at concentrations (16.5 mg/kg to 79.4 mg/kg) above the SSL at a DAF of 1 (14 mg/kg) and background UTL (3.34 mg/kg)
- Selenium: two detections (samples SB01 and SB04) at concentrations (0.68 mg/kg and 0.58 mg/kg, respectively) above the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

<u>Groundwater</u>

- Chloroform: detected at a concentration (0.49 μg/L) above the tap water PRG (0.17 μg/L)
- TCE: detected at a concentration (0.11 μg/L) above the tap water PRG (0.028 μg/L)

- Selenium (total and dissolved): detected at concentrations (22.4 μg/L total and 22.5 μg/L dissolved) above the adjusted tap water PRG (18 μg/L) and background (non-detect)
- Vanadium (dissolved): detected at a concentration (7 μg/L) above the adjusted tap water PRG (3.6 μg/L) and background (non-detect)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Soil

Three organic constituents (benzo(a)pyrene, 4,4'-DDE, and 4,4'-DDT) were detected in soil at concentrations above PRGs (62 μg/kg, 1,700 μg/kg, and 1,700 μg/kg, respectively). The PRGs for these three constituents are based on potential carcinogenic effects. Based on the maximum detected concentrations of these three constituents in relation to PRGs (derived using a target risk of 1×10^{-6}), the estimated risks would be 1×10^{-6} for benzo(a)pyrene, 2×10^{-6} for 4,4'-DDE, and 4×10^{-5} 4,4'-DDT, yielding a cumulative risk from the three potential carcinogens of approximately 4×10^{-5} for a residential scenario. Based on the relatively low maximum detected concentrations and the EPCs that would be used in risk calculations, risk estimates would be within acceptable levels and these three constituents would not be identified as risk drivers.

Of the three constituents discussed above, only one (4,4'-DDT) has a second PRG (36,000 μg/kg based on an HQ = 1) based on non-cancer (liver) effects. Due to the maximum detected concentration of 4,4'-DDT (67,000 μg/kg), an elevated EPC would be used in risk calculations; therefore, non-cancer risk estimates would exceed the acceptable level and 4,4'-DDT would likely be identified as a risk driver for the residential scenario.

Although aluminum, arsenic, iron, manganese, and vanadium were detected in soil above the adjusted PRGs, their non-cancer PRGs are based on skin and vascular effects (arsenic), neurotoxicity in offspring (aluminum), gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health effects from multiple non-carcinogenic constituents in site soil. Further, all arsenic, aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

Two PAHs, fluoranthene and pyrene, exceed conservative ecological screening values in two of four surface soil samples. The maximum concentrations for each of these constituents (120 μg/kg) are only 1.2 times the screening values. However, the field duplicate for the sample that contained the maximum concentrations (SS01) did not contain pyrene and contained fluoranthene at a concentration below the ecological screening value. The other sample (SS03) contained the two PAHs at concentrations just above the ecological screening value. Given the low magnitude of the exceedances and the developed nature of the site and surrounding area, no unacceptable ecological risks are likely associated with these PAHs.

Five pesticides, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, and endrin, exceed conservative ecological screening values in at least one surface soil sample, and in the case of 4,4'-DDE

and 4,4′-DDT, all samples exceed conservative ecological screening values (in some cases, by several orders of magnitude). Therefore, there may be unacceptable ecological risk associated with pesticides present as a result of a potential release. However, it is noted that the site is small, which would likely affect potential ecological exposures. It is further noted that the spatial distribution of the elevated pesticide levels, if localized, may limit potential exposures and, thereby, risks.

One detection of copper and one detection of zinc exceed conservative ecological screening values. However, the maximum copper concentration in surface soil is only 0.2 mg/kg above the screening value (HQ = 1.002). Further, the copper concentration in the other sample in this duplicate pair is less than the ecological screening value. This information suggests there are no unacceptable ecological risks associated with potential receptor exposure to copper at PAOC L. The HQ based on the maximum zinc concentration is just 2.15 (1.79 in the field duplicate) and the HQ based on the mean zinc concentration (113 mg/kg) is less than one. Thus, there is a low potential for risks related for zinc on a site-wide basis, especially given the low potential for exposure.

Selenium concentrations exceeded the ecological screening value and the background UTL in all four samples from the site, although the uniformity in the concentrations (0.74 to 0.81 mg/kg) suggests that this constituent may be present at background levels. Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at PAOC L (maximum of 0.81 mg/kg) may be within the range of background. Further, all selenium concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable risks, especially given the low potential for exposure.

In surface soil, one detection each of 4,4′-DDD, 4,4′-DDE, and dieldrin and two detections of 4,4′-DDT exceed the SSL at a DAF of 1. However, no pesticides were detected in any of the subsurface soil samples at concentrations above the SSL at a DAF of 1. Further, no pesticides were detected in groundwater at the site. Therefore, the SSL at a DAF of 1 is not likely a representative predictor of pesticide leaching through soil to groundwater at PAOC L.

The inorganics (copper, lead, and selenium) were detected at concentrations above the SSLs at a DAF of 1. However, dissolved copper was not detected in groundwater at the site and total copper was detected more than an order of magnitude below the tap water PRG and MCL. Lead was not detected in groundwater, and selenium was detected below the MCL and tap water PRG. This information suggests the SSLs at a DAF of 1 are not representative of inorganics leaching through soil to groundwater at the site. At a DAF of 6, none of the concentrations of the three inorganics exceeds the SSLs.

Groundwater

Two organic constituents (chloroform and TCE) were detected in groundwater at concentrations (0.49 μg/L and 0.11 μg/L, respectively) above the tap water PRGs (0.17 μg/L and 0.028 μg/L, respectively). However, the detected concentrations of chloroform and TCE are approximately two orders of magnitude less than their MCLs (80 μg/L and 5 μg/L, respectively).

The PRGs for chloroform and TCE are based on potential carcinogenic effects. Based on the maximum detected concentrations of these two constituents in relation to PRGs (derived using a target risk of 1×10^{-6}), the estimated risks would be 3×10^{-6} for chloroform and 4×10^{-5} for TCE, yielding a cumulative risk from the two potential carcinogens of approximately 4×10^{-5} for tap water. Based on the EPCs that would be used in risk calculations, risk estimates would be within acceptable levels and these constituents would not be identified as risk drivers.

Selenium (total and dissolved) was detected above its adjusted tap water PRG (18 µg/L based on an HQ=0.1) at concentrations around 22 µg/L. Based on the acceptable non-cancer HQ of 1, the acceptable risk-based concentration for tap water is 180 µg/L.

Vanadium (dissolved) was detected above its adjusted tap water PRG (3.6 µg/L based on an HQ=0.1) at a concentration of 7 µg/L. Based on the acceptable non-cancer HQ of 1, the acceptable risk-based concentration for tap water is 36 µg/L. Further, vanadium was detected in site surface and subsurface soil at concentrations below the background UTL. Therefore, the concentration of vanadium in groundwater is likely attributable to background.

No other constituent exceeds its tap water PRG in groundwater. Because the PRGs for selenium and vanadium are based on selenosis (integument effects) (selenium) and increased mortality (vanadium), there is no concern about potential cumulative human health effects from multiple non-carcinogenic constituents in site groundwater.

It is also important to note that only a single well was installed and used to represent background inorganics concentrations in groundwater for PAOC L. In actuality, background is represented by a range of concentrations because environmental media are not homogeneous. Therefore, the data from the background well for PAOC L (EPAN MW02) represent a single point within that range of background concentrations for each inorganic constituent.

Summary

The more realistic evaluation above suggests the concentrations of several pesticides in surface soil warrant further action, based on existing data. Therefore, the decision analysis process continues to Step 5a.

Step 5a: Would additional source area data permit more realistic evaluations?

It is possible that additional data regarding the spatial distribution of pesticides in soil will show that the concentrations posing potential risks are spatially restricted and, therefore, potential exposures would not likely result in unacceptable risks. Alternatively, additional data could help determine whether a limited removal action or expanded investigation is warranted.

18.4 Conclusions and Recommendations

Table 18-4 summarizes the results of the decision analysis for PAOC L, which indicates an historical release of pesticides was likely, based on human health and/or ecological screening value exceedances for pesticides in surface soil. Therefore, additional surface soil

sample collection is warranted to sufficiently characterize the release such that the spatial distribution can be further refined. Pesticides were not detected in subsurface soil above screening criteria.

The initial groundwater sample collected at PAOC L identified two VOCs below their respective MCLs and two inorganics below levels that would likely cause an unacceptable risk. No SVOCs, pesticides, or PCBs were detected in groundwater. Therefore, while NFA is likely appropriate for PAOC L groundwater, additional groundwater data are warranted to confirm this supposition.

The rationale, objective, and decision analysis for additional surface soil and groundwater sample data collection are provided below:

Rationale

Initial data evaluation suggests there has been a CERCLA-related release of pesticides whose concentrations in surface soil may represent unacceptable human and/or ecological risks. However, the extent of release has not been sufficiently characterized to permit a determination of the need for further action.

In addition, evaluation of the single groundwater sample from the well at PAOC L indicates the presence of two volatile constituents below MCLs, two inorganics below levels that would likely cause an unacceptable risk, and no SVOCs, pesticides, or PCBs. Although NFA is likely appropriate for groundwater at PAOC L, a second round of groundwater data is warranted to confirm this supposition.

Objective

Sufficiently delineate the extent of the pesticide release in surface soil around the former storage building by:

- Collecting additional surface soil samples between the initial samples and further out from building than initial samples (see Figure 18-2)
- Analyzing the samples for TCL pesticides

Confirm the initial groundwater sample results by:

- Collecting an additional groundwater sample from well EPAL-MW01
- Analyzing the groundwater sample for TCL VOCs, SVOCs, pesticides, PCBs, and TAL total and dissolved inorganics

Decision Analysis

Evaluate comprehensive soil dataset (initial data and supplemental data) in accordance with Step 5 of the decision analysis to determine if the concentrations of pesticides in soil pose a potentially unacceptable risk, whether further action (i.e., expanded investigation or limited removal) is warranted, or if NFA is warranted for soil.

Compare second round of groundwater data to initial round to determine if constituent levels are consistent. If warranted (i.e., concentrations are higher), evaluate the second round of data in accordance with the 6-step decision analysis.

TABLE 18-1
PAOC L Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	EPAL-SO01		EPAL-SO02	EPAL-SO03	EPAL-SO04
Sample ID					EPAL-SS01-0002	EPAL-SS01P-0002	EPAL-SS02-0001	EPAL-SS03-0002	EPAL-SS04-0001
Sample Date					02/27/06	02/27/06	03/08/06	02/27/06	03/08/06
Chemical Name									
Volatile Organic Compounds (UG/KG)									
Acetone	800	1,400,000	--	--	10 U	10 U	4 J	10 U	12 U
Semi-volatile Organic Compounds (UG/KG)									
Acetophenone	--	780,000	--	--	120 J	360 U	340 U	370 U	350 UJ
Benzo(a)anthracene	80	620	--	--	76 J	360 U	340 U	370 U	350 UJ
Benzo(a)pyrene	400	62	100	--	73 J	360 U	340 U	370 U	350 UJ
Benzo(k)fluoranthene	2,000	6,200	--	--	74 J	360 U	340 U	370 U	350 UJ
Chrysene	8,000	62,000	--	--	78 J	360 U	340 U	370 U	350 UJ
Fluoranthene	210,000	230,000	100	--	120 J	74 J	340 U	110 J	350 UJ
Pyrene	210,000	230,000	100	--	120 J	360 U	340 U	110 J	350 UJ
Pesticide/Polychlorinated Biphenyls (UG/KG)									
4,4'-DDD	800	2,400	10	--	6 JN	24	17 U	3.7 JN	940 J
4,4'-DDE	3,000	1,700	10	--	930	1,400	3,400	670 J	2,300
4,4'-DDT	2,000	1,700	10	--	910	2,800	530	300 J	67,000
Dieldrin	0.2	30	0.5	--	3.5 U	3.6 U	17 U	0.79 J	350 U
Endrin	50	1,800	0.04	--	0.78 J	3.6 U	17 U	3.7 UJ	350 U
Total Metals (MG/KG)									
Aluminum	55,000	7,600	--	35,000	8,630	9,080	10,800	8,740	8,990
Antimony	0.3	3.1	78	3.6	0.7 J	0.69 J	0.76 J	0.58 J	0.81 J
Arsenic	1	0.39	18	1.6	0.5 J	0.43 J	1 U	1.1 U	0.46 J
Barium	82	1,600	330	147	70.7	86.1	57.7	95.6	70.9
Calcium	--	--	--	8,840	34,100 J	52,200 J	16,600	16,300	38,700
Chromium	2	210	0.4	72	4.7	5.5	15.3	5.7	6.1
Cobalt	33	140	13	15.8	6.6	7.1	10	11.6	7.1
Copper	46	310	70	65.5	67.2	70.2	52.3	50.4	62.8
Cyanide	--	120	1	0.89	2.7 U	0.21 J	2.5 U	2.8 U	2.6 U
Iron	276	2,300	--	38,100	13,300	14,700	18,500	14,400	14,500
Lead	14	400	120	5.4	36.4	38	10.7	11.5	14.9
Magnesium	--	--	--	3,710	4,250	4,760	6,710	4,550	5,620
Manganese	57	180	220	1,630	368	418	464	699	423
Nickel	7	160	38	22.2	4.3 U	4.4 U	5.9	5.6	4.2 U
Potassium	--	--	--	5,270	1,030 J	1,200 J	1,230 J	698 J	941 J
Selenium	0.3	39	0.52	0.51	0.54 J	0.74 J	0.77 J	0.81 J	0.79 J
Vanadium	300	7.8	2	144	34.1	41.7	48.4	37.7	36.9
Zinc	620	2,300	120	32	258	215	90	48.4	53.8

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- JN - Qualitative identification questionable due to poor resolution. Analyte presumptively present at approximate quantity
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, endrin, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (benzo(a)pyrene, fluoranthene, pyrene) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (nickel, selenium, silver, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and Eco Criteria
Exceeds Background, HHRA, and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria
Exceeds Background and HHRA criteria

TABLE 18-2
PAOC L Subsurface Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPAL-SO01	EPAL-SO02	EPAL-SO03	EPAL-SO04
Sample ID				EPAL-SB01-0204	EPAL-SB02-0406	EPAL-SB03-0406	EPAL-SB04-0204
Sample Date				02/27/06	03/08/06	03/08/06	03/08/06
Chemical Name							
Volatile Organic Compounds (UG/KG)							
No Detections							
Semi-volatile Organic Compounds (UG/KG)							
No Detections							
Pesticide/Polychlorinated Biphenyls (UG/KG)							
4,4'-DDE	3,000	1,700	--	2.3 J	330	250	100
4,4'-DDT	2,000	1,700	--	1.2 J	180	25	12
Endosulfan I	900	37,000	--	1.9 UJ	1.9	1.8 U	1.9 U
Total Metals (MG/KG)							
Aluminum	55,000	7,600	35,000	19,400	10,100	9,380	10,300
Antimony	0.3	3.1	3.3	0.71 J	0.74 J	0.4 J	0.62 J
Arsenic	1	0.39	1.6	1.1 U	0.79 J	0.53 J	0.79 J
Barium	82	1,600	147	60.2	106	70.2	96.5
Beryllium	3	15	0.27	0.15 J	0.55 U	0.54 U	0.031 J
Cadmium	0.4	3.7	2.24	0.57 U	0.55 U	0.54 U	0.17 J
Calcium	--	--	8,840	3,640	76,900	51,600	86,000
Chromium	2	210	72	5.2	10.3	8.8	4.7
Cobalt	33	140	15.8	7.3	6.4	6.4	6.7
Copper	46	310	65.5	37	40.8	45	49.9
Iron	276	2,300	38,100	21,200	14,500	13,100	13,900
Lead	14	400	3.34	1.3	79.4	16.5	51.9
Magnesium	--	--	3,710	2,880	4,690	4,600	5,660
Manganese	57	180	1,630	367	339	351	391
Nickel	7	160	22.2	2.6 J	5.5	5.8	4.5 U
Potassium	--	--	2,000	2,620 J	2,150 J	1,960 J	1,950 J
Selenium	0.3	39	0.51	0.68 J	0.43 J	3.8 U	0.58 J
Sodium	--	--	2,250	567 U	801	541 U	706
Vanadium	300	7.8	144	66.6	39.4	35.9	35.9
Zinc	620	2,300	32	21.5	90.6	62.7	289

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 18-3
PAOC L Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Vieques HHRA GW	MCL - GW	PAOC-N EPAN-MW02 Background	EPAL-MW01
Sample ID				EPAL-GW01-06B
Sample Date				04/06/06
Chemical Name				
Volatile Organic Compounds (UG/L)				
Chloroform	0.17	80	NA	0.49 J
Trichloroethene	0.028	5	NA	0.11 J
Semi-volatile Organic Compounds (UG/L)				
No Detections				
Pesticide/Polychlorinated Biphenyls (UG/L)				
No Detections				
Total Metals (UG/L)				
Aluminum	3,600	--	263	911
Calcium	--	--	144,000	94,700
Chromium	11	100	3.6 J	4.3 J
Cobalt	73	--	--	0.77 J
Copper	150	1,300	--	4.6 J
Iron	1,100	--	198	631
Magnesium	--	--	75,600	40,600
Manganese	88	--	8 J	66.2
Nickel	73	--	2.4 J	2.7 J
Potassium	--	--	1780 J	32,500 J
Selenium	18	50	--	22.4 J
Sodium	--	--	323,000	281,000
Dissolved Metals (UG/L)				
Barium	730	2,000	--	73.7 J
Calcium	--	--	139,000	89,000
Chromium	11	100	0.7	0.66 J
Cobalt	73	--	--	0.43 J
Magnesium	--	--	73,400	39,100
Manganese	88	--	--	49.9
Nickel	73	--	--	1.4 J
Potassium	--	--	1710 J	32,800 J
Selenium	18	50	--	22.5 J
Sodium	--	--	311,000	266,000
Vanadium	3.6	--	--	7 J
Wet Chemistry (MG/L)				
Total dissolved solids (TDS)	--	--	NA	1,160

Notes:

ug/L - Micrograms per Liter

J - Analyte present; reported value may or may not be accurate or precise

NA - Not Applicable

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)

Vieques HHRA GW - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)

GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards (40 Code of Federal Regulations [CFR] 141)

-- Not detected in background well

-- Regulatory standard not promulgated

Exceeds Background and HHRA criteria

TABLE 18-4
PAOC L Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-Inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 5a Additional Source Area Data Beneficial?
Surface Soil	Yes					Additional source area data will likely facilitate better understanding of potential risks and enable more informed decision on need for further action
		VOCs	Yes	No	N/A	
		SVOCs	Yes	Benzo(a)pyrene > PRG	individual and cumulative HH risk within acceptable risk range	
				Fluoranthene > ECO	few exceedances, relatively low magnitude of exceedances, developed nature of site	
				Pyrene > ECO	few exceedances, relatively low magnitude of exceedances, developed nature of site	
		Pesticides	Yes	4,4'-DDD > ECO, SSL	small site; localized area may limit exposures; however, pesticides warrant further surface soil sampling and evaluation	
				4,4'-DDE > PRG, ECO, SSL	small site; localized area may limit exposures; however, pesticides warrant further surface soil sampling and evaluation	
				4,4'-DDT > PRG, ECO, SSL	small site; localized area may limit exposures; however, pesticides warrant further surface soil sampling and evaluation	
				Dieldrin > ECO, SSL	small site; localized area may limit exposures; however, pesticides warrant further surface soil sampling and evaluation	
				Endrin > ECO	small site; localized area may limit exposures; however, pesticides warrant further surface soil sampling and evaluation	
		Inorganics	Yes	Cu > ECO, SSL, BKG	maximum concentration comparable to ECO; not detected in groundwater (dissolved); detected in groundwater (total) below PRG and MCL; < SSL at a DAF of 2	
				Pb > SSL, BKG	not detected in groundwater; < SSL at a DAF of 3	
				Se > ECO, SSL, BKG	ECO based on plants; maintained grass limits receptors; < ECO for soil invertebrates; concentrations comparable to PAOCs J and K; detected in groundwater below the PRG (unadjusted) and MCL; < SSL at a DAF of 3	
				Zn > ECO, BKG	small site; localized area may limit exposures; mean concentration < ECO	
Subsurface Soil	Yes					Medium sufficiently characterized; no further action for medium
		Pesticides	Yes	No	N/A	
		Inorganics	Yes	Pb > SSL, BKG	not detected in groundwater; < SSL at a DAF of 6	
				Se > SSL, BKG	Comparable to PAOCs J and K; detected in groundwater below the PRG (unadjusted) and MCL; < SSL at a DAF of 3	
Groundwater	Yes					Medium likely sufficiently characterized; however, second round of data warranted to confirm
		VOCs	Yes	Chloroform > PRG	individual and cumulative HH risk within acceptable risk range; < MCL	
				TCE > PRG	individual and cumulative HH risk within acceptable risk range; < MCL	
		Inorganics	Yes	Se > PRG	acceptable HH risk level; < MCL	
				V > PRG	acceptable HH risk level; < MCL; < BKG in soil	

Photo 1 - Building for investigation at PAOC L

Photo 2 - Open doorway of building at PAOC L

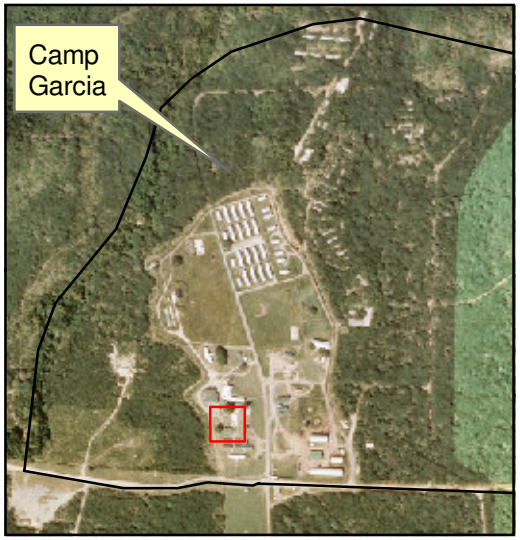
Photo 3 - Floor of building at PAOC L

Photo 4 - Floor of building at PAOC L

Figure 18-1
PAOC L Photographs
Former Paint and Transformer Storage Area
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

PHOTO DATE 2005

PHOTO DATE 1983



LEGEND

- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location
- Proposed Surface Soil Sample Location

Note:
Each PA/SI sampling location is preceded by "EPAL" (e.g. SS02/SB02 = EPAL-SS02 and EPAL-SB02, MW-01 = EPAL-MW01)

N

0 30 60 Feet

FIGURE 18-2
Proposed Additional Surface Soil Sample Locations at PAOC L
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

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SECTION 19

PAOC N—Former Fuel Farm and Filling Station

This section presents the results of the PA/SI performed at PAOC N—Former Fuel Farm and Filling Station at the Former VNTR.

19.1 Conceptual Site Model

The CSM for PAOC N is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews; as well as site-specific data collection.

19.1.1 Site History and Potential Sources of Release

Records indicate that PAOC N was a fuel farm and filling station formerly located at the Camp García Compound at the location shown on Figures 1-2, 1-3, and 19-1 (NAVFACENGCOM, 2003). An historic site map shows that three ASTs numbered 4504, 4505, and 4506 existed in the area. Another historic map shows the un-numbered tanks listed as fuel tanks (Figure 19-2). The fuel farm and filling station was built in 1985 and demolished in November 1992 (CH2M HILL, 2003b).

The site later became the Camp Garcia Refueling Station. A two-compartment, secondarily contained tank (Convault) was installed in 2000 (Figure 19-3). One compartment contained diesel fuel (2,000 gallons) and one compartment contained gasoline (1,000 gallons), both of which were used for vehicle refueling. The tank is constructed of vaulted steel and is still present. The other two tanks shown in Figure 19-3 have since been removed.

Interview records indicate that no known releases occurred at this facility. No evidence of hazardous material, hazardous waste, petroleum, or munitions storage or disposal was observed during the VSI conducted for the EBS in October 2002 (NAVFACENGCOM, 2003). However, due to the presence of the former fuel tanks, and because it they had not been investigated for possible leaks, the site was included in the PA/SI.

19.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 2002 (EBS) and in 2006 (PA/SI), as well as on regional information.

The land surrounding PAOC N is flat, at about 65 ft amsl and sloping about 1 ft to 2 ft every 100 ft to the south. The land around PAOC N is cleared periodically as part of routine maintenance activities.

The soil overlying the bedrock found in borings on PAOC N consists mostly of silts and silts with sand. For more information on the soils see Appendix D for the site-specific soil boring logs. Bedrock was encountered at and near PAOC N between 22 ft and 36 ft bgs. Bedrock under PAOC N is part of the KTd formation, which consists of plutonic rocks, largely granodiorite and quartz diorite. The bedrock borehole for PAOC N MW01 encountered the

granitic bedrock surface at 22 ft bgs, which was observed to continue to 50 ft bgs, where the borehole terminated. For more information on the bedrock geology, see Section 1.4.6.

The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon along the coast, a little less than 1 mile to the south and southeast, respectively. Based on the well at PAOC N, nearby wells, the topographic slope, and the regional groundwater gradient determined by the USGS (1989), groundwater in this area exists within the fractured bedrock and is presumed to flow in a southerly direction toward the coast, as described in Section 1.4.7.

19.2 Sampling Approach and Chemical Constituents Identified

As presented in the PA/SI Work Plan (CH2M HILL, 2006), four soil borings were installed at PAOC N at the locations illustrated on Figure 19-1. At each soil boring location, one surface soil sample and one subsurface soil sample were collected. Three soil borings were installed adjacent to the locations of the former and current ASTs, and one soil boring was installed at the location of the former fuel building. Slightly elevated PID readings relative to background were encountered at soil boring SB03 in the 1-to-3-foot interval; therefore, the subsurface soil sample at this location was collected from this interval. No PID or FID readings significantly above background were observed in the remaining soil borings (see Soil Boring Logs, Appendix D); therefore, subsurface soil samples were collected at default depths in accordance with the work plan (see Table 2-1 for subsurface soil sample depths). The soil boring at the location of the former fuel building was completed as a monitoring well. The surface and subsurface soil samples were analyzed for TCL VOCs and SVOCs, TAL metals, and petroleum hydrocarbons (TPH-DRO, TPH-GRO, and TPH-oil range organics [ORO]). Groundwater samples were analyzed for the same parameters. In addition, one monitoring well (EPAN-MW02) was installed upgradient of the site, as shown on Figure 19-1. This well also serves as the upgradient well for the power plant portion of PAOC S and for PAOC U. The groundwater sample collected from the background well was analyzed for TAL metals.

Tables 19-1, 19-2, and 19-3 summarize the constituents detected in PAOC N surface soil samples, subsurface soil samples, and groundwater samples, respectively, collected during the PA/SI. The tables also identify screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O.

19.3 PAOC N Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 19-1 through 19-3).

Appendix N, Section N.19 discusses the evaluation of the PAOC N data quality. As detailed in Section N.19, the PAOC N data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at PAOC N, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former fuel farm and filling station. Although there are no records of past releases at the site and there was no evidence of past releases observed during the site visit, the potential presence of CERCLA hazardous substances could not be confidently ruled out without sample collection due to the nature of the historical activities at the site. Sample collection took place during the 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

Surface Soil

- VOCs: none detected
- SVOCs: acetophenone, di-n-octylphthalate, bis(2-ethylhexyl)phthalate
- Inorganics above background UTLs: calcium, lead, magnesium, selenium, and zinc
- TPH: TPH-DRO

Subsurface Soil

- VOCs: none detected
- SVOCs: acetophenone, bis(2-ethylhexyl)phthalate
- Inorganics above background UTLs: selenium
- TPH: TPH-DRO

Groundwater

- VOCs: none detected
- SVOCs: none detected
- Total inorganics above background (EPAN MW02): manganese and nickel
- Dissolved inorganics above background (EPAN MW02): chromium and manganese
- TPH: none detected

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

There are no records or visual evidence of past releases at PAOC N. However, based on the potential source areas at PAOC N (i.e., former fuel tanks and filling station), it is assumed that the detected constituent groups (i.e., SVOCs, inorganics, TPH) are potentially attributable to CERCLA-related releases from the former tanks because they are all

potentially associated with petroleum hydrocarbons. Therefore, all detected constituents are further considered in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Surface Soil

- SVOCs: no exceedances
- TPH-DRO: no exceedances
- Selenium: one detection (sample SS03) at a concentration (0.69 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)
- Zinc: one detection (sample SS03) at a concentration (183 mg/kg) above the ecological screening value (120 mg/kg) and background UTL (32 mg/kg)

Subsurface Soil

- SVOCs: no exceedances
- TPH-DRO: no exceedances
- Selenium: one detection (sample SB04) at a concentration (0.64 mg/kg) above the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

Groundwater

- Total and Dissolved inorganics: no exceedances

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Although aluminum, arsenic, iron, manganese, and vanadium were detected in soil above human health screening criteria, their non-cancer PRGs are based on cancer and skin and vascular effects (arsenic), neurotoxicity in offspring (aluminum), gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all arsenic, aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

Zinc exceeds the ecological screening value and background UTL in only one of four surface soil samples. The sample is bounded to the east, west, and south by the other three soil samples. However, the maximum HQ is just 1.53 and the mean HQ is less than 1. Thus,

potential unacceptable risks associated with zinc at this site are not likely, especially considering the small size of the site and even smaller area where zinc was found above the screening value. The site is also within the developed portion of Camp Garcia and is periodically mowed or cleared of vegetation during routine maintenance.

Selenium was detected in only one surface soil sample and one subsurface soil sample above the background UTL, the ecological screening value, and SSL at a of 1. However, selenium was not detected in groundwater at the site, which suggests the SSL at a DAF of 1 is not representative of selenium leaching through soil to groundwater. At a DAF of 3, no selenium concentrations exceed the SSL. The maximum HQ for selenium is only 1.33. Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at PAOC N (maximum of 0.69 mg/kg) may be within the range of background. Further, all selenium concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable risks, especially given the very low potential for exposure.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases are the former fuel tanks and the filling station. Based on this information, soil samples were collected at each of these areas, and a groundwater sample was collected in the downgradient part of the site, the spatial distribution and resulting data of which indicate the potential source area has been sufficiently characterized.

19.4 Conclusions and Recommendations

Table 19-4 summarizes the results of the decision analysis for PAOC N, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil or groundwater at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Therefore, based on the above information, it is likely that NFA is warranted for PAOC N. Although there is no historical information that suggests fuel for the generators at the power plant portion of PAOC S was supplied via direct piping from PAOC N (former fuel farm and filling station), because of their close proximity (i.e., approximately 100 feet), a geophysical survey will be conducted between the former fuel tank locations at PAOC N and the former PAOC S power plant building to ascertain whether an underground fuel pipeline exists between the former tanks and the former power plant.

TABLE 19-1
PAOC N Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	PREQB UST Limit	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	EPAN-SO01	EPAN-SO02	EPAN-SO03	EPAN-SO04	
Sample ID						EPAN-SS01-0001	EPAN-SS02-0001	EPAN-SS03-0001	EPAN-SS04-0001	EPAN-SS04P-0001
Sample Date						02/01/06	02/01/06	02/01/06	02/01/06	02/01/06
Chemical Name										
Volatile Organic Compounds (UG/KG)										
No Detections										
Semi-volatile Organic Compounds (UG/KG)										
Acetophenone		--	780,000	--	--	350 U	350 U	350 U	260 J	350 U
Di-n-octylphthalate		10,000,000	240,000	--	--	350 U	120 J	350 U	360 U	350 U
bis(2-Ethylhexyl)phthalate		--	35,000	--	--	170 J	350 U	350 U	79 J	350 U
Total Metals (MG/KG)										
Aluminum		55,000	7,600	--	35,000	11,000	8,790	7,640	8,110	8,190
Antimony		0.3	3.1	78	3.6	0.72 J	0.69 J	0.59 J	0.97 J	0.65 J
Arsenic		1	0.39	18	1.6	0.67 J	0.5 J	0.56 J	1.1 U	0.43 J
Barium		82	1,600	330	147	52.2	89.4	74.9	58	62.1
Calcium		--	--	--	8,840	20,700	41,200	26,200	46,600 J	30,300 J
Chromium		2	210	0.4	72	17.4	6.6	5.8	9.5 J	6.5 J
Cobalt		33	140	13	15.8	11.8	9.7	7.9	8.6	8.5
Copper		46	310	70	65.5	46.7	49.2	49.4	39.4	37.5
Iron		276	2,300	--	38,100	19,000	15,800	14,900	16,500	14,100
Lead		14	400	120	5.4	8.8	5.2	5.8	4.6	3.9
Magnesium		--	--	--	3,710	7,130	5,270	4,730	5,240	4,720
Manganese		57	180	220	1,630	480 J	557 J	470 J	426 J	418 J
Nickel		7	160	38	22.2	9.5	4.3	4.2 U	4.3	4.3 U
Potassium		--	--	--	5,270	904 J	536 U	558 J	589 J	497 J
Selenium		0.3	39	0.52	0.51	3.7 UJ	0.4 J	0.69 J	3.8 UJ	3.8 UJ
Vanadium		300	7.8	2	144	57.8	44.6	42	51.1	41.3
Zinc		620	2,300	120	32	42.1	28.7	183	23.8	24.6
Total Petroleum Hydrocarbons (MG/KG)										
TPH-diesel range	100	--	--	--	--	8.4 J	8.9 J	13	11	8.9 J

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (chromium, copper) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and Eco Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 19-2
PAOC N Subsurface Soil Detection and Exceedance Results
Preliminary Assesment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**PREQB UST Limit**	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPAN-SO01	EPAN-SO02	EPAN-SO03	EPAN-SO04
Sample ID					EPAN-SB01-0406	EPAN-SB02-0406	EPAN-SB03-0103	EPAN-SB04-0406
Sample Date					02/01/06	02/01/06	02/01/06	02/01/06
Chemical Name								
Volatile Organic Compounds (UG/KG)								
No Detections								
Semi-volatile Organic Compounds (UG/KG)								
Acetophenone		--	780,000	--	340 U	360 U	350 U	100 J
bis(2-Ethylhexyl)phthalate		--	35,000	--	160 J	84 J	350 U	350 U
Total Metals (MG/KG)								
Aluminum		55,000	7,600	35,000	7,340	7,490	8,700	6,250
Antimony		0.3	3.1	3.3	0.56 J	0.49 J	0.58 J	0.52 J
Arsenic		1	0.39	1.6	1 U	1.1 U	1.1 U	0.73 J
Barium		82	1,600	147	48.4	46.5	53.6	39.6
Calcium		--	--	8,840	3,210	2,110	5,560	2,380
Chromium		2	210	72	9.4	8.6	9.9	9.2
Cobalt		33	140	15.8	8.6	7.3	7.5	6.4
Copper		46	310	65.5	51.7	50.1	50.6	54.7
Iron		276	2,300	38,100	21,000	17,900	18,500	20,000
Lead		14	400	3.34	0.72 J	0.54 J	2	1.1 U
Magnesium		--	--	3,710	2,960	2,410	2,680	2,300
Manganese		57	180	1,630	323 J	316 J	408 J	231 J
Nickel		7	160	22.2	3.8 J	3.6 J	4.3 U	4.3 U
Potassium		--	--	2,000	522 U	578 J	550 J	533 U
Selenium		0.3	39	0.51	0.41 J	3.8 UJ	3.8 U	0.64 J
Sodium		--	--	2,250	154 J	200 J	540 U	533 U
Vanadium		300	7.8	144	75.8	63.3	63.3	71.1
Zinc		620	2,300	32	17.4	14.3	19.3	13.1
Total Petroleum Hydrocarbons (MG/KG)								
TPH-diesel range	100	--	--	--	10 U	11 U	11 U	8.2 J

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 19-3
PAOC N Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Vieques HHRA GW**	**MCL - GW**	**PAOC-N EPAN-MW02 Background**	EPAN-MW01
Sample ID				EPAN-GW01-06B
Sample Date				04/04/06
Chemical Name				
Volatile Organic Compounds (UG/L)				
No Detections			NA	
Semi-volatile Organic Compounds (UG/L)				
No Detections			NA	
Total Metals (UG/L)				
Barium	730	2,000	200	104 J
Calcium	--	--	144,000	78,900
Chromium	11	100	3.6 J	3.1 J
Iron	1,100	--	198	122
Magnesium	--	--	75,600	51,100
Manganese	88	--	8 J	13.1 J
Nickel	73	--	2.4 J	4 J
Potassium	--	--	1,780 J	1,730 J
Sodium	--	--	323,000	216,000
Dissolved Metals (UG/L)				
Calcium	--	--	139,000	74,200
Chromium	11	100	--	0.7 J
Magnesium	--	--	73,400	48,200
Manganese	88	--	--	0.82 J
Potassium	--	--	1,710 J	1,630
Sodium	--	--	311,000	204,000
Wet Chemistry (MG/L)				
Total dissolved solids (TDS)	--	--	NA	948
Total Petroleum Hydrocarbons (MG/L)				
No Detections				

Notes:

ug/L - Micrograms per Liter

J - Analyte present; reported value may or may not be accurate or precise

U - Analyte not detected

NA - Not Applicable

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)

Vieques HHRA GW - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)

GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards (40 Code of Federal Regulations [CFR]141)

-- Not detected in background well

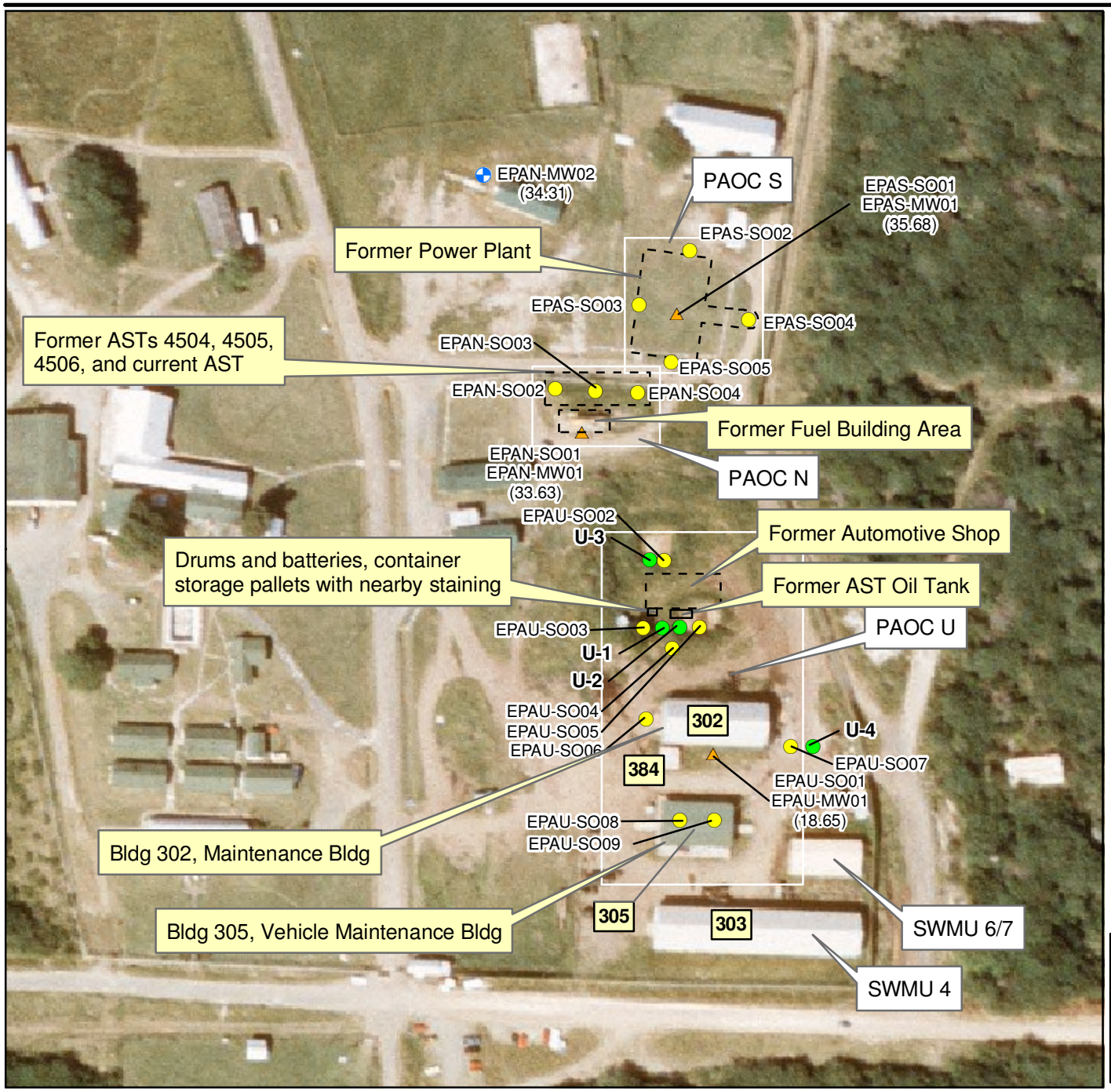
-- Regulatory standard not promulgated

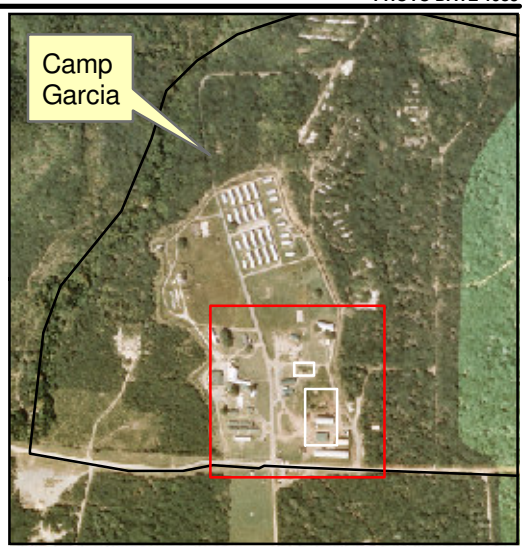
TABLE 19-4
PAOC N Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium pending confirmation of no underground fuel line to PAOC S
		SVOCs	Yes	No	N/A	
		Inorganics	Yes	Se > ECO, SSL, BKG	ECO based on plants; maintained grass limits receptors; < ECO for soil invertebrates; not detected in groundwater; < SSL at a DAF of 3	
				Zn > ECO, BKG	small site, individual exceedance, maintained site, mean concentration < ECO	
		TPH-DRO	Yes	No	N/A	
Subsurface Soil	Yes					Medium sufficiently characterized; no further action for medium (see above)
		SVOCs	Yes	No	N/A	
		Inorganics	Yes	Se > SSL, BKG	not detected in groundwater; < SSL at a DAF of 3	
		TPH-DRO	Yes	No	N/A	
Groundwater	Yes					Medium sufficiently characterized; no further action for medium (see above)
		Inorganics	Yes	No	N/A	

PHOTO DATE 1983

PHOTO DATE 1983





LEGEND

- PA/SI Monitoring Well Location with Water Level Elevation, Feet Above Mean Sea Level
- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Surface and Subsurface Soil Sample and Monitoring Well Location with Water Level Elevation, Feet Above Mean Sea Level
- EBS Surface Soil Sample Location

Note: Water Level Elevations collected 4/3/06-4/4/06

N

0 100 200 Feet

FIGURE 19-1
1983 Aerial Photograph of the PAOC N, S, and U Areas
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

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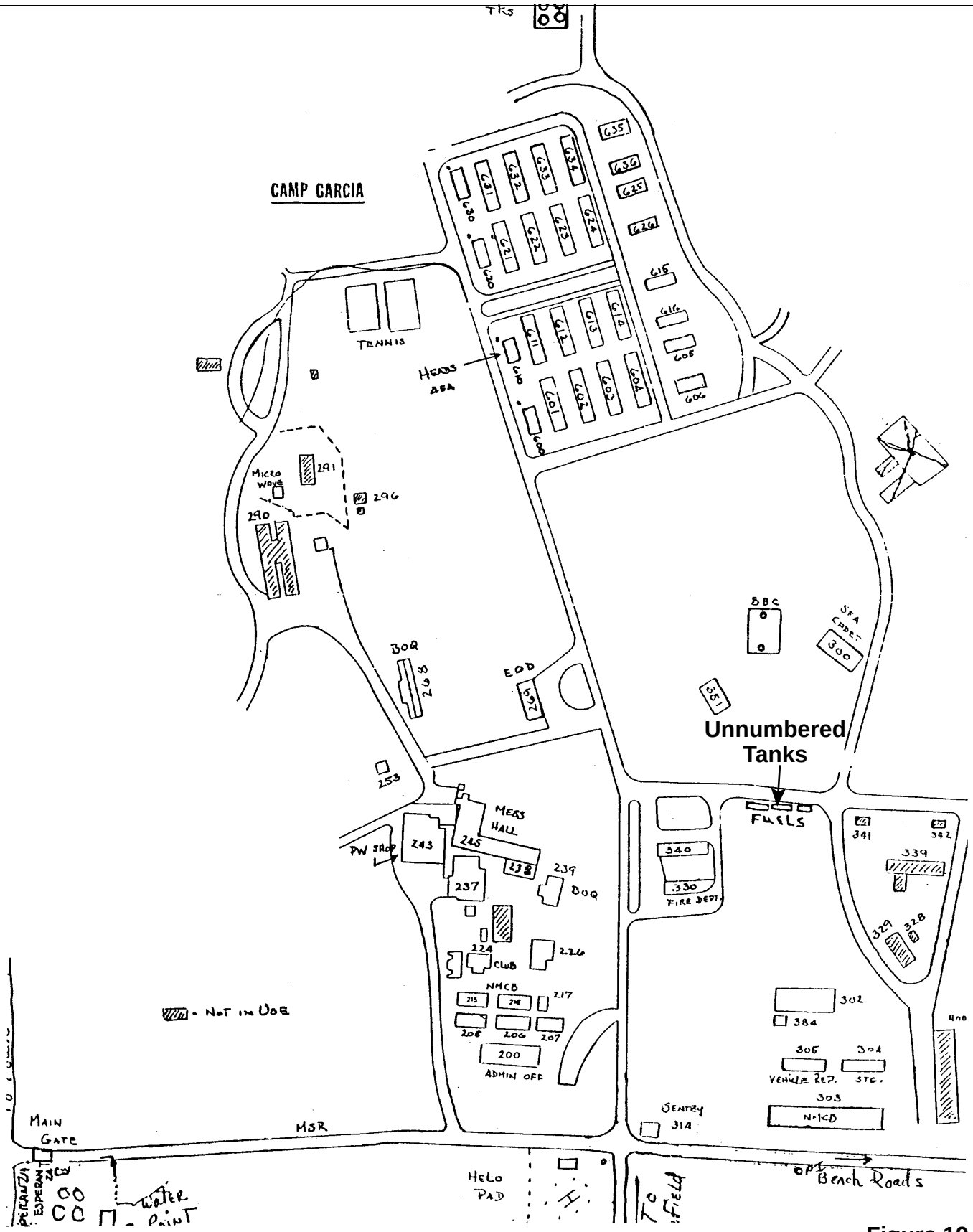

Figure 19-2
PAOC N Former Fuel Farm and Filling Station
Historical Site Map, Unknown Date

Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Figure 19-3
Camp Garcia Refueling Station
Site Photograph Taken August 2000
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 20

PAOC S—Former POL Pipeline and Power Plant

This section presents the results of the PA/SI performed at PAOC S—Former POL Pipeline and Power Plant.

20.1 Conceptual Site Model

The CSM for PAOC S is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews; as well as site-specific data collection.

20.1.1 Site History and Potential Sources of Release

PAOC S includes the location of a former petroleum, oil, and lubricant (POL) pipeline that ran above ground (other than where it crossed under Red Beach Road) from the aboveground fuel tanks at SWMU 2 to an area south of the Camp García Compound (Figures 1-2 and 1-3) where there was a valve used to fill fuel trucks (García, 2004). The pipeline and probable valve locations are shown on Figure 20-1. As stated in Section 4, the former fuel tanks at SWMU 2 stored diesel fuel, gasoline, aviation gas, and JP-5 fuel. Therefore, it is probable that these fuels were transported in the former pipeline at PAOC S. Records show that the pipeline was removed in 1984 (NAVFACENGCOM, 2003). A power plant, also identified on an historical aerial photograph (Figure 20-2), was added to PAOC S for the purposes of investigation, but has no known direct relationship with the former pipeline. The location of the former power plant in relation to other, nearby PAOCs is shown in Figure 19-1. Although no records are known to exist regarding the type of fuel used at the PAOC S power plant, it is likely the generator(s) used diesel fuel. According to former Camp Garcia personnel, there are no records of USTs at Camp Garcia and that all fuel tanks were ASTs. Therefore, any fuel storage at the PAOC S power plant would have been in AST(s), specifically a day tank.

Personnel interviewed during the EBS indicated that no known releases occurred at these facilities. Further, no evidence of hazardous material, hazardous waste, petroleum, or munitions storage or disposal was observed during a site visit (NAVFACENGCOM, 2003). However, because the POL pipeline extended from the SWMU 2 fuel farm to an area south of the Camp García Compound, and because it had not been investigated for possible leaks, the former pipeline area was included in the PA/SI. Additionally, the former power plant building was included in the PA/SI as a potential source area.

20.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 2002 (EBS) and in 2006 (PA/SI), as well as on regional information.

Former POL Pipeline

The PAOC S pipeline originated at SWMU 2 on a peninsula between Bahia Tapon and Bahia de la Chiva, at an elevation of approximately 30 ft amsl. As shown in Figure 20-1, the pipeline ran past the northern edge of Bahia Tapon, north of a black mangrove wetland/salt flat at an elevation of approximately 5 ft amsl, and up to the eastern edge of the former Camp Garcia runway, at an elevation of approximately 26 ft amsl. The peninsula contains moderately sloped hills, whereas the area north of the wetlands and the area by the edge of the runway forms a very gentle slope to the south-southeast. The current vegetation is thorn scrub, likely because the land was cleared when the pipeline was installed.

The southeastern end of the pipeline overlies bedrock of the Cretaceous formation Kv, consisting of sandstones, siltstones, conglomerates, lava, tuff and tuffaceous breccias and some limestones. These formations were largely deposited in marine environments. They have extensive deep weathering, forming the fine grained soils of sands, silts, and clays (see the boring logs in Appendix D for site-specific descriptions). West of SS15 (Figure 20-1), the former pipeline crossed into Quaternary alluvial deposits of sands, silts, clays, and gravels (Qa). These geologic materials are mostly in the form of floodplain, terrace, and piedmont fan deposits. For more information on the bedrock geology, see Section 1.4.6.

There are no ephemeral streams at or immediately adjacent to the site; as noted above, the former pipeline traversed an area just north of bays and wetlands. Based on the topographic slope and the regional groundwater gradient determined by the USGS (1989), groundwater in this area exists within the alluvial deposits and fractured bedrock and is presumed to flow in a southerly direction toward the coast.

Former Power Plant

This area is relatively flat, at about 65 ft amsl, and sloping 1 ft to 2 ft every 100 ft to the south. The land around PAOC S is cleared periodically as part of routine maintenance activities.

Soils in the area are unsaturated and generally consist of some combination of sand, silt and/or clay, though there are a few layers of well graded sand (see the boring logs in Appendix D for site-specific descriptions). Bedrock was encountered at and near PAOC S between 30 ft and 36 ft bgs. Bedrock under the former power plant area of PAOC S is part of the KTd formation, which consists of plutonic rocks, largely granodiorite and quartz diorite. Coring in the borehole for PAOC S MW01 encountered granodiorite bedrock surface at 30 ft bgs and continued in granodiorite to 45 ft bgs, where the borehole terminated. For more information on the bedrock geology, see Section 1.4.6.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon along the coast, a little less than 1 mile to the south and southeast, respectively. Based on the well at PAOC S, nearby wells (Figure 19-1), the topographic slope, and the regional groundwater gradient determined by the USGS (1989), groundwater in this area exists within the fractured bedrock and is presumed to flow in a southerly direction toward the coast, as described in Section 1.4.7.

20.2 Sampling Approach and Chemical Constituents Identified

As presented in the PA/SI Work Plan (CH2M HILL, 2006), 14 soil borings were installed at the locations along the former pipeline, as shown on Figure 20-1. At each soil boring location, one surface soil sample and one subsurface soil sample were collected. Eleven of the soil borings (SO09 through SO19) were installed at approximately 500-ft intervals along the POL pipeline. Three additional soil borings (SO06 through SO08) were installed in the vicinity of the probable valve location. The surface and subsurface soil samples were analyzed for TCL VOCs and SVOCs.

In addition to the above, two surface soil samples (SO20 and SO21) were collected in a potential depositional area downgradient of the pipeline, but upgradient of a salt flat, in observed land crab habitat and analyzed for TCL VOCs and SVOCs. The locations of these two samples were selected in the field by USFWS and NOAA personnel at the beginning of the PA/SI fieldwork.

Five soil borings (SO01 through SO05) were installed around the perimeter and in the center of the former power plant building, as shown in Figure 19-1. No PID or FID readings significantly above background were observed in the soil borings (see Soil Boring Logs, Appendix D); therefore, subsurface soil samples were collected at default depths (or refusal, whichever was encountered first) in accordance with the work plan (see Table 2-1 for subsurface soil sample depths)The building center boring was completed as a monitoring well. The surface and subsurface soil samples were analyzed for TCL VOCs, SVOCs, pesticides and PCBs; and TAL metals. The groundwater sample was analyzed for TCL VOCs, SVOCs, pesticides and PCBs; TAL metals, and TDS.

Tables 20-1, 20-2, and 20-3 summarize the constituents detected in PAOC S surface soil samples, subsurface soil samples, and groundwater samples, respectively, collected during the PA/SI. The tables also identify screening criteria exceedances. Raw analytical data for the PA/SI samples are provided in Appendix O. Note that the groundwater data from the upgradient well at PAOC N (EPAN-MW02), which is also upgradient of the former power plant part of PAOC S, was used for initial background comparison for the groundwater data collected at PAOC S.

20.3 PAOC S Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 20-1 through 20-3).

Appendix N, Section N.20 discusses the evaluation of the PAOC S data quality. As detailed in Section N.20, the PAOC S data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at PAOC S, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former POL pipeline and power plant. Although there are no records of past releases at the site and there was no evidence of past releases observed during the site visit, the potential presence of CERCLA hazardous

substances could not be confidently ruled out without sample collection due to the nature of the historical activities at the site. Sample collection took place during the 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

Former Power Plant

Surface Soil

- VOCs: none detected
- SVOCs: bis(2-ethylhexyl)phthalate
- Pesticides: 4,4'-DDD, 4,4'-DDE, 4,4'-DDT
- PCBs: none detected
- Inorganics above background UTLs: calcium, lead, magnesium, mercury, selenium, and zinc

Subsurface Soil

- VOCs: none detected
- SVOCs: bis(2-ethylhexyl)phthalate
- Pesticides: 4,4'-DDE, 4,4'-DDT, methoxychlor
- PCBs: none detected
- Inorganics above background UTLs: copper, magnesium, selenium,

Groundwater

- VOCs: none detected
- SVOCs: none detected
- Pesticides: none detected
- PCBs: none detected
- Total inorganics above background (EPAN MW02): aluminum, barium, cobalt, iron, manganese, selenium
- Dissolved inorganics above background (EPAN MW02): aluminum, barium, manganese, nickel

Former POL Pipeline

Surface Soil

- VOCs: none detected
- SVOCs: di-n-butylphthalate, di-n-octylphthalate

Subsurface Soil

- VOCs: none detected
- SVOCs: bis(2-ethylhexyl)phthalate

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

There are no records or visual evidence of past releases at PAOC S. However, based on the potential source areas at PAOC S (i.e., former POL pipeline and power plant), it is assumed that the constituent groups detected in site media, except for pesticides, are potentially attributable to CERCLA-related releases. The pesticides detected at this site are the same pesticides and of similar concentrations detected at other sites across Vieques. This information, coupled with the history of the site, suggests the pesticides are present due to normal pesticide use, not a CERCLA-related release (see Pesticides and Herbicides under Section 1.1.1). Therefore, pesticides are not considered further in the decision analysis process. All other detected constituents are further considered in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Former Power Plant

Surface Soil

- SVOCs: no exceedances
- Mercury: one detection (sample SS01) at a concentration (1.2 mg/kg) above the SSL at a DAF of 1 (0.1 mg/kg), the ecological screening value (0.1 mg/kg), and background UTL (0.057 mg/kg)
- Selenium: four detections (samples SS01, SS02, SS03, and SS04) at concentrations (0.62 mg/kg to 0.74 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

Subsurface Soil

- SVOCs: no exceedances

- Copper: one detection (sample SB01) at a concentration (83.3 mg/kg) above the SSL at a DAF of 1 (46 mg/kg) and background UTL (65.5 mg/kg)
- Selenium: two detections (samples SB01 and SB03) at concentrations (0.68 mg/kg and 0.69 mg/kg, respectively) above the SSL at a DAF of 1 (0.3 mg/kg) and background UTL (0.51 mg/kg)

Groundwater

- Total and dissolved inorganics: no exceedances

Former POL Pipeline

Surface Soil

- SVOCs: no exceedances

Subsurface Soil

- SVOCs: no exceedances

As shown above, there are exceedances of the most conservative screening values for the former power plant portion of PAOC S. Therefore, the decision analysis process for those data continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Former Power Plant

Although aluminum, arsenic, iron, manganese, and vanadium were detected in soil above the adjusted PRGs (unadjusted PRG for arsenic), their non-cancer PRGs are based on neurotoxicity in offspring (aluminum), skin and vascular effects (arsenic), gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health effects from multiple non-carcinogenic constituents in site soil. Further, all arsenic, aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

Mercury exceeds the ecological screening value and background UTLs in one of five surface soil samples collected at the former location of the power plant building, while selenium exceeds in four of the five samples. Neither of these constituents likely poses an unacceptable risk to ecological receptors on a site-wide basis based upon the following:

- The site is very small and provides very limited habitat, especially considering the area is maintained by periodic mowing. Thus, the potential exposures to ecological receptors are minimal.
- The HQ for selenium based on the maximum detected concentration is only 1.42. Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at PAOC S (maximum of 0.74 mg/kg) may be within the range of background. Further, all selenium concentrations are less than ecological

screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). Thus, selenium has a low potential for unacceptable risks, especially given the very low potential for exposure.

- Mercury was not detected in four of the five surface soil samples, which were collected around the sample with the elevated mercury concentration (1.2 mg/kg in SS01). Thus, the exceedance for mercury is restricted to a relatively small area centered near SS01, and the mean mercury concentration in the area is below the ecological screening value.

Mercury and selenium exceed the SSLs at a DAF of 1 in surface soil samples (one for mercury and four for selenium) and copper and selenium exceed the SSLs at a DAF of 1 in subsurface soil samples (one for copper and two for selenium). Neither copper nor mercury was detected in groundwater, and mercury was not detected in any subsurface soil samples. Total selenium was detected in groundwater, but its concentration is an order of magnitude or more below the tap water PRG and MCL. Dissolved selenium was not detected in groundwater. This information indicates that the SSLs at a DAF of 1 for the inorganic constituents detected at PAOC S are not representative predictors of leaching to groundwater. At a DAF of 12 none of the inorganics concentrations exceeds the SSL; none of the selenium or copper concentrations exceed the SSL at a DAF of 3.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases are the former pipeline and power plant. Based on this information, multiple soil samples and a groundwater sample were collected within these areas, the spatial distribution and resulting data of which indicate the potential source area has been sufficiently characterized.

20.4 Conclusions and Recommendations

Tables 20-4 and 20-5 summarize the results of the decision analysis for PAOC S, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil or groundwater at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. The soil data collected along the pipeline portion of PAOC S suggest a fuel release did not occur; therefore, analysis of other constituents, such as inorganics, is not warranted. Further, pesticide detections at the site are consistent with normal pesticide application associated with maintenance of the historical facilities present at the site. Therefore, based on the above information, it is likely that NFA is warranted for PAOC S. Although there is no historical information that suggests fuel for the generators at the power plant portion of PAOC S was supplied via direct piping from PAOC N (former fuel farm and filling station), because of their close proximity (i.e., approximately 100 feet), a geophysical survey will be conducted between the former fuel tank locations at PAOC N and the former PAOC S power plant building to ascertain whether an underground fuel pipeline exists between the former tanks and the former power plant.

TABLE 20-1
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Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	Vieques (East) Background Zone Qa SS	Vieques (East) Background Zone Kv SS	EPAS-SO01[1]		EPAS-SO02[1]	EPAS-SO03[1]	EPAS-SO04[1]	EPAS-SO05[1]	EPAS-SO06[2]
Sample ID							EPAS-SS01-0001	EPAS-SS01P-0001	EPAS-SS02-0001	EPAS-SS03-0001	EPAS-SS04-0001	EPAS-SS05-0001	EPAS-SS06-0002
Sample Date							02/02/06	02/02/06	02/02/06	02/02/06	02/02/06	02/02/06	02/16/06
Chemical Name													
Volatile Organic Compounds (UG/KG)													
No Detections													
Semi-volatile Organic Compounds (UG/KG)													
Di-n-butylphthalate	270,000	610,000	200,000	--	--	--	380 U	360 U	370 U	340 U	380 U	360 U	360 U
Di-n-octylphthalate	10,000,000	240,000	--	--	--	--	380 U	360 U	370 U	340 U	380 U	360 UJ	360 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	--	380 U	90 J	370 U	340 U	380 U	360 U	360 U
Pesticide/Polychlorinated Biphenyls (UG/KG)													
4,4'-DDD	800	2,400	10	--	--	--	7.9	4.6	1.8 J	3.4 U	3.8 U	6.9	NA
4,4'-DDE	3,000	1,700	10	--	--	--	550	650	270	330	17	580	NA
4,4'-DDT	2,000	1,700	10	--	--	--	110	100	70	15	5.4	270	NA
Total Metals (MG/KG)													
Aluminum	55,000	7,600	--	35,000	35,000	35,000	10,400	9,530	10,600	7,310	10,200	9,790	NA
Antimony	0.3	3.1	78	3.6	3.6	3.6	0.63 J	0.67 J	0.5 J	0.49 J	0.25 J	0.53 J	NA
Arsenic	1	0.39	18	1.6	1.6	1.6	1.1 U	1.1 U	0.78 J	1 U	0.55 J	0.55 J	NA
Barium	82	1,600	330	147	212	212	56.6	53.7	65.8	52.5	53.3	77.7	NA
Cadmium	0.4	3.7	32	2.24	2.24	2.24	0.13 J	0.036 J	0.12 J	0.52 U	0.015 J	0.029 J	NA
Calcium	--	--	--	8,840	11,900	8,840	19,800 J	7,840	22,000	16,500	25,700	23,800	NA
Chromium	2	210	0.4	72	72	72	9.6	9.1	9.3	6.2	9.6	8.2	NA
Cobalt	33	140	13	15.8	15.8	25.5	10.5	10.8	12.6	8.6	9.4	10.9	NA
Copper	46	310	70	65.5	52.8	94.2	50.5	45.5	41.2	44.7	33.7	43.6	NA
Iron	276	2,300	--	38,100	38,100	43,200	17,500	17,000	19,600	13,700	17,100	16,600	NA
Lead	14	400	120	5.4	5.4	5.4	12 J	7.5 J	6.9 J	3.6 J	12.3 J	6 J	NA
Magnesium	--	--	--	3,710	22,200	22,200	5,040	4,190	5,550	5,560	3,870	4,540	NA
Manganese	57	180	220	1,630	1,630	1,630	568	551	638	432	485	489	NA
Mercury	0.1	2.3	0.1	0.057	0.057	0.057	1.2	1.2	0.11 U	0.1 U	0.12 U	0.11 U	NA
Nickel	7	160	38	22.2	22.2	41	4.6	4.8	4.5 U	4.2 U	4.6 U	4.4 U	NA
Potassium	--	--	--	5,270	5,270	5,270	1,160 J	857 J	852 J	519 U	918 J	953 J	NA
Selenium	0.3	39	0.52	0.51	0.51	0.51	0.68 J	0.41 J	0.62 J	0.69 J	0.74 J	0.41 J	NA
Vanadium	300	7.8	2	144	144	144	51.9	51.6	63.3	38.5	58.7	53.4	NA
Zinc	620	2,300	120	32	32	32	54.3	38	28.8	24.1	21	29.9	NA

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SS, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA SO.
mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, cadmium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and Eco Criteria
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Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	Vieques (East) Background Zone Qa SS	Vieques (East) Background Zone Kv SS	EPAS-SO07[2]	EPAS-SO08[2]	EPAS-SO09[2]	EPAS-SO10[2]	EPAS-SO11[2]	EPAS-SO12[2]	
Sample ID							EPAS-SS07-0002	EPAS-SS08-0002	EPAS-SS09-0002	EPAS-SS10-0002	EPAS-SS11-0002	EPAS-SS12-0002	EPAS-SS12P-0002
Sample Date							02/16/06	02/16/06	02/15/06	02/08/06	02/08/06	02/08/06	02/08/06
Chemical Name													
Volatile Organic Compounds (UG/KG)													
No Detections													
Semi-volatile Organic Compounds (UG/KG)													
Di-n-butylphthalate	270,000	610,000	200,000	--	--	--	360 U	360 U	350 U	350 U	360 U	360 U	420 U
Di-n-octylphthalate	10,000,000	240,000	--	--	--	--	360 U	360 U	74 J	350 U	360 U	360 U	420 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	--	360 U	360 U	350 U	350 U	360 U	360 U	420 U
Pesticide/Polychlorinated Biphenyls (UG/KG)													
4,4'-DDD	800	2,400	10	--	--	--	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	3,000	1,700	10	--	--	--	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	2,000	1,700	10	--	--	--	NA	NA	NA	NA	NA	NA	NA
Total Metals (MG/KG)													
Aluminum	55,000	7,600	--	35,000	35,000	35,000	NA	NA	NA	NA	NA	NA	NA
Antimony	0.3	3.1	78	3.6	3.6	3.6	NA	NA	NA	NA	NA	NA	NA
Arsenic	1	0.39	18	1.6	1.6	1.6	NA	NA	NA	NA	NA	NA	NA
Barium	82	1,600	330	147	212	212	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.4	3.7	32	2.24	2.24	2.24	NA	NA	NA	NA	NA	NA	NA
Calcium	--	--	--	8,840	11,900	8,840	NA	NA	NA	NA	NA	NA	NA
Chromium	2	210	0.4	72	72	72	NA	NA	NA	NA	NA	NA	NA
Cobalt	33	140	13	15.8	15.8	25.5	NA	NA	NA	NA	NA	NA	NA
Copper	46	310	70	65.5	52.8	94.2	NA	NA	NA	NA	NA	NA	NA
Iron	276	2,300	--	38,100	38,100	43,200	NA	NA	NA	NA	NA	NA	NA
Lead	14	400	120	5.4	5.4	5.4	NA	NA	NA	NA	NA	NA	NA
Magnesium	--	--	--	3,710	22,200	22,200	NA	NA	NA	NA	NA	NA	NA
Manganese	57	180	220	1,630	1,630	1,630	NA	NA	NA	NA	NA	NA	NA
Mercury	0.1	2.3	0.1	0.057	0.057	0.057	NA	NA	NA	NA	NA	NA	NA
Nickel	7	160	38	22.2	22.2	41	NA	NA	NA	NA	NA	NA	NA
Potassium	--	--	--	5,270	5,270	5,270	NA	NA	NA	NA	NA	NA	NA
Selenium	0.3	39	0.52	0.51	0.51	0.51	NA	NA	NA	NA	NA	NA	NA
Vanadium	300	7.8	2	144	144	144	NA	NA	NA	NA	NA	NA	NA
Zinc	620	2,300	120	32	32	32	NA	NA	NA	NA	NA	NA	NA

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SS, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA SO.
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Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, cadmium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set
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Sample ID							EPAS-SS13-0002	EPAS-SS14-0002	EPAS-SS15-0002	EPAS-SS16-0002	EPAS-SS17-0002	EPAS-SS18-0002	EPAS-SS19-0002
Sample Date							02/07/06	02/07/06	02/09/06	02/09/06	02/09/06	02/14/06	02/15/06
Chemical Name													
Volatile Organic Compounds (UG/KG)													
No Detections													
Semi-volatile Organic Compounds (UG/KG)													
Di-n-butylphthalate	270,000	610,000	200,000	--	--	--	360 U	350 U	360 U	390 U	360 U	350 U	370
Di-n-octylphthalate	10,000,000	240,000	--	--	--	--	360 U	830	360 U	390 U	360 U	350 U	350 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	--	360 U	350 U	360 U	390 U	360 U	350 U	350 U
Pesticide/Polychlorinated Biphenyls (UG/KG)													
4,4'-DDD	800	2,400	10	--	--	--	NA	NA	NA	NA	NA	NA	NA
4,4'-DDE	3,000	1,700	10	--	--	--	NA	NA	NA	NA	NA	NA	NA
4,4'-DDT	2,000	1,700	10	--	--	--	NA	NA	NA	NA	NA	NA	NA
Total Metals (MG/KG)													
Aluminum	55,000	7,600	--	35,000	35,000	35,000	NA	NA	NA	NA	NA	NA	NA
Antimony	0.3	3.1	78	3.6	3.6	3.6	NA	NA	NA	NA	NA	NA	NA
Arsenic	1	0.39	18	1.6	1.6	1.6	NA	NA	NA	NA	NA	NA	NA
Barium	82	1,600	330	147	212	212	NA	NA	NA	NA	NA	NA	NA
Cadmium	0.4	3.7	32	2.24	2.24	2.24	NA	NA	NA	NA	NA	NA	NA
Calcium	--	--	--	8,840	11,900	8,840	NA	NA	NA	NA	NA	NA	NA
Chromium	2	210	0.4	72	72	72	NA	NA	NA	NA	NA	NA	NA
Cobalt	33	140	13	15.8	15.8	25.5	NA	NA	NA	NA	NA	NA	NA
Copper	46	310	70	65.5	52.8	94.2	NA	NA	NA	NA	NA	NA	NA
Iron	276	2,300	--	38,100	38,100	43,200	NA	NA	NA	NA	NA	NA	NA
Lead	14	400	120	5.4	5.4	5.4	NA	NA	NA	NA	NA	NA	NA
Magnesium	--	--	--	3,710	22,200	22,200	NA	NA	NA	NA	NA	NA	NA
Manganese	57	180	220	1,630	1,630	1,630	NA	NA	NA	NA	NA	NA	NA
Mercury	0.1	2.3	0.1	0.057	0.057	0.057	NA	NA	NA	NA	NA	NA	NA
Nickel	7	160	38	22.2	22.2	41	NA	NA	NA	NA	NA	NA	NA
Potassium	--	--	--	5,270	5,270	5,270	NA	NA	NA	NA	NA	NA	NA
Selenium	0.3	39	0.52	0.51	0.51	0.51	NA	NA	NA	NA	NA	NA	NA
Vanadium	300	7.8	2	144	144	144	NA	NA	NA	NA	NA	NA	NA
Zinc	620	2,300	120	32	32	32	NA	NA	NA	NA	NA	NA	NA

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SS, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA SO.
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Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
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Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, cadmium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set
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Sample ID							EPAS-SS20-0002	EPAS-SS21-0002	EPAS-SS21P-0002
Sample Date							02/06/06	02/06/06	02/06/06
Chemical Name									
Volatile Organic Compounds (UG/KG)									
No Detections									
Semi-volatile Organic Compounds (UG/KG)									
Di-n-butylphthalate	270,000	610,000	200,000	--	--	--	470 U	450 U	410 U
Di-n-octylphthalate	10,000,000	240,000	--	--	--	--	470 U	450 U	410 U
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	--	470 U	450 U	410 U
Pesticide/Polychlorinated Biphenyls (UG/KG)									
4,4'-DDD	800	2,400	10	--	--	--	NA	NA	NA
4,4'-DDE	3,000	1,700	10	--	--	--	NA	NA	NA
4,4'-DDT	2,000	1,700	10	--	--	--	NA	NA	NA
Total Metals (MG/KG)									
Aluminum	55,000	7,600	--	35,000	35,000	35,000	NA	NA	NA
Antimony	0.3	3.1	78	3.6	3.6	3.6	NA	NA	NA
Arsenic	1	0.39	18	1.6	1.6	1.6	NA	NA	NA
Barium	82	1,600	330	147	212	212	NA	NA	NA
Cadmium	0.4	3.7	32	2.24	2.24	2.24	NA	NA	NA
Calcium	--	--	--	8,840	11,900	8,840	NA	NA	NA
Chromium	2	210	0.4	72	72	72	NA	NA	NA
Cobalt	33	140	13	15.8	15.8	25.5	NA	NA	NA
Copper	46	310	70	65.5	52.8	94.2	NA	NA	NA
Iron	276	2,300	--	38,100	38,100	43,200	NA	NA	NA
Lead	14	400	120	5.4	5.4	5.4	NA	NA	NA
Magnesium	--	--	--	3,710	22,200	22,200	NA	NA	NA
Manganese	57	180	220	1,630	1,630	1,630	NA	NA	NA
Mercury	0.1	2.3	0.1	0.057	0.057	0.057	NA	NA	NA
Nickel	7	160	38	22.2	22.2	41	NA	NA	NA
Potassium	--	--	--	5,270	5,270	5,270	NA	NA	NA
Selenium	0.3	39	0.52	0.51	0.51	0.51	NA	NA	NA
Vanadium	300	7.8	2	144	144	144	NA	NA	NA
Zinc	620	2,300	120	32	32	32	NA	NA	NA

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SS, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SS, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SS, Vieques Eco SO, and Vieques HHRA SO.
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NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDD, 4,4'-DDE, 4,4'-DDT) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper, mercury) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (di-n-butylphthalate, nickel, selenium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, cadmium, cobalt, lead) (EPA, 2005b)
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria

TABLE 20-2
PAOC S Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	**Vieques (East) Background Zone Qa SB**	**Vieques (East) Background Zone Kv SB**	EPAS-SO01[1]	EPAS-SO02[1]	EPAS-SO03[1]		EPAS-SO04[1]	EPAS-SO05[1]
Sample ID						EPAS-SB01-0406	EPAS-SB02-0406	EPAS-SB03-0406	EPAS-SB03P-0406	EPAS-SB04-0406	EPAS-SB05-0406
Sample Date						02/02/06	02/02/06	02/02/06	02/02/06	02/02/06	02/02/06
Chemical Name											
Volatile Organic Compounds (UG/KG)											
No Detections											
Semi-volatile Organic Compounds (UG/KG)											
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	130 J	350 U	380 U	380 U	380 U	360 U
Pesticide/Polychlorinated Biphenyls (UG/KG)											
4,4'-DDE	3,000	1,700	--	--	--	35	29	3.8 U	3.8 U	3.8 U	2.8 J
4,4'-DDT	2,000	1,700	--	--	--	6.7	13	3.8 U	3.8 U	3.8 U	1.8 J
Methoxychlor	8,000	31,000	--	--	--	20 U	18 U	20 U	20 U	19 U	11 J
Total Metals (MG/KG)											
Aluminum	55,000	7,600	35,000	35,000	35,000	12,500	6,860	10,100	9,450	8,450	7,620
Antimony	0.3	3.1	3.3	3.3	3.3	0.56 J	0.31 J	0.46 J	0.22 J	0.26 J	0.22 J
Barium	82	1,600	147	212	212	82.5	44	79.4	73.3	71	47.3
Calcium	--	--	8,840	11,900	8,840	4,120	2,500	3,060	2,660	2,630	2,240
Chromium	2	210	72	72	72	9.1	5.1	8.4	9.6	6.3	6
Cobalt	33	140	15.8	15.8	25.5	12.2	6	8.7	10.1	7.6	6.7
Copper	46	310	65.5	52.8	94.2	83.3	47	41.2	36.9	28.6	48.5
Iron	276	2,300	38,100	38,100	43,200	20,300	12,300	19,000	20,600	14,400	13,100
Lead	14	400	3.34	3.34	3.34	1.4 J	0.88 J	1.1 J	1.2 J	1 J	0.72 J
Magnesium	--	--	3,710	22,200	22,200	5,200	2,800	3,610	2,920	2,660	2,660
Manganese	57	180	1,630	1,630	1,630	563	297	468	386	424	342
Nickel	7	160	22.2	22.2	41	6.4	4.3 U	4.7 U	5.2	4.5 U	4.4 U
Potassium	--	--	2,000	2,000	2,000	623 J	538 U	734 J	777 J	567 U	570 J
Selenium	0.3	39	0.51	0.51	0.51	0.68 J	3.8 U	0.64 J	0.69 J	0.45 J	3.9 U
Vanadium	300	7.8	144	144	144	63.4	39.2	66	79.3	52.9	43.8
Zinc	620	2,300	32	32	32	28.5	14.9	18.4	17.3	13.6	14.1

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SB, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SB, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SB, Vieques Eco SO, and Vieques HHRA SO.
mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA,1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 20-2
PAOC S Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	**Vieques (East) Background Zone Qa SB**	**Vieques (East) Background Zone Kv SB**	EPAS-SO06[2]	EPAS-SO07[2]	EPAS-SO08[2]	EPAS-SO09[2]	EPAS-SO10[2]	
Sample ID						EPAS-SB06-0406	EPAS-SB07-0406	EPAS-SB08-0406	EPAS-SB09-0406	EPAS-SB10-0406	EPAS-SB10P-0406
Sample Date						02/16/06	02/16/06	02/16/06	02/15/06	02/08/06	02/08/06
Chemical Name											
Volatile Organic Compounds (UG/KG)											
No Detections											
Semi-volatile Organic Compounds (UG/KG)											
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	81 J	380 U	350 U	380 U	360 U	360 U
Pesticide/Polychlorinated Biphenyls (UG/KG)											
4,4'-DDE	3,000	1,700	--	--	--	NA	NA	NA	NA	NA	NA
4,4'-DDT	2,000	1,700	--	--	--	NA	NA	NA	NA	NA	NA
Methoxychlor	8,000	31,000	--	--	--	NA	NA	NA	NA	NA	NA
Total Metals (MG/KG)											
Aluminum	55,000	7,600	35,000	35,000	35,000	NA	NA	NA	NA	NA	NA
Antimony	0.3	3.1	3.3	3.3	3.3	NA	NA	NA	NA	NA	NA
Barium	82	1,600	147	212	212	NA	NA	NA	NA	NA	NA
Calcium	--	--	8,840	11,900	8,840	NA	NA	NA	NA	NA	NA
Chromium	2	210	72	72	72	NA	NA	NA	NA	NA	NA
Cobalt	33	140	15.8	15.8	25.5	NA	NA	NA	NA	NA	NA
Copper	46	310	65.5	52.8	94.2	NA	NA	NA	NA	NA	NA
Iron	276	2,300	38,100	38,100	43,200	NA	NA	NA	NA	NA	NA
Lead	14	400	3.34	3.34	3.34	NA	NA	NA	NA	NA	NA
Magnesium	--	--	3,710	22,200	22,200	NA	NA	NA	NA	NA	NA
Manganese	57	180	1,630	1,630	1,630	NA	NA	NA	NA	NA	NA
Nickel	7	160	22.2	22.2	41	NA	NA	NA	NA	NA	NA
Potassium	--	--	2,000	2,000	2,000	NA	NA	NA	NA	NA	NA
Selenium	0.3	39	0.51	0.51	0.51	NA	NA	NA	NA	NA	NA
Vanadium	300	7.8	144	144	144	NA	NA	NA	NA	NA	NA
Zinc	620	2,300	32	32	32	NA	NA	NA	NA	NA	NA

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SB, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SB, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SB, Vieques Eco SO, and Vieques HHRA SO.
mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA,1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 20-2
PAOC S Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	**Vieques (East) Background Zone Qa SB**	**Vieques (East) Background Zone Kv SB**	EPAS-SO11[2]	EPAS-SO12[2]	EPAS-SO13[2]	EPAS-SO14[2]	EPAS-SO15[3]	EPAS-SO16[3]
Sample ID						EPAS-SB11-0406	EPAS-SB12-0406	EPAS-SB13-0406	EPAS-SB14-0406	EPAS-SB15-0204.5	EPAS-SB16-0406
Sample Date						02/08/06	02/08/06	02/07/06	02/07/06	02/09/06	02/09/06
Chemical Name											
Volatile Organic Compounds (UG/KG)											
No Detections											
Semi-volatile Organic Compounds (UG/KG)											
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	380 U	390 U	390 U	370 U	370 U	450 U
Pesticide/Polychlorinated Biphenyls (UG/KG)											
4,4'-DDE	3,000	1,700	--	--	--	NA	NA	NA	NA	NA	NA
4,4'-DDT	2,000	1,700	--	--	--	NA	NA	NA	NA	NA	NA
Methoxychlor	8,000	31,000	--	--	--	NA	NA	NA	NA	NA	NA
Total Metals (MG/KG)											
Aluminum	55,000	7,600	35,000	35,000	35,000	NA	NA	NA	NA	NA	NA
Antimony	0.3	3.1	3.3	3.3	3.3	NA	NA	NA	NA	NA	NA
Barium	82	1,600	147	212	212	NA	NA	NA	NA	NA	NA
Calcium	--	--	8,840	11,900	8,840	NA	NA	NA	NA	NA	NA
Chromium	2	210	72	72	72	NA	NA	NA	NA	NA	NA
Cobalt	33	140	15.8	15.8	25.5	NA	NA	NA	NA	NA	NA
Copper	46	310	65.5	52.8	94.2	NA	NA	NA	NA	NA	NA
Iron	276	2,300	38,100	38,100	43,200	NA	NA	NA	NA	NA	NA
Lead	14	400	3.34	3.34	3.34	NA	NA	NA	NA	NA	NA
Magnesium	--	--	3,710	22,200	22,200	NA	NA	NA	NA	NA	NA
Manganese	57	180	1,630	1,630	1,630	NA	NA	NA	NA	NA	NA
Nickel	7	160	22.2	22.2	41	NA	NA	NA	NA	NA	NA
Potassium	--	--	2,000	2,000	2,000	NA	NA	NA	NA	NA	NA
Selenium	0.3	39	0.51	0.51	0.51	NA	NA	NA	NA	NA	NA
Vanadium	300	7.8	144	144	144	NA	NA	NA	NA	NA	NA
Zinc	620	2,300	32	32	32	NA	NA	NA	NA	NA	NA

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SB, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SB, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SB, Vieques Eco SO, and Vieques HHRA SO.
mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA,1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 20-2
PAOC S Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques (East) Background Zone KTd SB	Vieques (East) Background Zone Qa SB	Vieques (East) Background Zone Kv SB	EPAS-SO17[3]	EPAS-SO18[3]	EPAS-SO19[3]
Sample ID						EPAS-SB17-0203.75	EPAS-SB18-0406	EPAS-SB19-0204
Sample Date						02/09/06	02/14/06	02/15/06
Chemical Name								
Volatile Organic Compounds (UG/KG)								
No Detections								
Semi-volatile Organic Compounds (UG/KG)								
bis(2-Ethylhexyl)phthalate	--	35,000	--	--	--	380 U	110 J	360 U
Pesticide/Polychlorinated Biphenyls (UG/KG)								
4,4'-DDE	3,000	1,700	--	--	--	NA	NA	NA
4,4'-DDT	2,000	1,700	--	--	--	NA	NA	NA
Methoxychlor	8,000	31,000	--	--	--	NA	NA	NA
Total Metals (MG/KG)								
Aluminum	55,000	7,600	35,000	35,000	35,000	NA	NA	NA
Antimony	0.3	3.1	3.3	3.3	3.3	NA	NA	NA
Barium	82	1,600	147	212	212	NA	NA	NA
Calcium	--	--	8,840	11,900	8,840	NA	NA	NA
Chromium	2	210	72	72	72	NA	NA	NA
Cobalt	33	140	15.8	15.8	25.5	NA	NA	NA
Copper	46	310	65.5	52.8	94.2	NA	NA	NA
Iron	276	2,300	38,100	38,100	43,200	NA	NA	NA
Lead	14	400	3.34	3.34	3.34	NA	NA	NA
Magnesium	--	--	3,710	22,200	22,200	NA	NA	NA
Manganese	57	180	1,630	1,630	1,630	NA	NA	NA
Nickel	7	160	22.2	22.2	41	NA	NA	NA
Potassium	--	--	2,000	2,000	2,000	NA	NA	NA
Selenium	0.3	39	0.51	0.51	0.51	NA	NA	NA
Vanadium	300	7.8	144	144	144	NA	NA	NA
Zinc	620	2,300	32	32	32	NA	NA	NA

Notes:
[1] - Samples associated with this station were compared against Vieques (East) Background Zone KTd SB, Vieques Eco SO, and Vieques HHRA SO.
[2] - Samples associated with this station were compared against Vieques (East) Background Zone Qa SB, Vieques Eco SO, and Vieques HHRA SO.
[3] - Samples associated with this station were compared against Vieques (East) Background Zone Kv SB, Vieques Eco SO, and Vieques HHRA SO.
mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
NA - Not Analyzed
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA,1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 20-3
PAOC S Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Vieques HHRA GW**	**MCL - GW**	**PAOC-N EPAN-MW02 Background**	EPAS-MW01	
Sample ID				EPAS-GW01-06B	EPAS-GW01P-06B
Sample Date				04/03/06	04/03/06
Chemical Name					
Volatile Organic Compounds (UG/L)					
No Detections					
Semi-volatile Organic Compounds (UG/L)					
No Detections					
Pesticide/Polychlorinated Biphenyls (UG/L)					
No Detections					
Total Metals (UG/L)					
Aluminum	3,600	--	263	242	298
Barium	730	2,000	200	244	246
Calcium	--	--	144,000	137,000	138,000
Chromium	11	100	3.6 J	1.3 J	1.5 J
Cobalt	73	--	--	0.47 J	0.45 J
Iron	1,100	--	198	207	267
Magnesium	--	--	75,600	60,100	60,400
Manganese	88	--	8 J	11.3 J	13.2 J
Nickel	73	--	2.4 J	1.4 J	1.3 J
Potassium	--	--	1780 J	1,360 J	1,360 J
Selenium	18	50	--	2.8 J	2 J
Sodium	--	--	323,000	274,000	275,000
Dissolved Metals (UG/L)					
Aluminum	3,600	--	--	200 U	34.2 J
Barium	730	2,000	--	239	233
Calcium	--	--	139,000	135,000	132,000
Magnesium	--	--	73,400	59,200	58,000
Manganese	88	--	--	0.74 J	1 J
Nickel	73	--	--	0.81 J	0.76 J
Potassium	--	--	1710 J	1,320 J	1,280 J
Sodium	--	--	311,000	269,000	261,000
Wet Chemistry (MG/L)					
Total dissolved solids (TDS)	--	--	NA	1,330	1,320

Notes:
- mg/L - Milligrams per Liter
- ug/L - Micrograms per Liter
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- NA - Not Applicable

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Vieques HHRA GW - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards (40 Code of Federal Regulations [CFR] 141
-- Not detected in background well
-- Regulatory standard not promulgated

TABLE 20-4
PAOC S - Former Power Plant Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

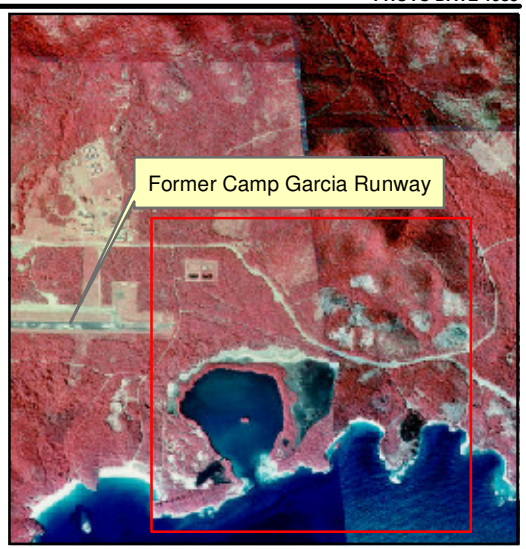
Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium pending confirmation of no underground fuel line from PAOC N
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Hg > ECO, SSL, BKG	detected in only one of five surface soil samples; small, maintained area; mean concentration < ECO; not detected in subsurface soil; not detected in groundwater; < SSL at a DAF of 12	
				Se > ECO, SSL, BKG	ECO based on plants; mowed grass limits receptors; < ECO for soil invertebrates; not detected in groundwater (dissolved); detected in groundwater (total) below PRG and MCL; < SSL at a DAF of 3	
Subsurface Soil	Yes					Medium sufficiently characterized; no further action for medium (see above)
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Cu > SSL, BKG	not detected in groundwater; < SSL at a DAF of 2	
				Se > SSL, BKG	not detected in groundwater (dissolved); detected in groundwater (total) below PRG and MCL; < SSL at a DAF of 3	
Groundwater	Yes					Medium sufficiently characterized; no further action for medium (see above)
		Inorganics	Yes	No	N/A	

TABLE 20-5
PAOC S - Former POL Pipeline Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		SVOCs	Yes	No	N/A	
Subsurface Soil	Yes					Medium sufficiently characterized; no further action for medium
		SVOCs	Yes	No	N/A	

PHOTO DATE 1985

PHOTO DATE 1985



LEGEND

- PA/SI Surface and Subsurface Soil Sample Location
- POL Pipeline
- SWMU 2

N

0 800 1,600 Feet

FIGURE 20-1
PAOC S Pipeline Sample Locations
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\FIGURE_20_1_PAOC_S_SAMPLINGLOCATIONS.MXD

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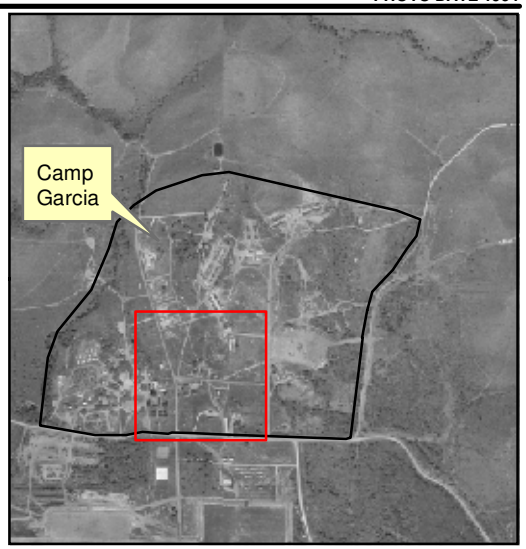
PHOTO DATE 1964



N

0 200 400 Feet

FIGURE 20-2
PAOC S Former Power Plant Location
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

CH2MHILL

\\APHRODITE\PROJECTS\18GIS\VIEQUES2\FIGURES\MXD\PI_PAOC_FIGURES\FIGURE_20_2_PAOC_S_FormerPowerPlantLocation.MXD

SECTION 21

PAOC U—Vehicle Maintenance Area

This section presents the results of the PA/SI performed at PAOC U—Vehicle Maintenance Area at the Former VNTR.

21.1 Conceptual Site Model

The CSM for PAOC U is based on review of historical information such as records, aerial photographs, site inspection documentation, and interviews; as well as site-specific data collection.

21.1.1 Site History and Potential Sources of Release

PAOC U is a vehicle maintenance area, in the southern central portion of Camp Garcia, in the area surrounding Building 302 at the location shown on Figures 1-2, 1-3, and 19-1. An automotive repair/maintenance shop, located in a former cargo transport box was sited on the location identified in Figure 19-1 as the "Former Automotive Shop." Historical maps also refer to former Building 305 as a "vehicle maintenance building" and Building 302 as a "maintenance building" (Figure 19-1). Building 305 was also identified in the EBS as PAOC T, the former public works grounds contractor storage shed and mechanics shop. PAOC T, which is also shown on Figure 19-1, was investigated as part of PAOC U during the PA/SI. Hazardous waste, hazardous materials, and petroleum products were historically stored at PAOC U. Some minor staining of soil was observed outside of the former automotive shop in the vicinity of the used oil AST and container storage pallets on the south side of the former building (Figure 19-1) (NAVFACENGCOM, 2003).

The AST located on the south side of the former automotive shop was a 500-gallon used oil tank. It was installed in 2000 and was constructed of vaulted steel (NAVFACENGCOM, 2003). The drums, batteries, and ASTs shown in Figure 21-1 have been removed from the site, and the former automotive shop was moved to Building 302, which is an open air warehouse with a concrete floor and steel beams supporting a steel roof (Ruiz, 2004).

Based on the above information, the potential sources of CERCLA-related releases are the former maintenance buildings (i.e., Buildings 302 and 305) and the associated materials storage areas adjacent to the historical buildings. Based on the nature of the historical activities at the site, potential releases would have likely been to the ground surface in these areas.

21.1.2 Physical Setting

The description of the site's physical setting is based on site inspections conducted in 2002 (EBS) and in 2006 (PA/SI), as well as on regional information.

The land surrounding PAOC U is relatively flat, at about 65 ft amsl and sloping about 1 ft to 2 ft every 100 ft to the south. The land around PAOC U is cleared periodically as part of routine maintenance activities.

Soils in the area generally consist of some combination of sand, silt and clay, with occasional beds of well graded sands (for additional details, see Appendix D for the site-specific soil boring logs). Bedrock was encountered at and near PAOC U between 30 ft and 36 ft bgs. Bedrock under PAOC U is mapped as being part of the KTd formation, which generally consists of plutonic rocks, largely granodiorite and quartz diorite. However, the bedrock borehole drilled at PAOC U penetrated a light gray volcanic deposit from the top of bedrock encountered at approximately 30 ft to 49 ft bgs, where the borehole terminated. For more information on the bedrock geology, see Section 1.4.6.

There are no surface water bodies at or immediately adjacent to the site. The closest surface water body topographically downgradient of the site is Bahia Corcho and Bahia Tapon along the coast, a little less than 1 mile to the south and southeast, respectively. Based on nearby wells, the topographic slope, and the regional groundwater gradient determined by the USGS (1989), groundwater in this area exists within the fractured bedrock and is presumed to flow in a southerly direction toward the coast.

21.2 Sampling Approach and Chemical Constituents Identified

Four soil samples were collected from PAOC U in December 2002 as part of the EBS, as shown in Figure 19-1. Two surface soil samples (U-1 and U-2) were collected from the soil staining area near the container storage pallets, one surface soil sample (U-3) was collected north of the Former Automotive Shop location, and one surface soil sample (U-4) was collected near the southeast corner of maintenance building 302. The EBS samples were analyzed for Appendix IX VOCs, SVOCs, pesticides, herbicides, and PCBs. These samples were also analyzed for sulfide, cyanide, and TPH-DRO and TPH-GRO.

As presented in the PA/SI Work Plan (CH2M HILL, 2006), nine soil borings were installed at the locations shown on Figure 19-1. At each of the soil borings, one surface soil sample and one subsurface soil sample were collected. Two of the soil borings were installed in the location of former Vehicle Maintenance Building 305 (i.e., PAOC T); three soil borings were installed adjacent to Former Maintenance Building 302; and four soil borings were installed around the Former Automotive Shop. As shown in Figure 19-1, five of the nine borings were installed in the general locations of the EBS samples to determine if concentrations changed over time. No FID readings significantly above background were observed in the soil borings (see Soil Boring Logs, Appendix D); therefore, subsurface soil samples were collected at default depths in accordance with the work plan (see Table 2-1 for subsurface soil sample depths). In addition, the boring on the south side of Building 302 was completed as a monitoring well. The surface and subsurface soil samples were analyzed for TCL VOCs, SVOCs, and pesticides/PCBs; TAL metals, and pH. Groundwater samples were analyzed for the same parameters plus TDS.

Tables 21-1, 21-2, and 21-3 summarize the constituents detected in PAOC U surface soil samples, subsurface soil samples, and groundwater samples, respectively, collected during the EBS and PA/SI. The tables also identify screening criteria exceedances. Raw analytical

data for the EBS and PA/SI samples are provided in Appendix O. Note that the groundwater data from the upgradient well at PAOC N (EPAN-MW02), which is also upgradient of PAOC U, was used for initial background comparison for the groundwater data collected at PAOC U.

21.3 PAOC U Release Assessment Decision Analysis

This subsection discusses the sample results in the context of the Data Evaluation Decision Tree (Figure 1-4) with reference to the detection tables (Tables 21-1 through 21-3).

Appendix N, Section N.21 discusses the evaluation of the PAOC U data quality. As detailed in Section N.21, the PAOC U data are acceptable for use in evaluating whether a release of hazardous waste or hazardous constituents warranting further action occurred at PAOC U, which is done in Steps 1 through 5 below.

Step 1: Is the site potentially CERCLA-eligible?

Historical information suggests the site was a former vehicle maintenance area where hazardous waste and materials were historically stored and minor staining of soil was observed. Based on this information, the potential for the presence of CERCLA hazardous substances could not be confidently ruled out without sample collection, which was conducted during the 2002 EBS and 2006 PA/SI. Therefore, the decision analysis proceeds to Step 2.

Step 2: Were any inorganics above the background UTL detected or were any non-inorganics detected?

For the samples collected during the EBS and PA/SI, the following inorganics above the background UTLs and non-inorganics were detected by medium:

<u>Surface Soil</u>

- VOCs: acetone, methylene chloride
- SVOCs: bis(2-ethylhexyl)phthalate
- Pesticides: 4,4'-DDE, 4,4'-DDT, endrin ketone, gamma-chlordane, methoxychlor
- Herbicides: none detected
- PCBs: none detected
- Inorganics above background UTLs: arsenic, calcium, cobalt, copper, lead, magnesium, mercury, selenium, thallium, and zinc
- TPH GRO: none detected
- TPH DRO: none detected

<u>Subsurface Soil</u>

- VOCs: none detected

- SVOCs: none detected
- Pesticides: beta-BHC
- PCBs: none detected
- Inorganics above background UTLs: mercury and selenium

Groundwater

- VOCs: chloroform
- SVOCs: none detected
- Pesticides: none detected
- PCBs: none detected
- Total inorganics above background (EPAN MW-02): aluminum, cobalt, copper, iron, manganese, mercury, potassium, selenium, vanadium
- Dissolved inorganics above background (EPAN MW-02): barium, cadmium, cobalt, manganese, nickel, potassium selenium, vanadium

Step 3: Are there any inorganic constituents above background or non-inorganic constituents that are potentially attributable to historic CERCLA-related releases at the site?

Based on the potential source areas at PAOC U (i.e., vehicle maintenance facilities and hazardous waste/materials storage), it is assumed that the constituent groups detected in site media, except for pesticides, are potentially attributable to CERCLA-related releases. The pesticides detected at this site are the same pesticides and of similar concentrations detected at other sites across Vieques. This information, coupled with the history of the site, suggests the pesticides are present due to normal pesticide use, not a CERCLA-related release (see *Pesticides and Herbicides* under Section 1.1.1). Therefore, pesticides are not considered further in the decision analysis process. All other detected constituents are further considered in the decision analysis process.

Step 4: For potentially complete exposure pathways, are there any exceedances (over that of background) of the most conservative screening values?

In this step of the decision analysis, the data for the CERCLA-related constituents identified in Step 3 are compared to the screening criteria described in Section 1 and shown on the detection tables. Those constituents that exceed one or more criteria (and background for inorganics) are listed below by medium.

Surface Soil

- Methylene chloride: three detections (samples EBS U-1, EBS U-2, and EBS U-4) at concentrations (5.4 µg/kg to 7.1 µg/kg) above the SSL at a DAF of 1 (1 µg/kg)
- SVOCs: no exceedances

- Arsenic: three detections (samples SS07, SS08, and EBS U-1) at concentrations (1.7 mg/kg to 2.9 mg/kg) above the PRG (0.39 mg/kg), SSL at a DAF of 1 (1 mg/kg), and the background UTL (1.6 mg/kg)
- Cobalt: one detection (sample EBS U-3) at a concentration (18 mg/kg) above the ecological screening value (13 mg/kg) and the background UTL (15.8 mg/kg)
- Copper: one detection (sample EBS U-1) at a concentration (81.2 mg/kg) above the ecological screening value (70 mg/kg), the SSL at a DAF of 1 (46 mg/kg) and the background UTL (65.5 mg/kg)
- Lead: one detection (sample EBS U-2)) at a concentration (15.1 mg/kg) above the SSL at a DAF of 1 (14 mg/kg) and the background UTL (5.4 mg/kg)
- Selenium: eight detections (samples SS03, SS04, SS05,SS06, EBS U-1, EBS U-2, EBS U-3, and EBS U-4) at concentrations (0.63 mg/kg to 1.4 mg/kg) above the ecological screening value (0.52 mg/kg), the SSL at a DAF of 1 (0.3 mg/kg) and the background UTL (0.51 mg/kg)
- Thallium: three detections (samples EBS U-2, EBS U-3, EBS U-4) at concentrations (0.98 mg/kg to 1.4 mg/kg) above the adjusted PRG (0.52 mg/kg), the SSL at a DAF of 1 (0.036 mg/kg), the background UTL (0.13 mg/kg), and in the case of EBS U-2, above the ecological screening value (1 mg/kg).
- Zinc: one detection (sample EBS U-3) at a concentration (121 mg/kg) above the ecological screening value (120 mg/kg), and the background UTL (32 mg/kg).

Subsurface Soil

- Mercury: one detection (sample SB 02) at a concentration (0.4 mg/kg) above the SSL at a DAF of 1 (0.1 mg/kg) and the background UTL (0.057 mg/kg)
- Selenium: three detections (samples SB02, SB06, SB07) at concentrations (0.54 mg/kg to 0.77 mg/kg) above the SSL at a DAF of 1 (0.3 mg/kg) and the background UTL (0.51 mg/kg)

Groundwater

- Chloroform: detected at a concentration (0.31 μg/L) above the tap water PRG (0.17 μg/L)
- Iron (total): detected at a concentration (1,270 μg/L) above the adjusted tap water PRG (1,100 μg/L)
- Vanadium (total and dissolved): detected at a concentration (23.2 μg/L dissolved and 26.8 μg/L total) above the adjusted tap water PRG (3.6 μg/L)

As shown above, there are exceedances of the most conservative screening values. Therefore, the decision analysis process continues to Step 5.

Step 5: Can more realistic evaluations of the data be performed, and if so, do they suggest contaminant levels warrant NFA?

Soil

Arsenic was detected in 3 of 13 surface soil samples above its background UTL and human health screening level (0.39 mg/kg based on 1×10^{-6} ELCR), at a maximum concentration of 2.9 mg/kg. Based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}) and the acceptable non-cancer HQ, acceptable risk-based concentrations for a residential scenario range from 0.39 mg/kg (1×10^{-6} ELCR) to 22 mg/kg (HQ=1). Based on the low maximum detected concentration and the low EPC that would be used in risk calculations (based on a calculated UCL of the mean concentration), risk estimates for arsenic would be within acceptable levels and arsenic would not be identified as a risk driver. No other carcinogenic constituents were detected in soil above PRGs.

Thallium was detected in only 3 of 13 surface soil samples at concentrations (1.4 mg/kg maximum detected concentration) above its human health screening level (0.52 mg/kg based on an HQ=0.1) and background UTL. Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 5.2 mg/kg (HQ=1); all thallium concentrations are below this level. Further, all three of the thallium exceedances are for samples collected during the EBS. These thallium concentrations are suspect because the analytical method utilized tended to give falsely elevated results. This supposition is supported by the fact that none of the samples collected at PAOC U during the PA/SI contained thallium at elevated concentrations with respect to the various screening criteria.

As noted above, only arsenic and thallium were detected in soil at concentrations above human health screening criteria and background UTLs. The non-cancer PRGs for these constituents are based on skin and vascular effects (arsenic) and liver effects (thallium). Although aluminum, iron, manganese, and vanadium were detected in soil above the adjusted PRGs, their PRGs are based on neurotoxicity in offspring (aluminum), gastrointestinal effects (iron), central nervous system effects (manganese), and increased mortality (vanadium), so there is no concern about potential cumulative human health effects from multiple constituents in site soil. Further, all aluminum, iron, manganese, and vanadium concentrations are below the background UTLs.

Five inorganics (cobalt, copper, selenium, thallium, and zinc) exceed ecological screening values and background UTLs in at least one surface soil sample. Cobalt, copper, thallium, and zinc each exceed in only 1 of 13 samples. The HQs based on the maximum concentrations of these three inorganics are 1.38 (cobalt), 1.62 (copper), 1.4 (thallium), and 1.01 (zinc). Selenium concentrations exceed the ecological screening value in 8 of 13 samples with a maximum HQ of 2.69. However, the mean concentrations of each of these inorganics, except for selenium, are below the ecological screening values. Although the background UTL for selenium in this soil type is 0.51 mg/kg, selenium concentrations up to 1.3 mg/kg were detected during the east Vieques background soil inorganics investigation in nearby soil types (CH2M HILL, 2007b). This suggests that the selenium concentrations detected at PAOC U (maximum of 1.4 mg/kg) may be within the range of background. Further, all selenium concentrations are less than ecological screening values based upon other receptors (e.g., 4.10 mg/kg for soil invertebrates). This information suggests that potential risks to ecological receptors from these inorganics are likely acceptable, especially given the

low magnitude of exceedances and their spatially restricted nature. In addition, the site is very small and provides very limited habitat, especially considering the area is maintained by periodic mowing. Thus, the potential exposures to ecological receptors are minimal.

Methylene chloride was detected in three surface soil samples collected during the EBS above the SSL at a DAF of 1. However, it was not detected in the surface or subsurface soil samples collected from the same locations during the PA/SI, nor was it detected in groundwater. This suggests that methylene chloride may have been a sampling or laboratory artifact during the EBS or that it is no longer present in site soils.

Six inorganics (arsenic, copper, lead, mercury, selenium, and thallium) were detected at concentrations above the SSLs at a DAF of 1. However, arsenic was not detected in subsurface soil nor in groundwater. Further, thallium was not detected above the SSL at a DAF of 1 and background UTL in samples collected from the same areas during the PA/SI. In addition, thallium was not detected in groundwater at the sites. None of the remaining four inorganics were detected in groundwater above an MCL or tap water PRG. In fact, lead was not detected in groundwater, and dissolved copper and mercury were not detected in groundwater. The above information suggests the SSLs at a DAF of 1 are not representative predictors of inorganics leaching through soil to groundwater at PAOC U. Other than thallium, none of the inorganics were detected in soil above an SSL at a DAF of 5.

It is also noted that the pH of surface and subsurface soils was measured to search for signs of spilled acids. pH results were all above 7, showing the soil samples were not acidic.

<u>Groundwater</u>

Chloroform was detected in groundwater at a concentration (0.31 μg/L) just above the tap water PRG (0.17 μg/L based on 1×10^{-6} ELCR); however, it was detected more than two orders of magnitude below the MCL. Further, based on the acceptable ELCR range (1×10^{-4} to 1×10^{-6}), the acceptable risk-based concentrations range from 0.17 μg/L (1×10^{-6} ELCR) to 17 μg/L (1×10^{-4} ELCR). The detected concentration is near the lower end of this range.

Iron (total) was detected in groundwater at a concentration (1,270 μg/L) above its human health screening level (1,100 μg/L based on an HQ=0.1). Based on the acceptable target non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 11,000 μg/L (HQ=1), which is an order of magnitude higher than the detected concentration. Most importantly, the iron concentrations in site soil are below the background UTL, which indicates the iron in groundwater is attributable to background.

Vanadium (total and dissolved) was detected in groundwater above its human health screening level (3.6 μg/L based on an HQ=0.1). The detected concentrations are 26.8 μg/L (total) and 23.2 μg/L (dissolved). Based on the acceptable non-cancer HQ, the acceptable risk-based concentration for a residential scenario is 36 μg/L (HQ=1), which is higher than the detected vanadium concentrations. Similar to iron, the vanadium concentrations in site soil are below the background UTL, which indicates the vanadium in groundwater are attributable to background.

The PRG for chloroform is based on potential carcinogenic effects. Because the PRGs for iron and vanadium are based on gastrointestinal effects (iron) and increased mortality

(vanadium), there is no concern about potential cumulative human health effects from multiple non-carcinogenic constituents in site groundwater.

Step 6: Does the historic information and/or spatial distribution of data indicate the potential source area was sufficiently sampled?

The historical information (aerial photographs, interviews, site inspections) indicates the most likely sources of CERCLA-related releases are the stained soil areas and the areas associated with former vehicle maintenance. Based on this information, multiple soil samples and a groundwater sample were collected within these areas, the spatial distribution and resulting data of which indicate the potential source area has been sufficiently characterized.

21.4 Conclusions and Recommendations

Table 21-4 summarizes the results of the decision analysis for PAOC U, which indicates there has not been a CERCLA-related release at the site that has resulted in contamination of soil or groundwater at concentrations that would pose a potentially unacceptable risk to human or ecological receptors or leaching concern for groundwater. Further, pesticide detections at the site are consistent with normal pesticide application associated with maintenance of the historical facilities present at the site. Therefore, it is recommended that a NFA decision document be prepared for PAOC U.

TABLE 21-1
PAOC U Surface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	Region IX SSLs - DAF 1	Vieques HHRA SO	Vieques Eco SO	Vieques (East) Background Zone KTd SS	EPAU-SO01	EPAU-SO02	EPAU-SO03	EPAU-SO04		EPAU-SO05	EPAU-SO06	EPAU-SO07	EPAU-SO08	EPAU-SO09	VNTR-U-1	VNTR-U-2	VNTR-U-3	VNTR-U-4
Sample ID					EPAU-SS01-0001	EPAU-SS02-0001	EPAU-SS03-0001	EPAU-SS04-0001	EPAU-SS04P-0001	EPAU-SS05-0001	EPAU-SS06-0001	EPAU-SS07-0001	EPAU-SS08-0001	EPAU-SS09-0001	EBS U-1	EBS U-2	EBS U-3	EBS U-4
Sample Date					03/01/06	03/03/06	03/03/06	03/03/06	03/03/06	03/03/06	03/03/06	03/03/06	03/01/06	03/03/06	12/12/02	12/12/02	12/12/02	12/12/02
Chemical Name																		
Volatile Organic Compounds (UG/KG)																		
Acetone	800	1,400,000	--	--	10 UJ	10 UJ	10 UJ	10 UJ	10 UJ	11 UJ	11 UJ	10 UJ	10 UJ	7 J	10 U	10 U	10 U	10 U
Methylene Chloride	1	9,100	--	--	10 U	10 U	10 U	10 U	10 U	11 U	11 U	10 U	10 U	10 U	7.1	6	5 U	5.4
Semi-volatile Organic Compounds (UG/KG)																		
bis(2-Ethylhexyl)phthalate	--	35,000	--		360 U	340 U	360 U	350 U	350 U	350 U	350 U	350 U	340 U	380 U	333 U	574	2020	333 U
Pesticide/Polychlorinated Biphenyls (UG/KG)																		
4,4'-DDE	3,000	1,700	10	--	23	54	82	4.5 J	4.7	51	3.5 U	53	37	3.8 U	3.3 U	52.7	3.3 U	21.5
4,4'-DDT	2,000	1,700	10	--	31	8	10	1.7 J	2.1 J	3.7	3.5 U	18	2.9 J	3.8 U	3.3 U	16.1	3.3 U	14.5
Endrin ketone	50	1,800	100	--	3.6 U	3.4 U	3.6 U	3.5 U	3.5 U	3.5 U	3.5 U	3.5 U	1.3 J	3.8 U	NA	NA	NA	NA
gamma-Chlordane	500	1,600	--	--	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	1.8 U	0.52 J	1.8 U	1.9 U	16.7* U	16.7* U	16.7* U	16.7* U
Methoxychlor	8,000	31,000	--	--	18 U	18 U	18 U	18 U	18 U	18 U	18 U	18 U	18 U	19 U	18.9	16.7 U	16.7 U	16.7 U
Appendix IX Organophosphate Pesticides (UG/KG)					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
No Detections																		
Appendix IX Herbicides					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
No Detections																		
Total Metals (MG/KG)																		
Aluminum	55,000	7,600	--	35,000	7,160	12,000	7,750	7,760	7,230	9,900	18,300	7,220	11,900	19,500	NA	NA	NA	NA
Antimony	0.3	3.1	78	3.6	0.6 J	0.78 J	0.83 J	0.77 J	0.84 J	0.56 J	0.61 J	0.22 J	0.53 J	0.56 J	5.45 U	5.2 U	4.1 U	5.9 U
Arsenic	1	0.39	18	1.6	1.1 U	1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.1 U	1.7	2.3	1.1 U	2.9	1.1	1.4	1.4
Barium	82	1,600	330	147	63.8	65.5	67.3	61.1	56.9	64.7	84.5	61.7	43.1	71.7	32.7	46.3	60	38
Cadmium	0.4	3.7	32	2.24	0.27 J	0.52 U	0.54 U	0.16 J	0.14 J	0.54 U	0.54 U	0.53 U	0.25 J	0.12 J	0.66	0.43 U	1.4	0.49
Calcium	--	--	--	8,840	23,400	9,580	12,300	3,620	3,180	5,770	3,620	99,100	25,900	3,140	NA	NA	NA	NA
Chromium	2	210	0.4	72	10.8	14.7	11.3	10.9	10.7	11.4	15.2	13.4	17	14.2	27.4	13.9	9	10.5
Cobalt	33	140	13	15.8	9.1	15.6	10.2	10.8	9.6	10.3	11.5	8.8	13.2	11	15.5	9	18	5.7
Copper	46	310	70	65.5	33.4	50.5	40.4	42.6	38.9	50	56.7	25.4	45.8	60	81.2	42.5	52	22
Cyanide	--	120	1	0.89	0.23 J	2.6 U	0.21 J	0.2 J	2.6 U	0.18 J	0.19 J	0.52 J	2.6 U	2.8 U	1 U	1 U	1 U	1 U
Iron	276	2,300	--	38,100	14,900	23,400	17,900	17,400	16,400	18,200	25,000	14,000	19,400	23,200	NA	NA	NA	NA
Lead	14	400	120	5.4	4.8	2.8	4.7	2.8	4.3	5.1	1.7	8.1	3.7	1.6	8.6	15.1	4.6	2.4
Magnesium	--	--	--	3,710	3,550	7,470	2,460	1,840	1,710	2,610	3,370	16,100	9,890	3,390	NA	NA	NA	NA
Manganese	57	180	220	1,630	598	763	676	701	591	592	677	365	429	549	NA	NA	NA	NA
Mercury	0.1	2.3	0.1	0.057	0.11 U	0.1 U	0.11 U	0.1 U	0.11 U	0.11 U	0.11 U	0.11 U	0.1 U	0.11 U	0.068	0.0769 U	0.0833 U	0.0357 U
Nickel	7	160	38	22.2	4.6	7.7	4.3 U	4.8	4.2 J	4.9	7.4	5.6	10.6	7.3	15.3	5.6	5.5	3.9 U
Potassium	--	--	--	5,270	692	1,090	763	867	843	796	1,320	861	689	1,370	NA	NA	NA	NA
Selenium	0.3	39	0.52	0.51	3.8 UJ	0.46 J	0.63 J	0.83 J	0.46 J	0.63 J	1.2 J	0.5 J	0.5 J	0.41 J	1.3	1.1	1.1	1.4
Thallium	0.036	0.52	1	0.13	0.018 J	0.52 U	0.54 U	0.014 J	0.013 J	0.54 U	0.027 J	0.027 J	0.52 U	0.013 J	0.909 U	1.4	1	0.98
Vanadium	300	7.8	2	144	57.7	71.3	69.7	66.7	63	66.9	78.8	44.9	70.6	69.2	72	71	66	60
Zinc	620	2,300	120	32	42.2	30.5	18.4	16.1	14.2	27.3	21.5	27.2	25.5	22.8	88.1	57	121	14
Total Petroleum Hydrocarbons (MG/KG)																		
TPH GRO					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
No Detections																		
TPH DRO					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
No Detections																		
Wet Chemistry																		
Sulfide					NA	NA	NA	NA	NA	NA	NA	NA	NA	NA				
No Detections																		
pH		--	--	--	7.95	8	8.02	8.14	8.22	7.95	8.25	8.1	8.27	7.65	NA	NA	NA	NA

Notes:
mg/Kg - Milligrams per Kilogram
ug/Kg - Micrograms per Kilogram
J - Analyte present; reported value may or may not be accurate or precise
U - Analyte not detected
UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise
* EBS sample analyzed for technical chlordane, consisting of alpha and gamma chlordane, heptachlor, and other hydrocarbons.
Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
Vieques Eco SO - Screening values for compounds (4,4'-DDE, 4,4'-DDT, cyanide) (MHSPE, 2000)
Vieques Eco SO - Screening values for compounds (chromium, copper) (Efroymson, Will, and Suter, 1997)
Vieques Eco SO - Screening values for compounds (endrin ketone) (Beyer, 1990)
Vieques Eco SO - Screening values for compounds (nickel, selenium, thallium, vanadium, zinc) (Efroymson, et al., 1997)
Vieques Eco SO - Screening values for compounds (antimony, arsenic, barium, cadmium, cobalt, lead) (EPA, 2005b)
EBS surface samples collected from 0 to 0.5 feet bgs.
NA - Not Analyzed
-- Not part of background data set
-- Regulatory standard not promulgated

Exceeds Background and Eco Criteria
Exceeds Background and DAF 1 Criteria
Exceeds Background, HHRA, and DAF 1 Criteria
Exceeds Background, Eco, and DAF 1 Criteria
Exceeds Background, HHRA, Eco, DAF 1 Criteria

TABLE 21-2
PAOC U Subsurface Soil Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Region IX SSLs - DAF 1**	**Vieques HHRA SO**	**Vieques (East) Background Zone KTd SB**	EPAU-SO01	EPAU-SO02	EPAU-SO03	EPAU-SO04	EPAU-SO05	EPAU-SO06	EPAU-SO07	EPAU-SO08	EPAU-SO09	
Sample ID				EPAU-SB01-0406	EPAU-SB02-0406	EPAU-SB03-0406	EPAU-SB04-0406	EPAU-SB05-0406	EPAU-SB06-0406	EPAU-SB07-0406	EPAU-SB08-0406	EPAU-SB09-0406	EPAU-SB09P-0406
Sample Date				03/01/06	03/03/06	03/03/06	03/03/06	03/03/06	03/03/06	03/03/06	03/01/06	03/03/06	03/03/06
Chemical Name													
Volatile Organic Compounds (UG/KG)													
No Detections													
Semi-volatile Organic Compounds (UG/KG)													
No Detections													
Pesticide/Polychlorinated Biphenyls (UG/KG)													
beta-BHC	0.1	320	--	1.8 U	0.77 J	1.8 U	1.8 U	1.8 U	2 U	1.8 U	1.8 U	1.8 U	1.8 U
Total Metals (MG/KG)													
Aluminum	55,000	7,600	35,000	6,260	5,790	5,700	7,100	5,530	7,220	6,990	5,020	6,380	5,810
Antimony	0.3	3.1	3.3	0.44 J	0.36 J	0.35 J	0.22 J	0.22 J	0.48 J	6.4 UJ	0.48 J	0.44 J	0.43 J
Barium	82	1,600	147	43.6	46.7	37	49.2	37.5	54.8	55.6	42	48.7	45.6
Cadmium	0.4	3.7	2.24	0.036 J	0.053 J	0.52 U	0.06 J	0.53 U	0.58 U	0.54 U	0.028 J	0.53 U	0.53 U
Calcium	--	--	8,840	2,000	1,980	2,010	2,340	1,980	3,300	2,210	1,680	2,060	1,980
Chromium	2	210	72	5.9	5.8	6.9	6.4	5.7	9.1	6.4	5.8	7.1	6.5
Cobalt	33	140	15.8	6.4	6.3	6.1	7.4	6.3	7.4	8.2	6.1	7.5	8
Copper	46	310	65.5	40.6	49.5	42	49.6	48	50.1	48.3	39.1	40.8	41.8
Iron	276	2,300	38,100	11,300	12,400	12,700	13,800	12,700	17,100	13,600	10,400	12,400	11,900
Lead	14	400	3.34	1.1 U	1.1 U	1 U	1.1 U	1.1 U	1.2	1.1 U	1 U	1.1 U	1.1 U
Magnesium	--	--	3,710	1,980	2,340	2,070	2,620	2,220	2,860	2,380	1,960	2,210	2,160
Manganese	57	180	1,630	301	323	281	365	268	337	552	305	362	341
Mercury	0.1	2.3	0.057	0.11 U	0.4	0.1 U	0.11 U	0.1 U	0.12 U	0.11 U	0.1 U	0.11 U	0.11 U
Nickel	7	160	22.2	3.6 J	2.9 J	4.2 U	4 J	4.2 U	3.7 J	4.3 U	3 J	4.3 U	4.3 U
Potassium	--	--	2,000	541 U	529 U	524 U	528 U	526 U	577 U	597	513 U	564	531 U
Selenium	0.3	39	0.51	3.8 UJ	0.54 J	3.7 UJ	3.7 UJ	3.7 UJ	0.77 J	0.68 J	0.5 J	3.7 UJ	0.46 J
Thallium	0.036	0.52	0.13	0.54 U	0.53 U	0.024 J	0.017 J	0.53 U	0.55 U	0.54 U	0.51 U	0.53 U	0.53 U
Vanadium	300	7.8	144	43.5	43.1	45.6	46.1	43.8	63.4	46.8	39.8	45.8	43.7
Zinc	620	2,300	32	11	12.8	11.2	15	12.6	16.7	14.5	10.6	12.8	12.4
Wet Chemistry													
pH	--	--	--	8.34	7.97	8	8.12	7.91	7.91	7.87	7.65	7.85	8.05

Notes:
- mg/Kg - Milligrams per Kilogram
- ug/Kg - Micrograms per Kilogram
- J - Analyte present; reported value may or may not be accurate or precise
- U - Analyte not detected
- UJ - Analyte not detected; quantitation limit may be inaccurate or imprecise

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Region IX SSL - DAF 1 values from EPA Soil Screening Guidance: Users Guide (EPA, 1996)
Vieques HHRA SO - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
-- Not part of background data set
-- Regulatory standard not promulgated
Exceeds Background and DAF 1 Criteria

TABLE 21-3
PAOC U Groundwater Detection and Exceedance Results
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Station ID	**Vieques HHRA GW**	**MCL - GW**	**PAOC-N EPAN-MW02 Background**	EPAU-MW01	
Sample ID				EPAU-GW01-06B	EPAU-GW01P-06B
Sample Date				04/03/06	04/03/06
Chemical Name					
Volatile Organic Compounds (UG/L)					
Chloroform	0.17	80	NA	0.25 J	0.31 J
Semi-volatile Organic Compounds (UG/L)					
No Detections					
Pesticide/Polychlorinated Biphenyls (UG/L)					
No Detections					
Total Metals (UG/L)					
Aluminum	3,600	--	263	1,020	430 R
Calcium	--	--	144,000	82,400	81,100
Chromium	11	100	3.6 J	1.7 J	0.59 J
Cobalt	73	--	--	1.8 J	1.5 J
Copper	150	1,300	--	4.4 J	25 U
Iron	1,100	--	198	1,270	390 R
Magnesium	--	--	75,600	55,200	54,700
Manganese	88	--	8 J	76.1	45.2
Mercury	1.1	2	--	0.04 J	0.04 J
Nickel	73	--	2.4 J	1.3 J	0.9 J
Potassium	--	--	1780 J	1,940 J	5,000 U
Selenium	18	50	--	3.5 J	3.2 J
Sodium	--	--	323,000	262,000	264,000
Vanadium	3.6	--	--	26.8 J	50 U
Dissolved Metals (UG/L)					
Barium	730	2,000	--	94.7 J	96.5 J
Cadmium	1.8	5	--	0.28 J	5 U
Calcium	--	--	139,000	82,400	80,900
Chromium	11	100	--	0.48 J	10 U
Cobalt	73	--	--	1.4 J	1 J
Magnesium	--	--	73,400	54,700	54,800
Manganese	88	--	--	0.98 J	0.92 J
Nickel	73	--	--	0.89 J	0.99 J
Potassium	--	--	1,710 J	1,860 J	1,930 J
Selenium	18	50	--	2.6 J	4.3 J
Sodium	--	--	311,000	258,000	262,000
Vanadium	3.6	--	--	23.2 J	22.9 J
Wet Chemistry (MG/L)					
Total dissolved solids (TDS)	--	--	NA	1,130	1,150

Notes:
- mg/L - Milligrams per Liter
- ug/L - Micrograms per Liter
- J - Analyte present; reported value may or may not be accurate or precise
- R - Unreliable result
- U - Analyte not detected
- NA - Not Applicable

Human health, ecological, and leaching screening values are those provided in the Master QAPP (CH2M HILL, 2007a), and listed below (as modified by Table 1-1)
Vieques HHRA GW - Screening values from the October 2004 EPA Region IX Preliminary Remediation Goals (PRGs) (EPA, 2004)
GW-MCLs from EPA Regulations Title 40 Protection of Environment, CFR Part 141 National Drinking Water Standards (40 Code of Federal Regulations [CFR] 141)
-- Not detected in background well
-- Regulatory standard not promulgated
Exceeds Background and HHRA criteria

TABLE 21-4
PAOC-U Decision Tree Summary
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Medium	Step 1 Site Potentially CERCLA-eligible?	Step 2 Inorganics Above Background or Non-inorganics Detected?	Step 3 Potentially Attributable to CERCLA Release?	Step 4 Exceedances of Comparison Criteria?	Step 5 More Realistic Evaluation?	Step 6 Medium Sufficiently Characterized?
Surface Soil	Yes					Medium sufficiently characterized; no further action for medium
		VOCs	Yes	methylene chloride > SSL	not detected during PA/SI; not detected in subsurface soil or groundwater	
		SVOCs	Yes	No	N/A	
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	As > PRG, SSL, BKG	within acceptable HH risk range; not detected in subsurface soil or groundwater; < SSL at a DAF of 3	
				Co > ECO, BKG	mean concentration < ECO	
				Cu > ECO, SSL, BKG	mean concentration < ECO; < SSL in subsurface soil; detected in groundwater below PRG and MCL; < SSL at a DAF of 2	
				Pb > SSL, BKG	< SSL in subsurface soil; not detected in groundwater	
				Se > ECO, SSL, BKG	ECO based on plants; mowed grass limits receptors; < ECO for soil invertebrates; detected in groundwater below PRG and MCL; < SSL at a DAF of 5	
				Tl > PRG, ECO, SSL, BKG	acceptable HH risk level; mean concentration < ECO; < SSL in subsurface soil; not detected in groundwater; no exceedances in PA/SI samples	
				Zn > ECO, BKG	mean concentration < ECO	
Subsurface Soil	Yes					Medium sufficiently characterized; no further action for medium
		Pesticides	No	N/A	N/A	
		Inorganics	Yes	Hg > SSL, BKG	detected in only one soil sample; detected in groundwater below PRG and MCL; < SSL at a DAF of 4	
				Se > SSL, BKG	detected in groundwater below PRG and MCL; < SSL at a DAF of 3	
Groundwater	Yes					Medium sufficiently characterized; no further action for medium
		VOCs	Yes	Chloroform > PRG	with acceptable HH risk range; < MCL	
		Inorganics	Yes	Fe(total) > PRG, BKG	acceptable HH risk level; all soil concentrations < BKG	
				V (total, dissolved) > PRG, BKG	acceptable HH risk level; all soil concentrations < BKG	

Photo 1 - Stained area at drum and battery area adjacent to automotive shop

Photo 2 - AST adjacent to drum/battery storage

(photos included in EBS, April, 2003)

Figure 21-1
PAOC U Former Automotive Shop Site Photographs
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

SECTION 22

Summary of Conclusions and Recommendations

Table 22-1 summarizes the historical information, data collection, findings, conclusions, and recommendations for each of the 20 sites included in this PA/SI Report. As shown in the table, the following activities are proposed for the sites:

Expanded SI

- SWMU 1
- SWMU 2
- SWMU 6/7
- SWMU 10
- AOC G
- PI-4
- PAOC L

Contaminated Soil Removal and Confirmatory Soil Sampling

- AOC A

Drum Removal and Confirmatory Soil Sampling

- PI-7

NFA (Preparation of a NFA Decision Document)

- SWMU 4 (pending evaluation of regional groundwater data)
- SWMU 5
- SWMU 8
- SWMU 12
- AOC F
- PAOC J (pending evaluation of regional groundwater data)
- PAOC K (pending evaluation of regional groundwater data)
- PAOC N (pending confirmation of no underground fuel pipeline to PAOC S)
- PAOC S (pending confirmation of no underground fuel pipeline from PAOC N)
- PAOC U

TABLE 22-1
Summary of Conclusions and Recommendations
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site Name	Site Description	Site History	Potential Source(s)	Potential Release Mechanism(s)	Site-specific Data Collected	Results of a 7-step Decision Analysis	Conclusions	Recommendations
SWMU 1	Camp Garcia Landfill	Unlined landfill reportedly used for trench disposal of municipal (non-hazardous) waste from 1954 to 1978	Buried waste	Leaching of constituents from waste into soil, groundwater, and/or ephemeral stream	Geophysical survey of landfill extent; 50 surface soil samples of landfill cover material; 4 downgradient monitoring wells; 1 upgradient (background) monitoring well	Data do not indicate a release has occurred to surface soil or groundwater; however, potential source area not sufficiently characterized.	Uncertainty regarding landfill boundary, nature of landfilled material, and condition of subsurface soil, groundwater, and ephemeral stream warrants additional evaluation.	1. Perform additional geophysics to complete landfill boundary delineation. 2. Excavate 20 test pits to characterize the waste. 3. Collect soil samples within and immediately below the waste in each pit to determine if releases to soil have occurred. 4. Install 4 monitoring wells to characterize groundwater within landfill boundary. 5. Resample existing wells to confirm previous findings. 6. Collect 4 ephemeral stream samples to determine if releases to ephemeral stream have occurred.
SWMU 2	Fuels Off-loading	Fuel offloaded from barges, pumped to series of above-ground storage tanks (ASTs)	Fuel transfer operations and ASTs	Leaks or spills to ground surface	8 surface soil samples and 2 subsurface soil samples around fuel offloading area and in vicinity of some tanks	Data suggest potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk; however, potential source area not sufficiently characterized.	Spatial coverage of existing samples is not adequate to conclude no further action. Samples collected around four of eight historical tank locations.	Use slide hammer to collect surface soil and subsurface soil samples at all eight historical tank locations, the fuel offloading area and the former fuel transfer pipeline (if its location can be acertained) and screen visually and with vapor monitor. If residual soil contamination is observed (visually or with a PID) during the soil borings, the need for and location of wells will be discussed wtih the regulatory agencies and installed during the mobilization.
SWMU 4	Bldg. 303 Waste Areas	Storage sheds for spent batteries, waste rags, absorbent material, and grease; catch basin for hydraulic oil and cleaning/degreasing	Materials stored in sheds; catch basin	Leaks or spills to ground surface	12 surface soil samples and 1 subsurface soil sample around all potential source areas	Data suggest potential source area was sufficiently characterized.	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending evaluation of regional groundwater data to ensure no release attributable to SWMU 4
SWMU 5	Spent Battery Accumulation Area	Area where spent batteries and battery acid at OP-1 were temporarily staged	Batteries and battery acid	Leaks to ground surface or concrete surface with runoff to ground surface	4 surface soil samples adjacent to concrete pad in area where battery staging was done	Data suggest potential source area was sufficiently characterized.	Release has not occurred or potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document
SWMU 6/7	Waste Oil and Paint Accumulation Areas	Concrete pad and caged area used to stage waste oil in 55-gallon drums and paint in small containers	Drums and small containers of waste oil and paint	Leaks or spills to concrete surface; runoff to ground surface	10 surface soil samples around entire perimeter of concrete pad	Data suggest potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk; however, potential source area not sufficiently characterized.	Due to the nature of VOCs, which were detected in surface soil, subsurface soil sampling is warranted. In addition, 7 years have elapsed since sampling, so re-evaluation of VOCs in surface soil is warranted.	Collect 10 co-located surface soil and subsurface soil samples to confirm previous results (surface soil) and characterize subsurface soil.
SWMU 8	Waste Oil Accumulation Area	Area where waste lubricants and oil at OP-1 were temporarily staged	Drums of waste lubricants and oil	Leaks or spills to ground surface or concrete surface with runoff to ground surface	5 surface soil samples adjacent to concrete pad in area where drum staging was done	Data suggest potential source area was sufficiently characterized.	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document

TABLE 22-1
Summary of Conclusions and Recommendations
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site Name	Site Description	Site History	Potential Source(s)	Potential Release Mechanism(s)	Site-specific Data Collected	Results of a 7-step Decision Analysis	Conclusions	Recommendations
SWMU 10	Sewage Treatment Lagoons	Four historically unlined lagoons for Camp Garcia sanitary sewage treatment from 1950s to 2000 (lined in 1974); treated effluent discharged to land and/or sea until 1974; no discharge after 1974	Sewage treatment lagoons	Discharge to ground surface; leaching from lagoons into soil and/or groundwater	20 co-located surface soil and subsurface soil samples within lagoons; 5 monitoring wells (4 within and 1 outside lagoons)	Data suggest potential source area was sufficiently characterized and that constituent levels (other than thallium) do not pose unacceptable human health or ecological risk.	Uncertainty in thallium concentrations in soil and groundwater that warrants confirmation sampling.	Collect 2 co-located surface soil and subsurface soil samples in each lagoon (8 co-located sample locations total) and resample existing monitoring wells to re-assess thallium concentrations.
SWMU 12	Solid Waste Collection Area	Area where domestic solid waste (i.e., trash) from OP-1 were temporarily staged	Staged domestic solid waste (trash)	Leaks or spills to ground surface	5 surface soil samples within staging area	Data suggest potential source area was sufficiently characterized.	Material was domestic, staged in containers, and no evidence of release.	No further action; prepare no further action decision document
AOC A	Diesel Fuel Fill Pipe Area	15,000-gallon diesel fuel underground storage tank (UST) at OP-1; first one removed in 1997; second removed in 2003	UST and associated piping	Leaks or spills to ground surface and to subsurface soil	10 confirmatory subsurface soil samples around and beneath UST and associated piping following removal	Data suggest potential source area was sufficiently characterized, but TPH levels in soil below removed piping above PREQB corrective action criterion.	Additional soil removal is warranted to reduce TPH levels to below corrective action criterion.	Perform additional soil excavation beneath former piping and collect confirmatory soil samples.
AOC F	Rock Quarry	Source of gravel for road construction and other projects	None likely; trash observed in one area of quarry during 1995 site visit	None likely; leaking from trash to ground surface assumed for purposes of evaluation	5 surface soil samples around area where trash was observed; 42 composite crushed rock samples from quarried material	Data suggest potential source area was sufficiently characterized.	No release likely occurred.	No further action; prepare no further action decision document
AOC G	Pump Station and Chlorination Building	Building used for chlorination and pumping of sewage being treated in lagoons (SWMU 10)	Chlorine contact chamber; piping	Spills or leaks from chlorine contact chamber and/or associated piping to ground surface; spills or other discharge of pump maintenance fluids outside building	5 surface soil samples around building and chlorine contact chamber	Data suggest potential source area associated with SWMU 10 wastewater management was sufficiently characterized; potential source area associated with pump maintenance fluids not characterized.	No release associated with wastewater likely occurred or any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	Collect two co-located surface/subsurface soil samples adjacent to building door to determine if releases of pump maintenance fluids occurred
PI-4	Former Helicopter Maintenance Area, Trenched Area, Disturbed Areas, and Bermed Areas used for Fuel Bladder Storage	Helicopter maintenance area; barracks and mess; trenches that may have been associated with sanitary leach field; bermed area used for fuel bladder storage	Helicopter maintenance activities; unknown activities associated with trenches and disturbed areas; fuel bladders	Spills or leaks to ground surface; release to subsurface soil and/or groundwater from trenches	2 surface soil samples and 2 co-located surface soil and subsurface soil samples within bermed area; 5 co-located surface soil and subsurface soil samples at former helicopter maintenance building; 6 co-located surface soil and subsurface soil samples within the trenched area and nearby disturbed area; 2 co-located surface soil and subsurface soil samples within disturbed area south of helicopter maintenance area; 5 monitoring wells across the site	Data suggest soil within potential source areas was sufficiently characterized; however, groundwater within trenched area not sufficiently characterized.	Low levels of VOCs detected in groundwater, but not in soil warrant additional groundwater characterization to confirm groundwater contamination is not at unacceptable levels.	Collect a synoptic round of water levels to confirm direction of groundwater flow. Based on these findings, install two monitoring wells, one approximately 200 feet upgradient of the well with the single MCL exceedance, and the other approximately 200 feet downgradient of the same well. Collect a round of groundwater samples from the newly installed wells and all existing wells.

TABLE 22-1
Summary of Conclusions and Recommendations
Preliminary Assessment/Site Inspection Report
12 Consent Order Sites and 8 PI/PAOC Sites
Vieques, Puerto Rico

Site Name	Site Description	Site History	Potential Source(s)	Potential Release Mechanism(s)	Site-specific Data Collected	Results of a 7-step Decision Analysis	Conclusions	Recommendations
PI-7	Former Quarry, Tar Drum Disposal Area, Radar Communication Area	Three physically separate areas - former radar communication facility to the north; defunct rock quarry in the central area; and an area where drums containing tar residues were observed	Former radar communication facilities; drums in quarry and area to the south	Spills or leaks to the ground surface	3 co-located surface soil and subsurface soil samples around debris observed at the former radar communication facility location; 5 co-located surface soil and subsurface soil samples, 6 additional surface soil samples, and 1 monitoring well around drums and debris within the former quarry; 10 co-located surface and subsurface soil samples, 2 additional surface soil samples, and 2 monitoring wells around drums and debris in the tar drum disposal area	Data suggest potential source areas were sufficiently characterized	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk. However, drums may represent a potential future source of contamination.	Remove drums and contaminated soil (if present) and collect confirmatory soil sample(s) beneath the areas of drum and soil removal.
PAOC J	Former Vehicle Maintenance Area	Vehicle maintenance; facility demolished prior to 1980	Vehicle maintenance operations	Spills or leaks to ground surface	6 co-located surface soil and subsurface soil samples across former vehicle maintenance area	Data suggest potential source area was sufficiently sampled	No release likely occurred or any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending evaluation of regional groundwater data to ensure no release attributable to PAOC J
PAOC K	Former Wash Rack	Vehicle washing on a rack; facility demolished prior to 1980	Vehicle washing operations	Runoff of vehicle wash fluids to ground surface	5 co-located surface soil and subsurface soil samples at former wash rack location	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending evaluation of regional groundwater data to ensure no release attributable to PAOC K
PAOC L	Former Paint and Transformer Storage Area	Small, single room concrete block building used for storage of paints and transformers	Containers of paints; transformers	Spills or leaks onto concrete floor and tracked outside; spills or leaks outside building	4 co-located surface soil and subsurface soil samples and 1 monitoring well around building	Data suggest a release of pesticides may have occurred. Subsurface soil sufficiently characterized, but surface soil in potential source area not sufficiently characterized.	Additional soil sampling is warranted to sufficiently characterize the suspected release area. Another groundwater sample is warranted to confirm initial results.	Collect additional surface soil samples to evaluate extent of pesticides in suspected source area. Evaluate the data to determine if limited removal or expanded investigation is warranted. Collect second groundwater sample to confirm initial sample results.
PAOC N	Former Fuel Farm and Filling Station	3 ASTs present from 1985 through 1992; two-compartment AST (gas and diesel) installed in 2000	ASTs	Spills or leaks onto ground surface	3 co-located surface soil and subsurface soil samples around the former ASTs; 1 co-located surface soil and subsurface soil sample and 1 monitoring well at the former fuel building location	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending confirmation no underground pipeline to the PAOC S powerplant exists.
PAOC S	Former POL Pipeline and Power Plant	Two physically separate areas - underground fuel transfer pipeline from SWMU 2 to airfield (removed in 1984); former power plant in Camp Garcia	Former pipeline; power plant operations	Spills or leaks to ground surface; release also to subsurface from pipeline	14 co-located surface soil and subsurface soil samples along former pipeline; 2 surface soil samples between pipeline and saltflat; 5 co-located surface soil and subsurface soil samples and 1 monitoring well at the former power plant location	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document pending confirmation no underground pipeline from PAOC N exists.
PAOC U	Vehicle Maintenance Area	Vehicle maintenance; public works contractor storage shed; mechanics shop	Vehicle maintenance operations; materials storage	Spills or leaks to ground surface	4 surface soil samples, 9 co-located surface soil and subsurface soil samples, 1 monitoring well across vehicle maintenance area	Data suggest potential source area was sufficiently sampled	Any potential release has not resulted in constituent levels that pose an unacceptable human health or ecological risk.	No further action; prepare no further action decision document

SECTION 23

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