FINAL

Remedial Investigation/Feasibility Study
Tourtelot Cleanup Project
Benicia, California

Volume III
(Appendices)

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7 QES/STL Review of TEPH Laboratory Control Sample Non-Conformances, August 2000

List of Acronyms

Ag	silver
Al	aluminum
amDNTS	sum of 2-amino-4,6-dinitrotoluene and 4-amino-2,6-dinitrotoluene
ARAR	applicable or relevant and appropriate requirement
ARCS	Assessment and Remediation of Contaminated Sediment
As	arsenic
ASR	Archives Search Report
ASTM	American Society for Testing and Materials
ATF	Alcohol, Tobacco, and Firearms
Ba	barium
BAAQMD	Bay Area Air Quality Management District
Babcock	E.S. Babcock & Sons
Be	beryllium
bgs	below ground surface
BIP	blow in place
BTAG	Biological Technical Assistance Group
BTEX	benzene, toluene, enthylbenzene, xylene
C	Celsius
Ca	calcium
CADHS	California Department of Health Services
Cal/EPA	California Environmental Protection Agency
Cal/OSHA	California Occupational Safety and Health Administration
CAM	California Assessment Manual
CCC	Continuous Chronic Concentration
CCR	California Code of Regulations
CCV	Continuing Calibration Verification
Cd	cadmium
CDFG	California Department of Fish and Game
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability
CESPK	U.S. Army Corps of Engineers, Sacramento District
CFR	Code of Federal Regulations
cm/sec	centimeters per second
CNDDB	California Natural Diversity Data Base
Co	cobalt
COI	chemical of interest

Cr	chromium
Cu	copper
CWA	Clean Water Act
cy	cubic yard
°	degree
%D	Percent Difference
DDESB	Department of Defense Explosive Safety Board
DDT	4-4'-dichlorodiphenyltrichloroethane
DEM	Department of Environmental Management
dh/dl	averaged hydraulic gradient
DHS	Department of Health Services
DNB	dinitrobenzene
DNT	dinitrotoluene
DOD	Department of Defense
DOT	Department of Transportation
DQO	data quality objective
DTSC	Department of Toxic Substances Control
DWR	Department of Water Resources
EE/CA	environmental evaluation/cost analysis
EIR	environmental impact report
EM	electromagnetic
ENGEO	ENGEO, Inc.
EOD	Explosive Ordnance Disposal
EPA	Environmental Protection Agency
ESA	Endangered Species Act
F	Fahrenheit
Fe	iron
fps	feet per second
FS	feasibility study
GC	gas cromatography
gpm	gallons per minute
GPR	ground-penetrating radar
GRA	general response action
Granite	Granite Management Corporation
GSA	General Services Administration
HASP	Health and Safety Plan
HE	high explosive
Hg	mercury

HI	Hazard Index
HMX	octahydro-1,3,5,7-tetranitro-1,3,5-trizine
HRA	Hazard Risk Assessment
K	potassium
K_{oc}	soil sorption coefficient (normalized for organic carbon content)
LCL	lower control limit
LDC	Laboratory Data Consultants
LDR	land disposal requirement
LIDAR	light distance and ranging
LOEC	lowest observed effect concentration
LUFT	leaking underground fuel tank
µg/L	micrograms per liter
µL	microliter
µmhos/cm	micromhos per centimeter
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
Mg	magnesium
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mL/g	milliliter per gram
mm	millimeter
MMI	Modified Mercalli Intensity
Mn	manganese
Mo	molybdenum
mph	miles per hour
MPM	most probable munition
MS/MSD	matrix spike/matrix spike duplicate
MSA	Minimum Separation Area
MSD	Minimum Separation Distance
MSL	mean sea level
mV	millivolt
Na	sodium
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
ne	estimated effective porosity
Ni	nickel
NOAEL	no-observed-adverse-effect level
non-OE RI	Non-Ordnance and Explosives Remedial Investigation
NORCAL	NORCAL Geophysical Consultants, Inc.

NPDES	National Pollutant Discharge Elimination System
NTU	Nephelometric Turbidity Unit
O&M	operation and maintenance
OB/OD	open burn/open detonation
OCDD	1,2,3,4,6,7,8,9-octachlorodibenzo-p-dioxin
OE	ordnance and explosives
ONSITE	Onsite Environmental Laboratories (Mobile Facility)
P	phospherus
PAH	polynuclear aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PE	performance evaluation
PeCDF	pentachlorodibenzofuran
PETN	pentaerythritol tetranitrate
pg/g	picograms per gram
ppm	parts per million
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QCSR	Quality Control Summary Report
Quanterra	Quanterra, Inc.
%RSD	percent relative standard deviation
RAO	remedial action objective
RAP	Remedial Action Plan
RAW	Removal Action Work Plan
RCRA	Resource Conservation and Recovery Act
RDX	cyclonite
RF	response factor
RI	remedial investigation
RL	reporting limit
RRF	Relative Response Factor
RRR	Records Research Report
RWQCB	Regional Water Quality Control Board
S	sulfur
SAP	Sampling and Analysis Plan
SAR	synthetic aperture radar

SARA	Superfund Amendments and Reauthorization Act
Sb	antimony
Se	selenium
SECOR	SECOR International, Inc.
SEVERN	Severn Trent Laboratories
Si	silicon
SSHP	Site-Specific Health and Safety Plan
SUXOS	Senior Unexploded Ordnance Supervisor
SVOC	semivolatile organic compound
TBC	to be considered
TCDD	tetrachlorodibenzo-dioxin
TCDF	tetrachlorodibenzo-furan
TDEM	time-domain electromagnetic
TEC	threshold-effect concentration
TEF	toxicity equivalent factor
TEQ	toxicity equivalent
TEPH	total extractable petroleum hydrocarbon
Ti	titanium
Tl	thalium
TMF	total magnetic field
TNB	trinitrobenzene
TNT	trinitrotoluene
TPH	total petroleum hydrocarbon
TRV	toxicity reference value
TSS	total suspended solids
UMDA	Umatilla Depot Activity
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
UTL	upper tolerance limit
UV	ultraviolet
UXO	unexploded ordnance
UXOSO	Unexploded Ordnance Site Safety Officer
V	vanadium
VOC	volatile organic compound
Vp	linear pore water velocity
VSD	voluntary separation distance

APPENDIX A
Updated Aerial Photographic Analysis
Tourtelot Cleanup Project, Benicia, California

Introduction

This appendix presents a summary of historic features/activities at what is now the Tourtelot Cleanup Project Site (Project Site), in Benicia, California, based on a review of historic aerial photographs and reference documents. The summary is an update of the analysis submitted previously in the *Final Non-Ordnance and Explosives Remedial Investigation (RI)/Feasibility Study(FS) Work Plan* (Earth Tech, 2000). The update consisted of reanalyzing aerial photographs to refine and verify observed features based on interpretation of ground-level photographs, as well as performing a photointerpretation of additional aerial photographs not available previously. The Project Site is approximately 30 miles northeast of San Francisco and lies partially within the boundaries of the Former Benicia Arsenal, a U.S. Army installation (see Figure A-1).

The analysis provides evaluations for each set of photographs and includes reproductions of the analyzed photographs on which relevant features of the site have been indicated. A summary evaluation is included for each set of photographs. These summary evaluations provide technical backup to the history/activities included in Chapter 2.0 of this document.

For descriptive purposes, the Project Site has been divided into three geographic areas: the "North Valley," the "Ridge," and the "South Valley" (see Figure A-1). Currently, the Project Site is bordered by the Southampton residential development to the west and south, the Valero refinery to the southeast, industrial and commercial facilities to the east, open space to the north, and Lake Herman Recreational Area to the northwest. Current elevations at the site vary from approximately 60 feet above mean sea level (msl) in the southeastern region of South Valley to 300 feet above msl in the northwestern region of the Ridge area.

Methodology

Earth Tech conducted an initial analysis of aerial photographs for the Project Site in December 1999, and a supplemental evaluation in May 2000. A total of 44 photographs, comprising 20 vintages or sets of photographs (see Table A-1) was inspected initially under a mirror stereoscope equipped with 10-power magnifying binoculars, and with 3-power binoculars during the supplemental evaluation. These photographs were taken between 1937 and 1997. Two or more images were available for most sets of photographs to enable stereoscopic analysis. Stereographic coverage was not available for the aerial photographs dated 5/23/1975 and 7/22/1995. The analysis focused on determining the presence or absence of features at the Project Site that could have been related to Benicia Arsenal and subsequent activities. These features included construction (buildings), earth moving (grading), roads, and other ground-disturbing activities (e.g., possible past agricultural and demolition activities) in the Project Site. Additionally, topographic maps covering the area were inspected as a reference for the photography. These maps included the most recent (photo revised in 1980) Benicia and Vine Hill, California, 7.5-minute U.S. Geological Survey (USGS) quadrangle maps, as well as the historic 15-minute Carquinez quadrangle dated 1896; the 1942 (based on 1937 aerial photography) 15-minute Carquinez quadrangle prepared by the War Department, Corps of Engineers; the 1952 USGS 7.5-minute Benicia quadrangle; and the 1961 Army Map Service Benicia 7.5-minute quadrangle. The *Benicia Arsenal, Records Research Report (RRR), Final* (Jacobs Engineering, 1999) and the *Archives Search Report (ASR) for Benicia Arsenal* (USACE, 1994) were reviewed for information on the types of activities known or suspected to have occurred within and in the area immediately surrounding the Project Site, as requested by the Department of Toxic Substances Control (DTSC). Based upon this analysis, the following descriptions/interpretations

of land use were completed. All the photographs used in this analysis of the Project Site have been scanned and are included in this appendix.

The final RRR for the Benicia Arsenal (Jacobs Engineering, 1999) was also reviewed in detail to provide additional insight into activities conducted at the project site. Ground-level photographs included in the report were useful in the identification of site features.

Brief Site History

The U.S. Army acquired approximately 2,700 acres of land in the city of Benicia between 1849 and 1958. The U.S. Army established the Benicia Arsenal on this land and used it as an ordnance depot. A 110-acre portion of the Project Site, formerly owned by the Tourtelot family, was leased by the U.S. Army from 1944 to 1960. The U.S. Army developed the Project Site and used various portions for military operations such as demolition and demilitarization activities. In 1962, the Department of Defense declared the entire Benicia Arsenal excess.

Descriptions of known activities in the North Valley, Ridge, and South Valley areas are provided below. In each of these three areas, a series of features known to occur or that have occurred is defined; the presence/absence of these features is tracked throughout this analysis and is summarized in Table A-2, Summary of Photointerpretation.

North Valley

An area of ground scarring, identified as the TNT Strips, is situated on the hillside along the northern slope boundary of the North Valley. It was reported that explosives were burned in this area, resulting in the strips. The only known activity to occur within the TNT Strips is the burning of 2,4,6-trinitrotoluene (TNT); when the organic materials were burned in this area, TNT, its breakdown products, and polynuclear aromatic hydrocarbons (PAHs) were generated.

Midway Road is south of the TNT Strips. This road trends approximately east-west and extends west from the eastern end of a tree line that is prominent since 1937 on most aerial photographs of the site area.

The Howitzer Test Facility was mainly on the south side of the valley and included three main structures and various other support structures/areas. These structures were the Test Firing Tunnels (two parallel tunnels, known as Building 181); the Test Firing Butts (Building 182); and a concrete Powder Loading Room (Building 183). Between 1957 and 1958, a Cement Test Block (referred to as Buildings 540 and 542) was constructed between the Test Firing Tunnels and the Test Firing Butts. These facilities were reportedly used to check the accuracy of howitzer gun barrels. All of these facilities were dismantled in late 1996.

The North Valley Military Landfill was situated to the north and east of Buildings 540, 542, and 181.

Immediately northwest of the Howitzer Test Facility was the Ammunition Renovation/Primer Destruction Site. Two wooden buildings, two canvas shelters, and "squirrel cages," or metal tanks, were constructed in this area in 1950 (the building numbers are unknown). The Primer Destruction Site was used from 1945 to 1947. These facilities were reportedly used to renovate and paint ordnance, and to destroy primers by burning.

Ridge

The Dynamite Burn Site, reported as being approximately one-half the size of a football field, was situated along the Ridge, just south of the North Valley. In that area, out-of-service dynamite was disposed of through burning between 1947 and 1948. A road (described hereafter as a "J"-shaped road) trended southeast from the Howitzer Test Facility (North Valley) to the Dynamite Burn Site in the Ridge area. Grading commenced on the Ridge in 1990 and a series of soil/debris piles was noted on the graded areas after the top of the Ridge had been graded.

South Valley

The South Valley trends approximately from west to east immediately south of the Ridge. The Flare Site and three demolition sites have been identified in this area; these sites were locations where flares and other ordnance and explosives (OE) scrap/fragmentation were destroyed. No permanent buildings were observed in the aerial photographs in these areas. An access road to these sites was also traced from the eastern end of the valley to the west through the South Valley's history.

Summary of the Photographic Analysis

The results of the photographic analysis and of the review of reference documents is presented as text and as illustrations. A detailed analysis is included for each set of photographs of the same vintage. Scanned images of each set of photographs (vintage) are also included. In addition, one of the photographs of each set for the period 1937 to 1989 was selected to show relevant features by drawing a line pointing to the feature and coding it with a letter. The letter is coded to the identifier letter included on the summary of the photointerpretation on the figures. Features identified through the analysis are illustrated on Figure 2-10 of this document. Table A-2 presents a summary of the interpretation of all aerial photographs analyzed.

Photographs: ABO 52-31 (Figure A-2) and ABO 52-32 (Figure A-3)

Source: National Archives Stereo Pairs from SECOR International Incorporated; U.S. Department of Agriculture

Photo Scale: 1:20,000

Date of Photograph: 8-20-1937

General Description of Photographs:

Portions of the Project Site are in the northwestern corner of Photograph ABO 52-31 and on the western edge of Photograph ABO 52-32. Lake Herman is visible to the northwest of the Project Site on Photograph ABO 52-32. Railroad tracks, including a number of spurs, are to the east of the Project Site. No evidence of the Benicia Arsenal is present in the photographs; these photographs pre-date the government's lease of the Project Site in 1944. The Suisun Bay is in the southeastern corner of both photographs. The original topography noted in these photographs shows rolling hills, knolls, and gullies throughout the Project Site.

Project Site Description:

These photographs appear to pre-date any construction on the Project Site.

- **North Valley:** There is very little to be seen in terms of man-made features in the North Valley. A dirt road (possibly Midway Road) appears at the base of the slope running northwest from the prominent east-west tree line on the southeastern boundary of the North Valley. A spring is noted near the east end of the tree line. A plowed field is noted northeast of the Project Site. The Project Site fence line is (faintly) visible. No evidence of grading activities is noted within the North Valley. A fenced area is located outside the Project Site on the northeast facing slope of the ridge north of the North Valley (in the valley of Sulphur Springs Creek) and shows unidentified light-toned strips and round features of ground disturbance; a bridge extends across the creek from this area. A similar pattern is noted outside the site area on hills 0.5 mile east of the North Valley and in a fenced homestead surrounded by a line of trees approximately 0.5 mile south of the mouth of the South Valley. The pattern may represent agricultural activities not related to the Benicia Arsenal.

- **Ridge:** A prominent northwest trending fence extends along the southwest flank of the Ridge and reaches the bottom of the South Valley's ravine. Another fence zigzags across the ridge to the northeast, toward the North Valley.

- **South Valley:** A small stand of trees is noted to the southeast in the South Valley. No grading activity is observed. Two springs are noted on the north slope of the upper reaches of the valley, one below the northern end of the prominent northwest trending fence, and the other below what is now Andrew Court. A trail is visible in the bottom of the South Valley.

Photographs: 16PS 5 M782-1:V: 101 (Figure A-4) and 16PS 51M782-1:V: 102 (Figure A-5)
16PS 5 M782-1:V: 114 (Figure A-6) and 16PS 51M782-1:V: 115 (Figure A-7)

Source: DIA, Archive II, Benicia, CA, Can No. 3A927

Photo Scale: 1:20,000

Date: 1-16-1945

General Description of Photographs:

The Project Site is within the coverage of these four photographs. The Project Site is identifiable in the eastern half of Photograph 101; it is in the southeastern portion of Photograph 102. Portions of the Project Site are visible on Photographs 114 and 115. The Project Site is situated in the northwestern quarter of Photograph 114 and on the western edge of Photograph 115. Lake Herman is visible to the northwest of the Project Site on Photographs 101 and 102 but is not visible on Photographs 114 and 115. The dam appears higher than in the previous photograph and a new spillway has been constructed in a topographic saddle southwest of the dam. A number of railroad spurs have been constructed to the east of the Project Site and are clearly visible in all four photographs. Four spurs are immediately adjacent to the site: spur A at the mouth of South Valley; spur B at the southeast end of the Ridge; spur E at the intersection of Midway Road and Sulphur Springs Creek; and spur G on the northeast side of the North Valley ridge. The site perimeter road, Ledo Road, is clearly visible extending from the mouth of the South Valley around the end of the Ridge into the lower reaches of the North Valley and continuing on the west side of Sulphur Springs Road. Buildings and roads associated with the Benicia Arsenal are clearly visible to the south of the Project Site. Portions of Suisun Bay are visible in the southeastern corner of Photographs 114 and 115. There is one complex of buildings approximately 2,300 feet south of the South Valley, possibly a homestead; another building, possibly a barn, is situated on top of a hill just south of the present-day McAllister Drive Land Bridge.

Project Site Description:

These photographs appear to pre-date any construction on the Project Site portion of the Benicia Arsenal.

- **North Valley:** There appear to be no man-made changes to the North Valley since 1937. A small earthflow is apparent in the future Howitzer Test Facility area. The fenced area with light strips and round features outside of the Project Site northeast of the North Valley noted in the 1937 photograph has been graded for the construction of spur G and is no longer visible. The Project Site fence line is visible, although no TNT Strips or any other structures (e.g., Howitzer Test Facility, Ammunition Renovation/Primer Destruction Site) are visible in the North Valley on Photographs 101-102. There appears to be some ground disturbance, not related to Arsenal activity, just south of the prominent east-west-trending tree line in the southeastern portion of the North Valley. Midway Road is faintly visible. The North Valley Military Landfill is not visible in any of these photographs. The prominent tree line/brush that runs east and west from the railroad spurs is evident in Photographs 114-115. Grading activity is noted off-site in the lower reaches of the North Valley related to the construction of Ledo Road, and rail spur E is seen at the south end of the North Valley. An earthflow associated to a spring (?) is noted in the area of the future Howitzer Test Facility.

- **Ridge:** There is no ground disturbance or activity noted along the Ridge area. No structures are visible.

- **South Valley:** There is no evidence of activity noted within the South Valley in these photographs. Ledo Road extends from the South Valley around the southeast end of the Ridge

Photographs: VVWZM7AMS 1 Dec 47 43 827 (Figure A-8) and
VVWZM7AMS 1 Dec 47 43 828 (Figure A-9)

Source: DIA

Photo Scale: 1:27,000

Date: 12-1-1947

General Description of Photographs:

The Project Site is situated in the central portion of Photograph 827 and the central-western portion of Photograph 828. Lake Herman is visible to the northwest of the Project Site in both photographs. Railroad tracks and spurs are visible to the east of the Project Site. By 1947, there are a number of buildings in the Valero refinery area. More buildings have been constructed on the Benicia Arsenal site to the southeast, which is visible on both photographs. A number of boats and/or ships appear to be docked in Suisun Bay, as noted in the southeastern corner of Photograph 828. There is a small complex of buildings between D-1, D-2, and the Valero refinery buildings, near the South Valley portion of the Project Site.

Project Site Description:

- **North Valley:** Portions of the Howitzer Test Facility, Ammunition Renovation/Primer Destruction Site, the North Valley Military Landfill, and Midway Road have been constructed at this time. A fence surrounds these facilities. Linear ground disturbances interpreted as the TNT Strips are also visible. There are four TNT Strips (#1, #2, #4, #5). Ground disturbance is evident between TNT Strip #1 and TNT Strip #2, and between TNT Strip #2 and TNT Strip #5. Midway Road links the Ammunition Renovation/Primer Destruction Site and Howitzer Test Facility to Ledo Road. There are two small, square structures identified within an oval area surrounded by an earth berm within the Ammunition Renovation/Primer Destruction Site. It is possible that these structures are the "squirrel cages" (ca. 1945-1947) and the Powder Loading Room (Building 183). Immediately to the east is a large, rectangular structure, probably the Test Firing Butts (Building 182). The Test Firing Tunnels (Building 181) are visible. On the southeastern edge of the oval Ammunition Renovation/Primer Destruction Site is a dirt road, running northwest to southeast to the location of the Test Firing Tunnels. There appear to be three temporary structures or stockpiles of soil/debris in this area. The North Valley Military Landfill area is visible to the northeast of Building 181. The Project Site fence line is visible on the western edge of the site.

- **Ridge:** On the south edge of the oval Ammunition Renovation/Primer Destruction Site is a dirt road running south toward the Ridge area; this road is shaped like a "J" and links the Dynamite Burn Site with the facilities in the North Valley. At the end of the "J" is an area reported as a truck turnaround (the Dynamite Burn Site was reportedly to the north of this truck turnaround). A dirt road is seen above the truck turnaround area and leads to a possible sentry guardhouse to the south. The Dynamite Burn Site is visible as a faint criss-cross pattern of light and dark strips, which are interpreted to represent the burnt dynamite strips. No buildings exist within or north of the truck turnaround. The ground shows few signs of disturbance within the Dynamite Burn Site.

- **South Valley:** The Flare Site and Demolition Sites #1 and #2 are visible on the south side of the valley; Demolition Site #3 is visible on the north side of the valley. There is a dirt road leading to the Flare Site and Demolition Sites #1 and #2 through the valley. There is no evidence of grading activity noted in the South Valley. A small square structure (lookout tower) is visible approximately above Demolition Site #3 on the north slope of the valley next to the northwest-trending fence.

Photographs: 3-122 (Figure A-9A) and 3-123 (Figure A-9B); GS-EF

Source: U. S. Geological Survey

Photo Scale: 1:28,000

Date: 3-3-1948

General Description of Photographs:

These two photographs cover the Project Site. The site is identifiable in the south-central portion of Photograph 3-122; it is in the north-central portion of Photograph 3-123. Lake Herman is visible to the northwest of the Project Site on both photographs. The railroad spurs and the site perimeter road are visible. Buildings and roads associated with the Benicia Arsenal are visible to the south of the Project Site. Portions of Suisun Bay are visible in the southeastern corner of both photographs. The homestead and barn identified previously south of the present-day McAllister Drive Land Bridge are visible.

Project Site Description:

- **North Valley:** The five numbered TNT Strips (#1 to #4) are visible. A sixth unnumbered, discontinuous TNT Strip is visible between Strips #3 and #4. Light toned bands of disturbed ground parallel to the TNT Strips are visible. Other bands of disturbed ground parallel to the strips are visible to the northeast. Similar bands of disturbed ground but oriented at an angle are visible a short distance to the northwest of the strips. In the Howitzer Test Facility, only the Test Firing Tunnels (Building 181) and the Test Firing Butts (Building 182) are visible. In the Ammunition Renovation/Primer Destruction Site the two wooden buildings are one temporary canvas shelter are visible. The North Valley Military Landfill is visible. Midway Road and the "J"-shaped road are visible. A building pad is visible adjacent to the "J"-shaped road immediately south of the Ammunition Renovation/Primer Destruction Site. The security fence and the site fence are visible.

- **Ridge:** Two prominent dark-toned strips oriented NE-SW across the top of the Ridge are interpreted to represent the Dynamite Burn Site. That area exhibits significant ground disturbance with several trails crossing it. The "J"-shaped road wraps around the Dynamite Burn Site. A trail extends from the end of this road to the south and east to connect with another trail that extends from the fence to Demolition Site #3. Several trails are visible throughout the Ridge, and a jagged band of disturbed ground with sparse vegetation criss-crosses the southeastern half of the Ridge top.

- **South:** The three demolition sites and the Flare Site are visible. The access road is visible and extends west of Demolition Site #3 to the bottom of the valley, from where a trail extends up the north flank of the valley toward the fence. An unidentified object, possibly a container, is visible at the upper end of Demolition Site #1.

Photographs: ABO-3K 135 (Figure A-10) and ABO-3K 144 (Figure A-11)

Source: U.S. Department of Agriculture

Photo Scale: 1:20,000

Date: 8-3-1952

General Description of Photographs:

The Project Site is situated in the north-central portion of Photograph 135. A portion of the Project Site is visible on the eastern edge of Photograph 144. Stereoscopic coverage of the photographs is marginal because they are from adjacent flight lines. Lake Herman is visible to the northwest of the Project Site on both photographs. Railroad spurs are visible to the east of the Project Site. There are a number of buildings associated with the Benicia Arsenal in the Valero refinery area. The Benicia Arsenal is visible to the southwest of the Project Site on Photograph 135. The Suisun Bay is visible in the southeastern corner of Photograph 135. Southampton Bay is visible on the southwest corner of Photograph 144.

Project Site Description:

- **North Valley:** Five TNT Strips, the Powder Loading Room (Building 183), and the Test Firing Butts (Building 182) in the Howitzer Test Facility are visible in the 1952 photograph. The ground disturbance between the TNT Strips noted in the 1947 photograph is no longer apparent. Midway Road, Ledo Road and the prominent east-west-trending tree line are also visible. There is a small road leading to this location. The North Valley Military Landfill, just east of the Test Firing Tunnel location, appears faintly. The property fence line is visible along the western boundary of the Project Site. There is some ground disturbance noted in the Ammunition Renovation/Primer Destruction Site. Several structures are noted, including what appear to be wooden buildings, canvas shelters and metal tanks ("squirrel cages"). Similar structures are seen in a January 1950 photograph taken at ground-level (see Figure 2-9 of this document). A dark toned area in Spur E is interpreted as a possible burn cage based on its appearance and the description in the RRR (Jacobs Engineering, 1999).

- **Ridge:** A faint network of dirt roads converges on the Dynamite Burn Site from all directions. The "J"-shaped road links the Dynamite Burn Site to the facilities in the North Valley. There is a dark area at the truck turnaround. The criss-cross pattern noted in the 1947 photographs is visible. Neither the soil/debris piles nor grading are visible along the Ridge. Rail spur B appears outside of the Project Site at the south end of the ridge. Ledo Road is visible.

- **South Valley:** The only activities visible in the South Valley are a few roads and a disturbed area extending into the mouth of the valley related to the construction of rail spur A. This disturbed area lies along the southeastern border of the South Valley and the Project Site boundary. The major road (Ledo Road) access extends westward from this area. Several other smaller roads/trails also cross the South Valley. Demolition Site #3 is visible. The road leading to the area is visible around the Flare Site/demolition sites. Two springs noted in the 1937 photographs are visible on the north slope of the South Valley.

Photographs: 146 6inv (Figure A-12) and 147 6inv (Figure A-13)

Source: unknown

Photo Scale: 1:24,000 (calculated)

Date: 5-5-1960

General Description of Photographs:

The Project Site is situated in the east-central portion of Photograph 146; it is in the northeastern quarter of Photograph 147. Lake Herman is visible to the northwest of the Project Site on both photographs. Railroad tracks and spurs are still clearly visible to the east of the Project Site; some of the tracks may have been removed from the spurs. There are a number of buildings associated with the Benicia Arsenal in the Valero refinery area. The Benicia Arsenal is visible to the south of the Project Site. Suisun Bay is not visible on Photograph 146 but is visible in the southeastern corner of Photograph 147. A number of boats and/or ships appear to be docked in Suisun Bay, as noted in the southeastern corner of Photograph 147; Benicia Bridge is also visible. The photograph prints are grainy and of low quality.

Project Site Description:

- **North Valley:** There appears to be an area of recent grading that is lighter than the surrounding area in the Howitzer Test Facility and the Ammunition Renovation/Primer Destruction Site not visible in previous photographs. The Powder Loading Room (Building 183), the Test Firing Tunnels (Building 181) and the Test Firing Butts (Building 182) are visible. There is evidence of ground disturbance in the area surrounding the North Valley Military Landfill. The ground disturbance has produced scarring in this area that appears lighter than the surrounding area; this disturbance was not observed in previous photographs of the North Valley. None of the buildings associated with the Ammunition Renovation/Primer Destruction Site are visible in these photographs. Midway Road and the prominent east-west-trending tree line are visible in these photographs. Four TNT Strips are also visible; TNT Strip #3 is not visible.

- **Ridge:** The Dynamite Burn Site is visible in these photographs. Light shaded areas suggest grading activities at the Dynamite Burn Site, as well as in the southern part of the Ridge area (i.e., toward the South Valley). South of the prominent east-west-trending tree line that borders the southeastern edge of the North Valley is a light-colored, depressed area that follows the natural relief of the topography. There is evidence of road grading at the location of the soil/debris stockpiles. The "J"-shaped road, which links the Dynamite Burn Site to the North Valley, is visible. The Project Site fence line is prominent along the west edge of the Ridge.

- **South Valley:** There is disturbance along the South Valley from the off-site railroad tracks and westward. Most of this disturbance appears lighter than the surrounding area and includes the Flare Site and demolition sites. The Flare Site and the three demolition sites are visible.

Photograph: SOL 1-60 (Figure A-14), SOL 1-61 (Figure A-15), and YOL 1-59 (Figure A-16)

Source: Geonex

Photo Scale: 1:24,000

Date: 7-2-1962

General Description of Photographs:

The Project Site is identifiable in the central-western section of Photograph SOL 1-60 and the southwestern corner of Photograph SOL 1-61. Portions of the Project Site are in the northwestern corner of Photograph YOL 1-59. Lake Herman is situated to the northwest of the Project Site, which is identifiable in the northwestern quarter of Photograph SOL 1-60 and in the southwestern quarter of Photograph SOL 1-61. Lake Herman is not visible in Photograph YOL 1-59. Railroad tracks and spurs are still clearly visible to the east of the Project Site. There are a number of buildings associated with the Benicia Arsenal in the Valero refinery area. The Benicia Arsenal is visible to the south of the Project Site. Suisun Bay is visible to the southeast in Photographs SOL 1-60 and YOL 1-59, but is not visible in Photograph SOL 1-61. A number of boats and/or ships appear to be docked in Suisun Bay, as noted in the southeastern corner of Photograph YOL 1-59.

Project Site Description:

- **North Valley:** Four TNT Strips are clearly visible. The Howitzer Test Facility is visible; the southern portion of this area appears to be surrounded by trees not noted in previous photographs. The Test Firing Tunnels (Building 181), the Test Firing Butts (Building 182), Buildings 540 and 542, and the Powder Loading Room (Building 183) are visible. Other buildings associated with the Ammunition Renovation/Primer Destruction Site are not visible. There is visible ground disturbance to the east and southeast of the Howitzer Test Facility, at the North Valley Military Landfill area. Both the Howitzer Test Facility and the Ammunition Renovation/Primer Destruction Site appear to be contained inside of a fence, which is noted in previous photographs since 1947. The Ammunition Renovation/Primer Destruction Site appears disturbed. Midway Road is visible. The prominent east-west tree line is visible. A dark area is visible off-site in rail spur E (burn cage?).

- **Ridge:** The "J"-shaped road extending south from the Howitzer Test Facility to the Ridge is visible. The Dynamite Burn Site is visible near the end of the "J"-shaped road in these photographs. Some disturbance is shown along the Ridge, including Ledo Road visible running south from the edge of the prominent east-west tree line in the southeastern portion of the North Valley toward the South Valley. A darker area of vegetation that contrasts with the surrounding lighter vegetation of the area is noted along the east edge of the Ridge; this darker area was not apparent in any prior photographs.

- **South Valley:** Faint traces of the Flare Site and the Demolition Site #3 are visible. Roads leading to these areas are faint.

Photograph: GS-VBZJ 3-68 (Figure A-17) and 3-69 (Figure A-18)

Source: USGS

Photo Scale: 1:24,000

Date: 4-22-68

General Description of Photographs:

This description is based on an interpretation of scanned copies of the original photographs of medium quality. The Project Site is identifiable in the north central section of Photograph 3-68 and the central portion of Photograph 3-69. Lake Herman is identifiable in the west center of Photograph and in the northwestern quarter of Photograph 3-69. Railroad tracks and spurs are still clearly visible to the east of the Project Site. There are a number of buildings associated with the Benicia Arsenal in the Valero refinery area; however, many tanks are present on the Valero refinery property. The Benicia Arsenal is visible. Suisun Bay is visible to the southeast in both Photographs. The Benicia Bridge is visible in the southeast corner of Photograph 3-69. A number of boats and/or ships appear to be docked in Suisun Bay, as noted in the southeastern corner of both photographs.

Project Site Description:

- **North Valley:** The North Valley area shows more vegetation than the surrounding area since 1962. Five TNT Strips are clearly visible. The Howitzer Test Facility, the Ammunition Renovation/Primer Destruction Area and the polygonal security fence are visible. The Test Firing Tunnels (Building 181), the Test Firing Butts (Building 182), the Powder Loading Room (Building 183), and Buildings 540 and 542 are visible. One structure is visible in the Ammunition Renovation/Primer Destruction Site and may represent a wooden building at the east end of the berm. There appears to be an elongated structure along the side of the berm not observed in previous photographs. Midway Road is visible. The Project Site fence line is visible along the western edge of North Valley. The prominent east-west tree line is visible.

- **Ridge:** The Dynamite Burn Site is visible as a light colored northeast-southwest strip. An unidentified structure is on the hilltop immediately north of the strip. The "J"-Road is visible and has been extended around the Dynamite Burn Site to the west and southwest toward the west fence, and from there to the northwest toward the northeast trending fence.

- **South Valley:** The Flare Site and Demolition Sites #2 and #3 are visible. The access road leading to these areas is visible. An unidentified structure is visible along the west fence approximately 600 feet northwest of Demolition Site #3. A road is visible along the west fence and extends north approximately to the present athletic fields area.

Photograph: 3594-1-179 (Figure A-19), 3594-1-180 (Figure A-20), 3594-1-181 (Figure A-21), 3594-1-191 (Figure A-22), and 3594-1-192 (Figure A-23)

Source: Geonex

Photo Scale: 1:24,000

Date: 7-10-1973

General Description of Photographs:

Only the northern portion of the Project Site is visible in the south-central edge of photograph 3594-1-179. The entire parcel is visible in the center of Photographs 3594-1-180 and 1-181. Photographs 3594-1-191 and 3594-1-192 contain only the eastern side of the Project Site. Lake Herman is visible on Photographs 179-181, but is not visible on Photographs 191 and 192. Former railroad spurs, now occupied by warehouses, line the eastern edge of the Project Site. There is a plowed area south of the Project Site along the Valero refinery property line. Tanks are visible on the Valero refinery property. Tract housing and other development is now present in the location of the former Benicia Arsenal. The Suisun Bay is not visible in any of these photographs.

Project Site Description:

- **North Valley:** Five TNT Strips are visible; a sixth unnumbered TNT Strip appears as well between TNT Strips #3 and #4. This additional TNT Strip was not observed on previous photographs. Within the Howitzer Test Facility the Test Firing Butts (Building 182), the Test Firing Tunnels (Building 181), the Powder Loading Room (Building 183), and Buildings 540 and 542 are visible. The polygonal security fence around the Howitzer Test Facility is no longer visible. One wooden building associated with the Ammunition Renovation/Primer Destruction Site is visible. There is a building visible south of the TNT Strips on the "J"-shaped road next to the Ammunition Renovation/Primer Destruction Site; this building was observed on the 1968 photographs.

- **Ridge:** The "J"-shaped road traveling southwest from the North Valley to the Dynamite Burn Site is visible. The Dynamite Burn Site is fainter than in previous photographs. There is a dirt road running southwest from the Dynamite Burn Site, traveling southwest to a point where it meets Ledo Road, in the South Valley, parallel to the property fence line. The disturbance noted in 1962 south-southeast of the tree line/Dynamite Burn Site is visible; no soil/debris piles are visible on the west edge of the Ridge. An unidentified structure occurs along the fence above Demolition Site #3.

- **South Valley:** The Flare Site and Demolition Sites #1, #2, #3 are visible. There is an access road leading to these areas. In Photograph 192, there are some graded roads visible from the tree line, extending in a crescent shape to the south edge of the Project Site; these roads extend toward the Flare Site and demolition sites. One of the springs observed previously appears south of the Project Site fence.

Photograph: Unnumbered (Figure A-24)

Source: Unknown

Photo Scale: 1:6,000 (calculated)

Date: 5/23/1975

General Description of Photographs:

This is a blurry copy of one unnumbered, otherwise unidentified photograph showing the entire Project Site in the middle. Ledo Road is clearly visible. Three high-tension power line towers are visible along the northeast flank of the Project Site. The southern shore of Lake Herman is visible on the extreme northwest corner of the photograph. Former railroad spurs A, B, E, G and F are visible.

Project Site Description:

- **North Valley:** TNT Strips #1, #2, # 4, and #5 are visible. TNT Strips #1 and #2 appear to be outside the fenced area. Within the Howitzer Test Facility the Test Firing Butts (Building 182), the Test Firing Tunnels (Building 181), the Powder Loading Room (Building 183), and Buildings 540 and 542 are visible. There appears to be some ground disturbance over the North Valley Military Landfill. The wooden building in the Ammunition Renovation/Primer Destruction Site closest to the Test Firing Butts is faintly visible in this photograph and there is a light-toned area to the west that may represent a pad observed in the 1950 ground-level photograph (see Figure 2-9 of this document). The fence around the Howitzer Test Facility is not visible.

- **Ridge:** The "J"-shaped road traveling southwest from the North Valley to the Dynamite Burn Site is visible; the road extends around the burn area toward the west fence. The Dynamite Burn Site is not visible. The lookout tower along the west fence above Demolition Site #3 is visible.

- **South Valley:** The Flare Site and Demolition Sites #2 and #3 are visible in the photograph, and the access road leading to these areas is clearly visible. Demolition Site #3 is visible. No evidence of grading is noted on these photographs.

Photographs: 83103-1 (Figure A-25) and 83103-2 (Figure A-26)

Source: unknown

Photo Scale: 1:14,400

Date: 5-12-1983

General Description of Photographs:

The Project Site is situated in the central portion of Photograph 83103-1 and the south-central portion of Photograph 83103-2. Lake Herman is visible to the northwest of the Project Site on both photographs. No railroad tracks are visible, although the former beds and spurs are visible to the east of the Project Site. Several warehouses have been constructed on the abandoned rail spurs. Valero refinery tanks and buildings are visible to the south. The Benicia Arsenal and the Suisun Bay are not visible in the photographs. A high-tension power line is visible along the northeastern side of the Project Site.

Project Site Description:

- **North Valley:** The Project Site fence line is very faint. Five TNT Strips are visible. There is ground disturbance visible within the Ammunition Renovation/Primer Destruction Site that was not observed in previous photographs. The Test Firing Butts (Building 182), the Powder Loading Room (Building 183), and the possible remnants of the "squirrel cages" are visible; ground disturbance is noted in the middle of this area. Buildings 540 and 542, and the various buildings associated with the Ammunition Renovation/Primer Destruction Site are also visible in these photographs. The north face of the entrance to Building 181 (Test Firing Tunnels) is clearly visible as an east-west-trending linear feature. A dirt road lies between the buildings in the northern half of the Howitzer Test Facility. This road extends to the east and southeast of Building 181. The North Valley Military Landfill area is faintly visible, although a network of dirt roads traverses the area. Midway Road is visible.

- **Ridge:** The Dynamite Burn Site is faintly visible, surrounded by a number of dirt roads and trails. These roads or trails are not as numerous in the 1973 photographs. Only a portion of the "J"-shaped road remains visible. A ring-like disturbed area is visible on the ridge top approximately 500 feet northwest of the Dynamite Burn Site.

- **South Valley:** Only Demolition Site #3 is clearly visible on the photograph. A box-like structure (foundation for a lookout tower?) is visible along the northwest-trending fence between the Dynamite Burn Site and Demolition Site #3. From the Ridge area to the south and southeastward, there are a number of dirt roads and trails, and surface scarred areas previously observed to have some ground disturbance (especially around the area of Demolition Site #1, the Flare Site, and the demolition sites). Several of these roads were observed in the 1973 photographs. The access road to the Flare and demolition sites is shown affected by a landslide in the area currently covered by the McAllister Drive Land Bridge.

Photograph: WAC-88CA 29-44 (Figure A-27) and WAC-88CA 29-45 (Figure A-28)

Source: Geonex

Photo Scale: approximately 1:34,700 (calculated from contact print) (152.35mm film)

Date: 9-12-1988

General Description of Photographs:

The Project Site is situated in the central portions of Photographs WAC-88CA 29-44 and WAC-88CA 29-45 (Figure A-25). Lake Herman is situated to the northwest of the Project Site and is visible on both photographs. There are warehouses at the site of the former railroad spurs to the east of the Project Site. Tanks and buildings are present on the Valero refinery property, which lies to the southeast of the Project Site. More housing tracts are being constructed to the west and southwest of the Project Site. The entire southern portions of the former Benicia Arsenal have been developed. Suisun Bay and the Benicia Bridge are visible in the southeastern corner of Photograph 29-44. Southampton Bay is visible on the southwestern area of Photograph 29-44.

Project Site Description:

- **North Valley:** The Project Site fence line is very faint but a disturbed strip along it is visible (firebreak?). Midway Road and a number of other roads are visible in the North Valley. Only traces/outlines of former military use areas remain. None of the buildings associated with the Howitzer Test Facility or the Ammunition Renovation/Primer Destruction Site are visible, except for the Test Firing Tunnels (Building 181) and the foundations of the former structures. Trails are visible over the North Valley Military Landfill area. To the west of these areas is an area of disturbance that was visible in 1973 and 1983. Only faint traces of three TNT Strips are visible. The prominent east-west-trending tree line is visible.

- **Ridge:** The Dynamite Burn Site is visible. There are several dirt roads/trails present throughout the Ridge area. The "J"-shaped road is visible. There is a small, cleared area visible on the western edge of the Ridge.

- **South Valley:** The Flare Site and Demolition Site #3 are visible. Several roads, including the one used to access the Flare Site and demolition sites, are observed throughout the South Valley. No evidence of grading is visible. The access road has been rerouted around the toe of the landslide that was visible in 1983.

Photographs: SOL 136 AV 3601 4 19 (Figure A-29) and SOL 136 AV 3601 4 20 (Figure A-30)

Source: Pacific Aerial Surveys

Photo Scale: 1:36,000

Date: 7-18-1989

General Description of Photographs:

The Project Site is situated in the southwestern quarter of Photograph SOL 136 AV 3601 4 19 and in the northwestern quarter of Photograph AV 36014 20. Lake Herman is visible to the northwest of the Project Site in both photographs. Very little of the railroad tracks is visible to the east. Most of the spurs have been replaced with warehouses and other structures. Tanks and buildings are present on the Valero refinery property, southeast of the Project Site. More housing tracts are being constructed to the west and southwest of the Project Site. The entire southern portions of the former Benicia Arsenal have been developed. Suisun Bay and the Benicia Bridge are visible in the southeastern corner of both photographs. A number of boats and/or ships appear to be docked in Suisun Bay.

Project Site Description:

- **North Valley:** It appears that little of the Howitzer Test Facility remains, and faint ground disturbance is visible at the Ammunition Renovation/Primer Destruction Site. The Powder Loading Room (Building 183), the Test Firing Butts (Building 182), and Test Firing Tunnels (Building 181) are visible. Two of the TNT Strips are faintly visible. The North Valley Military Landfill is faintly visible. Several trails are visible throughout the Howitzer Test Facility. The prominent east-west-trending tree line remains visible. It appears that the Project Site boundary fence line has been replaced with a dirt road or a firebreak has been constructed along it; this appearance is especially strong along the western edge. Midway Road is visible.

- **Ridge:** The Dynamite Burn Site is visible but is fainter than in previous photographs. Several roads extend from the burn area to the "J"-shaped road. There is an area of disturbance on the top of the ridge to the northwest. There are many dirt roads present throughout the Ridge.

- **South Valley:** Only Demolition Site #3 is visible in the South Valley. The access road is visible; it has been rerouted around the toe of the landslide identified previously. Two other prominent roads cross the South Valley in the vicinity of Demolition Site #3.

Photographs: WAC North Bay 90 6-23 (Figure A-31) and WAC North Bay 90 6-24 (Figure A-32)

Source: WAC Corporation

Photo Scale: approximately 1:17,500 (calculated)

Date: 5-13-1990

General Description of Photographs:

These are color aerial photographs. The Project Site is situated in the northwestern quarter of Photograph 90 6-23 and in the southwestern quarter of Photograph 90 6-24. Lake Herman is visible to the northwest of the Project Site in both photographs. Railroad tracks and spurs are no longer visible. Warehouses are situated to the east and southeast of the Project Site. Tanks and buildings are present on the Valero refinery property, southeast of the Project Site. More housing tracts are being constructed to the west of the Project Site. Housing tracts and other development are present to the south of the Project Site. The Suisun Bay is visible on Photograph 6-23.

Project Site Description:

- **North Valley:** The Test Firing Butts structure (Building 182) is visible, along with the Powder Loading Room (Building 183). The Ammunition Renovation/Primer Destruction Site and one wooden building are visible. The TNT Strips are partially obscured by dirt roads in the area. The north-facing entrance of the Test Firing Tunnels (Building 181) is prominently visible. Buildings 540 and 542 are not visible. The North Valley Military Landfill is obscured by a number of dirt roads and trails. The east-west-trending tree line is visible. The fence line is faintly visible, as is Midway Road.

- **Ridge:** The tree line noted in the North Valley is visible, and extends into the Ridge area. The "J"-shaped road leading to the Dynamite Burn Site and the property fence road are visible. A small building is observed south of the approximate middle of the tree line; the building (lookout tower?) had been noted in the 1947 photographs. There are many dirt roads and trails along the Ridge from off-highway recreational vehicles. A dirt road extends off-site to Kearney Street along the top of the Ridge. There are numerous roads throughout this area.

- **South Valley:** There are still a number of roads and trails throughout the South Valley. The Flare Site and demolition sites are not visible due to the large number of roads/trails (including the original road that was used to access these sites) that cross the area. Construction of the McAllister Drive Land Bridge has begun. Grading activities are noted at the head of and south of the South Valley. Housing has been constructed to the west and southwest of the Project Site.

Photographs: Not labeled with Identification numbers (Figures A-33 and A-34)

Source: unknown

Photo Scale: 1:15,600

Date: 9-??-1990

General Description of Photographs:

The Project Site is situated in the north-center of both color photographs. Lake Herman is visible to the northwest of the Project Site in both photographs. Railroad tracks and spurs are no longer visible. Warehouses are situated to the east of the Project Site. Tanks and buildings are present on the Valero refinery property, southeast of the Project Site. More housing tracts are being constructed to the west of the Project Site. Housing tracts and other development are present to the south of the Project Site. The Suisun Bay is not visible in either of the photographs.

Project Site Description:

- **North Valley:** The TNT Strips are not visible. Several off-highway recreational vehicle dirt roads/trails traverse the area. The Ammunition Renovation/Primer Destruction Site and one wooden building are visible. The North Valley Military Landfill is visible. A dirt road has replaced the fence line on the western edge of the Project Site. There is some grading activity above the Test Firing Tunnels (Building 181). Buildings 181, 182 and 183 are visible. The east-west-trending tree line is still prominent. Midway Road is very faint and is surrounded by a number of additional roads.

- **Ridge:** The Dynamite Burn Site is graded with visible changes to the elevation along the top of the Ridge. More dirt road/trails are apparent throughout the Ridge; these are straighter and wider than in previous photographs. The "J"-shaped road is mostly graded over, and additional dirt roads appear in that area.

- **South Valley:** Grading activities are identified off-site to the south, southwest, and west edges of the Project Site. The McAllister Drive Land Bridge that connects the southern portion of the South Valley to the Ridge area has been constructed. A road network covers much of the South Valley area. Demolition Site #3 is still visible, but the Flare Site, Demolition Sites #1 and #2, and the access road are no longer visible. There is an east-west-trending run-off control ditch along the south side of the South Valley. Graded pads being prepared for development are also visible south of the Project Site.

Photographs: 91000 2 6-3 (Figure A-35) and 91000 2 6-4 (Figure A-36)

Source: Geonex

Photo Scale: 1:24,000

Date: 02-17-1991

General Description of Photographs:

The Project Site is noted in the northern half of Photograph 91000 2 6-3 and in the center of Photograph 91000 2 6-4. Railroad tracks and spurs are no longer visible. Warehouses are situated to the east of the Project Site. Tanks and buildings are present on the Valero refinery property, southeast of the Project Site. More housing tracts are being constructed to the south and west of the Project Site. Housing tracts are now present to the south of the Project Site. The Suisun Bay and the Benicia Bridge are visible in the southeast corner of Photograph 91000 2 6-3. Southampton Bay is visible on the southwest corner of the same photograph.

Project Site Description:

- **North Valley:** The Project Site fence line is extremely faint. The tree line is still prominent. East of the Howitzer Test Facility, there is a disturbed area in the shape of a figure eight. This figure eight was not observed in any of the previous photographs. Portions of Buildings 181, 182, 540, and 542 are visible. The wooden building associated with the Ammunition Renovation/Primer Destruction Site is visible. Portions of the TNT Strips are visible. The Ammunition Renovation/Primer Demolition Site is visible. Grading west and southwest of the Howitzer Test Facility is noted, as are soil/debris piles on the western side of the Project Site. The North Valley Military Landfill is visible and ground disturbance is visible over it. Midway Road is visible. Several other roads cross the North Valley.

- **Ridge:** There are many dirt trails/roads throughout the Project Site; several of these were noted in previous photographs. The grading along the Ridge was expanded to include additional adjacent areas to the west and north of the previous grading. The graded areas appear lighter than the surrounding area, and several soil piles are noted on the northwestern end of the grade area. The "J"-shaped road and the Dynamite Burn Site are no longer visible due to grading.

- **South Valley:** Grading for housing and the east-west-trending run-off control ditch is noted to the south and southwest throughout the South Valley. Only the bench of Demolition Site #3 is still visible. Access roads leading to the Flare Site and Demolition Sites #1 and #2 are visible. The McAllister Drive Land Bridge is complete.

Photograph: SOL AV-4070 24 48 (Figure A-37) and SOL AV-4070 24 49 (Figure A-38)

Source: Pacific Aerial Surveys

Photo Scale: 1:12,000

Date: 6-21-1991

General Description of Photographs:

The Project Site is situated in the north-center of Photograph SOL AV-4070 24 49 and in the south-center of Photograph SOL AV-4070 24 48. Railroad tracks and spurs are no longer visible. Warehouses are situated to the east of the Project Site. Tanks and buildings are present on the Valero refinery property, which lies to the southeast of the Project Site. More housing tracts are being constructed to the south and west of the Project Site. Housing tracts and other development are now present to the south of the Project Site in the former Benicia Arsenal.

Project Site Description:

- **North Valley:** This photograph is similar to the February 17, 1991, photograph, except that the figure eight shaped dirt road/trail is no longer visible. The TNT Strips are visible. There has been grading to the west and southwest of the Howitzer Test Facility. Soil/debris piles are identified on the western edge and in the south-central portion of the property. Many dirt trails are evident in the North Valley. These trails had been observed in previous photographs of the North Valley. The Test Firing Butts (Building 182), the Powder Loading Room (Building 183), the Test Tunnels (Building 181), and Buildings 540 and 541 are visible. The wooden building at the Ammunition Renovation/Primer Destruction Site is visible. Midway Road is visible. The North Valley Military Landfill is visible but crossed by several trails. The fence line is visible.

- **Ridge:** The Dynamite Burn Site is not visible. Soil/debris stockpiles are present on the Ridge. The "J"-shaped road is not visible. Grading has occurred along the western edge of the Ridge and southward toward the South Valley.

- **South Valley:** Remnants of the access road to the Flare Site and demolition sites are visible. The run-off control ditch along the south side of the South Valley is visible. The Flare Site and Demolition Sites #1 and #2 are not visible. The bench of Demolition Site #3 is visible. The McAllister Drive Land Bridge is visible. Housing tract lots are graded to the south and west of the Project Site; however, there are none within the Project Site.

Photograph: SOL AV-4535 12 17 (Figure A-39) and SOL AV-4535 12 18 (Figure A-40)

Source: Pacific Aerial Surveys

Photo Scale: 1:12,000

Date: 9-3-1993

General Description of Photographs:

The Project Site is in the south-central quarter of Photograph 17 and in the northwestern quarter of Photograph 18. Lake Herman is situated to the northwest of the Project Site and is visible on both photographs. Railroad tracks and spurs are no longer visible. Warehouses are situated to the east of the Project Site. Tanks and buildings are present on the Valero refinery property, which lies to the southeast of the Project Site. Construction has begun on several athletic fields to the west of the Project Site. More housing tracts are being constructed to the south and west of the Project Site. Housing tracts and other development are present to the south of the Project Site.

Project Site Description:

- **North Valley:** The TNT Strips, the Test Firing Butts (Building 182), the Test Firing Tunnels (Building 181), and the Powder Loading Room (Building 183) are visible. Remnants of Building 540 and Building 542 are visible. The Ammunition Renovation/Primer Destruction Site and one wooden building are visible. Midway Road is visible. The North Valley Military Landfill is not visible. Ground disturbance activities associated with the dirt roads and trails in the area southeast of the TNT Strips, and to the south toward the Ridge area, are visible.

- **Ridge:** Grading since 1990 has removed visible signs of the Dynamite Burn Site. There are several soil/debris stockpiles on the Ridge. Only the northern portion of the "J"-shaped road is visible. There is a small, square area that appears to be a type of fenced enclosure on the southwestern edge of the westernmost portion of the graded area (soil/debris piles); this square area was not observed on previous photographs. South of the square enclosure is a high contrast, dark, circular area in a gully leading into the South Valley.

- **South Valley:** Disturbed areas are visible throughout the South Valley in 1993. The Flare Site and Demolition Sites #1 and #2 are not visible, but the bench of Demolition Site #3 is visible. Remnants of the road leading to these areas are visible. The run-off control ditch along the south side of the South Valley is visible. The McAllister Drive Land Bridge is visible in these photographs.

Photograph: Southampton X-1 (Figure A-41)

Source: Greiner

Photo Scale: 1:12,000

Date: 7-22-1995

General Description of Photograph:

This is high contrast Xerox copy of one aerial photograph, without stereoscopic coverage. The Project Site is in the middle of the photograph. Lake Herman is situated to the northwest of the Project Site and is visible on upper middle of the photograph. The locations of former railroad tracks and spurs are visible. Warehouses are situated to the east of the Project Site. Tanks and buildings are present on the Valero refinery property, southeast of the Project Site. Several athletic fields are visible to the west of the Project Site. Housing tracts construction to the south and west of the Project Site is visible. Grading for additional housing tracts north of South Valley is visible. Grading in the Ridge area is visible. McAllister Land Bridge is completed.

Project Site Description:

- **North Valley:** Only TNT Strips #1 and #2 are visible. The Test Firing Butts (Building 182), the Test Firing Tunnels (Building 181), and the Powder Loading Room (Building 183) are visible. Remnants of Building 540 and Building 542 are faintly visible. The Ammunition Renovation/Primer Destruction Site and one wooden building are visible. Midway Road is visible. The North Valley Military Landfill is not visible. Increased ground disturbance associated with the dirt roads and trails in the area southeast of the TNT Strips, and to the south toward the Ridge area, is visible.

- **Ridge:** There are additional soil/debris stockpiles on the Ridge. Only the northern portion of the "J"-shaped road is still visible. The square area observed in the 1993 photographs on the southwestern edge of the westernmost portion of the graded area is still visible. Additional dirt roads are visible on the Ridge.

- **South Valley:** The Flare Site and Demolition Sites #1 and #2 are not visible, but the bench of Demolition Site #3 is visible. Remnants of the road leading to these areas are visible. The run-off control ditch along the south side of the South Valley is visible. The McAllister Drive Land Bridge is complete, the south half is paved and the side slopes are covered with brushy vegetation. The roads in the off -site housing tract pad area are paved.

Photograph: SOLNO AV 5140 33 30 (Figure A-42) and SOLNO AV 5140 33 31 (Figure A-43)

Source: Pacific Aerial Surveys

Photo Scale: 1:24,000

Date: 4-26-1996

General Description of Photographs:

The Project Site is situated in the southwestern quarter of Photograph SOLNO AV5140 33 30 and the center of Photograph SOLNO AV 5140 33 31. Lake Herman is situated to the northwest of the Project Site and is visible on both photographs. Railroad tracks and spurs are no longer visible. Warehouses are situated to the east of the Project Site. Tanks and buildings are present on the Valero refinery property, which lies to the southeast of the Project Site. Completed athletic fields are to the west. More housing tracts are being constructed to the south and west of the Project Site. Housing tracts and other development are present to the south of the Project Site in the former Benicia Arsenal. The Suisun Bay is visible in the southeastern corner of Photograph SOLNO AV 5140 33 31.

Project Site Description:

- **North Valley:** Not much change is noted in the North Valley since 1993. Five TNT Strips are visible. The Howitzer Test Facility, including the Test Firing Butts (Building 182), the Powder Loading Room (Building 183), the Test Tunnel (Building 181), and Buildings 540 and 542 are still visible. The Ammunition Renovation/Primer Destruction Site and its associated buildings are not visible. Midway Road is visible; however, the North Valley Military Landfill is not visible. There is ground disturbance to the southwest of the Howitzer Test Facility. There is a clearly defined road traveling from west to southeast between the housing areas at the southern end of the Project Site near Kearny Street. The ground disturbance has been noted in previous photographs, while the road was not. There appear to be fewer dirt trails south of the TNT Strips than in previous photographs because more vegetation cover has overgrown the disturbed areas.

- **Ridge:** Grading has removed signs of the Dynamite Burn Site. Several soil/debris piles are visible. The remnants of the "J"-shaped road are visible. The square area noted on the 1993 photographs is visible; but the dark, contrasting, circular area is not.

- **South Valley:** Neither the Flare Site nor Demolition Sites #1 and #2 are visible, but Demolition Site #3 is visible. The old access road is still visible. The McAllister Drive Land Bridge is visible and appears paved to its center. The run-off control ditch is visible, and previously observed areas with ground disturbance have a greater amount of vegetative cover.

Photograph: SOL AV 5461 12 21 (Figure A-44)
SOL AV 5461 12 20 (Figure A-45)

Source: Pacific Aerial Surveys

Photo Scale: 1:12,000

Date: 7-28-1997

General Description of Photographs:

These are the most recent aerial photographs of the Project Site analyzed. The Project Site is in the center of the photographs. Lake Herman is situated to the northwest of the Project Site and is visible. Railroad tracks and spurs are no longer visible. Warehouses are situated to the east, while the Valero refinery property to the south includes a large number of tanks. A number of housing tracts are being developed to the west and southwest. Several roads in the Andrew Court housing area have now been paved. Completed athletic fields are also situated to the west. Housing tracts and other development are now present to the south of the Project Site in the former Benicia Arsenal. The Suisun Bay is not visible in this photograph.

Project Site Description:

- **North Valley:** Five TNT Strips (#1 through #5) are visible. All of the structures associated with the Howitzer Test Facility (Buildings 181, 183, 540, 542) and Ammunition Renovation/Primer Destruction Site are not visible, but the general outline of the area is visible. A debris stockpile occurs in the former Test Firing Butts (Building 182) area, and the outline of the building's foundation area is visible. Midway Road is visible. The area around the Test Firing Tunnels (Building 181) shows signs of disturbance, erosion and vegetation regrowth in the surrounding area. The North Valley Military Landfill is not discernible in 1997. Stockpile #3 is visible in the area previously occupied by Buildings 540 and 542 and is partially over the North Valley Military Landfill.

- **Ridge:** There are a number of soil/debris piles visible on the western edge of the Project Site along the Ridge. The area also contains the square, enclosed area, as noted previously. The dark circular area is visible in the same area as it was in 1993. Graded areas show signs of increased vegetative cover in those areas.

- **South Valley:** Off-site construction activities south of the South Valley are visible in the photographs. The Flare Site and Demolition Sites #1 and #2 are not visible; only Demolition Site #3 is visible. The former access road is less visible but shows evidence of erosion and is partially covered with brushy vegetation. Vegetation is denser than in previous photographs. McAllister Drive Land Bridge is visible and the southern half appears to be paved.

References

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Earth Tech, Inc., 2000. *Final Non-Ordnance and Explosives Remedial Investigation (RI)/Feasibility Study (FS) Work Plan, Tourtelot Cleanup Project, Benicia, California*, February 15.

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Pacific Aerial Surveys, 1993. Aerial photographs of Benicia Arsenal, Solano County, California, scale 1:12000, frames SOL AV 4535 12 17 and SOL AV 4535 12 18, September 3.

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U.S. Department of Agriculture, 1952. Aerial photographs of Benicia Arsenal, Solano County, California, scale 1:20000, frames ABO-3K-135 and ABO-3K-144, August 3.

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A-38 Photograph SOL AV-4070 24 49
A-39 Photograph SOL AV-4535 12 17 (9-3-1993)

Table A-1. List of Aerial Photographs Analyzed for the Project Site

Photograph/Set Number	Date	Nominal Scale	Source
ABO 52-31 and ABO 52-32	8-20-1937	1:20,000	National Archives Stereo Pairs from SECOR International Incorporated; U.S. Department of Agriculture
16PS 5 M782-1:V:101, 16PS 51M782-1:V:102, 16PS 5 M782-1:V:114, and 16PS 51M782-1:V:115	1-16-1945	1:20,000	Eastman Topographic Safety; DIA Archive II, Benicia CA, Can No. 3A927
VVWZM7AMS 827 and VVWZM7AMS 828	12-1-1947	1:27,000	DIA
ABO-3K 135 and ABO-3K 144	8-3-1952	1:20,000	U.S. Department of Agriculture
146 6inv and 147 6inv	5-5-1960	1:24,000 (calculated)	Unknown
SOL 1-60, SOL 1-61, and YOL 1-59	7-2-1962	1:24,000	Geonex
3-122 and 3-123; GS-EF	3-3-1948	1:28,000	U.S. Geological Survey
GS-VBJZ 3-68 and 3-69	4-22-68	1:24,000	U.S. Geological Survey
3594-1-179, 3594-1-180, 3594-1-181, 3594-1-191, and 3594-1-192	7-10-1973	1:24,000	Geonex
Unnumbered	5/23/1975	1:6,000 (calculated)	Unknown
83103-1 and 83103-2	5-12-1983	1:14,400	Unknown
WAC-88CA 29-44 and WAC-88CA 29-45	9-12-1988	1:34,700 (calculated)	Geonex
SOL 136 AV 3601 4 19 and SOL 136 AV 3601 4 20	7-18-1989	1:36,000	Pacific Aerial Surveys
WAC-North Bay 90 6-23 and WAC-North Bay 90 6-24	5-13-1990	1:17,000 (calculated)	WAC Corporation
Not labeled with ID numbers (2 photos)	9-??-1990	1:15,600	Unknown
91000 2 6-3 and 91000 2 6-4	2-17-1991	1:24,000	Geonex
SOL AV-4070 24 48 and SOL AV-4070 24 49	6-21-1991	1:12,000	Pacific Aerial Surveys
SOL AV-4535 12 17 and SOL AV-4535 12 18	9-3-1993	1:12,000	Pacific Aerial Surveys
X-1	7-22-1995	1:12,000	Greiner
SOLNO AV 5140 33 30 and SOLNO AV 5140 33 31	4-26-1996	1:24,000	Pacific Aerial Surveys
SOL AV 5461 12 21 SOL AV 5461 12 20	7-28-1997	1:12,000	Pacific Aerial Surveys

Table A-2. Summary of Photointerpretation
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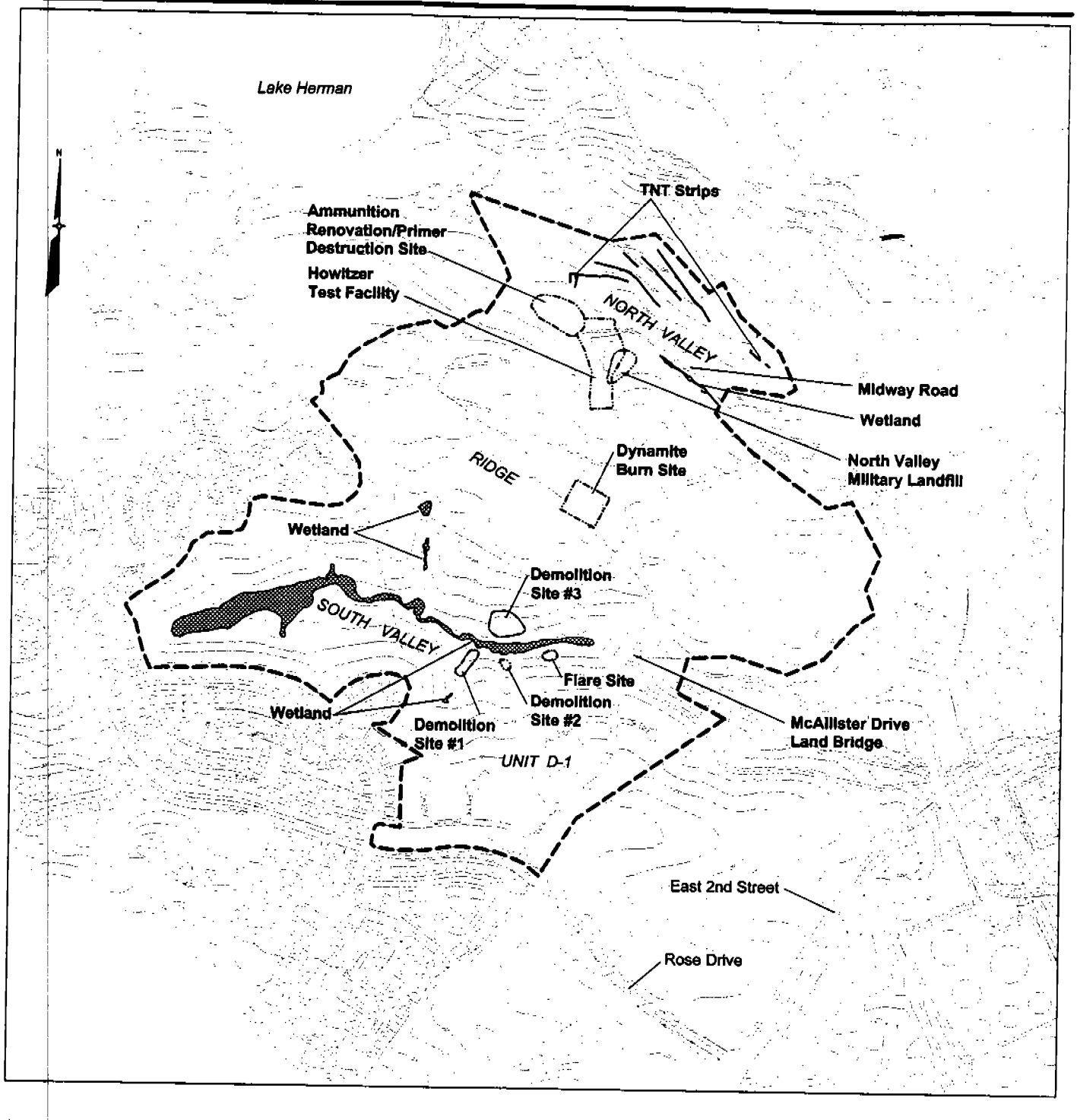
Identifier	Feature		Date of Photograph 08/20/1937	Date of Photograph 01/16/1945	Date of Photograph 12/01/1947	Date of Photograph 03/03/1948	Date of Photograph 08/03/1952	Date of Photograph 05/05/1960	Date of Photograph 07/02/1962
	North Valley								
A	TNT Strips		Not Visible	Not Visible	Four Visible; T3 not visible	6 visible (A1 to A5). One discontinuous unnumbered strip identified between strips T2 and T3 (A6 and A7)	5 TNT Strips Visible (A-1). Extension of strip #1 (A-2)	4 Visible, T3 not visible	4 visible; T3 not visible
	Howitzer Test Facility								
B		Test Firing Tunnels (2 each) (Bldg 181)	Not Visible	Not Visible	Visible	Visible	Visible	Visible	Visible
C		Test Firing Butts (Bldg 182)	Not Visible	Not Visible	Visible	Visible	Visible	Visible	Visible
D		Powder Loading Room (Bldg 183)	Not Visible	Not Visible	Visible	Not visible	Visible	Visible	Visible
E		Cement Test Block (Bldg 540 and 542)	Not Visible	Not Visible	Not Visible	Not Visible	Not Visible	Not Visible	Visible
	Ammunition Renovation/Primer Destruction Site								
F		2 Wooden Buildings	Not Visible	Not Visible	Visible	One visible	Visible	Not Visible	Not Visible
G		Two Temporary Canvas Shelters	Not Visible	Not Visible	Not Visible	One visible	Visible	Not Visible	Not Visible
H		"Squirrel Cages" (Metal Tanks)	Not Visible	Not Visible	Visible	Not Visible	Visible	Not Visible	Not Visible
I	North Valley Military Landfill		Not Visible	Not Visible	Visible	Visible	Visible	Visible	Visible
J	Midway Road		Visible	Not Visible	Visible	Visible	Visible	Visible	Visible
K	Fence Line		Visible	Visible	Visible (K-1); security fence (K-2)	Visible (K-1); security fence (K-2)	Visible (K-1); security fence (K-2)	Visible (K-1); security fence (K-2)	Visible (K-1); security fence (K-2)
L	Ground Disturbance		Fenced area northeast of Project Site, with NE/SW light-toned strips on hillside and round features below. Bridge crosses creek from this area to northeast.	Visible; south of the E-W treeline (L-1), not related to Arsenal activity, from rail spurs E (L-2) and G (L-3). Earthflow in area of future Howitzer Test Site (L-4).	Some ground disturbance between TNT Strips T1 and T2, T2 and T4 (L-1), at west end of T1 and T2 (L-2), and on the southeast extension of T1 (L-3). Rail spurs E (L-4) and G visible (L-5).	Bands of disturbed ground visible adjacent to TNT strips T1 G1(L1), T2 (L2), T3 (L3), and T5 (L4). Other bands in the same vicinity (L5)	Visible in Ammunition Renovation/Primer Destruction Site	Ground disturbance around Buildings 540 and 542 and around the North Valley Military Landfill	Ammunition Renovation/Primer Destruction Site has been disturbed (L-1); other areas of disturbance visible near the Howitzer Test Facility (L-2)
M	Other		Plowed field NE of property (M-1); prominent E-W tree line (M-2). Spring issues from northeast end tree line.	Prominent E-W tree line from rail spurs. Prominent Ledo Road visible extending around site from mouth of South Valley to north side of North Valley.	Prominent E-W tree line (M-1) from rail spur E Soil debris/stockpiles north of tunnels and berm in Ammunition Renovation Site (M-2).	Prominent E-W tree line (M1). Pad adjacent to "J"-road south of Ammunition Renovation/Primer Destruction Area (M2)	Prominent E-W tree line from rail spurs. Spring from northeast end of tree line.	Prominent E-W tree line from offsite rail spur	Prominent E-W Tree Line (M-1). Unidentified structure on "J"-road (M-2). Light area of contrast offsite, east of TNT Strips and perimeter fence (M-3).
	Ridge								
N	Dynamite Burn Site		Not Visible	Not Visible	Visible	Visible, strips oriented approximately NE-SW and NW-SE	Visible	Visible	Visible
O	Soil/Debris Piles		Not Visible	Not Visible	Not Visible	Not visible	Not Visible	Not visible	Not Visible
P	"J"-Shaped Road		Not Visible	Not Visible	Visible	Visible	Visible	Visible	Visible; truck turn-around at end of road.
Q	Ground Disturbance		Not Visible	Ledo Road along southwest end of ridge. Rail spur B constructed off-site on southwest end of ridge.	Disturbance from vehicle traffic (typical)	Visible in Dynamite Burn Site (Q1) and associated with dirt roads (Q2)	Disturbance in Dynamite Burn Site	Disturbance in Dynamite Burn Site	Disturbance along the top of the Ridge at end of "J" Road
R	Other		Prominent fence crosses ridge from NE to SW and connects to NW trending fence.	Fence	Vehicle tracks. Fence	Linear light-toned bands of sparser vegetation	Increased number of dirt roads throughout the area	New roads and extension of "J"-shaped Road	Dark area of contrast at east end the Ridge: brushy vegetation.
	South Valley								
S	Flare Site		Not Visible	Not Visible	Visible	Visible	Not visible	Visible	Visible
T	Demolition Sites		Not Visible	Not Visible	Visible	Visible (T1, T2, T3)	Only #3 visible	#3 visible	Only #3 visible
U	Road leading to Flare/Demo Sites		Not Visible	Not Visible	Visible	Visible (U1); extends west of Demolition Site #1 (U2)	Visible	Visible	Visible
V	McAllister Drive Land Bridge		Not built	Not built	Not built.	Not built	Not built.	Not built.	Not built.
W	Housing Tracts		None	none	Not built.	Not built	Not built.	Not built.	Not built.
X	Ground Disturbance		None	Rail spur A off-site	Ledo Road. Rail spur A	Dirt roads extend north-northwest from Demolition Site #3 to fence (X1) and north-northeast from bottom of valley (X2).	Disturbed area west of Railroad tracks and roads	Visible; disturbed area at the Flare Site and Demolition Sites	Not visible
Y	Other		Two springs on north side of drainage at upper reaches of the valley	Ledo Road at mouth of valley. No springs visible. Landslides visible. Rail spur A offsite	Fence. Springs not visible. Box-like structure above Demolition Site #3 (sentry guardhouse?)	1 spring visible (Y1); unidentified structure, possibly a container, at upper end of Demolition Site #1 (Y2)	2 springs visible	New roads (typical)	

Table A-2. Summary of Photointerpretation
(Page 2 of 3)

Identifier	Feature		Date of Photograph 4/22/68	Date of Photograph 07/10/1973	Date of Photograph 05/23/1975	Date of Photograph 05/12/1983	Date of Photograph 09/12/1988	Date of Photograph 07/18/1989	Date of Photograph 05/13/1990
	North Valley								
A	TNT Strips		5 visible	6 visible (one unnumbered strip identified between strips T2 and T3)	4 visible; #3 not visible	5 visible	3 visible	2 visible	Visible; obscured by trails
	Howitzer Test Facility								
B		Test Firing Tunnels (2 each) (Bldg 181)	Visible	Visible	Visible	Visible	Visible	Visible	Visible
C		Test Firing Butts (Bldg 182)	Visible	Visible	Visible	Visible	Visible	Visible	Visible
D		Powder Loading Room (Bldg 183)	Visible	Not visible	Visible	Visible	Visible	Visible	Visible
E		Cement Test Block (Bldg 540 and 542)	Visible	Visible	Visible	Visible	Not visible	Not visible	Not visible
	Ammunition Renovation/Primer Destruction Site								
F		2 Wooden Buildings	One visible	One visible	One visible	Not visible	Not visible	Not visible	Not visible
G		Two Temporary Canvas Shelters	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
H		"Squirrel Cages" (Metal Tanks)	Not visible	Not visible	Not visible	Remnants visible	Not visible	Not visible	Not visible
I	North Valley Military Landfill		Visible	Visible	Not visible	Visible	Not visible	Visible	Not visible
J	Midway Road		Visible	Visible	Visible	Visible	Visible	Visible	Visible
K	Fence Line		Visible	Visible	Visible	Visible	Visible. Firebreak (?) along side.	Visible	Visible
L	Ground Disturbance		Disturbance along west side of J-Road immediately south of unidentified building	Berm	Ground disturbance over Military Landfill. Light toned area representing pad (?) seen in ground-level 1950 photo west of wooden building.	Ground disturbance at Ammunition Renovation/Primer Destruction Site, and North Valley Military Landfill appears to be from off-road recreational vehicles. Berm noted in Ammunition Site is smaller than previously.	Disturbance (trails) west of Ammunition Renovation/Primer Destruction Site and over landfill.	Ground disturbance (trails) at the Howitzer Test Facility	Visible ground disturbance from off-highway recreational vehicles in the North Valley Military Landfill
M	Other		Unidentified building on south side along "J" Road still visible	One unidentified building south of Ammunition Renovation area along "J"-Road	Tree line is prominent	Road to the east and SE of Bldg 181	E-W tree line from rail spur E	E-W tree line from rail spurs	E-W tree line from rail spurs
	Ridge								
N	Dynamite Burn Site		Visible	Visible	Not visible	Visible	Visible	Visible	Not Visible
O	Soil/Debris Piles		Not visible	Not Visible	Not visible	Not visible	Not Visible	Not Visible	Not Visible
P	"J"-Shaped Road		Visible; extends around ridge to west and south west to west site fence in South Valley, then continues to northwest along fence.	Visible	Extends around Dynamite Burn Site to west fence.	Visible	Visible.	Visible	Visible
Q	Ground Disturbance		Disturbance on hilltop west of burn site.	Soil disturbance NW (Q-1) and SE (Q-2) of Dynamite Burn Site	Not visible	Visible around the Dynamite Burn Site surrounded by network of roads/trails; appears to be from off-road vehicles	Visible; cleared area along the western portion of the Ridge	Soil disturbance	Grading of Dynamite Burn Site has begun and includes a dirt road from the western edge of the Ridge toward Kearney Street
R	Other		Unidentified structure next to Dynamite Burn Site	Fence (R-1). Sentry guardhouse (?) along fence above Demolition Site #3 (R-2).	Sentry guardhouse (?) along west fence visible	Many trails (R1). Ring-like disturbed area north of Dynamite Burn Site (R2).	Many dirt roads present	Several roads present (typical)	Property fence road is visible Sentry guardhouse (?) along fence
	South Valley								
S	Flare Site		Visible	Visible	Visible	Not visible	Visible	Not visible	Not visible
T	Demolition Sites		# 2 and #3 visible	Visible	#2 and #3 visible	Only #3 visible (T3)	Only #3 visible	Only #3 visible	Not visible
U	Road leading to Flare/Demo Sites		Visible	Visible	Visible	Visible. Landslide affects road in Mc.Allister Land Bridge area.	Visible. Landslide advanced downslope, road rerouted around toe.	Visible; rerouted around toe of landslide	Visible
V	McAllister Drive Land Bridge		Not built	Not built	Not built	Not built	Not built	Not built	Under construction
W	Housing Tracts		Not built	Not built	Not visible	Not built	Visible to west and southwest.	Visible to the west and southwest	None within property
X	Ground Disturbance		Not visible	None visible	Not visible	Visible ground disturbance scarring in Flare Site and Demolition Sites	Not visible	Trails crossing towards Ridge (X-1); landslide (X-2)	Grading off-site south of property and at McAllister Land Bridge
Y	Other		Unidentified structure on-site adjacent to west fence approx. 600' NW of Demolition Site #3	Spring	Not visible	Several dirt roads from prominent tree line to south on Ridge. Structure along site fence above Demolition Site #3.	Same as in 1983		There are a number of off-highway recreational vehicle roads and trails

Table A-2. Summary of Photointerpretation
(Page 3 of 3)

Identifier	Feature		Date of Photograph 09/01/1990	Date of Photograph 02/17/1991	Date of Photograph 06/21/1991	Date of Photograph 09/03/1993	Date of Photograph 07/22/1995	Date of Photograph 04/26/1996	Date of Photograph 07/28/1997
	North Valley								
A	TNT Strips		Not visible	Visible	Visible	Visible	Only #1 and #2 visible	Visible	5 Visible
	Howitzer Test Facility								
B		Test Firing Tunnels (2 each) (Bldg 181)	Visible	Visible	Visible	Visible	Visible	Visible	Removed
C		Test Firing Butts (Bldg 182)	Visible	Visible	Visible	Visible	Visible	Visible	Removed. Debris stockpile visible
D		Powder Loading Room (Bldg 183)	Visible	Not visible	Visible	Visible	Visible	Visible	Removed
E		Cement Test Block (Bldg 540 and 542)	Not visible	Visible	Visible	Visible	Visible	Visible	Removed
	Ammunition Renovation/Primer Destruction Site								
F		2 Wooden Buildings	One visible	One visible	One visible	One visible	One visible	Not visible	Not visible
G		Two Temporary Canvas Shelters	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
H		"Squirrel Cages" (Metal Tanks)	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
I	North Valley Military Landfill		Not visible	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
J	Midway Road		Visible	Visible	Visible	Visible	Visible	Visible	Visible
K	Fence Line		Not visible	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
L	Ground Disturbance		Visible ground disturbance	Grading west and southwest of Howitzer Test Facility	Ground disturbance seen west and southwest of Howitzer Test Facility	Ground disturbance seen southeast of TNT Strips, south, and west of property due to trails and dirt roads	Extensive trail network	Grading activities seen to the southeast, south and west of the area	Extensive; the two berms associated with the Ammunition Renovation/Primer Destruction Area are gone
M	Other		Tree line is visible	Soil/debris piles on west side of property	Soil/debris piles on west and south-central parts of property; number of dirt trails evident	A number of dirt trails appear throughout the site	Tree line is prominent	Prominent tree line; clearly defined E-W-SE road from housing areas to Howitzer Test Facility	Tree line is prominent
	Ridge								
N	Dynamite Burn Site		Not visible	Graded	Graded	Graded	Graded	Graded	Grading completed
O	Soil/Debris Piles		Visible	Visible	Visible	Visible	There are additional soil/debris piles on the western edge	Visible	There are a number of soil/debris piles on the western edge
P	"J"-Shaped Road		Portions visible	Not visible	Not visible	Partially visible	Only north end still visible	Remnants visible	Not visible
Q	Ground Disturbance		Grading throughout the Ridge area with wider and straighter dirt roads than seen previously	Grading along the ridge expanded since September 1990; graded areas are lighter in contrast to surrounding area; soil piles visible	Grading along west edge of Ridge and southward toward South Valley	There is a small square area that appears in the western portion of the Ridge. Soil/debris stockpiles visible.	Previous grading has more vegetation cover; there are a number of soil/debris piles associated with grading	Soil/debris piles visible; the square area is visible	Soil/debris piles visible
R	Other		More dirt trails/roads observed	Many dirt roads/trails	None	Dark contrasting circular area visible south of the square area in a gully leading into the South Valley	Additional dirt roads visible.	Dark circular area seen south of the square area is not visible; Vegetation has covered most of the area previously disturbed	None
	South Valley								
S	Flare Site		Not visible	Not visible	Not visible	Not visible	Not visible	Not visible	Not visible
T	Demolition Sites		#3 visible	Only #3 visible	Only #3 visible	Only #3 visible	Only #3 visible	Only #3 visible	Only #3 visible
U	Road leading to Flare/Demo Sites		Remnants visible	Remnants visible	Remnants visible	Remnants visible	Less visible, eroded, some vegetation growth	Visible	Less visible, eroded, some vegetation growth
V	McAllister Drive Land Bridge		Construction complete	Visible	Visible	Visible	Visible, S half paved	Visible, south half paved	Visible, south half paved
W	Housing Tracts		None within property	None within property	None within property	None within property	None within property	None within property	None within property
X	Ground Disturbance		Off-site grading activities in south, southwest, and west edges of property	Graded areas off-site in south, southwest, and west edges of property	Final grading completed south and west	Disturbed areas visible	More vegetation cover in disturbed areas	Denser vegetation cover	Denser vegetation cover
Y	Other		E/W trending runoff control ditch on S side of valley	E/W trending runoff control ditch visible	E/W trending runoff control ditch visible	E/W trending runoff control ditch visible	E/W trending runoff control ditch visible. Roads in housing tract are paved	E/W trending runoff control ditch visible	E/W trending runoff control ditch visible



EXPLANATION

Project Site Boundary

FINAL

Figure A-1

Project Site Layout Map

Tourtelot Cleanup Project
Benicia, California

July 2001

0' 450' 900'
SCALE

Note: Contour interval equals 25 feet.

≈ 45 pictures
– too dark
to scan –

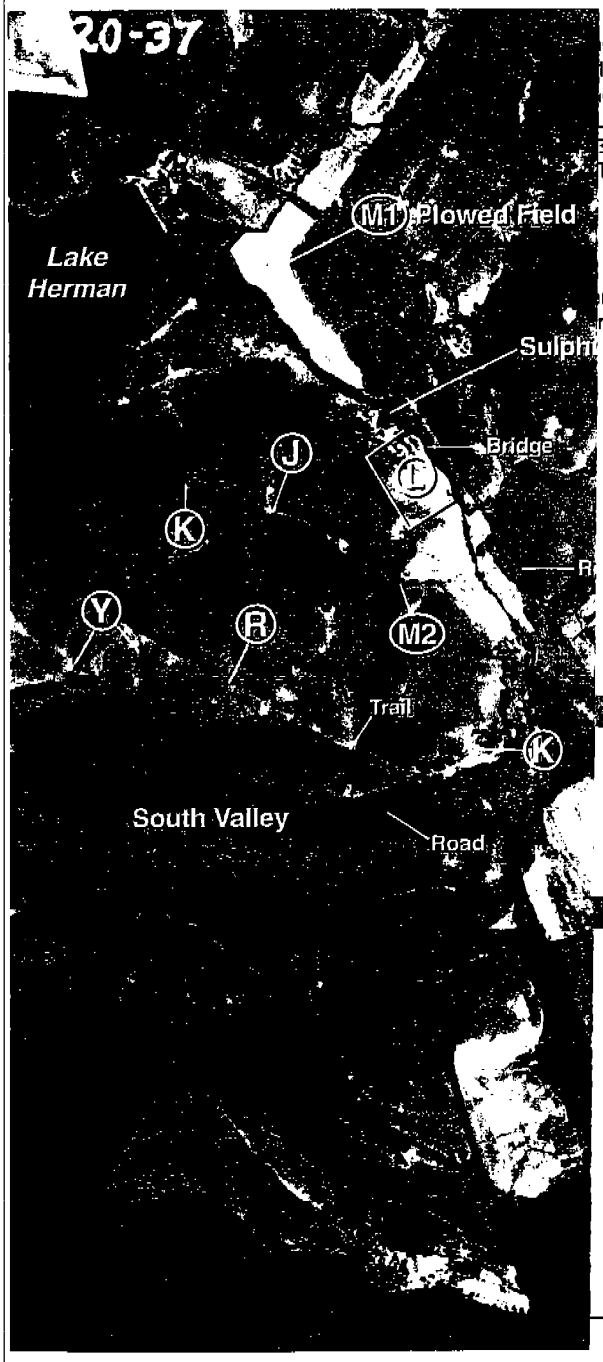
Nominal Scale 1:20,000

0 1667 3333 Feet

JRTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1937

A-2



of Photointerpretation

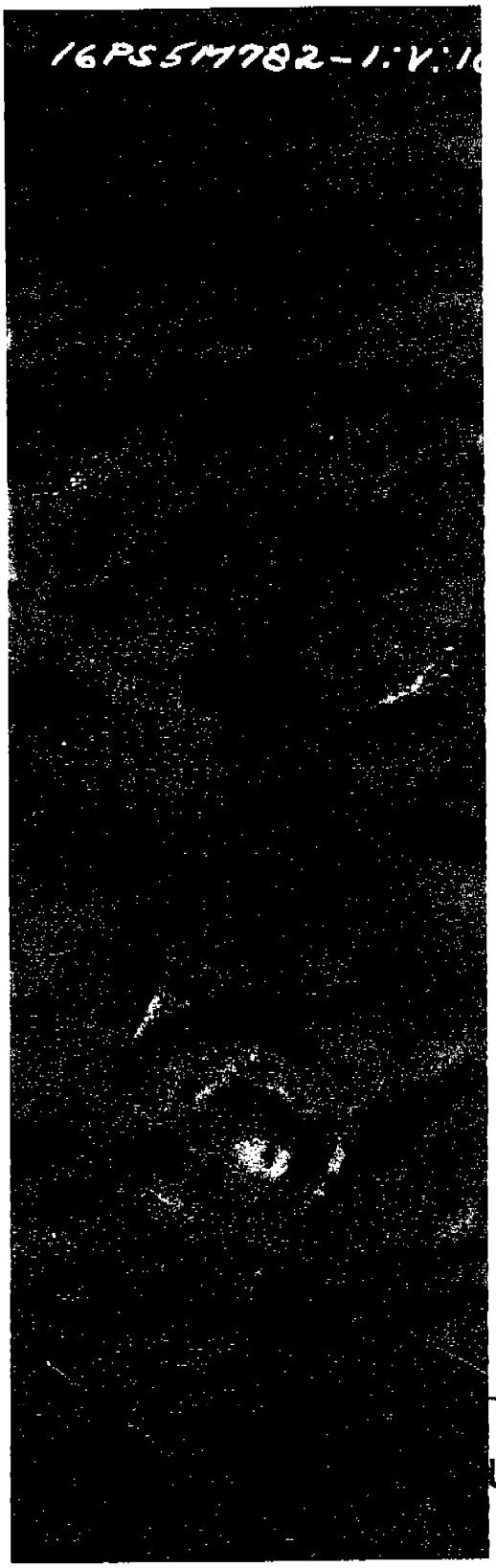
	Date of Photograph 08/20/1937
	Not visible
	Not visible
g Tunnels (2 each)	Not visible
1)	
g Butts (Bldg 182)	Not visible
Loading Room	Not visible
3)	
Test Block (Bldg 540	Not visible
n Buildings	Not visible
rary Canvas Shelters	Not visible
Cages" (Metal Tanks)	Not visible
	Not visible
	Visible
	Visible
	Fenced area northeast of Project Site, with NE/SW light-toned strips on hillside and round features below.
	Bridge crosses creek from this area to northeast.
	Plowed field NE of property (M-1); prominent E-W tree line (M-2). Spring issues from northeast end tree line.
	Not visible
	Not visible
	Not visible
	Not visible
	Prominent fence crosses ridge from NE to SW and connects to NW trending fence.
	Not visible
	Not visible
	Not visible
	Not built
	None
	None
	Two springs on north side of drainage at upper reaches of the valley

Nominal Scale 1:20,000

0 1667 3333 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1937



Nominal Scale 1:20,000

0 1667 3333 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1945

A-4

/ of Photointerpretation

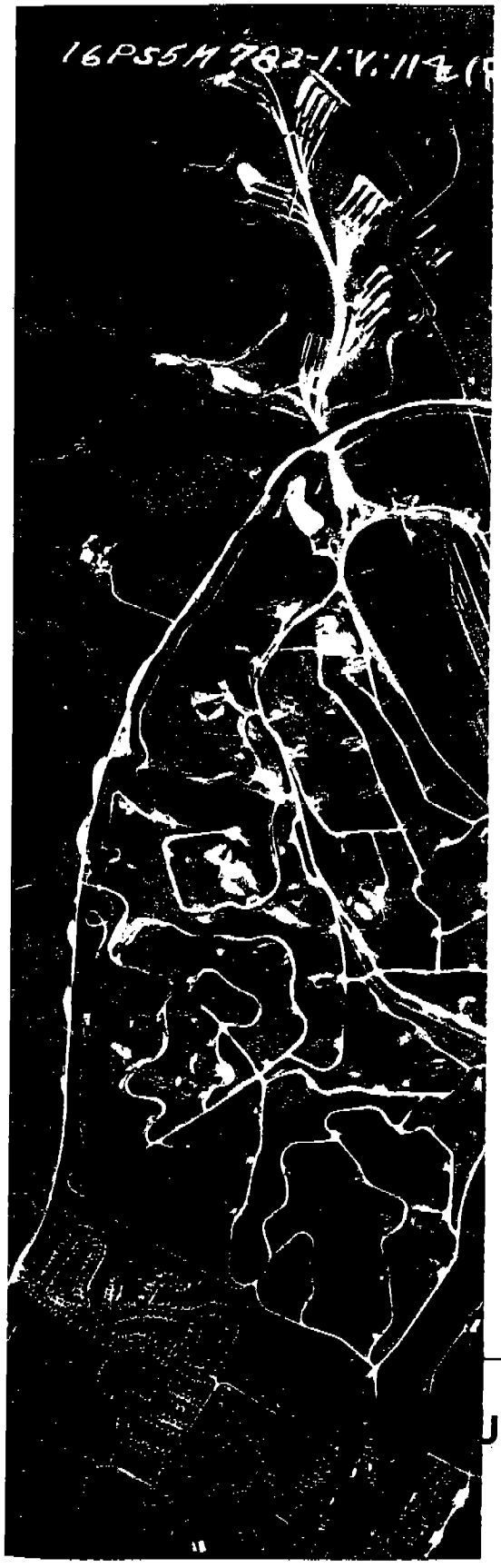
	Date of Photograph 01/16/1945
	Not visible
	Not visible
ng Tunnels (2 each) 31)	Not visible
ng Butts (Bldg 182)	Not visible
Loading Room 33)	Not visible
Test Block (Bldg 540 2)	Not visible
en Buildings	Not visible
orary Canvas Shelters	Not visible
l Cages" (Metal Tanks)	Not visible
	Not visible
	Not visible
	Visible
	Visible; south of the E-W tree line (L-1) not related to Arsenal activity, from rail spurs E (L-2) and G (L-3). Earthflow in area of future Howitzer Test Site (L-4).
	Prominent E-W tree line from rail spurs. Prominent Ledo Road visible extending around site from mouth of South Valley to north side of North Valley.
	Not visible
	Not visible
	Not visible
	Ledo Road along southwest end of ridge. Rail spur B constructed off-site on southwest end of ridge.
	Fence
	Not visible
	Not visible
	Not visible
	Not built
	none
	Rail Spur A off-site
	Ledo Road at mouth of valley. No springs visible. Landslides visible. Rail Spur A off-site.

Nominal Scale 1:20,000

0 1667 3333 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1945



Nominal Scale 1:20,000

0 1667 3333 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1945

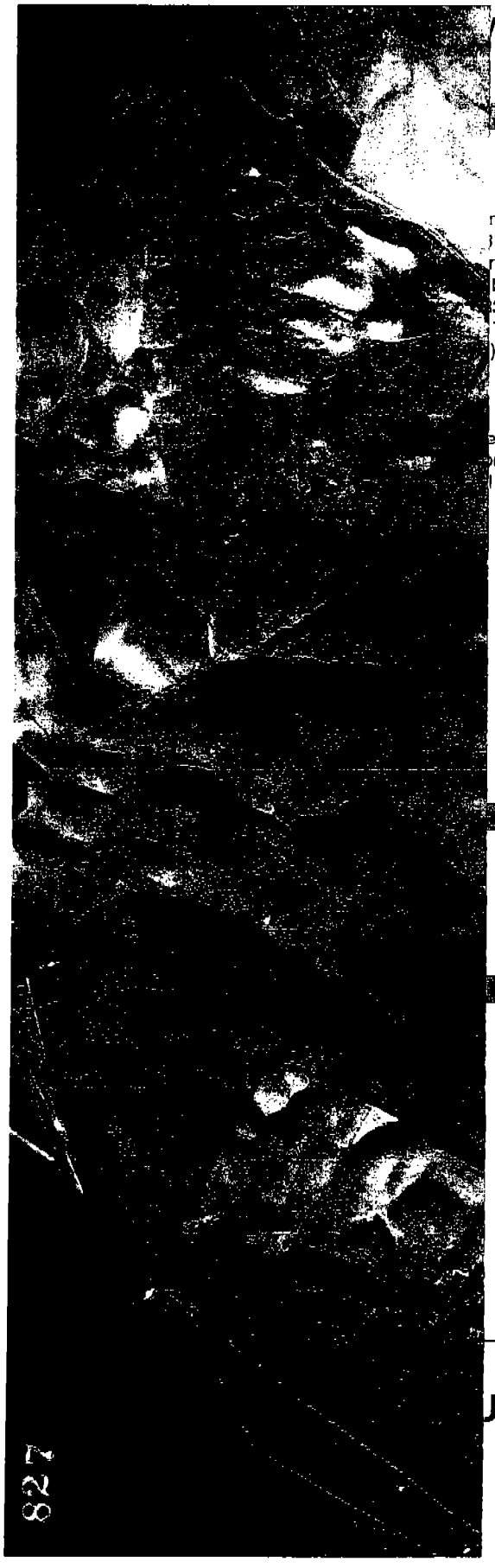
Nominal Scale 1:20,000

0 1667 3333 Feet

TOURTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1945

A-7



of Photointerpretation

	Date of Photograph 12/01/47
	Four visible; T3 not visible
ng Tunnels (2 each)	Visible
1)	
ng Butts (Bldg 182)	Visible
Loading Room	Visible
3)	
Test Block (Bldg 540	Not visible
)	
en Buildings	Visible
rary Canvas Shelters	Not visible
Cages" (Metal Tanks)	Visible
	Visible
	Visible
	Visible (K-1); security fence (K-2). Some ground disturbance between TNT Strips T1 and T2, T2 and T4 (L-1), at west end of T1 and T2 (L-2), and on the southeast extension of T1 (L-3). Rail spurs E (L-4) and G visible (L-5).
	Prominent E-W tree line (M-1) from rail spur E. Soil debris/stockpiles north of tunnels and berm in Ammunition Renovation Site (M-2).
	Visible
	Not visible
	Visible
	Disturbance from vehicle traffic (typical)
	Vehicle tracks. Fence
	Visible
	Visible
	Visible
	Not built.
	Not built.
	Ledo Road. Rail spur A
	Fence. Springs not visible. Box-like structure above Demolition Site #3 (sentry guardhouse?)

Nominal Scale 1:27,000

0 2250 4500 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1947

A-8

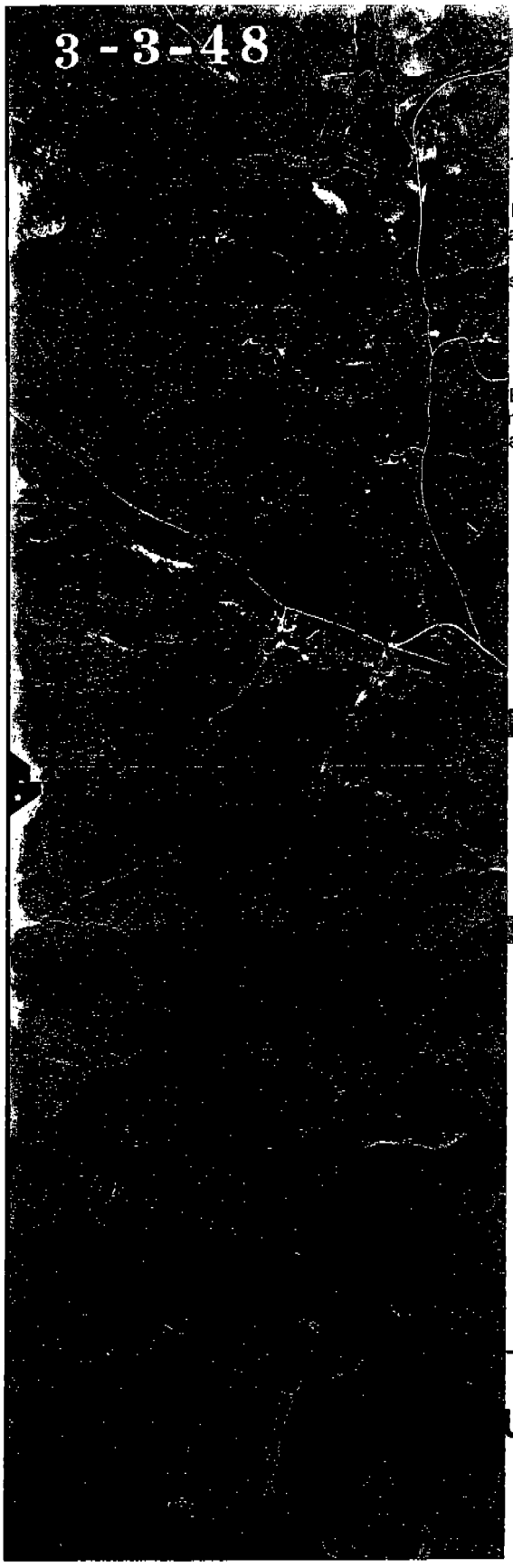
Nominal Scale 1:27,000

0 2250 4500 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1947

A-9



of Photointerpretation

	Date of Photograph 03/03/1948
	6 visible (A1 to A5). One discontinuous unnumbered strip identified between strips T2 and T3 (A6 and A7)
Tunnels (2 each)	Visible
Butts (Bldg 182)	Visible
ading Room	Not visible
st Block (Bldg 540	Not visible
Buildings	One visible
ry Canvas Shelters	One visible
ages" (Metal Tanks)	Not visible
	Visible
	Visible
	Visible (K-1); security fence (K-2).
	Bands of disturbed ground visible adjacent to TNT strips T1 G1 (L1), T2 (L2), T3 (L3). Other bands in the same vicinity (L5)
	Prominent E-W tree line (M1). Pad adjacent to "J"-road south of Ammunition Renovation/ Primer Destruction Site (M2)
	Visible, strips oriented approximately NE-SW and NW-SE
	Not visible
	Visible
	Visible in Dynamite Burn Site (Q1) and associated with dirt roads (Q2).
	Linear light-toned bands of sparser vegetation
	Visible
	Visible (T1, T2, T3).
	Visible (U1); extends west of Demolition Site #1 (U2).
	Not built
	Not built.
	Dirt roads extend north-northwest from Demolition Site #3 to fence (X1) and north-northeast from bottom of valley (X2).
	1 spring visible (Y1); unidentified structure, possibly a container, at upper end of Demolition Site #1 (Y2)

Nominal Scale 1:28,000

0 2333 4666 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1948

A-9a

Nominal Scale 1:28,000

0 2333 4666 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1948

A-9b

of Photointerpretation

	Date of Photograph 08/03/1952
	5 TNT strips visible (A-1). Extension of strip #1 (A-2)
g Tunnels (2 each)	Visible
1)	
g Butts (Bldg 182)	Visible
oading Room	Visible
3)	
Test Block (Bldg 540	Not visible
n Buildings	Visible
rary Canvas Shelters	Visible
Cages" (Metal Tanks)	Visible
	Visible
	Visible
	Visible (K-1); security fence (K-2)
	Visible in Ammunition Renovation/Primer Destruction Site
	Prominent E-W tree line from rail spurs. Spring from northeast end of tree line
	Visible
	Not visible
	Visible
	Disturbance in Dynamite Burn Site
	Increased number of dirt roads throughout the area
	Not visible
	Only #3 visible
	Visible
	Not built
	Not built
	Disturbed area west of Railroad tracks and roads
	2 springs visible

Nominal Scale 1:20,000

0 1667 3333 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

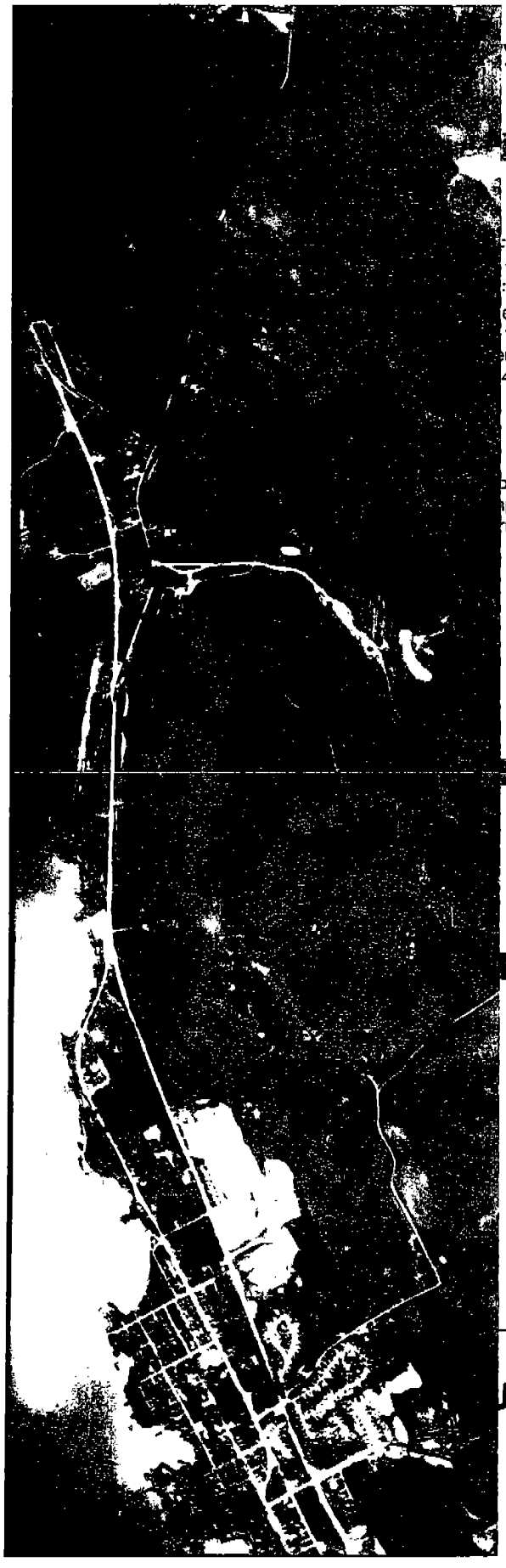
PHOTOINTERPRETATION
1952

Nominal Scale 1:20,000

0 1667 3333 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1952



y of Photointerpretation

	Date of Photograph 05/05/1960
	4 visible, T3 not visible
iring Tunnels (2 each) 181)	Visible
iring Butts (Bldg 182)	Visible
er Loading Room 183)	Visible
nt Test Block (Bldg 540 42)	Not visible
oden Buildings	Not visible
porary Canvas Shelters	Not visible
rel Cages" (Metal Tanks)	Not visible
	Visible
	Visible
	Visible (K-1); security fence (K-2)
	Ground disturbance around Buildings 540 and 542 and around the North Valley Military Landfill
	Prominent E-W tree line from off-site rail spur
	Visible
	Not visible
	Visible
	Disturbance in Dynamite Burn Site
	New roads and extension of "J"-shaped Road
	Visible
	#1, #2, and #3 visible
	Visible
	Not built
	Not built
	Visible; disturbed area at the Flare Site and Demolition Sites
	New roads

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1960

Nominal Scale 1:24,000

0 2000 4000 Feet

JRTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1960

A-13

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1962

of Photointerpretation

	Date of Photograph 07/02/1962
[redacted]	
	4 visible; T3 not visible
Tunnels (2 each)	Visible
Butts (Bldg 182)	Visible
ading Room	Visible
st Block (Bldg 540	Visible
Buildings	Not visible
ry Canvas Shelters	Not visible
ages" (Metal Tanks)	Not visible
	Visible
	Visible
	Visible
	Visible (K-1); security fence (K-2)
	Ammunition Renovation/Primer Destruction Site has been disturbed (L-1); other areas of disturbance visible near the Howitzer Test Facility (L-2)
	Prominent E-W tree line (M-1). Unidentified structure on "J"-road (M-2). Light area of contrast offsite, east of TNT Strips and perimeter fence (M-3).
[redacted]	
	Visible
	Not visible
	Visible; truck turn-around at end of road. Disturbance along the top of the Ridge at end of "J" Road
	Dark area of contrast at east end of the Ridge; brushy vegetation
[redacted]	
	Visible
	Only #3 visible
	Visible
	Not built.
	Not built.
	Not visible

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1962

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1962

A-16

Nominal Scale 1:24,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

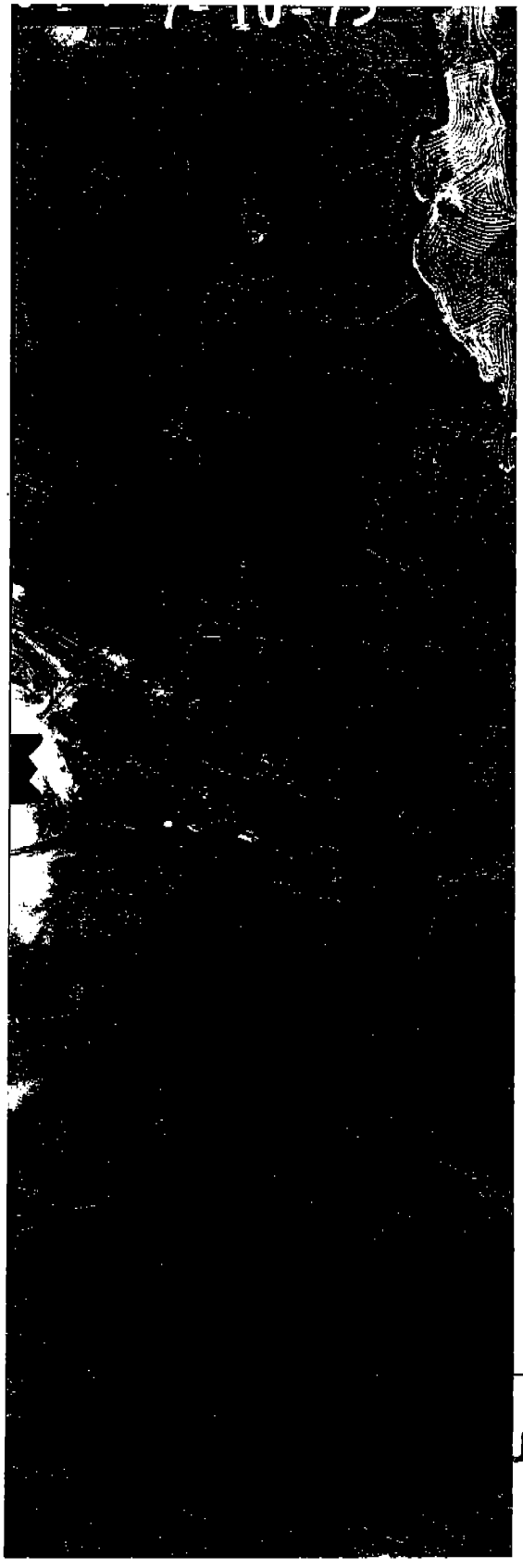
PHOTOINTERPRETATION
1968

Nominal Scale 1:24,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1968



Nominal Scale 1:24,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1973

›f Photointerpretation

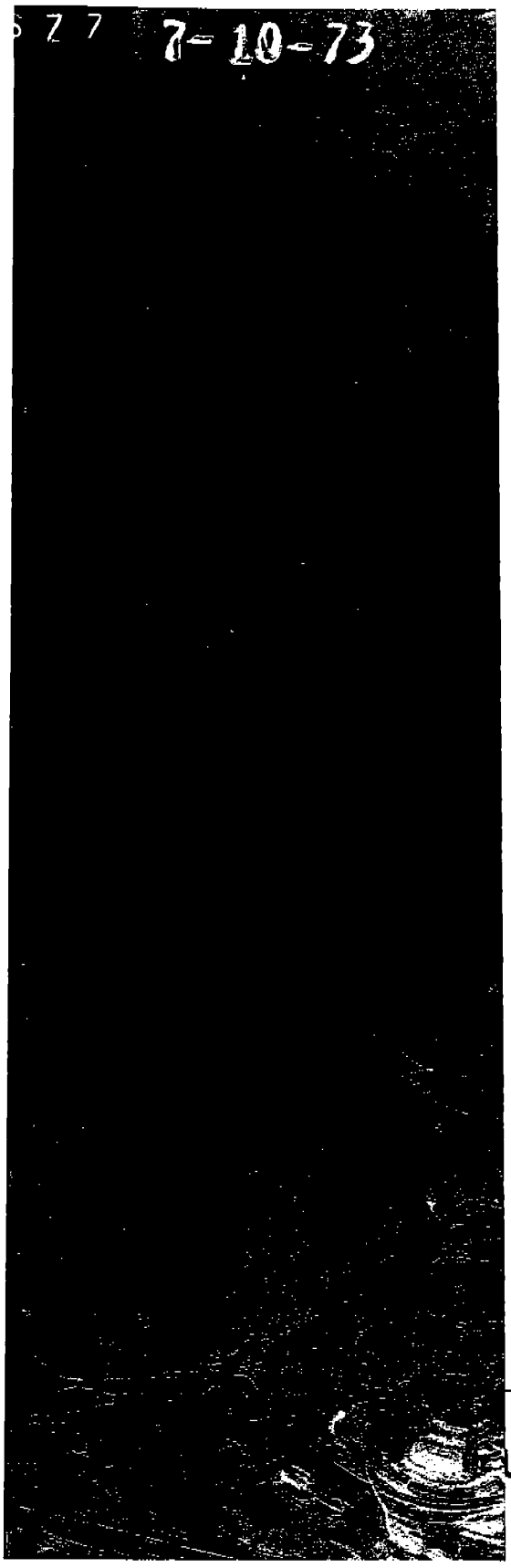
	Date of Photograph 07/10/1973
	6 visible (one unnumbered strip identified between strips T2 and T3)
Tunnels (2 each)	Visible
Butts (Bldg 182)	Visible
ading Room	Not visible
st Block (Bldg 540	Visible
Buildings	One visible
ry Canvas Shelters	Not visible
ages" (Metal Tanks)	Not visible
	Visible
	Visible
	Visible
	Berm
	One unidentified building south of Ammunition Renovation Site along "J" Road
	Visible
	Not visible
	Visible
	Soil disturbance NW (Q-1) and SE (Q-2) of Dynamite Burn Site
	Fence (R-1). Sentry guardhouse (?) along fence above Demolition Site #3 (R-2)
	Visible
	Visible
	Visible
	Not built
	Not built.
	None visible
	Spring

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1973

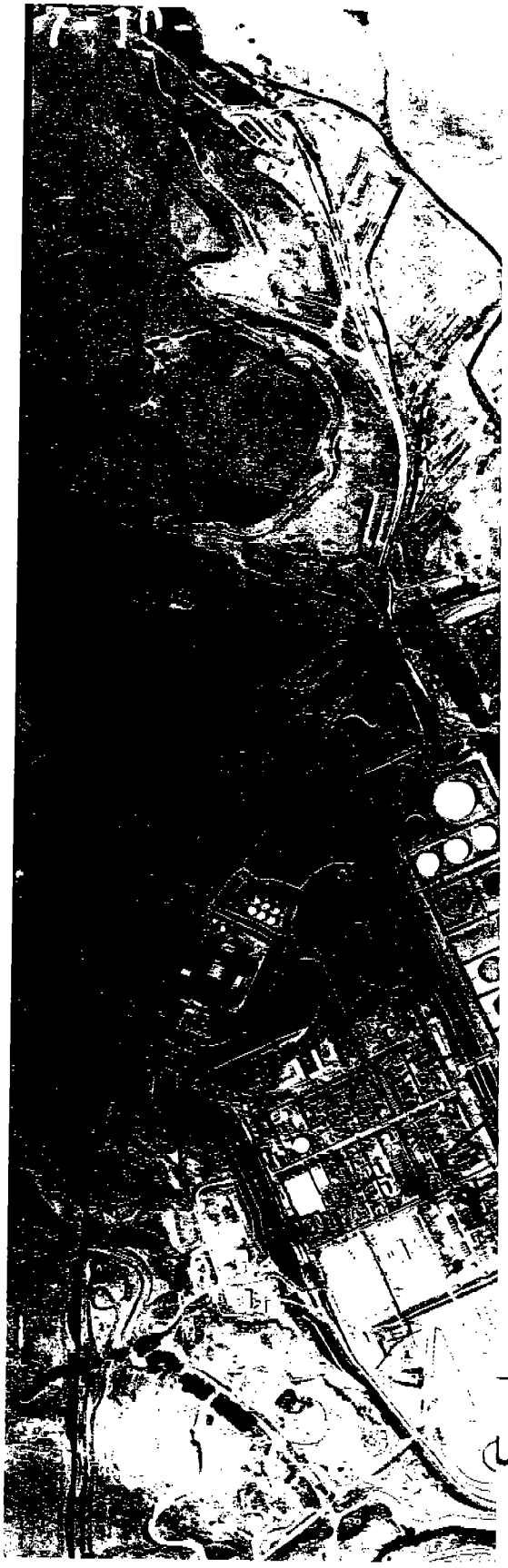


Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1973



Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

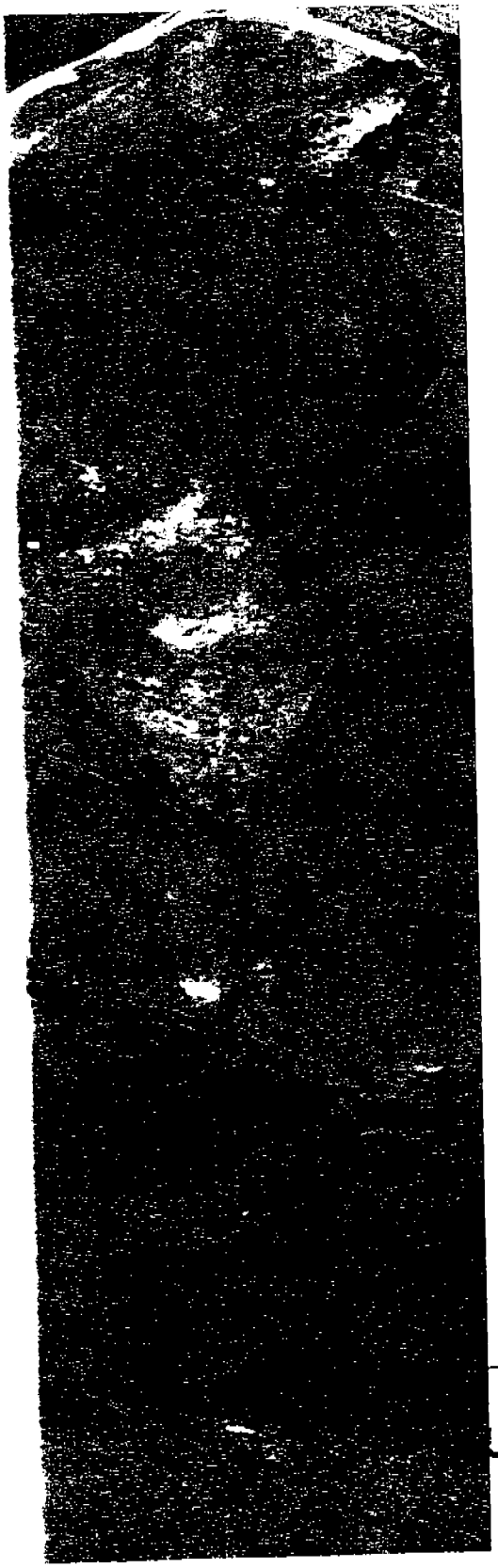
PHOTOINTERPRETATION
1973

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1973

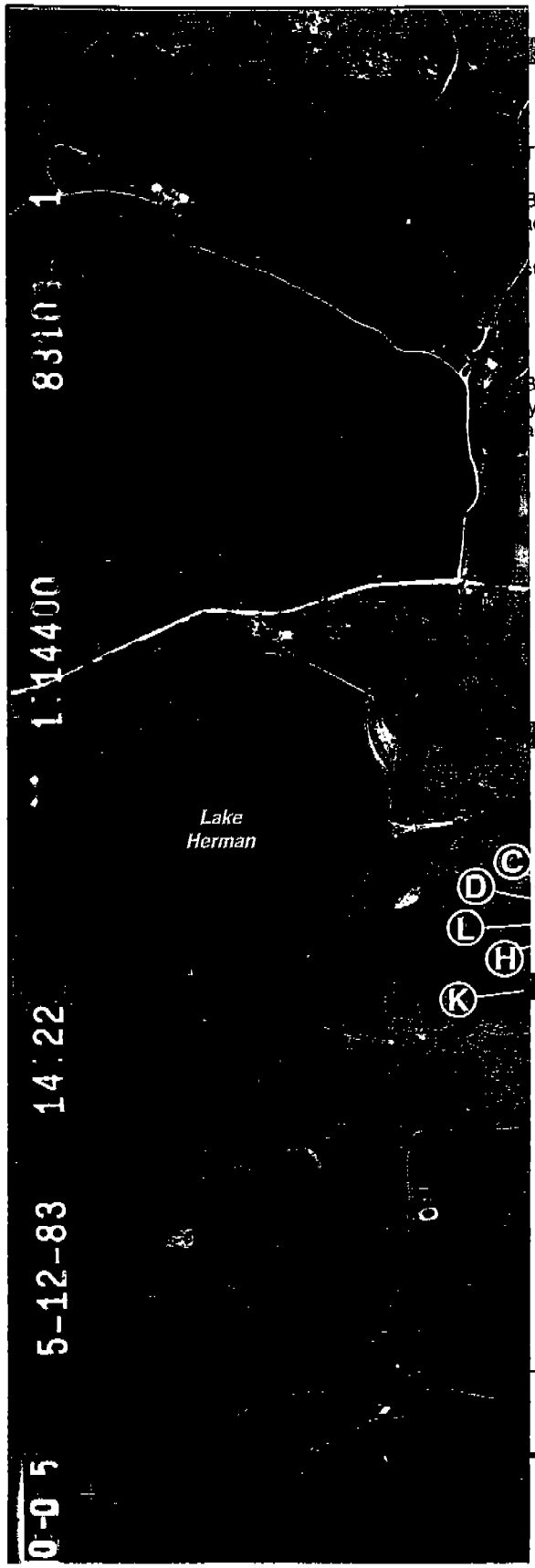


Nominal Scale 1:6,000

0 500 1000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1975



›f Photointerpretation

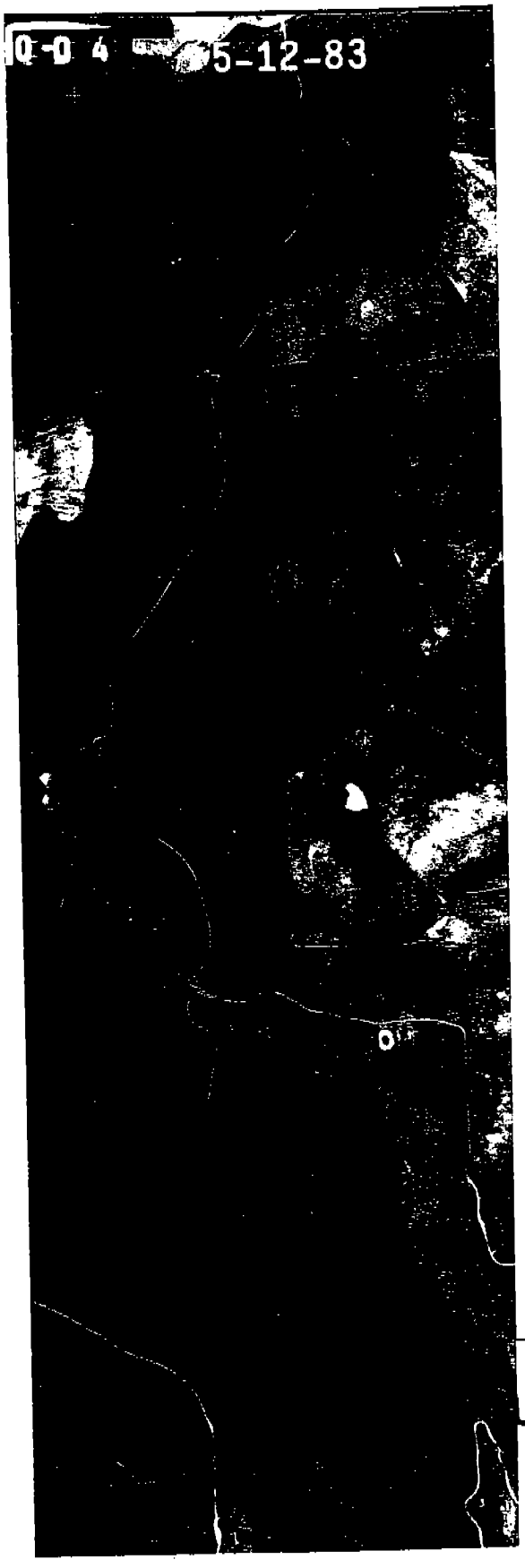
	Date of Photograph 05/12/1983
[redacted]	
	5 visible
Tunnels (2 each)	Visible
Butts (Bldg 182)	Visible
ading Room	Visible
t Block (Bldg 540	Visible
Buildings	Not visible
y Canvas Shelters	Not visible
ages" (Metal Tanks)	Remnants visible
	Visible
	Visible
	Visible
	Ground disturbance at Ammunition Renovation Area/Primer Destruction Site, and North Valley Military Landfill appears to be from off-road recreational vehicles. Berm noted in Ammunition Site is smaller than previously.
	Road to the east and SE of Bldg 181
[redacted]	
	Visible
	Not visible
	Visible
	Visible around the Dynamite Burn Site surrounded by network of roads/trails; appears to be from off-road vehicles
	Many trails (R-1). Ring-like disturbed area north of Dynamite Burn Site (R-2).
[redacted]	
	Not visible
	Only #3 visible (T3)
	Visible. Landslide affects road in McAllister Land Bridge area
	Not built
	Not built.
	Visible ground disturbance scarring in Flare Site and Demolition Sites
	Several dirt roads from prominent tree line to south on Ridge. Structure along site fence above Demolition Site #3.

Nominal Scale 1:14,400

0 1200 2400 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1983



Nominal Scale 1:14,400

0 1200 2400 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1983

Nominal Scale 1:34,700

0 2900 5800 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1988

of Photointerpretation

Date of Photograph
09/12/1988

	3 visible
g Tunnels (2 each)	Visible
)	
g Butts (Bldg 182)	Visible
oading Room	Visible
)	
est Block (Bldg 540	Not visible
n Buildings	Not visible
ary Canvas Shelters	Not visible
Cages" (Metal Tanks)	Not visible
	Not visible
	Visible
	Visible. Firebreak (?) along side. Disturbance (trails) west of Ammunition Renovation/Primer Destruction Site and over landfill.
	E-W tree line from rail spur E
	Visible
	Not visible
	Visible
	Visible; cleared area along the western portion of the Ridge
	Many dirt roads present
	Visible
	Visible
	Visible. Landslide advanced downslope, road rerouted around toe.
	Not built
	Visible to west and southwest.
	Not visible
	Same as in 1983

Nominal Scale 1:34,700

0 2900 5800 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1988

of Photointerpretation

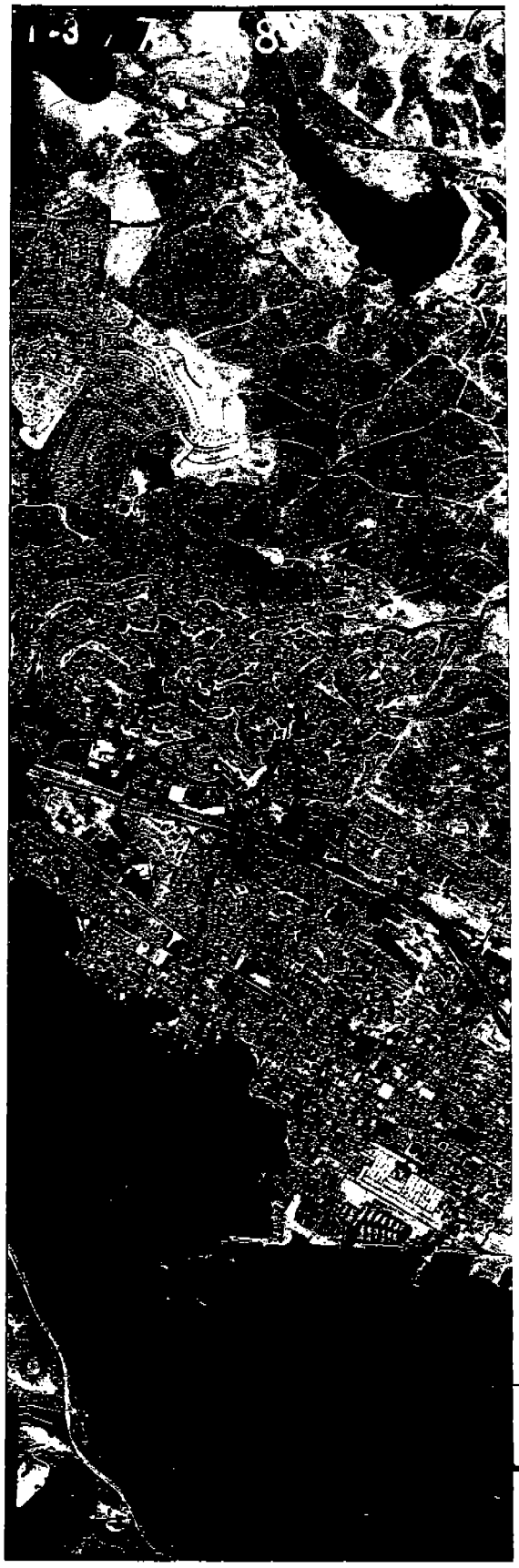
	Date of Photograph 07/18/89
[redacted]	
	2 visible
ng Tunnels (2 each)	Visible
1)	
ng Butts (Bldg 182)	Visible
Loading Room	Visible
3)	
Test Block (Bldg 540	Not visible
n Buildings	Not visible
rary Canvas Shelters	Not visible
Cages" (Metal Tanks)	Not visible
	Visible
	Visible
	Visible
	Ground disturbance (trails) at the Howitzer Test Facility
	E-W tree line from rail spurs
[redacted]	
	Visible
	Not visible
	Visible
	Soil disturbance
	Several dirt roads present (typical)
[redacted]	
	Not visible
	Only #3 visible
	Visible; rerouted around toe of landslide
	Not built
	Visible to the west and southwest. Trail crossing towards Ridge (X-1); landslide (X-2)

Nominal Scale 1:36,000

0 3000 6000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1989



Nominal Scale 1:36,000

0 3000 6000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1989

Nominal Scale 1:36,000

0 3000 6000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1990

Nominal Scale 1:17,000

0 1420 2840 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1990

Nominal Scale 1:15,600

0 1300 2600 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1990

Nominal Scale 1:15,600

0 1300 2600 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1990

See City Attorney's Office for original.

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1991

A-35

See City Attorney's Office for original.

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1991

A-36

See City Attorney's Office for original.

Nominal Scale 1:12,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1991

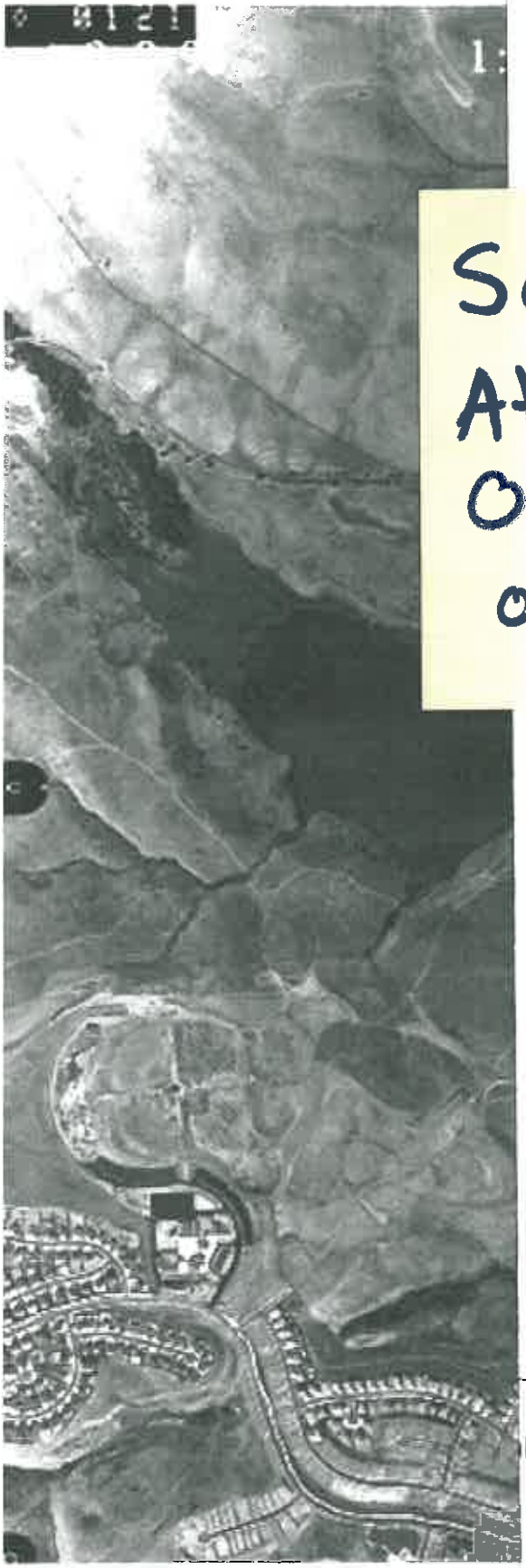
See City Attorney's Office for original.

Nominal Scale 1:12,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1991



See City Attorney's Office for original.

Nominal Scale 1:12,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1993

See City Attorney's Office for original.

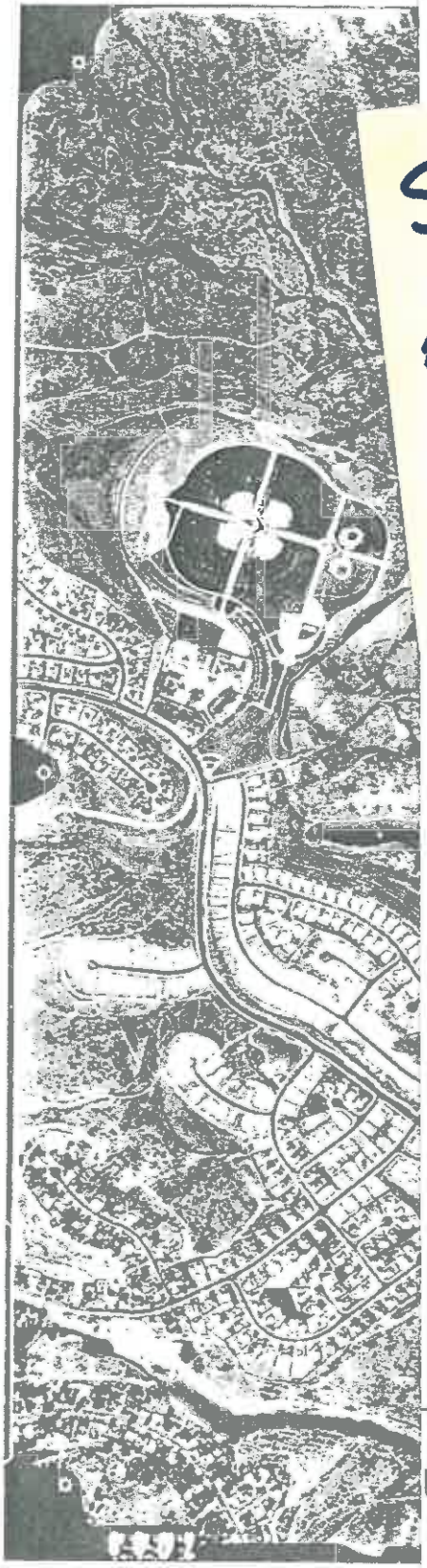
Nominal Scale 1:12,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1993

A-40



See City Attorney's Office for original.

Nominal Scale 1:12,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1995

A-41

See City Attorney's Office for original.

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1996

See City Attorney's Office for original.

Nominal Scale 1:24,000

0 2000 4000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1996

A-43

See City Attorney's Office for original.

Nominal Scale 1:12,000

0 1000 2000 Feet

URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1997

A-44

See City Attorney's Office for original.

Nominal Scale 1:12,000

0 1000 2000 Feet

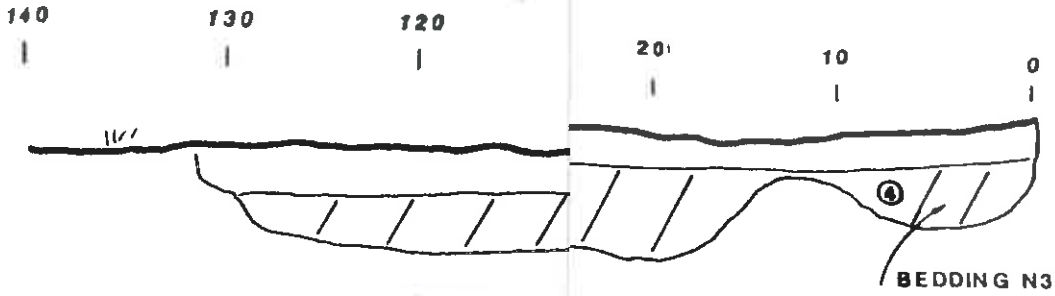
URTELOT CLEANUP PROJECT
BENICIA, CALIFORNIA

PHOTOINTERPRETATION
1997

A-45

ATTACHMENT B-1

ENGEO TRENCH DRAWINGS AND TEST PIT LOGS



See City Attorney's Office for original.

rismatic structure; moist,

or gravel, ...

on; yellow highly weathered rock fragments in a matrix

ly weathered to red brown in most places, finely bedded,

surfaces, generally very hard and well cemented; grains quartz or plagioclase ; fine to medium grained,

hly fractured.

THAMPTON TRENCH LOGS SOUTHAMPTON BENICIA, CALIFORNIA		FIGURE NO. 3
0' BY 1988	JOB NO	N8-1736-M10

See City Attorney's Office for original.

1. medium brown silty clay Sc
basal contact with stoneline
to approximately Station 45.

2. Sandstone; yellow oxidized
cemented very fine grained,

3. weathered Siltstone/Clayston
closely fractured rock surro
brown and dusky yellow; soft
calcium carbonate.

4. Siltstone/Claystone; light
moderate weathering; fractu

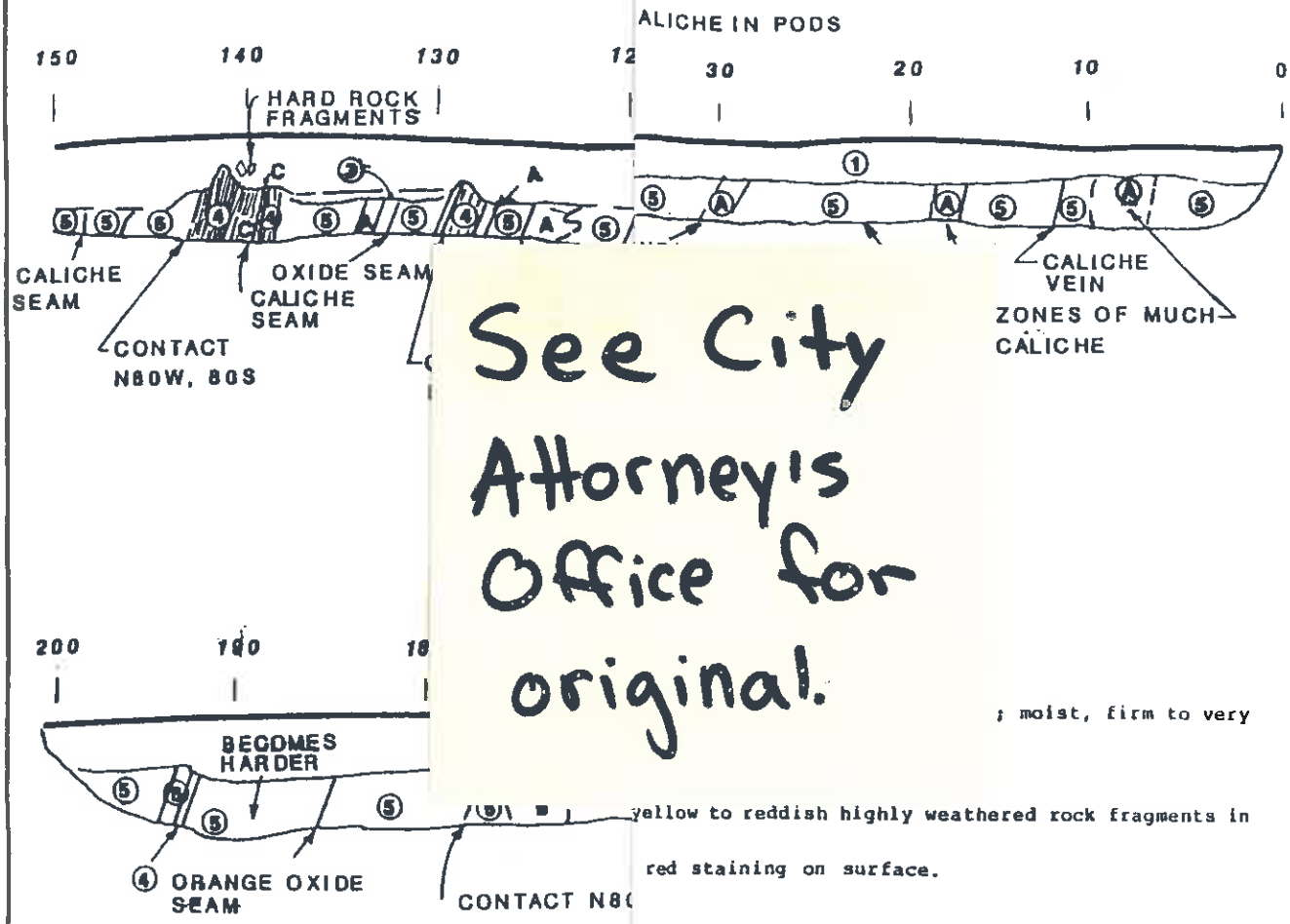
5. Siltstone; light olive brow
severe weathering; closely f

6. silty clay Colluvium with
developed prismatic soil st

HHAMPTON TRENCH LOGS
SOUTHAMPTON
BENICIA, CALIFORNIA

FIGURE NO. 4

JOB N9-1736-M10



See City Attorney's Office for original.

; moist, firm to very

yellow to reddish highly weathered rock fragments in

red staining on surface.

dded, moderately weathered to brownish in places,
nt on weathered surfaces.

disseminated throughout weathered rock.

clay with abundant scattered caliche; interfingers

nces.

nt scattered carbonate.

moderately weathered friable.

JTHHAMPTON TRENCH LOGS SOUTHAMPTON BENICIA, CALIFORNIA		FIGURE NO. 5
1"=10'	JOB NO. N9-1736-M10	
JANUARY 1989		

TP 1
WEST WALL

TP 4
WEST WALL

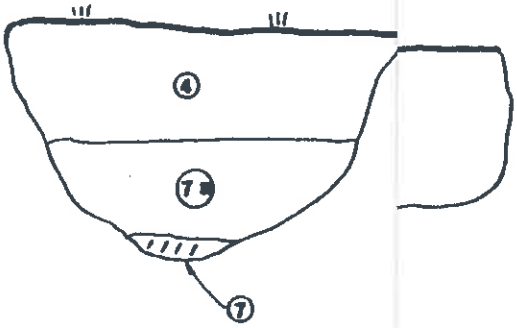
See City Attorney's Office for original.

TP
WES

SILTSTONE

BEDDING N50W, 15 W

TP 9 NORTH WALL



LEGEND

1. gray brown to dark gray brown silty clay s dium brown surfaces;
2. brown silty sandy clay Soil, dry, firm.
3. medium brown silty clay Soil, dry, firm. of quartz
4. red brown clay Soil, damp, compact. cemented; to medium
5. interbedded Shale and Siltstone; very hard clase, 10% staining. line. No
6. Shale; dark gray, damp, finely bedded.

ITHHAMPTON TRENCH LOGS
SOUTHAMPTON
BENICIA, CALIFORNIA

FIGURE NO. 6

1"=5' JOB No. 1736-M10

ATTACHMENT B-2

ENGEO BOREHOLE LOGS

DATE OF BORING: February 13, 1989

SURFACE ELEVATION: Approx. 380.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Dark brown silty CLAY, stiff, moist.				
			Brown silty CLAY, stiff, moist.				
			Grey fine SANDSTONE, hard, dry.				
5	1-1		Easier drilling. Brown SANDSTONE, damp, moist, completely weathered, highly jointed with some iron oxide stains.	37*		116.4	13.6
10	1-2			46*			
15			Grey fine SANDSTONE or shale, HARD, DRY.				
			Brown CLAYSTONE, highly fractured, highly weathered with oxide staining, moist.				
20	1-3			28*		113.1	17.7
25							
	1-4		Grey fine grained SANDSTONE, hard, dry, moderately fractured, moderately weathered.	70*			
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 1

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 2

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: February 13, 1989 SURFACE ELEVATION: Approx. 380.0 feet DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
30							
	1-5			50*			
35			Bottom of boring at approximately 33.5 feet. No free water encountered.				
40							
45							
50							
55							
60							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 1

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 2

DATE OF BORING: February 13, 1989

SURFACE ELEVATION: Approx. 200.0 feet

DEPTH (FEET)	SAMPLE NUMBER	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0		Dark brown silty CLAY, soft, wet.				
		Brown silty CLAY, soft, wet.				
		Dark brown silty CLAY, very stiff, moist.				
5	2-1	Brown sandy silty CLAY, stiff to very stiff, moist with occasional rounded gravel.	20*		112.3	15.7
10	2-2	▽ Brown silty CLAY with some fine rounded gravel, medium stiff to stiff, moist, lost sample.	9*			
15	2-3	Orange brown CLAYSTONE and interbedded grey shale, highly fractured and jointed, highly weathered, moist.	25*			
		Grey fine SANDSTONE, moderately fractured, moderately weathered, damp.				
20	2-4	(Very shale like)	50/3"*			
		Grey CLAYSTONE, thinly bedded, slightly weathered, moderately hard.				
25	2-5		50/3"*			
		Bottom of boring at approximately 25.25 feet.				
30						

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 2

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 3

DATE OF BORING: February 13, 1989

SURFACE ELEVATION: Approx. 205.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Dark brown silty CLAY, soft, wet.				
			Brown silty CLAY, stiff, moist.				
5	3-1		Brown CLAYSTONE, completely weathered, highly fractured, moist.	38*		116.6	14.8
10	3-2			23/3"*			13.5
15			Grey CLAYSTONE, moderately weathered, moderately fractured, dry, hard.				
20	3-3						
25							
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 3

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 4

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DATE OF BORING: February 13, 1989 SURFACE ELEVATION: Approx. 205.0 feet DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
30	3-4		Bottom of boring at approximately 30.5 feet. No free water encountered.				
35							
40							
45							
50							
55							
60							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 3

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 4

DATE OF BORING: February 14, 1989

SURFACE ELEVATION: Approx. 250.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Dark brown silty CLAY, soft. Becoming moist, hard.				
5	4-1			18*		114.0	15.6
10	4-2		Brown sandy SILT to siltstone, completely weathered, weak, damp, highly fractured.	24*			
15	4-3		Grey brown CLAYSTONE, completely weathered, closely fracture, damp to moist.	52			
20	4-4		Grey-light grey CLAYSTONE, moderately weathered, moderately fractured, hard, dry.	62			10.3
25			Bottom of boring at approximately 21 feet. No free water encountered.				
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 4

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 5

DATE OF BORING: February 14, 1989

SURFACE ELEVATION: Approx. 170.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown silty CLAY, stiff, moist to wet.				
			Orange brown silty CLAY, stiff, moist.				
5	5-1		Tan sandy silty CLAY, stiff, moist.	22*		96.9	16.6
			Tan silty SAND, to silty sandstone, moist, dense, weak, highly weathered with abundant, caliche deposit (to 50 percent).				
10	5-2		Interbedded grey CLAYSTONE and brown SANDSTONE, moderately bedded, moderately weathered, moderately strong.	50*			
15	5-3			64			
			Interbedded sandy SILTSTONE and CLAYSTONE, very weathered, very fractured, moderately weathered.				
20	5-4			34			35.7
			Bottom of boring at approximately 21.5 feet. No free water encountered.				
25							
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 5

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 6

DATE OF BORING: February 14, 1989

SURFACE ELEVATION: Approx. 145.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown-dark brown silty CLAY, medium stiff, moist to wet.				
5	6-1		Red brown sandy silty CLAY, hard, moist with approximately 1 percent fine rounded gravel.	26*		113.2	16.6
10	6-2		Grey brown CLAYSTONE with some interbedded brown fine SANDSTONE, highly to moderately weathered, highly fracture, moderately hard, damp.	26*		105.5	19.2
15	6-3			38			
20	6-4		Grey CLAYSTONE, highly fractured, moderately to slightly weathered, moderately hard, damp.	55			
25			Bottom of boring at approximately 20 feet. No free water encountered.				
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 6

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 7

DATE OF BORING: February 14, 1989

SURFACE ELEVATION: Approx. 200.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown to dark brown silty CLAY, stiff, moist.				
5	7-1		Brown SANDSTONE, moderately weathered, moderately fractured, hard, dry.	50*			
10			Grey-brown CLAYSTONE with interbedded brown sandstone, moderately fractured, moderately weathered, dry to damp, moderately hard to hard.				
15	7-2			55/6"			
			Bottom of boring at approximately 15.5 feet. No free water encountered.				
20							
25							
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 7

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 8

DATE OF BORING: February 14, 1989

SURFACE ELEVATION: Approx. 170.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Dark brown to black silty CLAY, soft, wet.				
			Dark brown to grey silty CLAY, stiff to very stiff, moist.				
5	8-1			21*		104.6	23.6
10	8-2		Dark brown to grey silty CLAY, stiff to very stiff, moist.	18*		105.0	23.7
15	8-3		Dark brown to grey silty CLAY, stiff to very stiff, moist.	15*		109.7	22.5
			Grey brown CLAYSTONE and SANDSTONE, moderately fractured, very weathered.				
20							
25							
30			Bottom of boring at approximately 30 feet.				

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 8

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 9

DATE OF BORING: February 17, 1989

SURFACE ELEVATION: Approx. 150.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Dark brown silty CLAY, medium stiff to stiff, moist.				
5	9-1			14*		94.9	26.2
10	9-2		Brown silty CLAY, medium stiff, wet.	17*		99.2	26.0
15	9-3			21*		98.3	28.4
20							
25	9-4		Greyish brown SANDSTONE, highly weathered, very fractured, moderately hard, saturated along all joints. Very hard drilling.	50/5"*		121.6	15.9
	9-5		Bottom of boring at approximately 28 feet.	50/1"			
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 9

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 10

DATE OF BORING: February 17, 1989

SURFACE ELEVATION: Approx. 185.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown to dark brown silty CLAY, hard, dry at surface, moist and medium stiff at 1 foot.				
			Brown silty CLAY, very stiff to hard, damp.				
5	10-1		Orange brown sandy CLAY, hard, damp to moist, (residual soil).	50/4"*			
10	10-2		Grey brown CLAYSTONE, hard, dry to damp, moderately weathered, moderately fractured.	50/6"*			
15	10-3			72			
			Bottom of boring at approximately 15.5 feet. No free water encountered.				
20							
25							
30							

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Benicia, California

BORING NO.: 10

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 11

DATE OF BORING: February 17, 1989

SURFACE ELEVATION: Approx. 175.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Red brown silty CLAY, moist, stiff.				
			Red brown sandy CLAY, hard, damp.				
5	11-1			33*		115.1	15.5
10	11-2		Brown silty CLAY with occasional gravel, fine, hard, moist, (residual soil).	58			
			Grey CLAYSTONE, highly weathered, moderately fractured, moderately hard, damp.				
15	11-3			106			
			Bottom of boring at approximately 18 feet. No free water encountered.				
20							
25							
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 11

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 12

DATE OF BORING: February 17, 1989

SURFACE ELEVATION: Approx. 100.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown silty CLAY, stiff, moist.				
			Red brown sandy silty CLAY, very stiff to hard, damp.				
5	12-1			40*		117.6	14.9
10	12-2			38			
			Brown silty CLAY, hard, damp, (residual soil).				
			Brown clayey SILTSTONE, highly weathered, moderately fractured, weak, moist.				
15	12-3			27			
	12-4			32			
20			Bottom of boring at approximately 19.5 feet. No free water encountered.				
25							
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 12

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 13

DATE OF BORING: February 17, 1989

SURFACE ELEVATION: Approx. 105.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Red brown silty CLAY, moist, stiff. Grading to damp.				
5	13-1		Brown clayey SAND to sandy CLAY, dry, hard with occasional rounded pebbles.	28*		123.0	13.3
	13-2		CLAYSTONE, completely weathered, highly fracture, dry, moderately hard.	61			10.9
10			Bottom of boring at approximately 9 feet. No free water encountered.				
15							
20							
25							
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 13

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 14

DATE OF BORING: February 20, 1989

SURFACE ELEVATION: Approx. 105.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown silty CLAY, moist, very stiff.				
5	14-1			23*		111.7	17.8
10	14-2			24*		109.5	19.8
15	14-3		Grey brown CLAYSTONE, completely weathered, very fractured, moderately weak.	71/11"			
20	14-4			84			
25			Bottom of boring at approximately 21.5 feet. No free water encountered.				
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 14

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 15

DATE OF BORING: February 20, 1989

SURFACE ELEVATION: Approx. 130.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown silty CLAY, moist, very stiff.				
5	15-1			20*		108.9	18.0
10	15-2		Color change to lighter brown.	39*		100.0	24.8
15	15-3		Brown, completely weathered silty SANDSTONE, moderately fractured, weak, damp.	93/10"			
20	15-4		Grey CLAYSTONE, moderately weathered, very fractured, hard, dry to damp.	94/11"			
25			Bottom of boring at approximately 21 feet. No free water encountered.				
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 15

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 16

DATE OF BORING: February 20, 1989

SURFACE ELEVATION: Approx. 140.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown silty CLAY, stiff, moist, with some gravel sized angular rock.				
5	16-1			30*		118.8	15.8
10	16-2		Grey brown to brown CLAYSTONE, completely weathered, to a brown silty CLAY, very fractured, dry, moderately weak.	33*			14.6
15	16-3			40			13.8
20			Grey CLAYSTONE, moderately weathered, moderately fractured, hard, damp.				
25	16-4			50/6"			
			Bottom of boring at approximately 25.5 feet. No free water encountered.				
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 16

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 17

DATE OF BORING: February 20, 1989

SURFACE ELEVATION: Approx. 135.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown to dark brown silty CLAY, soft to medium stiff, wet.				
5	17-1		Brown sandy silty CLAY with ample angular rock fragments, very stiff, damp.	34*		101.3	23.5
10	17-2		Grey brown CLAYSTONE very highly weathered, highly fractured, much discoloration, moderately weak.	30*			
15	17-3		Grey CLAYSTONE, moderately weathered, very fractured, dry, hard.	67			
20							
25			Bottom of boring at approximately 25 feet. No free water encountered.				
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 17

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 18

DATE OF BORING: February 20, 1989

SURFACE ELEVATION: Approx. 155.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			8 inch asphalt pavement section.				
			Grey to grey silty CLAY, medium stiff, moist, to wet. (FILL)				
5	18-1		Brown to dark brown silty CLAY, medium stiff, moist.	16*		100.1	24.7
10	18-2		Grey-brown CLAYSTONE, moderately weathered, moderately fractured, moderately hard, dry.	40*			
15							
20	18-3		▽	56			
			Bottom of boring at approximately 21.5 feet.				
25							
30							

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 18

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 19

DATE OF BORING: February 20, 1989

SURFACE ELEVATION: Approx. 160.0 feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Brown silty CLAY, stiff, moist.				
5	19-1		Brown grey CLAYSTONE, weathered to an orange silty CLAY, hard, damp, very fractured.	39*			
10	19-2		Grey CLAYSTONE, moderately weathered, very fractured, hard.	78			
15							
20	19-3			50/6"			
25							
30			Bottom of boring at approximately 30 feet. No free water encountered.				

ENGEO INCORPORATED

Southampton-Units D-1 through D-7

Benicia, California

BORING NO.: 19

DATE: February 1990

JOB NO.: N9-1736-M12

FIGURE NO. 20

DATE OF BORING: October 12, 1989

SURFACE ELEVATION: Approx. feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Dark brown silty CLAY with some gravel, slightly moist.				
5	20-1		Light olive clayey SILT with some sand and gravel, hard, slightly moist.	50/9"*	4.5+*	126.3	9.3
10	20-2		Light olive fine SILTSTONE with rust stains, hard, slightly moist.	50/6"*	4.5+*	113.1	10.3
	20-3		Mottled olive SILTSTONE, with rust stains, hard, moist.	68	4.5+*		
15			Bottom of boring at approximately 14.5 feet.				
20							
25							
30							

ENGEO INCORPORATED

Southampton Units D1 through D7

Benicia, California

BORING NO.: 20

DATE: January 1990

JOB NO.: N9-1736-M12

FIGURE NO. 21

DATE OF BORING: October 12, 1989

SURFACE ELEVATION: Approx. feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0			Dark brown silty CLAY, moist.				
	21-1		Brown silty CLAY with gravel, with rust stain, moist, stiff.	30*		109.6	15.7
5	21-2		Olive sandy SILT with gravel, moist, hard.	50/6"*			
			Olive SILTSTONE.				
	21-3		Olive sandy SILTSTONE with rust stains, moist, hard.	74	4.5+*		
10			Bottom of boring at approximately 9.5 feet.				
15							
20							
25							
30							

ENGEO INCORPORATED

Southampton Units D1 through D7

Benicia, California

BORING NO.: 21

DATE: January 1990

JOB NO.: N9-1736-M12

FIGURE NO. 22

DATE OF BORING: October 12, 1989

SURFACE ELEVATION: Approx. feet

DEPTH (FEET)	SAMPLE NUMBER	LOG, LOCATION AND TYPE OF SAMPLE	DESCRIPTION	N S.P.T. BLOWS/FT *MODIFIED FOR 3" O.D. SAMPLER	qu UNCON. COMP. STRENGTH (TSF) *FIELD PENET. APPROX.	IN PLACE DRY UNIT WEIGHT (PCF)	IN PLACE MOIST. CONTENT % DRY WEIGHT
0	22-1		Dark brown silty CLAY with gravel and sand, moist, very stiff.	28*	4.5+*	108.0	15.9
5	22-2		Olive SILTSTONE with carbonate veining, hard, slightly moist.	50/ 7.5"*	4.5+*	112.4	12.2
10	22-3		Olive SILTSTONE with carbonate veining and rust stains, hard, slightly moist.	50/3"	4.5+*		
			Bottom of boring at approximately 11.5 feet.				
15							
20							
25							
30							

ENGEO INCORPORATED

Southampton Units D1 through D7

Benicia, California

BORING NO.: 22

DATE: January 1990

JOB NO.: N9-1736-M12

FIGURE NO. 23

APPENDIX C
WORK PERFORMED

This appendix summarizes the work performed during the non-ordnance and explosives remedial investigation (non-OE RI). Non-OE RI data collection was achieved during four phases of field investigation work conducted between May 1999 and August 2000. The four phases of field work are identified in this document as follows: the interim investigation; the remedial investigation; the data gaps investigation; and, the removal action investigation. Collectively, these investigations are referred to as the non-OE RI. Field activities were conducted during the time periods indicated below:

- Interim Investigation - May 5, 1999 through July 21, 1999
- Remedial Investigation - December 2 through December 23, 1999
- Data Gaps Investigation - February 22 through February 28, 2000; March 23 through May 3, 2000; May 24, 2000; June 5 through June 7, 2000; August 3 through August 14, 2000; August 23 through August 25, 2000; and, August 31 and September 1, 2000
- Removal Action Investigation - May 8, 2000 through June 8, 2000.

With the exception of the interim investigation, all field activities were conducted in accordance with the protocols and procedures presented in Chapter 2.0 of the *Final Non-Ordnance and Explosives Remedial Investigation (RI)/Feasibility Study (FS) Work Plan*, dated February 15, 2000 (the "Final Work Plan"), Section 6.0 of the *Technical Memorandum for Remedial Investigation*, dated March 2, 2000 (the "Tech Memo") and Chapter 8.0 of the *Removal Action Work Plan*, dated May 9, 2000 (the "RAW"), unless otherwise stated in this appendix. It should be noted that the interim investigation was conducted prior to the development of a formal work plan; however, samples collected during the interim investigation were collected in accordance with industry standard protocols and procedures as described in this appendix. All data collected during the non-OE RI (including the interim investigation data) have been validated according to the Quality Assurance Project Plan (QAPP) and are considered to represent definitive-level data as discussed in the Quality Control Summary Report (QCSRs) (see Volume IV) and summarized in Section 5.1 of this document.

C.1 PERMITS

No permits were required by the Solano County Department of Environmental Management (DEM) for advancement of exploratory boreholes. The Solano County DEM did require permits for groundwater monitoring well installations. Well permit applications were submitted to Solano County DEM for their approval prior to monitoring well installations. Eighteen shallow groundwater monitoring wells were installed as part of the non-OE RI. Three single-cased shallow wells (TW-3, TW-4, and TW-12) were installed during the remedial investigation. Two of the wells, TW-3 and TW-4, were initially installed as temporary groundwater wells. The wells were considered "temporary" because they did not have a cement grout sanitary seal installed at the time of well construction. These wells were subsequently converted into "permanent" wells during the data gaps investigation by adding a sanitary seal. Placement of the sanitary seal was either observed by a Solano County DEM inspector, or placed in the absence of an inspector but with prior Solano County DEM approval. Another single-cased shallow well, TW-12, was installed as a permanent well during the remedial investigation. These wells were subsequently renamed MW-3(TW-3), MW-4(TW-4) and MW-12(TW-12) during the data gaps investigation. Twelve additional single-cased shallow groundwater monitoring wells (MW-1, MW-2, MW-5, MW-6, MW-7, MW-8, MW-9, MW-10, MW-11, MW-13, MW-14, and MW-15) and three double-cased deep groundwater monitoring wells (MW-3A, MW-3B, and

MW-4A) were installed during the data gaps investigation, after appropriate permits were received from Solano County DEM.

C.2 HEALTH AND SAFETY

All field activities performed at the Project Site were conducted in accordance with the requirements of the *Final Tourtelot Cleanup Project Site-Specific Safety and Health Plan, Benicia, California* (SSHP), prepared by Earth Tech, dated March 27, 2000 (Earth Tech, 2000d). This SSHP incorporates the requirements of the *Remedial Investigation/Feasibility Study Site-Specific Health and Safety Plan*, dated November 5, 1999 (Earth Tech, 1999) and *Draft Tourtelot Project Site-Specific Safety and Health Plan*, dated February 9, 2000 (Earth Tech, 2000a).

All field activities were performed by personnel meeting the requirements of Title 8 California Code of Regulations (CCR) Section 5192 (29 Code of Federal Regulations [CFR] Part 1910.120) (Hazardous Waste Operations and Emergency Response [HAZWOPER]). Prior to the start of any field investigation activities, all field personnel and authorized visitors were required to read and sign the SSHP. A site safety meeting was held each morning in accordance with the guidelines in the SSHP, and documented on Site Safety Meeting Forms maintained in the project file.

C.3 CLEARANCE

All investigation locations were pre-marked and cleared of any subsurface obstructions. Geophysical data for the Project Site was reviewed to identify potential underground utilities or subsurface obstructions.

C.3.1 Ordnance and Explosive Avoidance

All proposed investigation sample locations were cleared using standard ordnance and explosive (OE) avoidance techniques. An unexploded ordnance (UXO) specialist, who also served as the Site Safety Coordinator (SSC), accompanied each sampling crew during <u>all</u> field investigation activities. If a proposed borehole location could not be cleared by the UXO specialist, the borehole was relocated. Nearly all boreholes were able to be advanced at their initial proposed location with the exception of borehole FA-3 at the Flare Site during the interim investigation, and boreholes AR-5 and AR-11 during the data gaps investigation. Borehole FA-3 was supposed to be advanced toward the center of the residual ash-covered area at the Flare Site to a depth of 4.5 feet below ground surface (bgs); only a surface sample was able to be collected at the time of the interim investigation. Boreholes AR-5 and AR-11 were supposed to be located near a former building/structure and north of a geophysical anomaly, respectively, at the Ammunition Renovation/Primer Destruction Site. Both these boreholes had to be relocated based on the OE avoidance results.

OE Clearance During Hand Augering - Hand augers were used primarily during the interim investigation and removal action investigation, to advance boreholes less than 4.5 feet bgs. Hand augers were also used during the remedial investigation to collect soil samples from along the axis of the TNT Strips. The UXO specialist initially cleared the proposed hand auger borehole location, from the ground surface to a depth of 1 foot bgs, using a Schonstedt magnetic locator to enable soil samples to be safely collected from the target depths within the first 1 foot bgs. After soil samples were collected within the first 1 foot bgs, the UXO specialist placed the instrument tip down the borehole to clear the next 1-foot depth interval prior to continuation of the hand augering and sample collection. This process was duplicated at each hand augered borehole location. At locations where soil sample collection from hand augered boreholes exceeded 3 feet bgs, the UXO specialist cleared a 1-foot square area around the proposed borehole location. After sample collection within the first 1-foot bgs interval had been completed, the soil from the 1-foot square area was removed to a depth of 1 foot bgs, so the magnetometer could be placed into the

excavated hole. With the body of the meter placed in the excavated hole, the tip of the meter was able to clear borehole depths, advanced at 1-foot intervals, up to a maximum depth of 4.5 feet bgs.

Direct Push/Drill Rig - A direct push rig or a hollow-stem auger drill rig was used to advance boreholes during the remedial and data gaps investigations. The UXO specialist initially cleared the proposed borehole location, from the ground surface to a depth of 1 foot bgs as described above. The borehole was then advanced 1 foot and the augers and drive casing removed. A downhole Schonstedt magnetic locator was then used to clear the next 1 foot interval prior to replacing the augers and drive casing. The borehole was then advanced another 1 foot. This process was repeated in 1 foot increments to a maximum depth of 4 feet bgs. No OE clearance was performed beyond 4 feet bgs.

Removal Action Investigation - In order to facilitate the non-OE characterization of the soil beneath the North Valley Military Landfill, it was necessary to clear the proposed excavation locations of OE. The clearance consisted of a multi-step approach that included surface preparation, real-time geophysical investigation and mapping, establishment of a minimum separation distance, anomaly excavation, and OE disposal (see Photos 28 through 32).

A team of qualified UXO technicians supervised by a Senior UXO Supervisor (SUXOS) were utilized to conduct the surface OE clearance and removal of vegetation from the proposed excavation area and explosive magazine storage area. Blackhawk Geometrics utilized the EM61 electromagnetic (EM) system to investigate and map the proposed excavation areas. During the geophysical investigation, metallic anomalies (potential OE) were marked with "clay pigeons" to facilitate UXO crew reacquisition and excavation (see Photo 30 of this document). The UXO team commenced excavations of anomaly sources (potential OE) on May 16, 2000. A 1,701-foot minimum separation distance was enforced during the anomaly excavations to ensure public safety in the event of an accidental detonation; however, no OE was encountered during the removal action investigation. A list of items recovered during anomaly excavation is presented in Appendix G.

After the anomalies identified during the initial geophysical investigation were excavated, a track-mounted backhoe was used to excavate test pits in 1-foot lifts. As each foot of soil was removed, each test pit was reinvestigated using the EM61 to locate anomalies, followed by excavation of the anomalies and removal of another foot of soil. This process was repeated until the base of the landfill was reached.

C.4 EXPLORATORY TEST PITS

C.4.1 South Valley

Twelve test pits (P-1 through P-12) were advanced in the South Valley during the interim investigation to assist in the characterization of the depth to weathered/unweathered bedrock. The test pits were excavated on May 5 and 6, 1999, using a JD 450D crawler backhoe with a 36-inch bucket supplied by Lee's Backhoe of East Palo Alto, California. The depth of the test pits ranged from 4.5 feet to 12 feet bgs. Locations of the test pits are shown on Figure 4-2. Copies of the Test Pit Logs are included in Attachment C-1 of this appendix.

C.4.2 North Valley Military Landfill

Thirty test pits (LFP-1 through LFP-30) were advanced in the North Valley Military Landfill during the removal action investigation to characterize and assess the vertical and lateral extent of the landfill. The test pits were excavated from May 16 to May 26, 2000, using a track-mounted backhoe. Excavated material from the test pits was stockpiled on Visqueen™ (see Photos 40 and 41 of this document). Both the test pits and stockpile were covered with Visqueen™ at the end of each work day (see Photo 46 of this

document). Locations of the test pits are shown on Figure 4-3 of this document. The Test Pit Logs are presented on Figure 4-4 of this document.

C.5 SHALLOW SEISMIC REFRACTION SURVEY

A shallow seismic refraction survey was conducted in the South Valley during the interim investigation to assist in the characterization of the depth to weathered/unweathered bedrock. The seismic survey was conducted by NORCAL Geophysical Consultants, Inc., of Petaluma, California, during the period June 2 through June 9, 1999. Seismic refraction data was obtained from a series of traverses situated perpendicular to the east-west drainage of the South Valley. Seismic compressional P-wave refraction data were collected along six alignments comprising a total of 35 separate seismic refraction spreads. The lengths of the spreads ranged from 65 feet to 91 feet. Each seismic spread consisted of 12 geophones spaced 5 feet to 7 feet apart in a collinear array with shotpoints located at each end of the array. Seismic energy was produced by a 10-pound hammer striking a metal plate on the ground surface. All seismic refraction spread alignments were scanned with a metal detector prior to data acquisition. If metallic objects were detected, the geophone placement and shotpoints were relocated. Seismic profiles consisted of a 12-geophone spread and two shotpoints. Seismic data was acquired using a Geometrics ES-1225 12-channel seismograph and 4.5 Hz Mark Products geophones.

Preliminary seismic refraction analysis of each seismic spread consisted of determining the P-wave arrival time from the shotpoints to the respective geophones, and plotting the various arrival times to each geophone versus the respective distances from each shotpoint. Linear best-fit slopes to the data provided an initial indication of the number of "layers" and the apparent seismic velocities associated with each "layer" below the seismic spread. Refraction data were then entered into a seismic inverse modeling program which calculated the depth to seismic refractors (layer interfaces) and determined the average velocity of each seismic layer.

Locations of the seismic refraction survey traverses are shown on Figure 4-2. Seismic refraction data from the South Valley appeared to resolve the shallow subsurface into two or three seismic velocity layers as follows:

- V1 (surficial layer) - typical seismic velocity below 1,500 feet per second (fps) which has been interpreted as representing the thickness of residual soil and possible colluvium in localized areas
- V2 (intermediate layer) - typical seismic velocity in the range of 2,000 to 2,900 fps which has been interpreted as representing highly weathered bedrock material
- V3 (deepest layer) - typical seismic velocity greater than 3,000 fps which has been interpreted as representing less weathered bedrock material

The interpreted thickness of the surficial material and depth to less weathered bedrock along each seismic line are summarized in Table 1 of NORCAL's report presented in Attachment C-2 of this appendix. Interpreted thickness of surficial material are also summarized on Figure 4-5.

C.6 EXPLORATORY BOREHOLES

Several methods were used to advanced exploratory boreholes at the Project Site depending on the borehole location, proposed depth of the borehole, and the nature of the top soil, valley alluvium, and underlying bedrock. The Project Site terrain limited the types of drill rigs which could be deployed. A summary of the boreholes advanced during each investigative phase, including drill method, total depth of borehole, nominal borehole diameter, and date borehole advanced is presented in Table C-1.

During the interim investigation, exploratory boreholes were advanced using a hand auger since all boreholes were terminated 4.5 feet or less bgs. During the remedial investigation boreholes were advanced using either a hand auger (typically on the axis of the TNT Strips and places inaccessible with a drill rig) or a direct push MD-1 rig. A track-mounted Morooka MST-600 hollow-stem auger drill rig was also used for all boreholes for potential monitoring well installation, with the exception of boreholes TW-1, TW-5, and TW-7 where the direct push MD-1 rig was used. The hollow-stem auger drill rig was typically used in places where gravels could potentially be encountered (i.e., base of the valley alluvium), since the direct push method cannot be successfully advanced into this type of material. During the data gaps investigation, all boreholes were advanced with either a track-mounted Morooka MST-600, a CME-75, a CME-550, or CME-650 hollow-stem auger drill rig, except as follows.

At boreholes TNT-1P, TNT-1Q, and TNT-2F, located on the axis of the TNT Strips, the upper 2 feet to 3 feet of soil was hand augered due to the potential for high concentrations of explosive compounds within this zone. Soil samples were collected from the upper soil and initially analyzed for explosives using a field test (see Section C.12). Once it was determined that the levels of explosive compounds were below 10 percent, the borehole was enlarged using a hand auger and a fence post digger to approximately 12 inches in diameter for the installation of a 10-inch polyvinyl chloride (PVC) shallow conductor casing. After installation of the conductor casing, borehole advancement continued with the CME-550 hollow-stem auger drill rig.

The MD-1 direct push rig uses a combination of static push and percussion hammer to advance a borehole. Static push relies on the weight of the rig to push the drill rods into the ground. This weight applied to the drill rods is commonly referred to as the "reactive weight." The rate of penetration and maximum borehole depth are directly proportional to the reactive weight applied to the drill rods. When used in combination with percussion hammering, up to 20,000 pounds of reactive weight can be applied, which dramatically increases the force applied to the cutting shoe, enabling borehole advancement to greater depths and through more consolidated types of materials.

Hydraulic percussion hammers can deliver up to 500 foot-pounds of impact force. An anvil on the bottom of the hydraulic hammer transmits the striking force to the drill rods. The reactive weight (i.e., weight of the rig) is applied using hydraulic cylinders that press the hydraulic hammer on the drill rods. The hydraulic hammer can be used in conjunction with the reactive weight, depending on the type of material being penetrated.

The direct push method was used to collect continuous soil samples (see Section C.6.1) generally 2 feet to 3 feet in length. Discrete sections were then retained from the appropriate depth intervals required by the remedial investigation sampling program. The direct push drilling method produced a smaller-diameter borehole (nominally 3 inches in diameter) and created significantly less soil cuttings than the hollow-stem auger method. The only soil cuttings generated were from those portions of the continuous soil samples not retained for chemical analysis. Soil cuttings were placed in an appropriate container, pending analytical results and a determination of proper disposal (see Section C.21).

The hollow-stem auger drilling method involved drilling a borehole, nominally either 6 inches in diameter with the Morooka-MST-600 drill rig or 8 inches in diameter with the CME-75, CME-550 and CME-650 drill rigs, by simultaneously rotating and axially advancing the auger column into unconsolidated or poorly consolidated formations. As the auger flights rotated and advanced into the ground, they acted as a casing to stabilize the borehole. The pilot bit and teeth on the auger head drilled into the soil and directed the cuttings to the auger flights. As the auger flights rotated, the soil cuttings were brought to the surface by movement along the continuous flights on the outside of the hollow stem. The drill cuttings were removed from the ground surface by a shovel and placed in an appropriate container, pending analytical results and a determination of proper disposal (see Section C.21). A pilot bit at the bottom of the auger flights was used

to plug the hollow core of the augers during drilling except for when soil sampling was being performed (see Section C.6.1). During hollow-stem auger drilling, the augers acted as a temporary casing and prevented the borehole from collapsing, thereby reducing the possibility of cross-contamination.

The CME 550 and CME 650 drill rigs used during the data gaps investigation were capable of both hollow-stem auger and mud rotary drilling. The mud rotary method was used only during continuous coring (see Section C.6.1) in the deeper bedrock if dry coring with the hollow-stem auger could not be achieved. Continuous dry coring was used at boreholes TNT-1P, TNT-1Q, AR-7, and partially at borehole TNT-2F. Mud rotary drilling with either conventional NW diamond core drilling or HQ wireline coring was used at boreholes MW-3A and MW-4A, and partially at borehole TNT-2F. Borehole MW-3B was advanced by mud rotary drilling without any sampling. When drilling water was necessary, potable water of documented quality (see Section C.13.2) was obtained from an on-site fire hydrant.

The on-site field geologist prepared and maintained a geologic log for each borehole advanced by either a drill rig or a hand auger. Soil cuttings, discrete samples, and continuous cores were classified in accordance with the ASTM D 2488 *Description and Identification of Soils (Visual-Manual Procedures).* Bedrock cuttings, discrete samples, and continuous cores were identified and recorded using the standard nomenclature in the *Classification of Rocks* (Colorado School of Mines, 1955). Copies of the Test Borehole Logs are included in Attachment C-3 of this appendix.

Soil samples or bedrock cores were collected from the exploratory boreholes as described in Section C.6.1. During borehole advancement, all downhole equipment was decontaminated as described in Section C.20.1. All soil cuttings and drilling mud were contained in either 55-gallon Department of Transportation (DOT)-approved drums or lined roll-off bins pending soil analytical results and determination of the proper disposal (see Section C.21).

C.6.1 Soil and Bedrock Sample Collection

Soil samples collected from hand augered boreholes (see Table C-1), typically 4.5 feet bgs or less, were collected using a hand-held drive sampler. A 6-inch-long by 2.5-inch-diameter drive sampler was attached to the sampling rods. The sampler contained one 6-inch-long by 2-inch-diameter, certified, pre-cleaned, stainless steel liner. A hand-driven slide hammer was then attached to the top of the sampling rods. The dead weight of the sampler, rods, and slide hammer was allowed to rest on the ground surface or the bottom of the borehole and a seating blow applied. The sample rods were marked at 6-inch increments so the advancement of the sampler could be observed. The sampler was driven into the undisturbed soil with blows from the slide hammer. Blows were applied until the sampler had advanced 6 inches, or until it was determined that no visible advancement was being made. After the sampler had been driven to the desired depth, it was removed from the borehole, opened, and the liner removed.

Deep boreholes (greater than 4.5 feet bgs) were advanced using one of the drilling methods described in Section C.6 and summarized in Table C-1. During drilling, subsurface samples were collected either continuously (using the direct push method) or at discrete intervals (using the hollow-stem auger method). Continuous bedrock cores were also collected from those boreholes which were advanced deep into the bedrock, specifically boreholes TNT-1P, TNT-1Q, TNT-2F, AR-7, MW-3A, and MW-4A.

When continuous samples were collected, discrete samples were retained from the continuous sample for chemical analysis from the appropriate depth per the requirements of the field sampling program for each investigative phase. The depth at which samples were collected and retained for chemical analysis are recorded on the Test Borehole Logs (see Attachment C-3). During hollow-stem auger drilling, discrete samples were collected at a minimum of 5-foot intervals or less per the field sampling program.

In order to collect continuous cores using the direct push method, a dual-tube or "cased" system was used. A small-diameter drive casing (up to 3 inches) and an inner sample barrel were simultaneously pushed and hammered into the ground by the direct push rig. The sample barrel was made of a 3-foot-long section of thin-walled steel tubing. The sample barrel had an outside diameter (OD) slightly smaller than the inside diameter (ID) of the drive casing which allowed it to be raised and lowered freely inside the drive casing. The bottom of the sample barrel rested on a shoulder cut into the drive shoe. Six 6-inch-long certified, pre-cleaned, stainless steel liners were placed inside the sample barrel. A basket catcher was affixed to the bottom of the sample barrel, if necessary, to prevent loose soil from falling out of the sample liner when the sample barrel was retrieved. In order for the sample barrel and drive casing to be advanced into the ground simultaneously, an effective means of coupling the inner sample barrel with the outer drive casing is required. This was achieved by the internal rods, which kept the inner sample barrel seated against the drive shoe. The internal rods (3-foot sections of small-diameter steel sampling rods) served several purposes. First, they were used to lower the empty sample barrel to the bottom of the steel-cased borehole. Then, the rods were placed in compression inside of the drive casing by attaching the drive head; this kept the bottom of the sample barrel snug against the shoulder of the drive shoe. Finally, after the drive casing and sample barrel had been simultaneously advanced 2 feet to 3 feet, the internal rods and sample barrel were retrieved, providing access to the sample liner(s). Continuous cores were collected by repeating the sample collection process every 2 feet to 3 feet.

Discrete samples were collected using the hollow-stem auger drilling method, the pilot bit was removed and, if necessary, the inside of the hollow stem auger cleaned out. Samples were collected by lowering a split-spoon sampler (fitted with certified, pre-cleaned, stainless steel liners), attached to the drill rods, to the bottom of the borehole. The split-spoon sampler was then driven into the undisturbed formation with a 140-pound hammer repeatedly dropped from a height of approximately 30 inches. The number of times required for the hammer to drop to collect 6 inches of samples was recorded on the Test Borehole Log (see Attachment C-3) to provide qualitative information regarding the density of the material encountered. Depending on the drill rig and material being sampled, samples were collected using either an 18-inch-long, 1.5-inch diameter Standard Penetration Test (SPT) drive sampler, a 2.0-inch diameter California modified split-spoon drive sampler, or a 2.5-inch diameter split-spoon drive sampler. Three 6-inch-long, certified, pre-cleaned, stainless steel liners were placed inside the sampler. Upon sample retrieval, the sampler was opened and the lead sample liner retained for chemical analysis. The two remaining sample liners were used for lithologic description.

Soil samples collected for volatile organic compound (VOC) analysis by United States Environmental Protection Agency (EPA) Method SW8260B were sampled using the Encore™ sampling system according to EPA Method SW5035. Immediately upon retrieval of the soil sample liner, the Encore™ sampler was used to extract a "plug" of soil from the end of the liner. Both the main liner sample and "plug" were then labeled and handled according to the protocols and procedures described in Section C.15.

Boreholes TNT-1P, TNT-1Q, TNT-2F, AR-2, MW-3A and MW-4A were advanced at varying depth intervals into the bedrock in order to collect continuous bedrock cores which were used to evaluate hardness, strength, degree of weathering, degree of fracturing, amount of discoloration or staining, and stratification of the unweathered bedrock zone (see Photos 20 through 27 of this document). Where possible, the continuous bedrock cores were collected using a hollow-stem auger drill rig and a dry core sampler. At boreholes TNT-2F, MW-3A and MW-4A, dry coring was not possible due to the lithology encountered. At these locations mud rotary/wet coring sample collection method was used. Coring using water or drilling mud consisted of either conventional NW diamond coring or HQ wireline coring. The conventional NW diamond coring involved tripping out the drill rods after each core run. HQ wireline coring allows the drill rods to remain in the bottom of the hole while retrieving the inner core barrel containing the core rock sample with a wireline. Thus wireline coring is much more efficient and reduces the potential for hole instability.

All soil/bedrock samples retained for chemical analysis were identified with a unique sample identification number. A complete list of the sample identification numbers are presented in the analytical summary tables presented in this document.

C.7. EXPLORATORY BOREHOLE ABANDONMENT

C.7.1 Shallow Boreholes

Shallow hand augered boreholes (typically 4.5 feet bgs or less) were abandoned after completion of soil sample collection by backfilling the borehole to the ground surface with bentonite chips, which were hydrated with distilled water of documented quality (see Section C.13.2).

C.7.2 Deep Boreholes

Deep boreholes (typically greater than 4.5 feet bgs) which were advanced using either the direct push, hollow-stem auger, or mud rotary drilling method were abandoned after completion of soil sample collection by backfilling with a cement grout. The grout consisted of 2 pounds to not more than 4 pounds of 100 percent pure sodium bentonite powder and 5 gallons to not more than 8 gallons of approved potable water of documented quality for each 94-pound sack of Type II Portland cement. For most boreholes, the grout was poured from the surface through the open borehole. In the deeper boreholes where water was encountered or drilling fluid was used, the grout was placed via a tremie pipe set at the bottom of the borehole. Boreholes that were backfilled by the tremie method include TNT-1P, TNT-1Q, TNT-2F and AR-7. Additional grout was added as necessary from the surface to maintain the level of grout at the ground surface as settlement occurred. A stake was placed at each borehole location, with the borehole identification number noted on the stake, until the borehole location was surveyed (see Section C.16).

C.8 GROUNDWATER MONITORING WELL INSTALLATION

Groundwater monitoring wells were installed during both the remedial and data gaps investigations. Three single-cased shallow wells were installed during the remedial investigation; two temporary wells (TW-3 and TW-4) in the North Valley, and one permanent well (TW-12) downgradient of the McAllister Drive Land Bridge. The "permanent" well had a cement grout sanitary seal installed. The temporary wells had a bentonite seal but no cement grout sanitary seal was installed, since they were not anticipated to be used for any additional monitoring. Preliminary analytical data (i.e., unverified and unvalidated) from the remedial investigation indicated low concentrations of petroleum hydrocarbons and 2,4,6-trinitrotoluene (TNT) in the groundwater, therefore, temporary wells TW-3 and TW-4 were converted into "permanent" wells during the data gaps investigation by adding a cement grout sanitary seal installed. All wells installed during the remedial investigation were then renamed MW-3(TW-3), MW-4(TW-4), and MW-12(TW-12) when additional "permanent" monitoring wells were installed during the data gaps investigation. Twelve single-cased shallow "permanent" wells (MW-1, MW-2, MW-5, MW-6, MW-7, MW-8, MW-9, MW-13, MW-14, MW-15 in the North Valley and MW-10 and MW-11 in the South Valley) and two double-cased deep "permanent" wells (MW-3B and MW-4A in the North Valley) were installed during the data gaps investigation. One other double-cased deep well (MW-3A) was installed during the data gaps investigation. During installation of the conductor casing at well MW-3A, grout seeped into the conductor casing (see Section C.8.2). Later during development of well MW-3A (see Section C.8.3), the pH of the water being removed from the well was 12.04. Since overdevelopment of the well did not reduce the pH level, well MW-3A was declared a grout-impacted well for the purposes of the non-OE RI. A replacement well (MW-3B) was subsequently installed, approximately 15 feet upgradient of MW-3A. Well MW-3A will be appropriately abandoned in accordance with the Final Work Plan (Earth Tech, February 2000b) and the requirements of the Solano County DEM.

All groundwater monitoring wells were installed using the hollow-stem auger drilling method. The Morooka MST-600 drill rig equipment with 6-inch augers was used for monitoring well installations during the remedial investigation (i.e., MW-3[TW-3], MW-4[TW-4], and MW-12[TW-12]). During the data gaps investigation, monitoring wells MW-1, MW-2, MW-5, MW-7, MW-8, MW-9, MW-10, MW-11, MW-13, MW-14, and MW-15 were installed using the Morooka MST-600 drill rig equipped with 6-inch augers, monitoring well MW-6 was installed using the CME-550 drill rig equipped with 8-inch augers, and monitoring wells MW-3A, MW-3B, MW-4A were installed with the CME-650 drill rig equipped with 8-inch augers.

C.8.1 Single-Cased Shallow Wells

Each borehole for shallow monitoring well installation was advanced to the target depth (i.e., base of the alluvium and or underlying weathered bedrock zone) for monitoring well installation. During drilling, soil samples were collected and retained for chemical analysis at a minimum of 5-foot intervals or less (per the field sampling program) using an 18-inch-long, 1.5- , 2.0-, or 2.5-inch- diameter split-spoon sampler (see Section C.6.1). The borehole was lithologically logged using a combination of the soil samples and drill cuttings by the field geologist, working under the supervision of a California state-registered geologist (see Attachment C-3), in order to optimize the length and placement of the well screen interval.

Wells completed using the hollow-stem auger method were installed through the auger flights. The three wells installed during the remedial investigation (MW-3[TW-3], MW-4[TW-4], and MW-12[TW-12]) were constructed with 1-inch diameter casings consisting of a Schedule 40 PVC riser pipe and factory-slotted well screen. All wells installed during the data gaps investigation were constructed with 2-inch diameter Schedule 40 PVC riser pipe and factory-slotted well screen. All casing was flush threaded. Selection of monitoring well filter pack and slot size was based on visual soil classification by the field geologist. All wells were screened in fine-grained materials, therefore, 0.010-inch slot well screens with Lonestar #2/12 sand were used. The visual soil classification was confirmed by sieve analysis at an approved geotechnical testing laboratory (see Section C.8.1.5).

Screen and casing sections were certified clean by the supplier and left in the original plastic wrapping until it was time for the casing to be lowered through the flight augers.

Five-foot or 10-foot well screens were used for the monitoring wells. Blank well casing (riser pipe) was then placed from the top of the well screen to between 2 to 3 feet above the ground surface. The well casing was sealed at the bottom with a threaded PVC cap, and at the top with a well slip cap. Centralizers were not required since all the wells were installed through the hollow-stem auger annulus, with the inside diameter of the auger flights acting as the centralizer.

C.8.1.1 Filter Pack Placement

Once the casing was installed, the filter pack consisting of acid resistant, washed and graded silica sand (Lonestar #2/12) was placed in the annular space between the well casing and the borehole wall. The sand was furnished in sacks and was clean and free of oil, acid, organic or other deleterious material. The filter pack was placed from the bottom of the borehole to 2 feet above the top of the well screen. The filter pack was either poured or tremied into place through the hollow stem auger depending on the depth of the well. The auger flights were retracted in a stepwise manner. The annular space between the well screen and auger flights was probed with a weighted tape measure to confirm that the hole was open to a depth approximately equal to the bottom of the auger flights and to measure the progress of the filter pack placement. The auger flights were slowly retracted upward, allowing the filter pack material to settle out through the bottom of the auger flights. The auger flights were retracted (without spinning) no more than 6 inches at a time. The depth of the filter pack material was constantly measured relative to the bottom of the

auger flights to confirm that the filter material had settled out through the bottom of the flight augers. A small amount of filter pack material was always maintained above the bottom of the auger flights.

The filter pack procedure was closely monitored by constantly probing the depth of the filter pack material and comparing the volume of placed filter pack material with the estimated volume to fill up the annular space. If the volume estimates were consistent, then there was assurance that the filter pack material was being uniformly placed along the well screen. Periodic depth probing also located any points of bridging between the well casing and the borehole or auger flight. If a significant discrepancy arose between the sand volume used versus the filled volume measured, the source of this error was identified and corrected. No discrepancies were noted during the well installations.

C.8.1.2 Bentonite Seal Placement

A 2-foot (minimum) bentonite seal consisting of bentonite pellets manufactured by Enviro Plug was placed above the filter pack to separate the filter pack from the cement grout sanitary seal. The bentonite seal was free of additives that may affect water quality. In the case where the bentonite seal was placed in unsaturated conditions, the bentonite pellets were placed into the annular space above the filter pack and hydrated with either distilled water or approved potable water of documented quality (see Section C.13.2). In the case of a bentonite seal placed in saturated conditions (i.e., below the water table), the bentonite pellets or chips were placed above the filter pack in a manner so as to prevent bridging in the annular space. The bentonite pellets were allowed to hydrate per the manufacturer's specifications.

C.8.1.3 Grout Placement

After the bentonite seal had hydrated, the remaining annular space was grouted with a neat, non-shrinking, cement grout sanitary seal. Placement of the cement grout sanitary seal was either observed by a Solano County DEM inspector, or placed in the absence of an inspector but with prior Solano County DEM approval. The grout consisted of 2 pounds to not more than 4 pounds of 100 percent pure sodium bentonite powder and 5 gallons to not more than 8 gallons of approved potable water of documented quality for each 94-pound sack of Type II Portland cement. For the deep wells, grout was placed by a positive displacement method by pumping through a tremie pipe. The bottom of the tremie pipe was initially positioned in the annular space to a depth not greater than 5 feet above the bentonite seal and constructed to discharge to the sides rather than straight downward. The tremie pipe was slowly raised as the grout was placed and the auger flights retracted; however, the discharge end of the pipe and the auger flights remained submerged at all times until final removal of the auger flights. For shallow wells, grout was poured from the surface rather than tremied into the annular space, as the auger flights were retracted. Additional grout was added from the surface to maintain the level of grout at the ground surface as settlement occurred.

No cement grout sanitary seals were installed at wells MW-3(TW-3) and MW-4(TW-4) at the time of their construction, due to the anticipated temporary nature of these wells. The open annular space at the surface was protected by a temporary bentonite seal to prevent unwanted material from entering the annular space. A cement grout sanitary seal was placed in these wells during the data gaps investigation, at which time the temporary surface seal was removed and the annular space probed to determine whether the boreholes had collapsed. The boreholes had remained open due to the nature of the alluvium at these locations (i.e., fat clay). As with all other wells at the Project Site, placement of the cement grout sanitary seal was either observed by a Solano County DEM inspector, or placed in the absence of an inspector but with prior Solano County DEM approval.

C.8.1.4 Well Head Completion

All groundwater monitoring wells at the Project Site were completed above the ground surface. The well casings extend approximately 2 to 3 feet above the ground surface. A 4-inch square lockable steel monument was placed over the well casing and seated in a concrete surface pad. The pad slopes away from the well casing to avoid surface accumulation of water. A PVC slip cap was placed on the inside well casing. All groundwater monitoring wells have been secured with corrosion-resistant locks.

Well construction details are summarized in Table 4-9. Well completion diagrams showing well construction details are presented in Attachment C-4 of this appendix.

C.8.1.5 Grain Size Analysis

Two bulk samples (TW-1/B and TW-2/B) were collected for grain size analysis from the alluvium during advancement of boreholes TW-1 and TW-2. Particle size distribution tests were conducted by Cooper Testing Laboratory of Mountain View, California. The bulk sample collected from borehole TW-1 was described as a brown clay with sand. The bulk sample collected from borehole TW-2 was described as a brown mixed with dark brown sandy clay with trace gravel. A copy of the Particle Size Distribution Test Report is included in Attachment C-5 of this appendix.

C.8.2 Double-Cased Deep Wells

Three double-cased deep groundwater monitoring wells (MW-3A, MW-3B, and MW-4A) were installed in the bedrock zone during the data gaps investigation. As previously stated, grout intrusion during installation of the conductor casing at well MW-3A resulted in high pH values in groundwater extracted from this well. This well was declared a grout-impacted well and a replacement well (MW-3B) was installed. Well MW-3A will be abandoned in accordance with the Final Work Plan (Earth Tech, February 2000b) and the requirements of the Solano County DEM. Wells MW-3B and MW-4A were installed adjacent to existing shallow wells MW-3(TW-3) and MW-4(TW-4), respectively, in order to create "well pairs".

An 8-inch diameter pilot borehole was advanced at each well location in order to determine the depth to set the conductor casing in the unweathered/slightly weathered bedrock beneath the shallow groundwater-bearing zone (base alluvium/weathered bedrock). The pilot boreholes were advanced into slightly weathered bedrock at depths ranging from 35 feet to 39 feet bgs. The pilot boreholes for MW-3A and MW-4A were then reamed by mud rotary drilling using a 14-inch diameter tricone bit and potable water of documented quality (see Section C.13.2). A few feet of bentonite chips were then placed in the bottom of the reamed borehole, and a 10-inch diameter Schedule 80 PVC conductor casing was then installed in the borehole. Cement grout was then tremied into the annular space between the borehole wall and conductor casing and allowed to set for a minimum of 24 hours. Water from the mud rotary reaming was removed from the conductor casing and the casing was rinsed out with potable water of documented quality (see Section C.13.2). The borehole was then continued with hollow-stem augers, then a tricone bit to the final depth for monitoring well installation (53.5 feet for MW-3A and 50.6 feet for MW-4A). Two-inch diameter groundwater monitoring wells were installed as described above, with the exception that the sand was tremied during the deep well construction.

During installation of well MW-3A, an effective seal was not achieved at the base of the conductor casing, consequently, grout entered the conductor casing. The borehole was continued as described above and a monitoring well installed; however, water extracted from the well during development (see Section C.8.3) indicated elevated pH levels which did not decrease as development continued. The well was declared a grout-impacted well for the purposes of the non-OE RI and a replacement well (MW-3B) was installed approximately 15 feet upgradient of well MW-3A. Well MW-3B was drilled with an 8-inch diameter tricone

bit and drilling mud using potable water of documented quality (see Section C.13.2). Six-inch diameter PVC Schedule 80 conductor casing was installed to a depth of 39 feet bgs. During installation of the replacement well, additional bentonite was used in order to form an effective seal at the bottom of the conductor casing. No grout intrusion occurred at the replacement well. Groundwater extracted during development of replacement well MW-3B exhibited similar pH values to groundwater extracted from other wells at the Project Site (see Section C.8.3).

C.8.3 Groundwater Monitoring Well Development

During the remedial investigation, existing wells TW-3, TW-4 and TW-12 were not fully developed prior to groundwater sample collection. The wells were purged of a standard three bore volumes prior to sample collection. Purging was conducted using the same procedures outlined below for well development, except that the number of gallons of water removed from the wells prior to sample collection was the equivalent of three boreholes as opposed to ten bore volumes during development. Copies of the Well Purging and Sample Collection Forms for the grab groundwater samples collected during the remedial investigation are included in Attachment C-6 of this appendix. Since the wells were not developed, they were considered to be "grab" samples.

The existing wells and all the newly installed wells were developed during the data gaps investigation as follows.

Before well development, the static water level was measured using an electric sounder. After the static water level was measured, the depth to the bottom of the well was sounded and both measurements recorded on the Well Development Forms. Copies of the Well Development Forms from the data gaps investigation are included in Attachment C-7 of this appendix. Wells were developed using a bailer, with the exception of well MW-3A where a combination of bailing and pumping was used. A new polyethylene disposable bailer was used at each new well location. The fine-grained materials which had accumulated in the well casing during well installation were bailed from the well with a bailer until the bottom of the well casing could be probed. Bailing continued until groundwater parameters consisting of pH, electrical conductivity (EC), temperature, and turbidity had stabilized (i.e., pH ± 0.1 pH units, of previous reading, EC ± 5 percent of previous readings, temperature ± 0.5°Celsius (C) of previous reading, turbidity ±10 Nephelometric Turbidity Units [NTUs] after at least 30 minutes), or a minimum of ten well casing volumes had been removed.

In all cases (except well MW-5), ten bore volumes were removed. Most of the wells required development over several days to remove the ten bore volumes due to the lack of sufficient available water in the wells and the slow recharge rate. Due to the lack of sufficient water recharge at well MW-5, it was purged dry twice prior to sample collection; however, due to insufficient water volume, not all of the samples were able to be collected for the required analyses.

Field parameters monitored during well development were recorded on Well Development Forms (see Attachment C-7). Water level measurements and volume of water removed were also recorded on the form, as were color and any odor observed. If the well was developed dry (e.g. well MW-5), the samples were collected as soon as a sufficient volume of water had re-entered the well (i.e., well had recovered to 85 percent of its initial volume). Field instruments used to measure the field parameters were calibrated according to the procedures presented in Section C.18.

All well development water was appropriately contained pending groundwater analytical results and a determination of the proper disposal (see Section C.21). Any other downhole equipment used during the well development (such as water level meters) were decontaminated between well locations in accordance with the equipment decontamination procedures presented in Section C.20.1.

C.8.4 Groundwater Sample Collection

C.8.4.1 Purging

During the remedial investigation, wells TW-3, TW-4 and TW-12 were purged of the standard three bore volumes prior to groundwater sample collection; however, since the wells were not developed prior to purging/sampling, the groundwater samples from these wells were considered to represent "grab" groundwater samples. During the data gaps investigation, groundwater samples were collected immediately after well development where ten bore volumes were removed (with the exception of well MW-5), therefore, no additional purging was required prior to groundwater sample collection. During the data gaps investigation, the groundwater samples to be analyzed for perchlorate and hydrazine from wells MW-3(TW-3) and MW-4(TW-4) were inadvertently omitted. These wells were subsequently resampled, at which time three bore volumes were purged from the well prior to sample collection. All site wells, except MW-5, MW-13, and MW-15 which were dry, were resampled in August 2000. Three bore volumes were purged from the wells prior to sample collection during this monitoring event. Field parameters were monitored during purging and recorded on the Well Purging and Sample Collection Form (attached to the appropriate Well Development Forms in Attachment C-7).

C.8.4.2 Sample Withdrawal

Containers used to collect each type of sample, and their holding times, are summarized in Table C-2. Samples were collected using a disposable polyethylene bailer. The portion of bailer line that entered the water was stainless steel cable. Samples collected for chemical analysis were collected in plastic or glass containers filled to capacity. If preservatives were in the containers, they were not allowed to overflow while filling.

All groundwater samples designated for metals analysis were field filtered (i.e., dissolved metals). Both filtered and unfiltered surface water samples were collected from the South Valley wetland area for both dissolved and total metals analysis, per the requirements of the field sampling plan. Both filtered and unfiltered groundwater samples were also collected during the August 2000 monitoring event. Samples collected for dissolved metals analysis were field-filtered using a nitrogen pressure filtration chamber equipped with a 0.45-micron membrane. A field filter blank was collected when field filtering was performed, as described in Section C.13.3.

All water samples retained for chemical analysis were identified with a unique sample identification number. A complete list of the sample identification numbers are presented in the analytical summary tables presented in this document. It should be noted that due to insufficient water volume at well MW-5, the following compounds could not be analyzed: nitroglycerin and PETN, PAHs, metals, pesticides, perchlorate, hydrazine, and general water chemistry.

C.9 SEDIMENT, SURFACE WATER AND SEEP SAMPLE COLLECTION

Sediment samples were collected either by pushing a certified, pre-cleaned, 6-inch-long by 2-inch-diameter stainless steel liner into the substrate or by using an Ekman® dredge (where standing water precluded the use of a drive tube). Where the Ekman® dredge was used, the sediment was removed from the Ekman® dredge, mixed in a stainless steel mixing bowl with a stainless steel spoon, and placed into laboratory-supplied, pre-cleaned sample containers. A hand auger and hand-held drive sampler were used to collect the wetland sediment samples (WET-3 through WET-7) collected in August 2000 (see Section C.6.1).

Grab surface water samples from the wetland area, grab surface seep samples from seep areas, and grab water samples from exploratory test pits at the North Valley Military Landfill were collected directly in

appropriate laboratory-supplied, non-preserved containers and transferred, when appropriate, to preserved containers (see Table C-2).

All sediment and grab water samples retained for chemical analysis were identified with a unique sample identification number. A complete list of the sample identification numbers are presented in the analytical summary tables presented in this document.

C.10 STOCKPILE SAMPLE COLLECTION

During the interim and remedial investigation, discrete samples were collected from the Stockpiles #1 and #2 (located at the Ammunition Renovation/Primer Destruction Site), and Stockpile #3 (located at the Howitzer Test Facility). During the remedial investigation, soil samples were collected from the nine stockpile areas on the Ridge. Four samples were collected from each of the larger stockpile areas (RSP-1 through RSP-5) and two samples were collected from the smaller stockpile area (RSP-6 through RSP-9). Soil samples collected from each area were composited by the analytical laboratory into a single sample representing each stockpile area. During the data gaps investigation, the three stockpiles in the North Valley were resampled. Stockpiles #1 and #2 were each divided into halves, four samples were then collected from each half and composited by the analytical laboratory into a single sample. Stockpile #3 was divided into quarters, four samples were then collected from each quarter and composited by the analytical laboratory into a single sample. Stockpile samples (LFM-1 through LFM-4) were also collected from the stockpiled landfill soil matrix material excavated from the North Valley Military Landfill test pits during the removal action investigation.

The samples were collected from the stockpile soil matrix from 2 feet below the stockpile surface. Depending on field conditions, the stockpile samples were collected by either hand augering to the appropriate depth or by removing the upper 2 feet of soil with a shovel, then using a slide hammer for sample collection (as described in Section C.6.1). All stockpile sample locations were cleared by a UXO specialist.

All stockpile samples were identified with a unique sample identification number. A complete list of the sample identification numbers are presented in the analytical summary tables presented in this document.

C.11 PROJECT-SITE MOBILE LABORATORY

A California state-certified mobile laboratory was used during the remedial investigation to provide rapid turn-around definitive-level analytical data. The mobile laboratory was provided by ONSITE Environmental Laboratories (ONSITE) of Fremont, California, who analyzed soil samples for explosive compounds to direct the step-out program at the TNT Strips. The mobile laboratory also analyzed soil samples for polynuclear aromatic hydrocarbons (PAHs), total extractable petroleum hydrocarbons (TEPHs), and VOCs. All other samples were shipped to one of the following off-site analytical laboratories as indicated in the analytical summary tables presented in this document:

- Quanterra, Inc. of West Sacramento, California (acquired by Severn Trent Laboratories [STL])
- CalTest of Napa, California
- Truesdail Laboratories of Tustin, California
- E.S. Babcock & Sons of Riverside, California
- Frontier GeoSciences of Seattle, Washington.

Sample collection and sample handling protocols and procedures for the on-site mobile laboratory were the same as for the off-site laboratories. Samples were collected with decontaminated sampling equipment, preserved in the appropriate sample containers, labeled, and transported to the on-site mobile laboratory in

an ice chest under chain-of-custody (COC) protocol. It should be noted that the standard protocol of maintaining the samples at approximately 4°C ±2°C could not always be achieved due to the short time period between time of sample collection and delivery to the on-site mobile laboratory. The on-site mobile laboratory was subject to the same instrument calibration and maintenance requirements as the off-site analytical laboratories and was able to conduct calibration blanks, method blanks, matrix spike and matrix spike duplicates, internal standards, and surrogate and duplicate samples consistent with the requirements specified in the QAPP, as discussed in the QCSRs in Volume IV of the document.

C.12 FIELD TNT SOIL TESTING

A field soil test kit was used during the data gaps investigation to obtain rapid data in the field, in order to determine whether soil samples collected along the axis of the TNT Strips could be shipped to an off-site analytical laboratory. The TNT EnSys® soil test system was used. This system detects TNT, 1,3,5-trinitrobenzene (TNB), and 2,4-dinitrotoluene (DNT) in soil samples and provides quantitative results using approved EPA Method SW8515. The assay range was 1 mg/kg to 30 mg/kg (or parts per million [ppm]) total TNT in soil. Higher sample concentrations were quantified by sample extract dilution. The basic field test procedures were conducted as follows:

- Extract soil sample (approximately 1 to 2 inches from sample liner)
- Place extruded sample into a decontaminated plastic beaker and homogenize the sample with a decontaminated plastic spatula
    - Weigh 10 grams of homogenized soil sample in weigh boat
    - Measure 50 milliliters (mL) of acetone into a 50-mL tube
    - Add soil into the extraction jar
    - Pour acetone into the extraction jar
    - Shake extraction jar for 3 minutes and allow to settle for 5 minutes.
- Draw into a syringe 25 milliliters (mL) of liquid from above the sediment layer in the extraction jar
- Attach filter tip to the syringe and transfer 25 mL of the sample extract into a cuvette
- Place cuvette in spectrophotometer and record initial absorbance
- Add one drop of developer solution, cap, and shake for 3 seconds
- Remove stopper and place the "sample" cuvette in the cell holder and read sample absorbance
- Record the data and calculate the results.

The Project Chemist performed the field tests on March 29, 1999 on the following samples: TNT-1P/0, TNT-1P/0.5, TNT-1P/1, TNT-1P/2, TNT-1Q/0, TNT-1Q/1, TNT-1Q/2, TNT-2F/0, TNT-2F/1, and TNT-2F/2. A complete User's Guide is included in Attachment C-8 of this appendix. A field technician trained by the Project Chemist performed field tests on June 6 and 7, 2000 on the following samples: TNT-R16 through TNT-R20. None of the soil samples exceeded 100,000 mg/kg (10 percent) of explosives, the criteria used to determine if a sample could be shipped off-site for analysis. Definitive-level analyses of all samples shipped off-site was performed by the analytical laboratory.

Any equipment which came into direct contact with potentially contaminated soil was decontaminated between each sample analysis. Decontamination consisted of washing with a non-phosphate detergent (Liquinox®), followed by a double rinse with potable water, a rinse with pesticide-grade methanol, and a final rinse with de-ionized (DI) water of documented quality (see Section C.13.2).

C.13 FIELD QUALITY CONTROL

This section outlines the field quality control samples collected during the non-OE RI. The results of the field quality control sampling program are presented in the analytical summary tables and discussed in the QCSRs in Volume IV.

C.13.1 Replicate and Duplicate Samples

Replicate (soil) and duplicate (water) samples are defined as two samples collected independently at a single sampling location during a single act of sampling for analysis at one laboratory for each specified method. Field replicate/duplicates samples were collected separately at a particular location and time, in order to assess errors associated with sample heterogeneity, sampling methodology applicability, and sample handling techniques. Theoretically, each sample equally represents the medium at a given time and location.

Since more information can be obtained from samples with detectable concentrations, an effort was made to collect replicate/duplicate samples from those areas anticipated to have the highest potential for impact. Field replicate/duplicate samples for each matrix numbered approximately 10 percent of the original sample number per investigative phase, with a focus on critical sampling areas. Replicate soil samples were collected during all the investigation phases. Duplicate water samples were collected during the remedial and data gaps investigations, since water samples were only collected during these investigations.

Field replicate soil samples collected within the uppermost 3 feet of soil were generally collected from boreholes advanced within 6 inches of each other center-to-center (as close as the sampling method would allow), while replicate soil samples collected at greater than 3 feet bgs were generally taken at consecutive depths. Replicate soil samples were collected separately and placed directly into sample containers. In addition to the replicate soil samples, split soil samples were also collected for the California Environmental Protection Agency (Cal/EPA), Department of Toxic Substances Control (DTSC), and the U.S. Army Corps of Engineers (USACE) at a minimum frequency of 10 percent and 5 percent, respectively. Boreholes used for replicate and split sample collection were identified with an "A" (i.e., TNT-1C represents the borehole for primary sample collection, TNT-1CA represents the borehole for replicate and split sample collection). It should be noted that "A" boreholes are not shown on the figures since they are considered to represent the same location as the primary borehole. Additional replicate samples had to be collected during the remedial investigation due to the need to submit samples to an on-site mobile laboratory for certain analyses and an off-site laboratory for other analyses.

Field duplicate water samples were collected independently at a well location during one act of sampling. Duplicate water samples were collected by sequentially filling a sample bottle for a particular analysis and then the identical sample bottle for the duplicate sample. This procedure was continued for each type of sample bottle until all sample bottles were filled.

The replicate/duplicate samples were collected, labeled, packaged, and sealed in the same manner as the original field samples and submitted "blind" to the analytical laboratory. The duplicate samples were analyzed for the same parameters as the original field samples. Replicate/duplicate analytical results are included on the analytical summary tables (5-1 through 5-23) presented in this document, and discussed in the QCSRs (see Volume IV).

C.13.2 Source Water Sampling

No source water samples were collected during the interim investigation sampling program, since the work was performed prior to the development of a formal work plan. DI water was the only source water used during the interim investigation.

The only types of source water used during the remaining investigative phases were potable water and DI water. Potable water was obtained from the fire hydrant at the corner of McAllister Drive and Lynch Drive; this water was used during mud rotary drilling and for steam cleaning. The only other source water used was bottled DI water which was delivered to the site. Two source water samples were collected during the remedial investigation (SRC-1 and SRC-2) and four source water samples were collected during the data gaps investigation (WAT-3, WAT-4, SRC-3, and SRC-4).

The source water samples were analyzed for all compounds of interest, except hydrazine and chloropicrin. Source water analytical results are summarized in Table 5-24D of this document and are further discussed in the QCSRs (see Volume IV).

C.13.3 Trip Blanks, Equipment Blanks, Filter Blanks, and Temperature Blanks,

No equipment blanks or temperature blanks were collected during the interim investigation sampling program, since the work was performed prior to the development of a formal work plan. Filter blanks and trip blanks were not required during the interim investigation because water samples were not collected and samples were not analyzed for volatile organic compounds.

Trip Blanks - Trip blanks accompanied each cooler shipment of water samples, soil samples, or soil and water samples sent to the laboratory for analysis of VOCs by EPA Method SW8260B. The trip blanks were a set of VOA vials containing Type II analyte-free water that were prepared in the laboratory, taken to the sampling site, and returned to the laboratory with samples submitted for analysis of VOCs. Trip blanks were not opened in the field. Trip blanks were analyzed by the same VOC analytical method as the samples, and (in the case of water samples) were part of the same preparation batch as the samples. Trip blank analytical results are summarized in Table 5-24C of this document, and are further discussed in the QCSRs (see Volume IV).

Equipment Blanks - Equipment blanks were collected during the remedial, data gaps and removal action investigation field sampling activities. Equipment blanks were used to evaluate decontamination procedures for field sampling equipment. One set of equipment blanks was collected each day of soil sampling for each sampling crew. Since all water samples were collected with disposable polyethylene bailers, daily rinsate samples were not collected, per the Final Work Plan (Earth Tech, 2000b), a disposable bailer blank was collected per lot of bailers used.

Equipment blanks were collected using DI water that was poured through the bailers and split-spoon samplers and transferred into the appropriate sample bottles for analysis. Equipment blanks were collected immediately after the sampling device had been decontaminated between two sample collection points where target analyte detection was expected, but not necessarily at the start or completion of the sampling day. Equipment blank samples were collected, labeled, packaged, and sealed in the same manner as the original field samples and submitted "blind" to the analytical laboratory. Equipment blanks were identified by the borehole locations at which the equipment blank was collected, followed by the unique qualifier "K". Equipment blank samples were analyzed for all analyses performed on associated samples of the associated matrix. Equipment blank analytical results are summarized in Table 5-24E of this document, and are further discussed in the QCSRs (see Volume IV).

Equipment blanks were not collected for soil samples collected in certified, pre-cleaned, stainless steel liners driven directly into the sample medium without possible cross-contamination, per the Final Work Plan (Earth Tech, 2000b).

Filter Blanks - For water samples pumped through a metal filtration chamber, one field blank was collected from the filtration chamber each day of use. Field filter blanks were prepared by filtering Type II reagent-grade or equivalent water through a clean 0.45-micron membrane filter, collecting the water in the appropriate sample containers, and transporting it to the laboratory for inorganic analysis. Filter blanks were identified by the borehole locations at which the filter blank was collected followed by the unique qualifier "L". Filter blank analytical results are summarized in Table 5-24E of this document, and are further discussed in the QCSRs (see Volume IV).

Temperature Blanks - With the exception of the samples collected during the interim investigation, a temperature blank (sample bottle containing water) accompanied each cooler shipment of water samples, soil samples, or soil and water samples sent to the laboratory for analysis by methods requiring sample preservation by cooling. During the remedial investigation, the standard protocol of maintaining the samples at approximately 4°C ±2°C could not always be achieved due to the short time period between time of sample collection and analysis by the on-site mobile laboratory. It should be noted that, the on-site mobile laboratory initially did not have sufficient refrigeration capacity. Samples were, therefore, retained in the sample coolers and maintained at the appropriate temperature (i.e., 4°C ± 2°C) with bagged ice.

C.13.4 Field-Designated Matrix Spike & Matrix Spike Duplicate Samples

Matrix spike (MS)/matrix spike duplicate (MSD) samples were field-designated by the sampler for each shipment of samples. For every analytical batch of 20 or fewer soil samples within a sampling event from a major lithological type or from a major, distinct aqueous matrix, the laboratory prepared and analyzed an MS/MSD pair from a project sample collected by Earth Tech. The sampler designated one or more of the samples in each shipment by noting on the COC Record that the sample(s) were for MS/MSD (in the "Comments" section but not on the sample). Additional volume of sample was provided for MS/MSD water samples. Three times the usual volume, or more if specified by the analytical laboratory, was provided for the MS/MSD and marked on the COC Record. For water samples that required multiple containers (usually one for each analysis), a single sample number was applied to all containers of that sample. Samples designated for MS/MSD analysis were typical of the matrix and were collected from those areas not anticipated to be highly contaminated in order to minimize MS/MSD imprecision resulting from high levels of environmental impact. In order to minimize the effects of soil heterogeneity, the laboratory used a single or adjacent liners.

C.13.5 Field Audits

Two field audits were conducted during the non-OE RI, one during the remedial investigation and one during the data gaps investigation. No field audit was conducted during the interim investigation or the removal action investigation.

Field audits were conducted on December 9, 1999, and March 31, 2000, by William Knight, P.E., an Earth Tech Project Manager not associated with the Tourtelot Cleanup Project. The field auditor observed that procedures and techniques were in accordance with the Final Work Plan (Earth Tech, 2000b), Tech Memo (Earth Tech, 2000c) and best professional standards. Any specific issues identified during the audit were discussed with the Field Team Leader (FTL) during the audit who then decided what action to take. Responses for each issue were implemented by the FTL during the same day. All deviations were documented on a Non-Conformance Report (NCR) which included a description of the problem, how it was discovered, the corrective action, the follow-up and confirmation, and the appropriate signatures of those

involved. Specific findings and responses to the field audit are presented in the QCSRs (see Volume IV). No additional follow-up audits were required or performed.

Audits of the analytical laboratories were conducted as discussed in the QCSRs (see Volume IV).

C.14 SAMPLE STORAGE, PRESERVATION, AND HOLDING TIMES

Sample bottles that were pre-cleaned and treated according to EPA specifications for the appropriate methods were supplied by the analytical laboratory. Certified, pre-cleaned, stainless steel liners were used for soil/sediment sample collection. Table C-2 lists the sample containers and preservatives used during the non-OE RI for each analytical test method and matrix.

C.15 SAMPLE HANDLING AND SHIPMENT

C.15.1 Sample Sealing

Each sample container was sealed immediately after sample collection. In the case of soil liners, each end of the liner was covered with Teflon™ sheeting and plastic end caps and secured with plastic tape. In the case of the bottles used for water samples, sample bottle lids were not mixed, and all sample lids stayed with the original bottles. Since all sample containers for water analysis were able to be filled it was not necessary to mark the water level on the side of the sample bottle with a grease pencil.

C.15.2 Sample Identification System

All samples collected were assigned a unique sample identification number. A complete list of the sample identification numbers are presented in the analytical summary tables (5-1 through 5-23) presented in this document. Field QC samples (i.e., duplicates, equipment blanks, filter blanks, etc.) were sent blind to the laboratory; therefore, field location aliases were used. Samples specified for laboratory quality control (QC) (MS/MSD) were clearly marked with an asterisk and noted in the "Comments" section of the COC Record. A complete list of the field QC sample identification numbers are presented in the analytical summary tables (5-24A through 5-24E) and discussed in the QCSRs (see Volume IV).

C.15.3 Sample Labeling

Each sample was labeled immediately after the sample collection. Sample labels were affixed by the sampler to the sample containers. Sample labels were covered, if necessary, with clear tape after being affixed to the sample container, to protect the label from moisture.

C.15.4 Sample Packaging and Shipment

DOT regulations were followed for packaging and shipment. Samples were properly packaged for shipment and submitted to the designated analytical laboratory for analysis, under strict COC protocol. All glass sample bottles were wrapped in bubble-wrap or equivalent and sealed in self-sealing plastic bags to minimize the potential for cross-contamination and breakage during shipment. Soil samples contained in stainless steel liners were also sealed in self-sealing plastic bags.

Each cooler was filled with the sealed and bubble-wrapped sample containers. Additional packaging was used to prevent sample containers from moving or from making contact during shipment. Enough double-bagged ice or blue ice was added to the coolers to maintain sample temperature at 4° ±2°C during shipment. A temperature blank (see Section C.13.3) was placed in each cooler along with the samples.

C.15.4.1 Shipment by Commercial Carrier or Courier Service.

If the sample coolers were shipped by a commercial carrier or courier service (other than the analytical laboratory), the COC Record accompanying the coolers to the analytical laboratory was placed inside a sealed plastic bag and taped to the inside of the cooler lid. The coolers were then secured and custody-sealed for shipment to the analytical laboratory. The custody seal consisted of a regular paper custody seal or filament tape wrapped around the cooler at least twice, with the tape end signed before the cooler was shipped. Wide, clear tape was placed over paper custody seals to help ensure against accidental breakage. Custody seals were used for all sample containers shipped by either a commercial carrier (i.e., Federal Express) or a courier service.

The coolers were transported as environmental samples to the analytical laboratory as expeditiously as possible (e.g., via Federal Express overnight delivery service, if necessary). If the samples were sent by a commercial carrier, a bill of lading was used. Receipts of the bills of lading were retained as part of the permanent documentation. Commercial carriers/courier services were not required to sign-off on the COC Record as long as the form was sealed inside the sample cooler and the custody seals remained intact. A standard airbill was necessary in order to ship environmental samples by a commercial carrier.

C.15.4.2 Shipment by Earth Tech or Analytical Laboratory.

If the samples were delivered directly to the analytical laboratory by Earth Tech field personnel, or picked up from either the Project Site by the analytical laboratory, the COC Record was not secured inside the cooler lid. The COC Record was handed directly to the analytical laboratory personnel after COC sign-off protocols had been completed. Custody seals were not required for coolers delivered by Earth Tech or picked up from the Project Site by the analytical laboratory.

C.16 SURVEYING

All borehole and groundwater monitoring well locations were surveyed to a standard horizontal and vertical control by a surveyor licensed in the state of California. Boreholes were measured to the ground surface. Groundwater monitoring wells were surveyed to the ground surface and top of well casing. All elevations were surveyed to the nearest 0.01 foot and referenced to mean seal level (msl). The horizontal locations were surveyed to plus or minus two inches and referenced to the California State Plane Coordinate System. Surveyed locations are shown on Figures 4-2 and 4-3 of this document.

C.17 MEASUREMENT OF WATER LEVELS

Water levels in all groundwater monitoring wells were measured to establish depth to groundwater. Measurements were recorded as feet below the surveyed measuring point (i.e., top of casing), and recorded as feet above msl.

Water level measurements were collected after the groundwater monitoring wells were installed and the water level had been allowed to stabilize prior to any well development/purging activities (see Section C.8.4) and recorded on the Well Development or Well Purging and Sample Collection Forms (see Attachments C-6 and C-7). Complete rounds of groundwater level measurements were recorded on May 3, 2000, and August 2, 2000 for construction of groundwater elevation contour maps (see Figures 4-19 and 4-20). Water level measurements were recorded on the Water Elevation Form (see Attachment C-9 of this appendix).

C.18 FIELD TEST EQUIPMENT

Field instruments were calibrated prior to use, and the calibration information was recorded in the calibration logbooks maintained with the field instruments. All field instruments were maintained, calibrated or checked, and operated according to the manufacturers' specifications and guidelines.

C.18.1 pH Meter

A pH meter (Beckman pH/Temperature Meter) was used to measure pH according to EPA Method 150.1. The pH meter was calibrated at the beginning and end of each sampling day. The calibration included setting of a range with a 7.0-pH buffer solution and a 4.0-pH or a 10.0-pH buffer solution. The calibrating standards were checked to ensure expiration dates were not exceeded. The pH electrode was checked to ensure it was surrounded by sufficient liquid. The electrode was rinsed with DI water after each reading and the storage cap replaced. The pH meter was checked periodically during the sampling period. If drifting occurred (i.e., the reading varied by more than one-tenth of a unit between calibration checks), the probe was cleaned and the meter recalibrated.

C.18.2 Electrical Conductivity Meter

The EC meter (YSI Model 33 Conductivity Meter) was used to measure EC according to EPA Method 120.1. The EC meter was calibrated per the manufacturers specifications. The electrode was rinsed with DI water after each reading, and the electrode was kept clean.

C.18.3 Temperature Meter

Water temperature (Beckman pH/Temperature Meter) was measured according to EPA Method 170.1, using the temperature compensation probe on the pH meter. The probe was rinsed with DI water after each use.

C.18.4 Turbidity Meter

The turbidity meter (HF Scientific DRT-15C Turbidimeter) was used to measure turbidity according to EPA Method 180.1. The turbidity meter was calibrated at the beginning and end of each sampling day using factory-supplied standards. The meter was calibrated against the standard closest to the anticipated value of the sample (i.e., typically 0 NTUs to 10 NTUs). Care was taken to ensure that no air bubbles were in the standard solution and that the outside of the vial was clean of all marks that may affect the reading, including fingerprints. Sample vials were kept free of smudges and dirt and were rinsed with DI water between samples. The battery was also checked regularly.

C.18.5 Water Level Meter

The water level meter tape was calibrated before commencement of field activities by checking the markings on the tape against a steel tape. Water level readings were recorded to the nearest 0.01 foot. The alarm function was checked before use by immersion in water.

C.19 FIELD PERMEABILITY TESTING

From August 23 through August 25, 2000, a series of single-well, falling head slug tests were conducted at the Project Site. The tests were conducted to estimate the permeability of the alluvial and bedrock water-bearing zones in the North and South Valleys.

On August 23, wells MW-2, MW-3B, MW-6, MW-10, and MW-11 were tested. Prior to the initiation each of the tests, baseline water levels were taken in each well. Once a baseline was established, a 6-foot long, solid PVC displacement object was dropped down the well. Attached immediately above each displacement object was a Troll® 8000 data logging pressure transducer. The Trolls® were pre-programmed to begin collecting water level data the instant they hit water. The data-sampling rate was logarithmic for the first minute and once per minute thereafter.

On August 24, tests in wells MW-2, MW-3B, MW-6, MW-10, and MW-11 were terminated. All data were downloaded to a laptop computer prior to the test termination to ensure that the wells had recovered to within 80 percent of their original static water level. Once the tests were terminated, all equipment in the well bore was retrieved. The displacement objects were given a post-test check to ensure that no water had entered the objects during the test. On August 24, a similar test was initiated in monitoring well MW-4A. The test was terminated on August 25.

The falling head data were analyzed using the procedures outlined in Appendix D. The data files were pre-processed to correct for the height of water standing above the transducer after full recovery at the end of the test.

C.20 DECONTAMINATION PROCEDURES

C.20.1 Equipment Decontamination

The purpose of decontamination procedures during drilling, well installation, and soil/sediment and water sampling was to prevent impact of samples and cross-contamination between sampling locations. Before use, all drilling equipment and sampling equipment was decontaminated by steam-cleaning, or alternatively by washing with a non-phosphate detergent (Liquinox®). Equipment washed with a non-phosphate detergent was double rinsed with either potable water or DI water. Steam cleaning (using potable water) was used for drill rigs and drilling rods.

The decontamination procedure for sampling equipment incorporated a detergent wash, potable water rinse, rinse with pesticide-grade methanol, and a final rinse with DI water.

The following item-specific decontamination procedures were followed:

- **Heavy equipment (i.e., drill rig)** - Loose material was removed with a brush.
- **Auger flights and/or drive casing, drill rods, etc.** - Steam cleaned with a portable high-pressure steam spray prior to drilling each borehole location
- **Downhole abandonment equipment (i.e., tremie pipes)** - Steam cleaned with a portable high-pressure steam spray between each borehole location
- **Hand augers** - Washed with non-phosphate detergent followed by a double rinse with DI water between each borehole location

- **Samplers** - Washed with non-phosphate detergent wash followed by a double rinse with potable water; rinse with pesticide-grade methanol, then DI water between each sample location

- **Well casing and screen** - All well casing and screen was certified clean by the manufacturer and remained sealed in plastic prior to installation and did not require decontamination

- **Non-disposable Teflon™ bailer** - Non-disposable bailers were not used during the non-OE RI

- **Water level meter** - Washed with non-phosphate detergent followed by a double rinse with DI water; rinse with pesticide-grade methanol, then DI between each measurement location

- **Field instrument probes** - Wiped with a damp, disposable paper wipe and rinsed with DI water.

- **Slide hammer** - Washed with non-phosphate detergent followed by a double rinse with DI water between each sample when soil samples were collected in certified, pre-cleaned, stainless steel liners driven directly into the sample medium with a slide hammer.

Sampling equipment that was not readily decontaminated was discarded after each use. Discarded materials, including decontamination solutions, were accumulated and stored in appropriate containers pending proper disposal (see Section C.21).

Samples of the potable and DI water used for decontamination were collected as described in Section C.13.2.

C.20.2 Personnel Decontamination

Decontamination procedures were performed by all field personnel who came in contact with contaminated or potentially contaminated materials. Procedures for decontamination of field personnel are presented in Section 10.1 of the SSHP (Earth Tech, 2000d).

C.21 INVESTIGATION-DERIVED WASTE

All investigation-derived waste (IDW) currently remains on-site, pending appropriate disposal. IDW is defined as waste generated during the field investigation activities that has the potential to be hazardous, thus requiring special handling.

C.21.1 Soil

IDW soil was placed into DOT-approved 55-gallon drums and appropriately labeled, pending the results of the field sampling program. Drilling mud was placed in lined roll-off bins. The results of the field sampling program, as presented in this document, are being used as a first step in determining appropriate disposal. Based on the analytical results, additional samples may need to be collected from the IDW containers for analysis in order to further classify the IDW for disposal as either RCRA hazardous waste, non-RCRA California hazardous waste, designated or special waste, or non-hazardous waste. Additional sampling and analysis of the IDW may also be required in order to satisfy the requirements of a licensed disposal facility. Any hazardous soil will be transported by a licensed hazardous waste hauler and disposed of at a licensed disposal facility.

C.21.2 Water

IDW water derived from water sampling activities (including well development/ purgewater) and decontamination rinsate was placed in DOT-approved 55-gallon drums and appropriately labeled, pending the results of the field sampling program. The results of the field sampling program, as presented in this document, are being used as a first step in determining appropriate disposal. Based on the analytical results, additional samples may need to be collected from the IDW containers for analysis in order to further classify the IDW for disposal as either RCRA hazardous waste, non-RCRA California hazardous waste, designated or special waste, or non-hazardous waste. Additional sampling and analysis of the IDW may also be required in order to satisfy the requirements of a licensed disposal facility. Any hazardous water will be transported by a licensed hazardous waste hauler and disposed of at a licensed disposal facility.

C.21.3 Disposable Protective Clothing and Ground Covers

Other wastes included disposable protective clothing, plastic ground covers, and non-reusable sampling equipment (e.g., disposable bailers) that came in contact with contaminated or potentially contaminated soil or water. These wastes were collected, placed in a DOT-approved 55-gallon drum or other approved container, and labeled, pending appropriate disposal. These wastes were not mixed with the IDW soil or water.

C.22 ANALYTICAL TEST METHODS

Soil, sediment, surface water, and groundwater samples were submitted for analysis of the following in accordance with the requirements of the interim, remedial, data gaps and removal action investigation field sampling programs:

- Explosives - nitroaromatics and nitroamines, including nitroglycerin and PETN, by EPA Method SW8330
- TEPHs quantified against a diesel, motor oil, and kerosene standard, respectively, (TEPH-D/MO/K) by California Leaking Underground Fuel Tank (LUFT) Modified EPA Method SW8015
- PAHs by EPA Method SW8310
- VOCs by EPA Method SW8260B
- SVOCs, including chloropicrin and pentachlorophenol, by EPA Method SW8270C
- CAM 17 metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, molybdenum, nickel, selenium, silver, thallium, vanadium, and zinc), plus aluminum, calcium, iron, manganese, magnesium, potassium, phosphorus (total), and sodium, by EPA Methods SW6010B, SW7470A, and SW7471A
- Strontium by EPA Method SW6010B
- Methyl mercury by Frontier GeoScience proprietary Method FGS-070.1
- Dioxins/furans by EPA Method SW8290
- Organochlorine pesticides by EPA Method SW8081A

- Perchlorate by California Department of Health Services (CADOHS) Method 300.0 Modified
- Hydrazine by Modified EPA Method SW8315
- PCBs by EPA Method SW8082
- Nitrate/nitrite as nitrogen by EPA Method 300.0
- General water chemistry (nitrate/nitrite, chloride, and sulphate by EPA Method 300.0; total phosphorus by EPA Method 6010B; total organic carbon by EPA Method 415.1; TDS by EPA Method 160.1; and TSS by EPA Method 160.2)

SVOCs by EPA Method SW8270C were used for the determination of PAHs when severe interference was encountered during analysis of PAHs by EPA Method SW8310.

C.23 GENERAL FIELD AND LABORATORY DOCUMENTATION

The following field data documentation was used to record non-OE RI activities at the Project Site. Measurements made and samples collected were recorded either in a Daily Field Report/Log Book or on an appropriate field activity form. All entries on field forms (excluding Test Boring Logs) were made in indelible ink, and no white-out was allowed. Test Boring Logs were completed in pencil. If an incorrect entry was made on any field form, the information was crossed out with a single strike mark, initialed, and date-marked. All equipment used to make measurements were identified, along with the date of calibration. Field forms were signed and dated by field personnel responsible for their completion.

- **Daily Field Reports/Log Books** - A combination of Daily Field Reports and Log Books were used as a means of recording investigation and data collection activities on a daily basis.

- **Chain-of-Custody Records** - COC procedures were used to provide an accurate written record tracing possession of individual samples from the time of field collection through to analytical laboratory analysis. A sample was considered in custody if it was:
  - In a person's possession
  - In a secure area after having been in a person's physical possession
  - In a designated secure area restricted to authorized personnel.

  The COC Record was used to document the samples taken and the analyses requested. If necessary, corrections were made on the COC Record by drawing one line through the incorrect entry, entering the correction information, and initialing and dating the change.

  If the samples were shipped by commercial carrier or courier service, the COC Record initiated in the field was signed and dated, placed in a sealed plastic bag, and taped to the inside of the cooler lid. Signed airbills served as evidence of custody transfer between the field personnel and commercial carrier/courier service and the analytical laboratory. Copies of the COC Record and the airbill were retained by the field personnel prior to shipment. Upon receipt of the cooler, analytical laboratory personnel signed, dated, and retained one copy of the COC Record and the airbill for their records, returning the completed COC Record and signed airbill to Earth Tech.

  If the samples were delivered directly to the analytical laboratory by Earth Tech field personnel or picked up from the Project Site by the analytical laboratory, the COC Record initiated in the field was signed and dated as relinquished by the field personnel, and signed and dated as received by

the analytical laboratory. Copies of the COC Record were retained by the field personnel prior to relinquishment of the samples to the analytical laboratory.

When the laboratory received and logged in the contents of the shipping containers, the laboratory's sample control supervisor or the laboratory project manager faxed the completed COC Records with a sample log-in summary and completed cooler receipt forms to Earth Tech's Project Chemist within 24-48 hours. The cooler receipt forms were used by the laboratory for each cooler to verify sample condition, including proper sample containers, volumes, preservation, and any other pertinent information. Laboratory personnel contacted Earth Tech's Project Chemist regarding any discrepancies in the paperwork and sample preservation and documented non-conformance and corrective actions according to the analytical laboratory's standard operating procedures.

- **Geologic Logs** - The on-site field geologist prepared and maintained a geologic log for all soil boreholes advanced by either a drill rig or a hand auger (see Section C.6). Soil cuttings/samples were classified in accordance with the ASTM D 2488 *Description and Identification of Soils (Visual-Manual Procedures).* Bedrock cutting/samples were identified and recorded using the standard nomenclature in the *Classification of Rocks* (Colorado School of Mines, 1955). Each geologic log was reviewed and approved by a California state-registered geologist supervising the project. Copies of the Test Borehole Logs for the non-OE RI are included in Attachment C-3 of this appendix.

- **Monitoring Well Construction Logs** - Monitoring Well Construction Logs were used to provide a diagrammatic representation of the groundwater monitoring well construction. Copies of the Monitoring Well Construction Logs for the non-OE RI are included in Attachment C-4 of this appendix.

- **Well Development Forms** - Groundwater development activities were recorded on a Well Development Form. Groundwater sampling activities were also included on these forms if groundwater samples were collected immediately after well development. Copies of the Well Development Forms for the non-OE RI are included in Attachment C-7 of this appendix.

- **Well Purging and Sample Collection Forms** - Groundwater sampling activities were recorded on a Well purging and Sample Collection Form. Copies of the Well Purging and Sample Collection forms for the Non-EO RI are included in Attachments C-6 and C-7 of this appendix.

- **Instrument Calibration Logs** - Field instrument calibration information was recorded in the calibration log books kept with each field instrument.

- **Water Level Forms** - Groundwater level measurements were recorded on a Water Elevation Form. Complete rounds of water level measurements were collected on May 3, 2000 and August 2, 2000. Copies of the Water Elevation Forms are included in Attachment C-9 of this appendix.

C.24 FIELD DATA MANAGEMENT

C.24.1 Data Recording

Field data was recorded either in the Daily Field Report/Log Book or on the appropriate field activity forms. A unique field identification number was assigned to each sample throughout each investigative phase. Sample COC documentation was completed, as described in Section C.23, to document chain of possession and track the samples throughout shipping, handling, and analysis. A corresponding laboratory identification number was assigned and was used to track each sample through the analytical process.

Earth Tech's FTL was responsible for performing daily reviews of all field documentation for accuracy, legibility, and completeness, and for maintaining such information in the project file. Any inconsistencies discovered were resolved immediately, if possible, by seeking clarification from personnel responsible for the data collection.

C.24.2 Data Reporting

Measurement data generated during the non-OE RI are presented in this document, as appropriate, to support data use and interpretation. Chemical analytical results are presented in the analytical summary tables discussed in Chapter 5.0 of this document.

REFERENCES

Earth Tech, 1999. *Remedial Investigation/Feasibility Study Site-Specific Health and Safety Plan*, November 5.

Earth Tech, 2000a. *Draft Tourtelot Cleanup Project Site-Specific Safety and Health Plan*, February 9.

Earth Tech, 2000b. *Final Non-Ordnance and Explosive Remedial (RI)/Feasibility Study (FS), Tourtelot Cleanup Project, Benicia, California*, February 15.

Earth Tech, 2000c. *Technical Memorandum for Remedial Investigation, Tourtelot Cleanup Project, Benicia, California*, March 2.

Earth Tech, 2000d. *Final Tourtelot Cleanup Project Site-Specific Safety and Health Plan*, March 27.

Earth Tech, 2000e. *Final Removal Action Work Plan, Tourtelot Cleanup Project, Benicia, California*, May 9.

Table C-1. Summary of Exploratory Boreholes and Test Pits
(Page 1 of 6)

Location	Point ID	Drilling Equipment	Date Start	Borehole Diameter (inches)	Borehole Depth (ft. bgs)	Depth to Bedrock (ft. bgs)	Water Depth (ft. bgs)
TNT Strip #1	TNT-1A	Hand Auger	07/19/99	3	2.5		
TNT Strip #1	TNT-1B	Hand Auger	07/19/99	3	3.5	3.0	
TNT Strip #1	TNT-1C	Hand Auger	07/19/99	3	4.5	3.5	
TNT Strip #1	TNT-1C2	Hand Auger	12/18/99	3	4.0	3.5	
TNT Strip #1	TNT-1C3	MD-1	12/04/99	3	4.0	3.5	
TNT Strip #1	TNT-1C4	MD-1	12/04/99	3	4.5	4.0	
TNT Strip #1	TNT-1C5	MD-1	12/03/99	3	11.5	7.0	
TNT Strip #1	TNT-1C6	MD-1	12/04/99	3	5.5	5.0	
TNT Strip #1	TNT-1C7	MD-1	12/04/99	3	5.0	4.5	
TNT Strip #1	TNT-1C8	MD-1	12/06/99	3	5.5	5.0	
TNT Strip #1	TNT-1C9	Hand Auger	12/18/99	3	3.0		
TNT Strip #1	TNT-1C10	Hand Auger	12/18/99	3	2.5		
TNT Strip #1	TNT-1D	MD-1	12/07/99	3	2.5	2.5	
TNT Strip #1	TNT-1E	MD-1	12/08/99	3	3.0		
TNT Strip #1	TNT-1F	MD-1	12/08/99	3	3.0	3.0	
TNT Strip #1	TNT-1F2	MD-1	12/06/99	3	6.0	4.0	
TNT Strip #1	TNT-1F3	MD-1	12/06/99	3	6.0	4.0	
TNT Strip #1	TNT-1F4	MD-1	12/07/99	3	6.0	4.5	
TNT Strip #1	TNT-1F5	MD-1	12/06/99	3	3.5	3.5	
TNT Strip #1	TNT-1F6	MD-1	12/06/99	3	3.0	3.0	
TNT Strip #1	TNT-1F7	MD-1	12/07/99	3	5.0	4.0	
TNT Strip #1	TNT-1F8	Hand Auger	12/19/99	3	2.5		
TNT Strip #1	TNT-1F9	Hand Auger	12/19/99	3	2.0		
TNT Strip #1	TNT-1G	MD-1	12/07/99	3	5.5	4.5	
TNT Strip #1	TNT-1H	MD-1	12/07/99	3	5.0	4.5	
TNT Strip #1	TNT-1I	MD-1	12/07/99	3	3.0	2.5	
TNT Strip #1	TNT-1J	MD-1	12/08/99	3	5.0	4.5	
TNT Strip #1	TNT-1K	MD-1	12/08/99	3	5.5	4.5	
TNT Strip #1	TNT-1L	MD-1	12/08/99	3	5.0	5.0	
TNT Strip #1	TNT-1M	Hand Auger	12/19/99	3	2.5		
TNT Strip #1	TNT-1N	Hand Auger	12/19/99	3	2.5		
TNT Strip #1	TNT-1P	CME 550	03/27/00	8	47.0	3.0	
TNT Strip #1	TNT-1Q	CME 550	04/04/00	8	48.0	3.5	
TNT Strip #2	TNT-2A	Hand Auger	07/19/99	3	2.5		
TNT Strip #2	TNT-2B	Hand Auger	07/19/99	3	4.5	3.5	
TNT Strip #2	TNT-2C	Hand Auger	07/20/99	3	2.5		
TNT Strip #2	TNT-2D	Hand Auger	07/19/99	3	4.5	3.5	
TNT Strip #2	TNT-2E	Hand Auger	07/19/99	3	4.5	3.5	
TNT Strip #2	TNT-2F	CME 550	03/30/00	8	50.0	3.5	
TNT Strip #3	TNT-3A	Hand Auger	07/20/99	3	2.5		
TNT Strip #3	TNT-3B	Hand Auger	07/20/99	3	4.5		
TNT Strip #3	TNT-3C	Hand Auger	07/20/99	3	2.5		
TNT Strip #4	TNT-4A	Hand Auger	07/20/99	3	2.5		

Table C-1. Summary of Exploratory Boreholes and Test Pits
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Location	Point ID	Drilling Equipment	Date Start	Borehole Diameter (inches)	Borehole Depth (ft. bgs)	Depth to Bedrock (ft. bgs)	Water Depth (ft. bgs)
TNT Strip #4	TNT-4B	Hand Auger	07/20/99	3	4.5		
TNT Strip #4	TNT-4C	Hand Auger	07/20/99	3	2.5		
TNT Strip #4	TNT-4C1	MD-1	12/09/99	3	3.0	3.0	
TNT Strip #4	TNT-4C2	MD-1	12/19/99	3	3.0		
TNT Strip #4	TNT-4C3	MD-1	12/09/99	3	6.0	5.0	
TNT Strip #4	TNT-4C4	MD-1	12/09/99	3	3.0		
TNT Strip #4	TNT-4C5	MD-1	12/09/99	3	5.0	4.5	
TNT Strip #4	TNT-4C6	MD-1	12/09/99	3	4.0	3.5	
TNT Strip #4	TNT-4C7	MD-1	12/09/99	3	3.0		
TNT Strip #4	TNT-4C8	MD-1	12/09/99	3	3.0		
TNT Strip #4	TNT-4C9	MD-1	12/09/99	3	5.0	4.5	
TNT Strip #4	TNT-4C11	Hand Auger	12/19/99	3	2.5	2.5	
TNT Strip #4	TNT-4C12	Hand Auger	12/19/99	3	2.5	1.5	
TNT Strip #4	TNT-4C13	Hand Auger	12/19/99	3	4.0	3.0	
TNT Strip #4	TNT-4C14	Hand Auger	12/19/99	3	4.5	3.0	
TNT Strip #5	TNT-5A	Hand Auger	07/20/99	3	2.5		
TNT Strip #5	TNT-5A1	MD-1	12/10/99	3	6.0	5.5	
TNT Strip #5	TNT-5A2	MD-1	12/10/99	3	8.5	7.0	
TNT Strip #5	TNT-5A3	MD-1	12/10/99	3	7.0	6.5	
TNT Strip #5	TNT-5A4	MD-1	12/10/99	3	5.5	4.5	
TNT Strip #5	TNT-5A5	MD-1	12/10/99	3	8.5	7.0	
TNT Strip #5	TNT-5A6	MD-1	12/10/99	3	5.5	5.5	
TNT Strip #5	TNT-5A8	Hand Auger	12/21/99	3	4.5		
TNT Strip #5	TNT-5A9	Hand Auger	12/22/99	3	4.5		
TNT Strip #5	TNT-5A10	Hand Auger	12/21/99	3	7.8	7.5	
TNT Strip #5	TNT-5B	Hand Auger	07/20/99	3	2.5		
TNT Strip #5	TNT-5C	Hand Auger	07/20/99	3	2.5		
TNT Strip #5	TNT-5D	Hand Auger	07/20/99	3	2.5		
TNT Strip #5	TNT-5E	Hand Auger	07/20/99	3	2.5		
TNT Strip #5	TNT-5F	MD-1	12/10/99	3	10.5	10.0	
TNT Strip #5	TNT-5G	MD-1	12/10/99	3	5.0	5.0	
TNT Strip #5	TNT-5H	Hand Auger	12/19/99	3	2.5		
TNT Strip #5	TNT-5I	Hand Auger	12/19/99	3	2.5		
TNT Strip #5	TNT-5J	Hand Auger	12/22/99	3	6.5		
TNT Strip #5	TNT-5L	Hand Auger	12/22/99	3	6.5		
TNT Strips Area	TNT-R16	Morooka MST-600	6/7/00	4	17.5	16.5	
TNT Strips Area	TNT-R17	Morooka MST-600	6/7/00	4	16.5	14.5	
TNT Strips Area	TNT-R18	Morooka MST-600	6/7/00	4	14.8	4.5	
TNT Strips Area	TNT-R19	Morooka MST-600	6/7/00	4	20.5	10.5	
TNT Strips Area	TNT-R20	Morooka MST-600	6/7/00	4	13.5	2.5	
Bldg 183 Howitzer Test Facility	HF-1	MD-1	12/09/99	3	6.0	5.8	
Bldg 183 Howitzer Test Facility	HF-2	MD-1	12/06/99	3	11.5	9.0	
Howitzer Test Facility	HF-3	MD-1	12/07/99	3	22.0	18.0	

Table C-1. Summary of Exploratory Boreholes and Test Pits
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Location	Point ID	Drilling Equipment	Date Start	Borehole Diameter (inches)	Borehole Depth (ft. bgs)	Depth to Bedrock (ft. bgs)	Water Depth (ft. bgs)
Howitzer Test Facility	HF-3R	CME 650	04/06/00	8	10.5		
Howitzer Test Facility	HF-4	MD-1	12/08/99	3	25.0	24.5	
Howitzer Test Facility	HF-5	CME 650	04/06/00	8	26.0	24.5	
Howitzer Test Facility	HF-6	CME 650	04/07/00	8	25.0	24.0	
Howitzer Test Facility	HF-7	CME 650	04/06/00	8	23.0	20.5	
Howitzer Test Facility	HF-8	CME 550	04/05/00	8	26.5	17.5	13.0
Howitzer Test Facility	HF-9	CME 75	03/31/00	8	25.0	24.5	
Ammunition Renovation Site	AR-1	MD-1	12/11/99	3	10.0		
Ammunition Renovation Site	AR-2	MD-1	12/11/99	3	12.0	10.0	
Ammunition Renovation Site	AR-3	MD-1	12/10/99	3	19.0	14.0	
Ammunition Renovation Site	AR-4	MD-1	12/11/99	3	31.0	10.0	
Ammumition Renovation Site	AR-5	CME 650	04/14/00	8	16.0	11.0	
Ammumition Renovation Site	AR-6	CME 75	03/31/00	8	16.0	14.5	
Ammumition Renovation Site	AR-7	CME 75	03/30/00	8	20.8	14.0	
Ammumition Renovation Site	AR-8	CME 75	03/30/00	8	15.5	12.0	
Ammumition Renovation Site	AR-9	CME 75	03/31/00	8	16.5	16.0	
Ammumition Renovation Site	AR-10	CME 75	03/31/00	8	17.5	17.0	
Ammumition Renovation Site	AR-11	CME 650	04/14/00	8	17.5	14.5	
Ammumition Renovation Site	AR-12	CME 75	03/30/00	8	11.0	10.0	
North Valley	TW-1	MD-1	12/10/99	3	23.5	17.0	
North Valley	TW-2	Morooka MST-600	12/08/99	6	21.5	19.0	
North Valley	TW-5	MD-1	12/09/99	3	24.0	10.0	
North Valley	TW-6	MD-1	12/08/99	3	10.0	3.0	
North Valley	TW-7	MD-1	12/11/99	3	9.5	7.0	
North Valley	TW-8	Morooka MST-600	12/09/99	6	16.0	14.5	
North Valley	TW-9	Morooka MST-600	12/10/99	6	12.0	9.5	
South Valley	TW-11	Morooka MST-600	12/15/99	6	17.0	10.5	
Located 13 N 15 E from TW-1	MW-1	Morooka MST 600	02/22/00	6	24.0	16.5	
Located 13 S 27 W from TW-2	MW-2	Morooka MST 600	02/22/00	6	21.0	18.5	
North Valley	MW-3 (TW-3)	Morooka MST-600	12/10/99	6	31.5	20.0	25.0
North Valley	MW-4 (TW-4)	Morooka MST-600	12/13/99	6	27.0	26.0	22.0
North Valley	MW-3A	CME 650	04/03/00	8	53.5	20.0	
North Valley	MW-4A	CME 650	04/05/00	8	50.6	26.0	
North Valley	MW-5	Morooka MST 600	02/24/00	6	11.0	9.0	
Located 43 N of TW-6	MW-6	CME 550	04/05/00	8	21.0	6.0	14.0
North Valley	MW-7	Morooka MST 600	02/25/00	6	9.5	7.5	
North Valley	MW-8	Morooka MST 600	02/24/00	6	15.5	14.5	14.5
North Valley	MW-9	Morooka MST 600	02/25/00	6	15.5	9.5	
South Valley	MW-10	Morooka MST-600	03/28/00	6	15.5	13.5	
South Valley	MW-11	Morooka MST-600	03/27/00	6	23.0	21.0	
South Valley	MW-12 (TW-12)	Morooka MST-600	12/18/99	6	28.0	26.0	23.0
North Valley	MW-13	Morooka MST-600	03/29/00	6	20.5	2.5	
North Valley	MW-14	Morooka MST-600	03/29/00	6	13.0	10.0	

Table C-1. Summary of Exploratory Boreholes and Test Pits
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Location	Point ID	Drilling Equipment	Date Start	Borehole Diameter (inches)	Borehole Depth (ft. bgs)	Depth to Bedrock (ft. bgs)	Water Depth (ft. bgs)
South Valley	MW-15	Morooka MST-600	03/30/00	6	22.0	19.5	
Flare Site	FA-1	Hand Auger	07/21/99	3	2.5		
Flare Site	FA-2	Hand Auger	07/21/99	3	2.5		
Flare Site	FA-3	Hand Auger	07/21/99	3	1.0		
Flare Site	FA-4	Morooka MST-600	12/16/99	6	3.5	2.5	
Flare Site	FA-5	Morooka MST-600	12/16/99	6	6.5	2.0	
Flare Site	FA-6	Morooka MST-600	12/16/99	6	3.5	2.0	
Demo Site #1	DA1-1	Hand Auger	07/21/99	3	4.5		
Demo Site #1	DA1-2	Hand Auger	07/21/99	3	4.5		
Demo Site #2	DA2-1	Hand Auger	07/21/99	3	4.5		
Demo Site #2	DA2-2	Hand Auger	07/21/99	3	4.5		
Demo Site #3	DA3-1	Hand Auger	07/21/99	3	4.5	3.5	
Demo Site #3	DA3-2	Hand Auger	07/21/99	3	4.5	3.5	
Demo Site #3	DA3-3	Morooka MST-600	12/17/99	6	16.0	6.0	
Demo Site #3	DA3-4	Morooka MST-600	12/17/99	6	11.0	5.0	
Demo Site #3	DA3-5	Morooka MST-600	12/17/99	6	8.5	6.0	
Demo Site #3	DA3-6	Morooka MST-600	12/17/99	6	17.0	10.0	
McAllister Drive Land Bridge	LB-1	Hand Auger	12/18/99	3	5.0		
McAllister Drive Land Bridge	LB-2	Morooka MST 600	12/14/99	6	29.0		
McAllister Drive Land Bridge	LB-3	Hand Auger	12/18/99	3	5.0		
McAllister Drive Land Bridge	LB-4	Hand Auger	12/21/99	3	5.0		
McAllister Drive Land Bridge	LB-5	Hand Auger	12/21/99	3	5.0		
McAllister Drive Land Bridge	LB-6	Hand Auger	12/21/99	3	5.0		
Adjacent to Casey Court	GB-1	Hand Auger	03/23/00	3	6.0	4.5	
Adjacent to Casey Court	GB-2	Hand Auger	03/23/00	3	3.0	2.5	
Adjacent to Casey Court	GB-3	Hand Auger	03/23/00	3	3.0	2.0	
Sewerline Rd	GB-4	Morooka MST 600	03/23/00	6	10.5	8.5	
Sewerline Rd	GB-5	Morooka MST 600	03/23/00	6	7.5	4.5	
Sewerline Rd	GB-6	Morooka MST 600	03/23/00	6	5.0	2.2	
Sewerline Rd	GB-7	Morooka MST 600	03/23/00	6	7.5	6.2	
Sewerline Rd	GB-8	Morooka MST 600	03/23/00	6	7.5	5.0	
South Valley	GB-9	Hand Auger	03/23/00	3	5.5	5.0	
South Valley	GB-10	Hand Auger	03/23/00	3	3.0		
Demo Site #1	GB-11	Hand Auger	03/23/00	3	6.0		
Sewerline Rd	GB-12	Morooka MST 600	03/23/00	6	5.5	2.2	
Sewerline Rd	GB-13	Morooka MST 600	03/24/00	6	13.5	11.5	
Sewerline Rd 19	GB-14	Morooka MST 600	03/24/00	6	26.5	23.5	7.0
Sewerline Rd	GB-15	Morooka MST 600	03/24/00	6	11.5	8.5	
Sewerline Rd	GB-16	Morooka MST 600	03/24/00	6	23.5	22.0	
South Valley	GB-17	Morooka MST 600	03/27/00	6	18	16.0	16.0
Ridge at east end	GB-18	CME 650	04/18/00	8	8.8	7.5	
Ridge at east end	GB-19	CME 650	04/18/00	8	13.5	12.0	
Ridge at east end	GB-20	CME 650	04/17/00	8	9.5	9.0	

Table C-1. Summary of Exploratory Boreholes and Test Pits
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Location	Point ID	Drilling Equipment	Date Start	Borehole Diameter (inches)	Borehole Depth (ft. bgs)	Depth to Bedrock (ft. bgs)	Water Depth (ft. bgs)
Ridge at east end	GB-21	CME 650	04/18/00	8	13.5	9.5	
South Slope	GB-22	CME 650	04/18/00	8	8.7	4.0	
South Slope	GB-23	CME 650	04/18/00	8	9.0	3.0	
South Slope	GB-24	CME 650	04/18/00	8	21.5	21.0	
South Slope	GB-25	CME 650	04/19/00	8	13.5	9.5	
North Slope	GB-26	CME 650	04/21/00	8	5.5	4.0	
South Slope	GB-27	CME 650	04/21/00	8	13.2	5.5	
Westend	GB-28	CME 650	04/19/00	8	9.0	4.0	
Westend	GB-29	CME 650	04/19/00	8	5.5	4.5	
Lower Westend	GB-30	CME 650	04/21/00	8	12.6	12.0	
South Valley Demo Site # 1	P-1	Backhoe	05/05/99	-	8.0	8.0	
South Valley Demo Site # 2	P-2	Backhoe	05/05/99	-	9.0	9.0	
South Valley Demo Site # 2	P-3	Backhoe	05/05/99	-	9.0	9.0	
Flare Site	P-4	Backhoe	05/05/99	-	10.0	10.0	
South Valley	P-5	Backhoe	05/05/99	-	12.0		
North slope of South Valley	P-6	Backhoe	05/06/99	-	6.0	4.0	
North slope of South Valley	P-7	Backhoe	05/06/99	-	5.5	3.5	
North slope of South Valley	P-8	Backhoe	05/06/99	-	4.5	3.5	
North slope of South Valley	P-9	Backhoe	05/06/99	-	5.0	4.5	
North slope of South Valley	P-10	Backhoe	05/06/99	-	5.0	4.0	
North slope of South Valley	P-11	Backhoe	05/06/99	-	5.0	2.5	
North slope of South Valley	P-12	Backhoe	05/06/99	-	6.0	6.0	
North Valley Military Landfill	LFP-1	Backhoe	05/31/00	-	3.0		
North Valley Military Landfill	LFP-2	Backhoe	06/02/00	-	2.0		
North Valley Military Landfill	LFP-3	Backhoe	05/31/00	-	6.0		
North Valley Military Landfill	LFP-4	Backhoe	06/01/00	-	6.0		
North Valley Military Landfill	LFP-5	Backhoe	05/31/00	-	4.0		
North Valley Military Landfill	LFP-6	Backhoe	05/31/00	-	4.0		
North Valley Military Landfill	LFP-7	Backhoe	05/31/00	-	4.5		
North Valley Military Landfill	LFP-8	Backhoe	06/02/00	-	4.0		
North Valley Military Landfill	LFP-9	Backhoe	05/31/00	-	5.0		3.5
North Valley Military Landfill	LFP-10	Backhoe	05/31/00	-	6.0		
North Valley Military Landfill	LFP-11	Backhoe	05/31/00	-	6.0		
North Valley Military Landfill	LFP-12	Backhoe	05/30/00	-	6.0		
North Valley Military Landfill	LFP-13	Backhoe	05/30/00	-	5.0		
North Valley Military Landfill	LFP-14	Backhoe	05/30/00	-	6.0		
North Valley Military Landfill	LFP-15	Backhoe	05/30/00	-	6.0		
North Valley Military Landfill	LFP-16	Backhoe	05/30/00	-	6.0		
North Valley Military Landfill	LFP-17	Backhoe	05/30/00	-	7.0		
North Valley Military Landfill	LFP-18	Backhoe	05/30/00	-	6.0		
North Valley Military Landfill	LFP-19	Backhoe	05/30/00	-	6.0		
North Valley Military Landfill	LFP-20	Backhoe	05/30/00	-	5.0		
North Valley Military Landfill	LFP-21	Backhoe	05/30/00	-	6.0		

Table C-1. Summary of Exploratory Boreholes and Test Pits
(Page 6 of 6)

Location	Point ID	Drilling Equipment	Date Start	Borehole Diameter (inches)	Borehole Depth (ft. bgs)	Depth to Bedrock (ft. bgs)	Water Depth (ft. bgs)
North Valley Military Landfill	LFP-22	Backhoe	05/30/00	-	5.5		
North Valley Military Landfill	LFP-23	Backhoe	05/30/00	-	4.5		
North Valley Military Landfill	LFP-24	Backhoe	05/31/00	-	10.0		8.0
North Valley Military Landfill	LFP-25	Backhoe	06/01/00	-	8.0		
North Valley Military Landfill	LFP-26	Backhoe	06/01/00	-	5.0		
North Valley Military Landfill	LFP-27	Backhoe	06/01/00	-	3.0		
North Valley Military Landfill	LFP-28	Backhoe	06/01/00	-	3.0		
North Valley Military Landfill	LFP-29	Backhoe	05/31/00	-	4.0		
North Valley Military Landfill	LFP-30	Backhoe	06/02/00	-	4.0		

Notes:
ft. bgs = Feet below ground surface
MD-1 provided by Precision Drilling of Richmond, California
Marooka MST 600 provided by Clear Heart Construction and Drilling of Guerneville, California
CME 550 and CME 650 provided by All Terrain Exploration Drilling of Pleasant Grove, California
CME 75 provided by West Hazmat Drilling Corporation of Newark, California

Table C-2. Recommended Sample Containers, Preservation, and Holding Times for Selected Analytical Test Methods

(Page 1 of 2)

Parameter	Aqueous Sample Container[a]	Field Filter[e]	Volume Required: Water (mL)*	Volume Required: Soil (g)	Preservation [b]: Water	Preservation [b]: Soil	Maximum Holding Times [c]**
Metals (SW6010B) and Phosphorus	P, G, T	X	1000	250	HNO_3 to pH <2	4°C	6 months
Mercury (SW7470A/SW7471A)	P, G, T	X	1000	10	HNO_3 to pH <2	4°C	28 days
Methyl Mercury (FSG-070.1)	P		-	250	-	4°C	Freeze within 7 days (24 hours preferred), 1 year
Total Petroleum Hydrocarbons: TEPH Diesel, Kerosene, and Motor Oil (Mod SW8015 LUFT)	G, amber, T		1,000	250	Cool 4°C	4°C	7 days (water) and 14 days (soil) until extraction, 40 days after extraction
Organochlorine Pesticides/PCBs (SW8081A/SW8082)	G, Teflon™ screw cap		1000	250	Cool 4°C	4°C	7 days (water) and 14 days (soil) until extraction, 40 days after extraction
Volatile Organics (SW8260B) Preparation by SW5030 or SW5035	G, Teflon™ lined septum, T		3 x 40	25 for SW5035	Cool 4°C HCl to pH<2 (0.008% $Na_2S_2O_3$[d])	4°C; and Na_2SO_4 or Methanol for SW5035	14 days (7 days for waters if not pH adjusted); 48 hours for soils by SW5035 Encore™ sampler method if unpreserved
Semivolatile Organics (SW8270C)	G, Teflon™ screw cap, T		1000	250	Cool 4°C (0.008% $Na_2S_2O_3$[d])	4°C	7 days (water) and 14 days (soil) until extraction, 40 days after extraction
Chloropicrin - Chemical Warfare Degradates (SW8270CWM)	G, Teflon™ screw cap, T		1000	250	Cool 4°C (0.008% $Na_2S_2O_3$[d])	4°C	7 days (water) and 14 days (soil) until extraction, 40 days after extraction
Dioxins/Furans (SW8280A/ SW8290)	G, Teflon™ screw cap		1000	250	Cool 4°C (0.008% $Na_2S_2O_3$[d]) store in dark	4°C	7 days until extraction, 40 days after extraction
Polyaromatic Hydrocarbons (SW8310)	G, Teflon™ screw cap, T		1,000	250	Cool 4°C (0.008% $Na_2S_2O_3$[d])	4°C	7 days (water) and 14 days (soil) until extraction, 40 days after extraction
Speciated Hydrazines (SW8315-Mod)	G, Teflon™ lined septum, T		250	50	4°C, H_2SO_4 to pH<2	4°C	7 days until extraction, 3 days after extraction
Nitroaromatics & Nitroamines (SW8330); and Nitroglycerin/ PETN (SW8330/8332) Collect Separate Water Containers for Nitroglycerin/PETN	G, Teflon™- screw cap		1000	50	Cool 4°C (0.008% $Na_2S_2O_3$[d])	4°C	7 days (water) and 14 days (soils) until extraction, 40 days after extraction
Residue, Filterable (160.1) (TDS)	P, G		100	NA	Cool 4°C	NA	7 days

Table C-2. Recommended Sample Containers, Preservation, and Holding Times for Selected Analytical Test Methods

(Page 2 of 2)

Parameter	Aqueous Sample Container[a]	Field Filter[e]	Volume Required: Water (mL)*	Volume Required: Soil (g)	Preservation [b]: Water	Preservation [b]: Soil	Maximum Holding Times [c]**
Residue, Non-Filterable (160.2) (TSS)	P, G		100	NA	Cool 4°C	NA	7 days
Chloride, Sulfate (300.0)	P		100	50	Cool 4°C	4°C	28 days
Nitrate-N, Nitrite-N, Orthophosphate-P (300.0)	P, G		100	50	Cool 4°C	4°C	48 hours
Perchlorate (CADOHS 300.0-mod)	P		50	50	Cool 4°C	4°C	28 days
Total Organic Carbon (415.1, SW9060)	P, G		1000	150	Cool 4°C; H_2SO_4 or HCl to pH <2	4°C	28 days
Electrical Conductivity (120.1)(field)	P, G		100	NA	None Required	NA	Analyze immediately
Hydrogen ion (pH) (150.1) (field)	P, G		50	NA	None Required	NA	Analyze immediately
Temperature (170.1) (field)	P, G		1000	NA	None Required	NA	Analyze immediately
Turbidity (180.1) (field)	P, G		100	NA	None Required	NA	Analyze immediately

Notes:

mL = milliliter
g = gram

* Do not pre-wash bottle with samples.
** Extraction holding times are from date of sample collection; analysis times are from date of extraction.

REFERENCE: This table includes the requirements of the U.S. Environmental Protection Agency, as published in the Code of Federal Regulations, Volume 49, Number 209, 40CFR 136, dated October 26, 1984, page 43260.

a Polyethylene (P); glass (G); brass sleeves in the sample barrel, sometimes called California brass (T). Soil samples may be collected in either glass jars or stainless steel liners with both ends sealed with Teflon™ paper and plastic caps.

b Sample preservation should be performed immediately upon sample collection. For composite chemical samples, each aliquot should be preserved at the time of collection. When use of an automatic sampler makes it impossible to preserve each aliquot, then chemical samples may be preserved by maintaining at 4°C until compositing and sample splitting are completed.

c Samples should be analyzed as soon as possible after collection. The times listed are maximum times (in calendar days) that samples may be held before analysis and still be considered valid. Samples may be held for longer periods of time only if the monitoring laboratory has data on file to show that the specific types of samples under study are stable for the longer time. Some samples may not be stable for the maximum time period given in the table. The monitoring laboratory is obligated to hold the sample for a shorter period if knowledge exists to show this is necessary to maintain sample stability.

d Should only be used in the presence of residual chlorine.

e For dissolved metals and phosphorus, the sample shall be filtered in the field through 0.45 micron filter immediately (within 15 minutes) after sample collection and before sample preservation.

ATTACHMENT C-1

TEST PIT LOGS

EARTH TECH

TEST PIT LOG

PIT NO.: P-1

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 8.0' BGS
START DATE: 5/5/1999	COMPLETION DATE: 5/5/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: South Valley Demo Site # 1	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						0.0'-8.0' FAT CLAY (CH): dark brown grading to moderate yellowish brown and grayish brown with depth; damp; firm; increasing severely weathered; fragments of shale, siltstone and sandstone in sandy fat clay matrix.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
5								
						BEDROCK 8.0' SHALE: at bottom of test pit; very dense; damp; olive gray; moderately weathered. Total Depth 8.0'.		
10								
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-2

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 9.0' BGS
START DATE: 5/5/1999	COMPLETION DATE: 5/5/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: South Valley Demo Site # 2	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						0.0'-9.0' FAT CLAY (CH): dark brown grading to moderate yellowish brown and grayish brown with depth; damp; firm; increasing severely weathered; fragments of shale, siltstone and sandstone in sandy fat clay matrix.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
5								
						BEDROCK 9.0' SHALE: gray; at bottom of test pit; very dense; damp; olive gray; moderately weathered. Total Depth 9.0'.		
10								
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-3

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 9.0' BGS
START DATE: 5/5/1999	COMPLETION DATE: 5/5/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: South Valley Demo Site # 2	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						0.0'-0.9' FAT CLAY (CH): dark brown grading to moderate yellowish brown and grayish brown with depth; damp; firm; increasing severely weathered; fragments of shale, siltstone and sandstone in sandy fat clay matrix.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
5								
						BEDROCK 9.0' SHALE: severely weathered; light olive gray to gray; intensely fractured; breaks in angular pieces; very dense. Total Depth 9.0'.		
10								
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-4

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 10.0' BGS
START DATE: 5/5/1999	COMPLETION DATE: 5/5/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: South Valley; Flare Site	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-2.0' FAT CLAY (CH): dark brown damp; firm.		Advanced test pit with JD450 D crawler backhoe with 36" bucket
						RESIDUAL SOIL 2.0'-10.0' SANDY FAT CLAY (CH): light olive brown; damp; firm; inclusions of shale, siltstone and sandstone fragments; sandstone is moderate hard and fine grained.		
5								
10						BEDROCK 10.0' SANDSTONE: olive gray; fine grained; moderately weathered; very hard. Total Depth 10.0'		
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-5

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 12.0' BGS
START DATE: 5/5/1999	COMPLETION DATE: 5/5/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: South Valley	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-6.0' FAT CLAY (CH): dark brown; damp; firm.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
5								
						RESIDUAL SOIL 6.0'-11.0' FAT CLAY (CH): light olive brown; damp; firm with moderately weathered rock fragments of siltstone and sandstone.		
10						11.0'-12.0' SANDY FAT CLAY (CH): olive brown moist; firm.		
						Total Depth 12.0'.		
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-6

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 6.0' BGS
START DATE: 5/6/1999	COMPLETION DATE: 5/6/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North slope of South Valley.	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-4.0' FAT CLAY (CH): dark yellowish brown; trace sand; damp; firm.		Advanced test pit with JD450 D crawler backhoe with 36" bucket
5						BEDROCK 4.0'-6.0' SHALE: olive gray; moderately weathered; very dense; damp.		
						Total Depth 6.0'.		
10								
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-7

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 5.5' BGS
START DATE: 5/6/1999	COMPLETION DATE: 5/6/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North slope of South Valley.	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-3.5' FAT CLAY (CH): dark yellowish brown; damp; firm.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
5						BEDROCK 3.5'-5.5' SHALE: olive gray; moderately weathered; intensely fractured; very dense.		
						Total Depth 5.5'.		
10								
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-8

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 4.5' BGS
START DATE: 5/6/1999	COMPLETION DATE: 5/6/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North slope of South Valley.	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-3.5' FAT CLAY (CH): dark yellowish brown; damp; firm.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
						BEDROCK 3.5'-4.5' SHALE: olive gray; moderately weathered; very dense; dry to damp.		
5						Total Depth 4.5'.		
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15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-9

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 5.0' BGS
START DATE: 5/6/1999	COMPLETION DATE: 5/6/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North slope of South Valley.	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-2.5' FAT CLAY (CH): dark yellowish brown; damp; firm.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
						RESIDUAL SOIL 2.5'-4.0' SANDY FAT CLAY (CH): moderate yellowish brown; stiff; ~10-20% sand; traces shale/siltstone fragments; firm; dry to damp.		
5						BEDROCK 4.5'-5.0' SHALE: moderately weathered; light olive gray to light olive brown; intensely fractured; soft in hardness; very dense; dry to damp. Total Depth 5.0'		
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15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-10

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 5.0' BGS
START DATE: 5/6/1999	COMPLETION DATE: 5/6/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North slope of South Valley.	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-3.0' FAT CLAY (CH): dark yellowish brown; damp; firm.		Advanced test pit with JD450 D crawler backhoe with 36" bucket.
						RESIDUAL SOIL 3.0'-4.0' SANDY FAT CLAY (CH): moderate yellowish brown; stiff; ~10-20% sand; traces shale/siltstone fragments; firm; dry to damp.		
5						BEDROCK 4.0'-5.0' SHALE: moderately weathered; light olive gray to light olive brown; intensely fractured; soft in hardness; very dense; dry to damp. Total Depth 5.0'.		
10								
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-11

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 5.0' BGS
START DATE: 5/6/1999	COMPLETION DATE: 5/6/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North slope of South Valley.	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						RESIDUAL SOIL 0.0'-2.5' SANDY FAT CLAY (CH): moderate yellowish brown; stiff; ~10-20% sand; traces shale/siltstone fragments; firm; dry to damp.		Advanced test pit with JD450 D crawler, Backhoe with 3.0' bucket.
						BEDROCK 2.5'-5.0' SILTSTONE: olive gray; where moderatley weathered; gray where fresh; soft in hardness; very dense.		
5						Total Depth 5.0'.		
10								
15								
20								

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EARTH TECH

TEST PIT LOG

PIT NO.: P-12

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 39901
CLIENT: Granite	CONTRACTOR: Lee's Backhoe
EQUIPMENT: Backhoe JD450 D	OPERATOR: Lee
SAMPLING METHOD: N/A	TOTAL DEPTH: 6.0' BGS
START DATE: 5/6/1999	COMPLETION DATE: 5/6/1999
LOGGED BY: R Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North slope of South Valley.	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						TOPSOIL 0.0'-1.0' FAT CLAY (CH): dark brown; dry to damp; firm. RESIDUAL SOIL 1.0'-6.0' SANDY FAT CLAY (CH): moderate yellowish brown; stiff; ~10-20% sand; traces shale/siltstone fragments; firm; dry to damp. BEDROCK 6.0' SANDSTONE: dark yellowish brown on fresh surface; moderately weathered; fine grained; very hard. Total Depth 6.0'.		Advanced test pit with JD450 D crawler, Backhoe with 3.0' bucket.

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ATTACHMENT C-2

NORCAL SEISMIC REFRACTION SURVEY REPORT

NORCAL GEOPHYSICAL CONSULTANTS, INC.

June 16, 1999

Earth Tech
695 River Oaks Parkway
San Jose, CA 95134

Subject: Seismic Refraction Survey Report
Tourtelot Property
Benicia, California

Attention: Richard Burzinski

Gentlemen:

This letter report presents the findings of a seismic refraction survey performed by NORCAL Geophysical Consultants, Inc. at the project site. The seismic refraction survey was performed during the period June 2 through 9, 1998 by NORCAL geophysicists William J. Henrich and William Black. Mr. Richard Burzinski and Buzz Barton of Earth Tech provided survey orientation, field support and investigated the refraction survey alignments for buried UXO ordnance prior to data acquisition.

PURPOSE AND SCOPE OF WORK

The purpose of the geophysical survey was to estimate the thickness of overburden and highly weathered bedrock overlying more competent and less weathered rock. This information will be used to evaluate the approximate volume of overburden material for potential removal of buried ordinance. Our scope of work consisted of obtaining seismic refraction data along a series of traverses situated perpendicular to the site's major east-west drainage (see Plate 1). The configuration of the seismic coverage was designated by Earth Tech. The scope of work also included computer processing the seismic data to a tabular format and providing a written report with our interpretation of the results.

DATA ACQUISITION

We obtained seismic compressional P-wave refraction data along 6 alignments comprising a total of 35 separate seismic refraction spreads, labeled A through HH on Plate 1. The length of these spreads ranged from 65 to 91 feet. Each seismic spread consisted of 12 geophones spaced 5 to 7 feet apart in a collinear array and shotpoints located at each end of the array. Seismic energy was produced by impacts of a 10-pound hammer striking a metal plate on the ground surface. All seismic refraction spread alignments were scanned with a metal detector prior to data acquisition. If metallic objects were detected, the proposed geophone placement and shot points were relocated. Seismic profiles consisted of a 12-geophone spread and two shot points.

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We acquired seismic data using a Geometrics ES-1225 12-channel engineering seismograph and 4.5 Hz Mark Products geophones. Seismograph records showing the travel time of the seismic energy from the shotpoints to the respective geophones in each spread were printed in the field as analog plots as well as downloaded digitally as binary files to a portable computer.

DATA ANALYSIS

Preliminary seismic refraction analysis of each seismic spread consisted of: 1) determining the P-wave arrival time from the shotpoints to the respective geophones; and 2) plotting these various arrival times to each geophone versus the respective distances from each shotpoint. Linear best-fit line slopes to these data provide an initial indication of number of layers and apparent seismic velocities present below the refraction spread. Refraction data consisting of shotpoint and geophone coordinates, geophone arrival times and respective layer assignments were entered into a seismic inverse modeling program ***SIP*** (Rimrock Geophysics, 1997, Longmont, Colorado). This program calculates the depths to the seismic refractors (layer interfaces) beneath each geophone and determines the average velocity of each seismic layer. This information has been tabulated to summarize the number of layers and average velocities for each seismic spread as well as the thickness of the surficial layer and the depth to the highest velocity layer defined.

RESULTS

The locations of the seismic refraction spreads are shown on the Seismic Refraction Survey Location Map, Plate 1. They are designated as A through Z and AA through HH. This alphabetic designation is according to the sequence in which each spread was obtained and does not necessarily relate to the 6 major north-south trending alignments across the site drainage. For additional reference, at each of the 35 spreads shown, there are also 2 shotpoints (one at each end) shown. The shotpoint designations range from SP-1 to SP-68.

The tabulated results of the data analysis are presented in Table 1, Seismic Refraction Results. Definition of the various parameters shown on the table are as follows:

Line No. - refers to the six major north-south trending alignments across the site drainage.

Spread Symbol - alphabetic spread designation.

Seismic Layer Velocity - indicates the average layer velocities for each spread. Note that some spreads have two velocity layers while others have three layers. The seismic layers are designated as V1 (surficial layer), V2 (intermediate layer) and V3 (deepest layer).

Interpreted Thickness-Surficial Material (V1) - this is the range in thickness, in feet, of the V1 layer along each seismic spread. We interpret this layer as representing the thickness of the residual soil and possibly colluvium in localized areas. In areas where V2 is absent, the thickness of V1 is the same as the depth of less weathered rock (V3)

Interpreted Depth to Less Weathered Rock (V3) - refers to the range in depth, in feet, of the V3 layer which we have arbitrarily chosen to be any velocity equal to or greater than 3,000 FPS. We interpret this layer as representing less weathered bedrock. The indicated range in depths also refers to the interpreted thickness of the lower velocity overburden (which may include both soil and colluvium) and may also include the bedrock weathered zone that overlies the less weathered and higher velocity bedrock.

The data on Table 1 generally resolves the shallow subsurface into two or three seismic velocity layers. Where there are only two layers, it probably indicates where the residual soil grades into the less weathered bedrock. The presence of three layers probably indicates that there is a thicker bedrock weathered zone and that there may also be additional colluvium such as landslide debris overlying the less weathered rock. Along three of the spreads (Spreads A, W, and Q-1) the V3 layer is not defined. This may indicate that the bedrock weathered zone is thicker than elsewhere and the less weathered rock is at depths greater than the designed depth of investigation.

Table 1., Seismic Refraction Results

LINE NO.	SPREAD SYMBOL	SEISMIC LAYER VELOCITY (FPS)			INTERPRETED THICKNESS-SURFICIAL MATERIAL (FT)	INTERPRETED DEPTH TO LESS WEATHERED ROCK (FT)
		V1	V2	V3	V1	V3
1	A	700	2350	--	1-2	--
1	B	700	2000	5900	2-8	6-36
1	C	740	2475	8730	2.5-4	14-25.5
1	D	1580	--	7650	--	2-6
1	HH	1300	--	7000	--	0-14
1	GG	950	2700	8000	2.5-3	7-20
1	FF	1000	--	3700	--	1.5-8

2	E	750	--	3500	--	1-5
2	F	950	--	4000	--	5-8.5
2	G	800	--	6000	--	5-8.5
2	EE	1600	--	3700	--	3-8.5
2	CC	1600	--	4800	--	4-8
2	DD	950	--	3750	--	2-4.5
3	H	800	2400	5800	1-4	23-32
3	I	700	2100	4050	2.5-4.5	4.5-12
3	BB	1100	2700	5400	3-8	8-13
3	AA	875	2250	6500	0-2.5	16-19
3	Z	900	2300	3800	0.5-3.5	11-23.5
3	Y	900	--	3500	--	2.5-3.5
4	J	900	--	3600	--	3-4
4	K	650	2800	4700	3.5-4	13-16.5
4	L	1300	--	5400	--	8-13.5
4	M	800	--	6300	--	1-10
4	X	950	2300	5200	2.5-5	14-22
4	W	950	2900	--	0.5-7	--
5	N	900	--	3300	--	1-6
5	O	950	2000	4650	3-6	15-18
5	V	850	2400	8000	3-6	15-24
5	U	900	2300	3800	2-5	4-24
5	T	1175	--	4000	--	6-11
6	Q	950	--	3300	--	6-9

6	P	1200	--	3500	--	6-13
6	S	950	1800	7050	1-5	11-16
6	R	1000	--	3500	--	2-12
6	Q-1	900	2900	--	2-9	--

STANDARD CARE AND WARRANTY

The scope of services for this project consisted of using seismic refraction to characterize the shallow subsurface. The accuracy of our findings is subject to specific site conditions and limitations inherent to the techniques employed. We performed our services in a manner consistent with the level of skill ordinarily exercised by members of the profession currently employing similar methods. No warranty, with respect to the performance of services or products delivered under this agreement, expressed or implied, is made by NORCAL.

We appreciate the opportunity to provide you with this information. If you have any questions or require additional geophysical services, do not hesitate to call us.

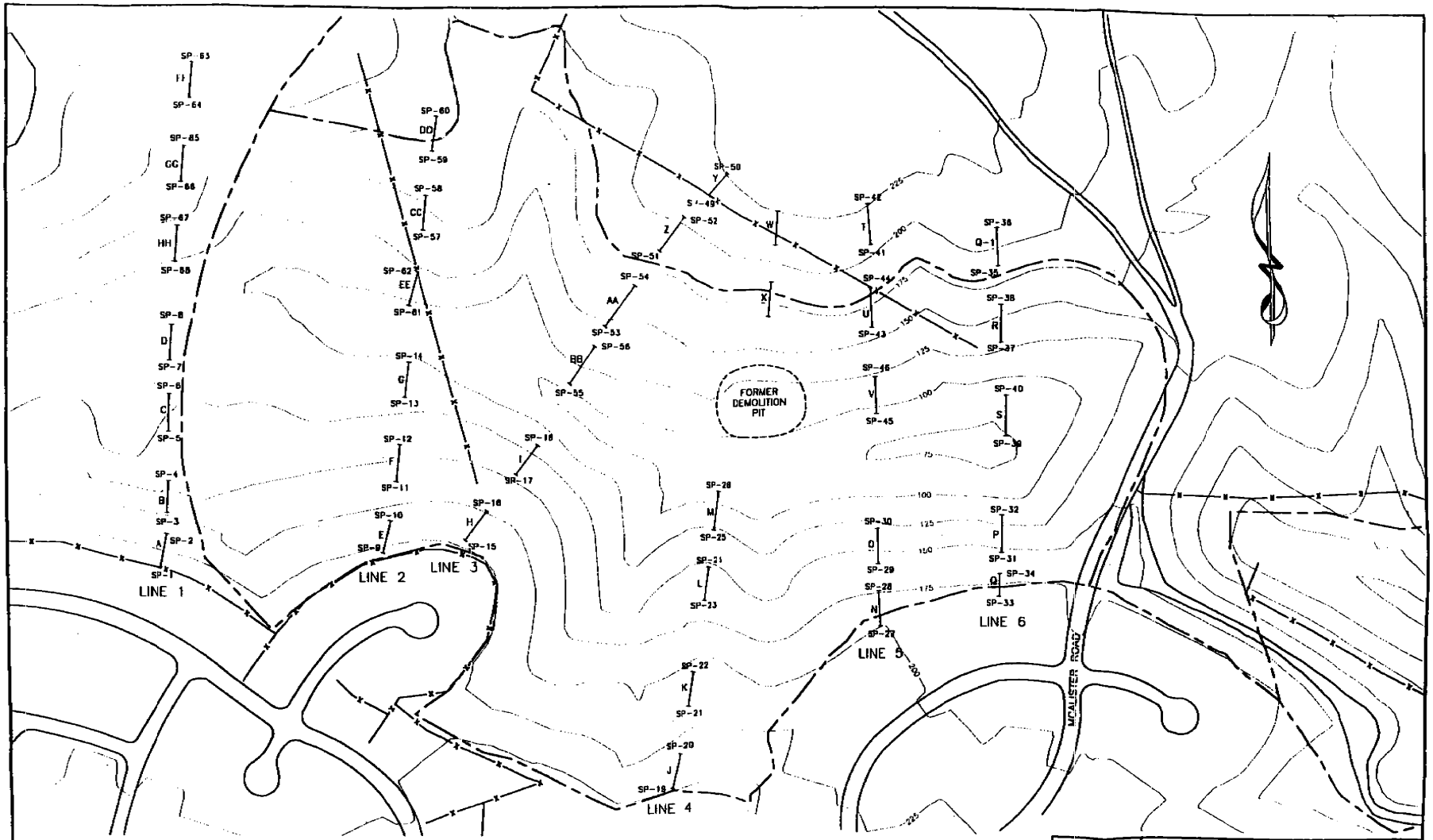
Respectfully,

NORCAL Geophysical Consultants, Inc.

William J. Henrich
Geophysicist GP-893

WJH/jh

Enclosure: Plate 1



LEGEND

A	SEISMIC PROFILE		PROPERTY LINE
SP-7	SHOT POINT		FENCE
	TOPOGRAPHIC CONTOUR (CONTOUR INTERVAL = 25 FEET)		

SCALE
0 100 200 400
(1 Inch = 200 feet)

NORCAL

SEISMIC REFRACTION SURVEY
LOCATION MAP
TOURTELOT PROPERTY

LOCATION: BENICIA, CALIFORNIA
CLIENT: EARTH TECH
NORCAL GEOPHYSICAL CONSULTANTS INC.
JOB #: 99-533.07
DATE: JUNE 1999
DRAWN BY: G RANDALL
APPROVED BY: WJH

PLATE 1

ATTACHMENT C-3

TEST BORING LOGS

EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1A
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:**
DRILLING EQUIPMENT: Hand Auger	**DRILLER:** R. Burzinski
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 2.5' BGS
START DATE: 7/19/1999	**COMPLETION DATE:** 7/19/1999
LOGGED BY: R. Burzinski	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1A/0.5 TNT-1A/1 TNT-1A/1.5 TNT-1A/2			RESIDUAL SOIL 0.0'-2.5' FAT CLAY (CH): dark brown; moderate plasticity; firm; damp. ~ 18" White to grey, soft translucent crystalline fragment in clay matrix. Total Depth 2.5'.		
5								
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1B
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:**
DRILLING EQUIPMENT: Hand Auger	**DRILLER:** R. Burzinski
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 3.5' BGS
START DATE: 7/19/1999	**COMPLETION DATE:** 7/19/1999
LOGGED BY: R. Burzinski	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1B/0.5 TNT-1B/1 TNT-1B/1.5 TNT-1B/2			RESIDUAL SOIL 0.0'-3.0' FAT CLAY (CH): moderate yellowish brown; firm; dry to damp. – color changed to light olive to gray		
						BEDROCK 3.0'-3.5' SHALE: olive gray; moderately weathered, hard. Total Depth 3.5'		Refusal of hand auger.
5								
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C

WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	PROJECT NO.: 35734
CLIENT: Granite	DRILLING CONTRACTOR:
DRILLING EQUIPMENT: Hand Auger	DRILLER: R. Burzinski
SAMPLING METHOD: Slide Hammer	TOTAL DEPTH: 4.5' BGS
START DATE: 7/19/1999	COMPLETION DATE: 7/19/1999
LOGGED BY: R. Burzinski	APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1C/0.5 TNT-1C/1 TNT-1C/1.5 TNT-1C/2			RESIDUAL SOIL 0.0'-3.5' FAT CLAY (CH): moderate yellow brown; firm; damp; sticky. -1.5' irregular angular fragments of soft grayish translucent crystalline material; surfaces of fragments is coated with reddish brown stains.		
			TNT-1C/3.5 TNT-1C/4			BEDROCK 3.5'-4.5' SHALE: olive gray; moderately weathered; soft; dense; damp. Total Depth 4.5'.		
5								
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C2
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** SECOR
DRILLING EQUIPMENT: Hand Auger	**DRILLER:**
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 4.0' BGS
START DATE: 12/18/1999	**COMPLETION DATE:** 12/18/1999
LOGGED BY: B. Robitaille	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1C2/0			RESIDUAL SOIL		Hand Augered samples collected by slide hammer.
			TNT-1C2/0.5			0.0'-3.5' FAT CLAY (CH): dark yellowish brown; soft to firm; dry.		
			TNTN-1C2/1			–Traces of white/gray crystalline powder and dark gray translucent crystals to approximately 1.0' bgs		
			TNTN-1C2/2			–Traces of small gravel	1.8	
			TNT-1C2/2.5				1	
			TNT-1C2/3.5			BEDROCK	1.2	
5						3.5'-4.0' SHALE/SILTSTONE: light olive gray; weathered; iron stained; very dense; damp; 1/4" gypsum vein.		
						Total Depth 4.0'.		
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1C2A/0, TNT-1C2A/0.5, TNT-1C2A/1, TNT-1C2A/2, TNT-1C2B/2, TNT-1C2A/2.5, TNT-1C2B/2.5

EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C3
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 4.0' BGS
START DATE: 12/4/1999
COMPLETION DATE: 12/4/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1C3/0			RESIDUAL SOIL		Direct push continuously sample.
			TNT-1C3/1			0.0'-3.5' FAT CLAY (CH): dark yellowish brown; 10% roots; hard; dry.	1.5	
			TNT-1C3/2			~1.5' Change to dusky yellowish brown.		
	1.0/1.0		TNT-1C3/3				2	
			TNT-1C3/3.5			BEDROCK		
5						3.5'-4.0' SHALE: grayish brown; weathered; dense; damp.		Backfill borehole to surface with Portland cement grout.
						Total Depth 4.0'.		
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1C3A/0 TNT-1C3A/1 TNT-1C3A/2 TNT-1C3A/3.5

EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C4
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 4.5' BGS
START DATE: 12/4/1999
COMPLETION DATE: 12/4/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1C4/0			RESIDUAL SOIL 0.0'-4.5' FAT CLAY (CH): dusky yellowish brown; about 10% plant roots, hard, dry.		Direct push continuously sample.
			TNT-1C4/1					
			TNT-1C4/2			~light olive gray at 2'.		
	1.5/1.5							
			TNT-1C4/3.5					
			TNT-1C4/4			BEDROCK 4.0'-4.5' SHALE/SILTSTONE: weathered; light olive gray to moderate yellowish brown; very dense; damp.		Backfill borehole to surface with Portland cement grout.
5						Total Depth 4.5'.		
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1C4A/0 TNT-1C4A/1 TNT-1C4A/2

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C5
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 11.5' BGS
START DATE: 12/3/1999
COMPLETION DATE: 12/4/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
						RESIDUAL SOIL		Direct push continuously sample.
			TNT-1C5/0.5			0.0'-7.0' FAT CLAY (CH): dark yellowish brown; 5-10% trace roots; firm to stiff; moist.		
	1.5/3.0		TNT-1C5/1				0	
			TNT-1C5/2					
						~Color change to pale yellowish brown.		
	2.9/3.0		TNT-1C5/4				0	
5								
			TNT-1C5/6					
	2.0/2.0					BEDROCK	0	
			TNT-1C5/8			7.0'-11.5' SHALE/SILTSTONE: weathered; mottled dark yellowish brown to dark yellowish orange; intensely fractured; compact; very dense to hard; dry to slightly damp.		
	1.75/2.0						20	
10			TNT-1C5/10			~Color change to olive gray.		
			TNT-1C5/10.5					
						Total Depth 11.5'.		11.5' Refusal. Backfill borehole to surface with Portland cement grout.
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1C5A/0 TN-1C5A/1 TNT-1C5A/2

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C6
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 5.5' BGS
START DATE: 12/4/1999
COMPLETION DATE: 12/4/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1C6/0 TNT-1C6/0.5 TNT-1C6/1 TNT-1C6/2			RESIDUAL SOIL 0.0'-5.0' FAT CLAY (CH): dark yellowish brown; 10% trace tree/plant roots; very stiff to hard; dry to slightly damp.	5.2	Direct push continuously sample beginning at 11:25.
	2.5/2.5		TNT-1C6/4 TNT-1C6/4.5			~Color change to grayish olive.	9.2	
5						BEDROCK 5.0'-5.5' SHALE/SILTSTONE: weathered; mottled moderate yellowish brown to grayish olive; dense; slightly damp. Total Depth 5.5'.		Backfill borehole to surface with Portland cement grout.
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1C6A/0 TNT-1C6A/0.5 TNT-1C6A/1 TNT-1C6A/2

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C7
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 5.0' BGS
START DATE: 12/4/1999
COMPLETION DATE: 12/4/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1C7/0			RESIDUAL SOIL 0.0'-4.5' FAT CLAY (CH): light olive gray; 5% trace plant roots; hard; dry.		Direct push continuously sample.
			TNT-1C7/1					
			TNT-1C7/1.5					
			TNT-1C7/2			–Color change to dusky yellowish brown.	2	
	2.0/2.0							Refusal at 5.0'
			TNT-1C7/4				7.1	
5			TNT-1C7/4.5			BEDROCK 4.5'-5.0' SHALE: weathered; light olive gray; very dense to hard; slightly damp. Total Depth 5.0'.		Backfill borehole to surface with Portland cement grout.
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1C7A/0 TNT-1C7A/1 TNT-1C7A/1.5 TNT-1C7A/2

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C8
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Precision Drilling
DRILLING EQUIPMENT: MD-1	**DRILLER:**
SAMPLING METHOD: Direct Push continuously sampled	**TOTAL DEPTH:** 5.5' BGS
START DATE: 12/6/1999	**COMPLETION DATE:** 12/6/1999
LOGGED BY: R. Goldberg	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	1.0/2.0		TNT-1C8/0			RESIDUAL SOIL 0.0'-5.0' FAT CLAY (CH): olive gray mottled with dark yellowish orange; 10-15% plant roots; stiff to hard; dry.		Direct push continuously. Background 2.0ppm.
			TNT-1C8/1					
	0.5/1.0		TNT-1C8/2				2.6	
	2.5/2.5							
			TNT-1C8/4					
5						BEDROCK 5.0'-5.5' SHALE: weathered; very dense to hard; slightly damp. Total Depth 5.5'.		Backfill borehole to surface with Portland cement grout.
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C9
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** SECOR
DRILLING EQUIPMENT: Hand Auger	**DRILLER:**
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 3.0' BGS
START DATE: 12/18/1999	**COMPLETION DATE:** 12/18/1999
LOGGED BY: B. Robitaille	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1C9/0			RESIDUAL SOIL 0.0'-3.0' FAT CLAY (CH): dark yellowish brown; moderately soft; dry; white to gray crystalline powder and dark gray translucent crystals in upper 1.0'.	2.2	Hand augered samples collected by slide hammer.
			TNT-1C9/2.5			Total Depth 3.0'.		
5								
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1C10

WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** SECOR
DRILLING EQUIPMENT: Hand Auger	**DRILLER:**
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 2.5' BGS
START DATE: 12/18/1999	**COMPLETION DATE:** 12/18/1999
LOGGED BY: B. Robitaille	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1C10/0			RESIDUAL SOIL 0.0'-2.5' FAT CLAY (CH): dark yellowish brown; moderately soft; dry.		Hand augered samples collected by slide hammer.
			TNT-1C10/2				2.1	
						Total Depth 2.5'.		
5								
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1C10A/0 TNT-1C10A/2

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1D
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 2.5' BGS
START DATE: 12/7/1999
COMPLETION DATE: 12/7/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.5/2.5		TNT-1D/0			RESIDUAL SOIL		
			TNT-1D/1			0.0'-2.5' FAT CLAY (CH): dusky yellowish brown mottled light olive gray and moderated yellowish brown; approximately 5% plant roots; stiff; dry.		
			TNT-1D/2				0.8	Refusal in bedrock @ 2.5'. Backfill borehole to surface with Portland cement grout.
						BEDROCK		
						2.5' SHALE: weathered.		
						Total Depth 2.5'.		
5								
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1E
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 3.0' BGS
START DATE: 12/8/1999
COMPLETION DATE: 12/8/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.5/3.0		TNT-1E/0 TNT-1E/0.5 TNT-1E/1 TNT-1E/2			RESIDUAL SOIL 0.0'-1.5' FAT CLAY (CH): moderate brown; roots; topsoil. 1.5'-3.0' FAT CLAY (CH): dusky yellowish brown mottled olive brown and dark yellowish orange; 10% plant roots; very stiff and hard; dry. Total Depth 3.0'.		Direct push continuously sample.
5								
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1EA/0

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Precision Drilling
DRILLING EQUIPMENT: MD-1	**DRILLER:**
SAMPLING METHOD: Direct Push continuously sampled	**TOTAL DEPTH:** 3.0' BGS
START DATE: 12/8/1999	**COMPLETION DATE:** 12/8/1999
LOGGED BY: R. Goldberg	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1F/0 TNT-1F/0.5 TNT-1F/1 TNT-1F/2			RESIDUAL SOIL 0.0'-3.0' FAT CLAY (CH): dusky yellowish brown; mottled w/dark yellowish-orange and light olive gray; 5-10% plant roots; hard; dry. BEDROCK 3.0' SHALE: weathered; medium light gray mottled moderate yellowish brown and dark yellowish orange; very dense; damp. Total Depth 3.0'	1.2	Refusal in bedrock at 3.0'. Backfill borehole to surface to surface with Portland cement grout.
5								
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1FA/0

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EARTH TECH.

TEST BORING LOG

BOREHOLE NO.: TNT-1F2
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Precision Drilling
DRILLING EQUIPMENT: MD-1	**DRILLER:**
SAMPLING METHOD: Direct Push continuously sampled	**TOTAL DEPTH:** 6.0' BGS
START DATE: 12/6/1999	**COMPLETION DATE:** 12/6/1999
LOGGED BY: R. Goldberg	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1F2/0			RESIDUAL SOIL 0.0'-4.0' FAT CLAY (CH): dusky brown; 10% plant roots upper 1"; very stiff to hard; dry. –Change to medium light gray mottled with dark yellowish brown at 1.0'-4.0'.		Direct push continuously sample.
			TNT-1F2/1					
			TNT-1F2/2				1.5	
	3.0/3.0							
			TNT-1F2/4			BEDROCK 4.0'-6.0' SHALE/SILTSTONE: weathered; mottled light olive gray and dark yellowish orange; dense; damp.	1.4	
5								
						Total Depth 6.0'.		Backfill borehole to surface with Portland cement grout.
10								
15								
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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F3
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 6.0' BGS
START DATE: 12/6/1999
COMPLETION DATE: 12/6/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1F3/0			RESIDUAL SOIL 0.0'-4.0' FAT CLAY (CH): dusky yellowish brown mottled with pale yellowish orange; 10-15% trace plant roots; very stiff; dry.		Direct push continuously sample.
			TNT-1F3/1					
			TNT-1F3/2				1.4	
	3.0/3.0					–Pale yellowish orange.		
			TNT-1F3/4			BEDROCK 4.0'-6.0' SHALE/SILTSTONE: weathered; mottled light olive gray and dark yellowish orange; damp.	1.2	
5						Total Depth 6.0'.		Backfill borehole to surface with Portland cement grout.
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F4
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 6.0' BGS
START DATE: 12/7/1999
COMPLETION DATE: 12/7/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	1.5/3.0		TNT-1F4/0			RESIDUAL SOIL 0.0'-1.5' FAT CLAY (CH): dusky brown; ~10% plant root; stiff; dry.		
			TNT-1F4/1					
			TNT-1F4/2			1.5'-6.0' FAT CLAY (CH): grayish brown mottled with dark yellowish orange; very stiff to hard; dry to damp.	0.9	
	3.0/3.0							
			TNT-1F4/4				1.4	Refusal at 6.0'.
5			TNT-1F4/5.5			BEDROCK 4.5'-6.0' SHALE/SILTSTONE: weathered; mottled light olive gray and dark yellowish orange; dense; damp.		
						Total Depth 6.0'		Backfill borehole to surface with Portland cement grout.
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F5
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 3.5' BGS
START DATE: 12/6/1999
COMPLETION DATE: 12/6/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1F5/0			RESIDUAL SOIL		Direct push continuously sample.
			TNT-1F5/1			0.0'-3.0' FAT CLAY (CH): dusky yellowish brown mottled with dark yellowish orange and light olive gray; 5-10% plant roots; hard; dry.	1.5	
			TNT-1F5/2				1.9	
	0.5/0.5					BEDROCK		
						3.5' SHALE/SILTSTONE: weathered; olive gray; dense; damp.		Backfill borehole to surface with Portland cement grout.
5						Total Depth 3.5'.		
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1F5A/0 TNT-1F5B/0

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F6

WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project | **PROJECT NO.:** 35734

CLIENT: Granite | **DRILLING CONTRACTOR:** Precision Drilling

DRILLING EQUIPMENT: MD-1 | **DRILLER:**

SAMPLING METHOD: Direct Push continuously sampled | **TOTAL DEPTH:** 3.0' BGS

START DATE: 12/6/1999 | **COMPLETION DATE:** 12/6/1999

LOGGED BY: R. Goldberg | **APPROVED BY:** A. Buangan CEG 824

LOCATION: North Valley; TNT Strip #1 | **SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.0/3.0		TNT-1F6/0 TNT-1F6/1 TNT-1F6/2			RESIDUAL SOIL 0.0'-3.0' FAT CLAY (CH): dusky yellowish brown to dark yellowish orange and light brown; 15% plant roots; firm; damp. BEDROCK 3.0' SHALE/SILTSTONE: weathered; light olive gray mottled yellowish gray; very dense. Total Depth 3.0'.	2	Direct push continuously sample. Backfill borehole to surface with Portland cement grout.
5								
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15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F7
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 5.0' BGS
START DATE: 12/7/1999
COMPLETION DATE: 12/7/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.0/3.0		TNT-1F7/0			RESIDUAL SOIL 0.0'-4.0' FAT CLAY (CH): grayish brown; 5% trace plant roots; very stiff to hard; dry.		
			TNT-1F7/1				1.4	
			TNT-1F7/2					
	2.0/2.0							
			TNT-1F7/4			BEDROCK 4.0'-5.0' SHALE/SILTSTONE: weathered; light olive gray mottled moderate yellowish brown; dense; damp.	1.5	
5						Total Depth 5.0'.		Backfill borehole to surface with Portland cement grout.
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F8

WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Earth Tech
DRILLING EQUIPMENT: Hand Auger	**DRILLER:**
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 2.5' BGS
START DATE: 12/19/1999	**COMPLETION DATE:** 12/19/1999
LOGGED BY: P. Ody	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1F8/0 TNT-1F8/1 TNT-1F8/2			RESIDUAL SOIL 0.0'-2.5' FAT CLAY (CH): dark yellowish brown; mottled grayish brown; firm to stiff; dry to damp.		
						Total Depth 2.5'.		
5								
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1F8A/2

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1F9
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Earth Tech
DRILLING EQUIPMENT: Hand Auger	**DRILLER:**
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 2.0' BGS
START DATE: 12/19/1999	**COMPLETION DATE:** 12/19/1999
LOGGED BY: P. Ody	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1F9/0 TNT-1F9/1 TNT-1F9/1.5			0.0'-2.0 FAT CLAY (CH): dark yellowish brown mottled grayish brown; firm to stiff; dry to damp.		
						Total Depth 2.0'.		
5								
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1F9A/0

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1G
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 5.5' BGS
START DATE: 12/7/1999
COMPLETION DATE: 12/7/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.5/3.0		TNT-1G/0			RESIDUAL SOIL 0.0'-4.5' FAT CLAY (CH): moderate yellowish brown to dusky yellow; 5% trace plant roots; stiff to very stiff; dry.		
			TNT-1G/1				0.8	
			TNT-1G/1.5					
			TNT-1G/2					
	2.5/2.5							
			TNT-1G/4				0.5	
5			TNT-1G/5			BEDROCK 4.5'-5.5' SHALE/SILTSTONE: weathered; light olive gray; very dense; damp. Total Depth 5.5'.		Refusal at 5.5'. Backfill borehole to surface with Portland cement grout.
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1GA/0

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1H
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 5.0' BGS
START DATE: 12/7/1999
COMPLETION DATE: 12/7/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.5/3.0		TNT-1H/0			RESIDUAL SOIL 0.0'-4.5' FAT CLAY (CH): dark yellowish brown to dusky yellow; 10-15% plant roots; firm to stiff; dry to damp.		
			TNT-1H/1					
			TNT-1H/2				0.5	
	2.0/2.0							
			TNT-1H/3.5					
			TNT-1H/4				0.4	
5						BEDROCK 4.5'-5.0' SHALE/SILTSTONE: weathered; mottled light olive gray to moderate yellow brown; very dense to hard; damp. Total Depth 5.0'		Refusal at 5.0'. Backfill borehole to surface with Portland cement grout.
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1I

WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project | **PROJECT NO.:** 35734

CLIENT: Granite | **DRILLING CONTRACTOR:** Precision Drilling

DRILLING EQUIPMENT: MD-1 | **DRILLER:**

SAMPLING METHOD: Direct Push continuously sampled | **TOTAL DEPTH:** 3.0' BGS

START DATE: 12/7/1999 | **COMPLETION DATE:** 12/7/1999

LOGGED BY: R. Goldberg | **APPROVED BY:** A. Buangan CEG 824

LOCATION: North Valley; TNT Strip #1 | **SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.5/3.0		TNT-1I/0			RESIDUAL SOIL		
			TNT-1I/1			0.0'-2.5' FAT CLAY (CH): dark yellowish brown to dusky yellow; 10-15% plant roots; firm to stiff; dry to damp.	1.2	
			TNT-1I/2			BEDROCK		Refusal at 3.0'. Backfill borehole to surface with Portland cement grout.
						2.5'-3.0' SHALE/SILTSTONE: weathered; dark yellowish brown orange mottled with light olive gray and white; very dense to hard; damp.		
5						Total Depth 3.0'.		
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1J
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 5.0' BGS
START DATE: 12/8/1999
COMPLETION DATE: 12/8/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.0/3.0		TNT-1J/0 TNT-1J/0.5 TNT-1J/1 TNT-1J/2			RESIDUAL SOIL 0.0'-4.5' FAT CLAY (CH): dark yellowish brown to dusky yellow; 10-15% plant roots; firm to stiff; dry to damp.	1.7	
	2.0/2.0		TNT-1J/4 TNT-1J/4.5				1.8	
5						BEDROCK 4.5'-5.0' SHALE/SILTSTONE: weathered; mottled light olive gray to moderate yellow brown; very dense to hard; damp. Total Depth 5.0'.		Refusal at 5.0' Backfill borehole to surface with Portland cement grout.
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1K
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project
PROJECT NO.: 35734
CLIENT: Granite
DRILLING CONTRACTOR: Precision Drilling
DRILLING EQUIPMENT: MD-1
DRILLER:
SAMPLING METHOD: Direct Push continuously sampled
TOTAL DEPTH: 5.5' BGS
START DATE: 12/8/1999
COMPLETION DATE: 12/8/1999
LOGGED BY: R. Goldberg
APPROVED BY: A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1
SURFACE ELEVATION:

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	2.5/3.0		TNT-1K/0			RESIDUAL SOIL		
			TNT-1K/0.5			0.0'-4.5' FAT CLAY (CH): dark yellowish brown to dusky yellow; 10-15% plant roots; firm to stiff; dry to damp.		
			TNT-1K/1					
			TNT-1K/2				0.7	
	2.5/2.5							
			TNT-1K/4					
5			TNT-1K/5			BEDROCK 4.5'-5.0' SHALE/SILTSTONE: moderate brown mottled with light olive gray; weathered; very dense to hard. Total Depth 5.5'.	0.9	Refusal at 5.0' Backfill borehole to surface with Portland cement grout.
10								
15								
20								

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1L
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Precision Drilling
DRILLING EQUIPMENT: MD-1	**DRILLER:**
SAMPLING METHOD: Direct Push continuously sampled	**TOTAL DEPTH:** 5.0' BGS
START DATE: 12/8/1999	**COMPLETION DATE:** 12/8/1999
LOGGED BY: R. Goldberg	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
	3.0/3.0		TNT-1L/0			RESIDUAL SOIL 0.0'-5.0' FAT CLAY (CH): dark yellowish orange mottled grayish brown and moderate yellowish brown; 10% plant roots 0-1.'; firm to stiff; dry to damp.		Direct push continuously sample.
			TNT-1L/1				0.9	
			TNT-1L/1.5					
			TNT-1L/2					
	2.0/2.0							
			TNT-1L/4				1.6	
5						BEDROCK 5.0' SHALE/SILTSTONE: weathered. Total Depth 5.0'.		Refusal at 5.0'. Backfill borehole to surface with Portland cement grout.
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1LA/0

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1M
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Earth Tech
DRILLING EQUIPMENT: Hand Auger	**DRILLER:**
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 2.5' BGS
START DATE: 12/19/1999	**COMPLETION DATE:** 12/19/1999
LOGGED BY: P. Ody	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1M/0			RESIDUAL SOIL		
						0.0'-2.5' FAT CLAY (CH): dark yellowish brown to dusky yellow; 10-15% plant roots; firm to stiff; dry to damp.		
			TNT-1M/1					
			TNT-1M/2					
						Total Depth 2.5'.		
5								
10								
15								
20								Note: Duplicate samples from 0'-3' were collected as collocated samples from an immediately adjacent borehole as follows: TNT-1MA/0 TNT-1MA/1

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EARTH TECH

TEST BORING LOG

BOREHOLE NO.: TNT-1N
WELL NO.: NA

PROJECT NAME: Tourtelot Cleanup Project	**PROJECT NO.:** 35734
CLIENT: Granite	**DRILLING CONTRACTOR:** Earth Tech
DRILLING EQUIPMENT: Hand Auger	**DRILLER:**
SAMPLING METHOD: Slide Hammer	**TOTAL DEPTH:** 2.5' BGS
START DATE: 12/19/1999	**COMPLETION DATE:** 12/19/1999
LOGGED BY: P. Ody	**APPROVED BY:** A. Buangan CEG 824
LOCATION: North Valley; TNT Strip #1	**SURFACE ELEVATION:**

DEPTH	RECOVERY / RQD	BLOW COUNT	SAMPLE NO.	MODE	SOIL CLASS / GRAPHIC LOG	DESCRIPTION	PID READING (PPM)	REMARKS
			TNT-1N/0			RESIDUAL SOIL		
			TNT-1N/1			0.0'-2.5' FAT CLAY (CH): dark yellowish brown to dusky yellow; 10-15% plant roots; firm to stiff; dry to damp.		
			TNT-1N/2			Total Depth 2.5'.		
5								
10								
15								
20								