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STATE OF NEVADA
KENNY C. GUINN
Governor

R. MICHAEL TURNIPSEED, *Director*

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Water Pollution Control
Facsimile 687-4684

Mining Regulation and
Reclamation
Facsimile 684-5259

Waste Management
Corrective Actions
Federal Facilities

Air Pollution Control
Air Quality Planning
Water Quality Planning

Facsimile 687-6396

DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES
DIVISION OF ENVIRONMENTAL PROTECTION
333 W. Nye Lane, Room 138
Carson City, Nevada 89706

March 27, 2003

Peter Broderick
Project Manager
United States Army Corps of Engineers
Sacramento District, HTRW Branch
1325 J. Street (CESPK-PM-H)
Sacramento, CA 95814

Subject: Final Remedial Action Work Plan, Former Tonopah Army Air Field, Tonopah, Nevada

Dear Mr. Broderick:

The Nevada Division of Environmental Protection (NDEP), Bureau of Federal Facilities (BFF) staff, received the subject document dated March 12, 2003. This document outlines the work to be performed for a Remedial Action Plan (RAP) and includes the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) for Tonopah Army Air Field. Based on this review, NDEP comments previously transmitted have been incorporated and this final document is therefore approved.

If you have any questions, please contact me at (775) 687-9396.

Sincerely,

Ramon Naranjo
Environmental Hydrologist
Bureau of Federal Facilities

PJL/KKB/REN/RCN/cb
Cc:
David T. Chavez, Nye County Manager, P.O. Box 153, Tonopah, NV 89049
Chuck Richmond, USACE 1325 J Street, Sacramento, CA 95814

RECEIVED
MAR 12 2003
ENVIRONMENTAL PROTECTION

March 10, 2003

Nevada Division of Environmental Protection
Bureau of Federal Facilities
333 Nye Lane
Carson City, NV 89706-0851
Attn: Ramon Naranjo

Re: Tonopah Army Air Field Final Remedial Action Work Plan

Dear Mr. Naranjo:

Per official protocol by notifying you with this letter, the attached subject document has been forwarded for your review and records. In addition, I have attached a copy of the Final Remedial Investigation Report, which too has been forwarded for your records.

We are planning to be in the field sometime either the week of 24 March or the week of 31 March. Upon finalizing our schedule, we will soon notify you by phone.

Looking forward to meeting with you in the field.

Respectfully,

Pat B

Peter Broderick
Project Manager
United States Army Corps of Engineers
1325 J. Street
Sacramento, CA 95814
Ph. 916.557.7430
E-mail: peter.c.broderick@usace.army.mil

REMEDIAL ACTION PLAN
WORK PLAN
FORMER TONOPAH ARMY AIR FIELD
TONOPAH, NEVADA

RECEIVED
MAR 1 2 2003
ENVIRONMENTAL PROTECTION

Final

Prepared By:

US Army Corps
of Engineers ®
Sacramento District
Environmental Design Section

March 2003

EXECUTIVE SUMMARY

This Removal Action Plan (RAP) for Tonopah Army Air Field (TAAF) describes the activities to be accomplished at twelve sites for the RAP. This RAP includes the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) as attachments. The eleven sites are Building 822 (Administration Building), Building 1149 (Bath House and Lavatory), Building 1151 (Bath House and Lavatory), Building 1220 (Boiler House), Building 1225 (Ammo Assembly Shop), Building 1245 (Timber Magazine Igloo), Building 390 (Gas Station), Building 480 (Recreation Building with Latrine), Taxiway 4 Fuel Island, the Ammo Clip Pile, Building 1380 (Hangar), and a landfill cover at the former landfill adjacent to the main runway south overrun. Sampling will be done at four of the sites. Samples will be collected from the excavations at Buildings 822, 1149, and 1151 and at the stained soil area behind Building 1245. A plastic bucket containing ½-cubic foot of contaminated soil from Building 1245 will be disposed. Piping remaining at Buildings 390 and 480 and the Taxiway 4 Fueling Island will be disposed. One pipe sticking out of the fuel island at the Taxiway 4 Fueling Island will be cut off and disposed. The concrete sumps at Buildings 1220 and 1225 will be cleaned out and backfilled with clean soil. The pipes connected to these two sumps will be cleaned out and grouted closed. Ammunition clips and shell casings at the Ammo Clip Pile will be disposed. A UST vent pipe at the southwest corner of Building 1380 will be removed and disposed. A new landfill cover will be built on the existing landfill located adjacent to the main runway.

Redevelopment of the TAAF is part of the planned Nevada Science Corridor.

The U. S. Army Corps of Engineers (USACE) under the Formerly Used Defense Site (FUDS) Program prepared this RAP.

The RAP, with the concurrence of the Nevada Division of Environmental Protection (NDEP), will assist in the evaluation and closure of this FUDS site.

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ACRONYM LIST

ACM	Asbestos Containing Material
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DOD	Department of Defense
EDS	Environmental Design Section
FSP	Field Sampling Plan
FUDS	Formerly Used Defense Sites
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RAP	Remedial Action Plan
RI	Remedial Investigation
SI	Site Investigation
TAAF	Tonopah Army Air Field
TPH-D	Total Petroleum Hydrocarbons-Diesel Fuel
TPH-O	Total Petroleum Hydrocarbons-Motor Oil
USACE	U. S. Army Corps of Engineers
UST	Underground Storage Tank
WP	Work Plan

1.0 INTRODUCTION

1.1 Scope of Remedial Action

This Work Plan (WP) describes the work to be performed for a Remedial Action Plan (RAP) of the Former Tonopah Army Airfield (TAAF), a Formerly Used Defense Site (FUDS) six miles east of Tonopah, Nevada. The WP includes the Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP) as attachments. The sampling and analysis program includes site-specific objectives, sampling strategy and rationale, sampling locations, sample collection methods, and sample handling procedures.

The purpose of this RAP is to complete the removal actions at ten sites. No groundwater sampling will be performed because the depth to groundwater is believed to be greater than 300-feet below ground surface (bgs). The data collected will be used to determine if the remediation activities have been satisfactorily completed.

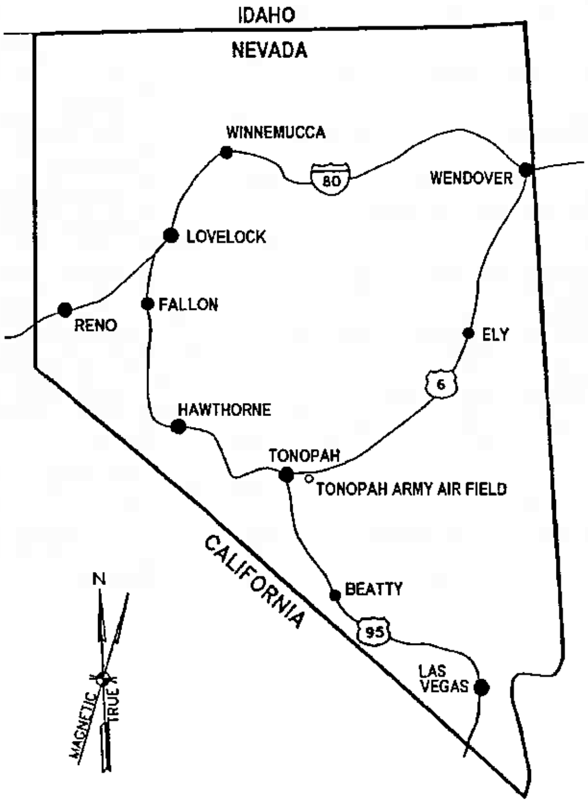


Figure 1-1: Vicinity Map

1.2 Installation History

The former TAAF is located six miles east of the city of Tonopah, Nye County, Nevada as shown in Figure 1-1. A TAAF base map is shown in Figure 1-2.

On 14 January 1941, 7,338.23 acres were transferred from the Department of Interior by executive order. An additional 617.87 acres were transferred on 12 January 1942 and 2,240 acres by Use Permit on 3 December 1943. Smaller areas were transferred by Use Permit through 15 May 1945 for a total of 10,433.62 acres.

Construction of the airfield and facilities began in early 1940s and the base was in operation by July 1942. The first aircraft to use the field were P-39s, followed by a base conversion for training B-24s and B-25s pilots. Department of Defense (DOD) improvements included runways, barracks, theaters, a stockade, a gymnasium, mess halls, a hospital, maintenance and hangar buildings. Additional improvements, which were completed by November 1943, included the addition of new hangars and the lengthening the runway. The base became the largest military operation in Nevada, with 1,264 officers and 5,273 enlisted men during the time the base was active.

The Tonopah facility was placed on inactive status 23 August 1945. The total acquired area of 10,433.62 acres was transferred to the War Assets Administration on 21 August 1948 for disposal. The site is currently owned by Nye County and is used primarily as a county airport for light aircraft. Other uses include a small oil refinery, a gravel mining operation, and a small private aircraft storage facility.

1.3 Remedial Action

USACE will conduct a Remedial Action (RA) at the twelve sites shown in Table 1-1. The RA is tentatively planned for fiscal year 2003.

TABLE 1-1: Remedial Action Plan Sites

Facility	Removal Action
Building 822, Administration Building	Remove and dispose 12 cubic yards of soil on the east side of the building slab. Backfill the excavation. Dispose two pipes left on the building slab during the RI.
Building 1149, Bath House and Lavatory	Remove and dispose 34-cubic yards of soil on the east side of the building. Backfill the excavation.
Building 1151, Bath House and Lavatory	Remove and dispose 12-cubic yards of soil on the south side of the building. Backfill the excavation.
Building 1220, Boiler House	Remove and dispose of debris in sump. Plug both pipes at the sump with concrete or grout. Backfill sump with clean soil.
Building 1225, Ammo Assembly Shop	Remove and dispose of debris in the sump. Plug both pipes to the sump with concrete or grout. Backfill sump with clean soil.
Building1245, Timber Magazine Igloo	Dispose 5-gallon bucket with contaminated soil.
Ammo Clip Pile	Remove Ammo clips and casings in an area 30-feet square and 4-inches deep.
Building 390, Gas Station	Dispose two pipes removed during the RI.
Building 480, Recreation Building with Latrine	Dispose 2 water pipes removed during the RI.
Taxiway 4 Fuel Island	Dispose of the piping left at the fuel island during the RI.
Building 1380, Hangar	Remove and dispose a UST vent pipe on the southwest corner of the building.
Former Landfill, located adjacent to the main runway south overrun	Construct a new landfill cover.

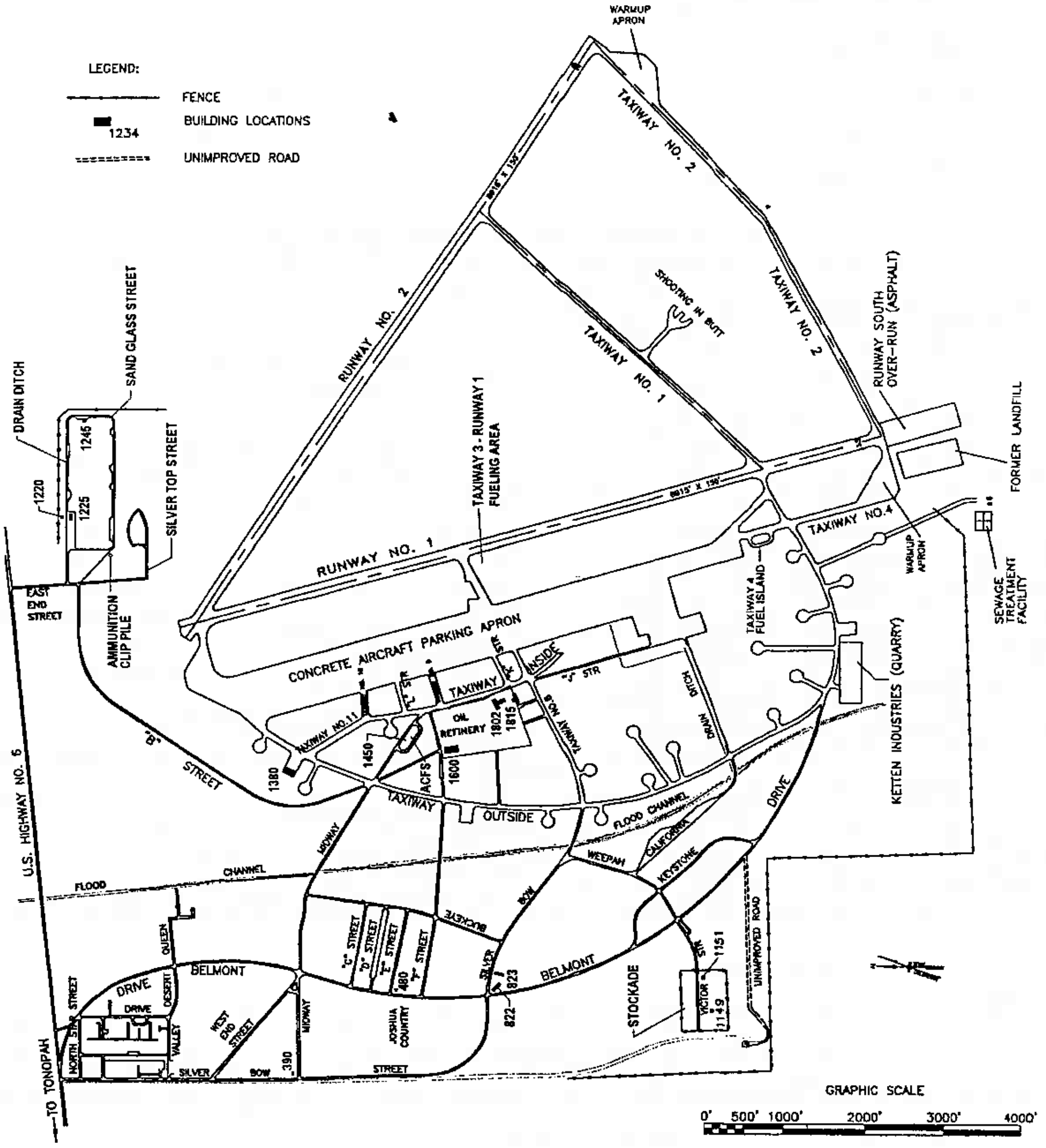


Figure 1-2: TAAF Base Map

1.4 Previous Investigations

1.4.1 1998 Removal Actions

USACE removed eleven concrete underground storage tanks (USTs), five metal USTs and four concrete oil pits in 1998. Samples were collected at all of the UST and oil pit sites. Table 1-2 summarizes the 1998 removal actions.

Table 1-2: Summary of the 1998 Removal Actions

Underground Storage Tanks				
LOCATION	**SIZE**	**TYPE**	**QUANTITY**	**COMMENTS**
Building 823	5,000 gallons	Concrete	1	The east end sample exceeded action limits.
Building 1220	2,500 gallons	Concrete	1	Samples under action limits.
Building 2580	2,500 gallons	Concrete	1	Samples under action limits.
Building 1149	2,500 gallons	Concrete	1	The east end sample exceeded action limits.
Building 1151	2,500 gallons	Concrete	1	The south end sample exceeded action limits.
Building 1128	2,500 gallons	Concrete	1	Samples under action limits.
Building 816	2,500 gallons	Concrete	1	Samples under action limits.
Building 832	2,500 gallons	Concrete	1	Samples under action limits.
Building 1750	2,500 gallons	Concrete	1	Samples under action limits.
Building 1743	2,500 gallons	Concrete	1	Samples under action limits.
Midway Street	2,500 gallons	Concrete	1	Samples under action limits.
Building 2585	25,000 gallons	Metal	2	Samples under action limits.
Building 2430	3,000 gallons	Metal	1	A spill occurred during the UST removal.
Midway Street	25,000 gallons	Metal	2	Samples under action limits.
Oil Pits				
Building 1710	1' x 1' x 6'	Concrete	1	Samples under action limits.
Building 2430	1' x 1' x 6'	Concrete	1	Samples under action limits.
Building 1380	1' x 1' x 6'	Concrete	1	Samples under action limits.
Building 2584	5' x 6'	Concrete	1	Unknown depth, set in foundation. Samples under action limits.

1.4.2 Preliminary Assessment

On 26-27 June 2000, USACE personnel performed a Preliminary Assessment (PA) visit to TAAF. A report of findings as a result of this site visit was documented and substantiated in the Preliminary Site Assessment Report, dated July 2001. Based upon observations and findings at the selected forty-five sites, eleven sites were determined to require further evaluation per Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) criteria for Site Inspections (SI).

During the June 2000 site visit, several sites containing small amounts of asbestos containing material (ACM), roofing material and/or building siding tile, were observed. In accordance with EC-200-3-7, *DERP-FUDS Program Manual (Official Interim Version)*, 30 September 1999, Section 1, Paragraph 3.9.4 states; "that projects are ineligible, that include ACM or lead-based paint, containment, removal, and/or disposal actions, except as required to safely complete an approved project within Occupational Safety and Health Administration (OSHA) guidelines and DOD policy. Therefore, any ACM or lead-based paint observed during the site reconnaissance cannot be remediated using FUDS money". Table 1-3 summarizes the Preliminary Assessment.

Table 1-3: Summary of Preliminary Assessment Sites

Facility	Recommendation
Building 187, Heating Plant	Determine if USTs are present.
Building 189A, Fuel Oil Pump House	No further action.
Building 374, Grease Shack	No further action.
Building 382, Equipment and Repair Shop	No further action.
Building 390, Gas Station	No further action.
Building 391, Oil and Storage Building	No further action.
Building 394, Motor Repair Shop	No further action.
Building 398, Gasoline Building	Determine if USTs are present.
Building 517, Paint and Oil Storage	No further action.
Building 523, Motor Repair Shop	No further action.
Building 527, Grease and Oil Storage Building	No further action.
Building 529, Motor Repair Shop	No further action.
Building 529A, Oil Storage	No further action.
Building 551, Equipment and Repair Shop	No further action.
Facility 560, Fuel Oil Storage Tanks	No further action.
Building 561, Fuel Oil Pump House	No further action.
Building 1038A, Fuel Oil Pump Shed	Investigate pipes for possible USTs.
Building 1060A, Fuel Oil Pump House	No further action.
Building 1072, Paint, Oil, and Dope Building	No further action.
Building 1180, Chemical Storage Warehouse	No further action.
Building 1183, Poison Gas Shed	Characterize drum for disposal.
Building 1185, Gas Instruction Building	No further action.
Building 1225, Ammo Assembly Shop	Investigate perimeter drain, sump, and pipe under the street
Building 1230, AC Magazine	No further action.
Building 1235, Black Powder Igloo	Characterize stained soil for ammunition related chemicals. Geophysical investigation for potential buried munitions.
Building 1240, Chemical Warfare Building	No further action.
Building 1242, Chemical Warfare Building	No further action.
Building 1245, Timber Magazine Igloo	Characterize stained soil for ammunition related chemicals.
Building 1250, Strategic Storage Igloo	Characterize stained soils for ammunition related chemicals.
Building 1255, Warehouse Igloo	Characterize stained soils for ammunition related chemicals
Building 1260, Pyrotechnic Magazine	No further action.
Building 1265, Ammo Storage Magazine	No further action.
Building 1270, Ammo Storage Magazine	No further action.
Building 1796, Boiler House	No further action.
Building 1840, Motor Repair Shop	No further action.
Building 1850, Oil and Grease Storage	No further action.
Building 2091, Paint Storage Building	No further action.
Building 2095, Engine Cleaning Building	No further action.
Building 2432, Grease and Oil Storage	No further action.
Building 2580, Arms Cleaning Building	No further action.
Building 2581, Dope Shed	No further action.
Building 2584, Grease and Oil Storage	No further action.

Table 1-3: Summary of Preliminary Assessment Sites

Facility	Recommendation
Former Landfill	Determine vertical and horizontal extent of landfill. Verify types of waste disposed in this landfill.
Former Sewage Treatment Plant	No further action.
Building 430 UST	No further action.
Building 2430, Hangar	Sample native soil beneath removed UST for VOCs, SVOCs, and 13 priority pollutant metals.

1.4.3 Site Inspection

The Site Inspection (SI) was performed at the eleven sites selected. A magnetometer survey was performed at three sites (Buildings 187, 398, and 1038A) to determine the presence of USTs. Five of the sites (Buildings 1225, 1235, 1245, 1250, and 1255), where soil staining was noticeable were sampled and analyzed for potential soil contamination. The area located at Building 2430, where a UST was previously removed, was investigated for soil contamination. The landfill, located adjacent to the airfield, was examined to determine the contents and extent. Table 1-4 summarizes the Site Inspection.

Table 1-4, Summary of Site Inspection Sites

Building/Site	Site Recommendations
Building 187, Heating Plant	No further government action.
Building 398, Gasoline Building	Conduct an RI at this site
Building 1038A, Fuel Oil Pump Shed	Conduct an RI at this site.
Building 1183, Poison Gas Shed	No further government action.
Building 1225, Ammo Assembly Shop	Remove debris from the two sumps and connecting pipe during the Remedial Action phase. Fill in the pipe..
Building 1235, Black Powder Igloo	No further government action.
Building 1245, Timber Magazine Igloo	Remove 1 cubic foot of soil at this site as part of the RI.
Building 1250, Strategic Storage Igloo	No further government action.
Building 1255, Warehouse Igloo	No further government action.
Building 2430, Hangar	Conduct an RI at this site.
Former Landfill	Construct a new landfill cover over the entire landfill during the Remedial Action Phase..
Taxiway 4 Fuel Island	Determine if product or sludge remain in the fuel lines at the fuel island. Perform a magnetometer survey of the pipe leaving the excavation.

1.4.4 Remedial Investigation

USACE personnel performed the Remedial Investigation (RI) during July 2002 and September 2002. The RI was performed at twenty-nine sites.

A visual site inspection was performed at eighteen sites to determine if evidence of any UST existed at these sites. A visual site inspection was performed at one site to determine the amount of debris to be disposed. Hand excavation of ½ cubic yard of stained soil was performed at one site. This soil was placed in a plastic 5-gallon bucket, sealed and placed behind the rear of the building. Trenches were excavated and soil samples collected and analyzed at eight sites. Surface soil samples were collected and analyzed at one site. Pipes were removed from the ground for disposal during the RA at three of the previously mentioned sites.

Table 1-5 summarizes the Remedial Investigation sites.

1.5 Project Staffing

This WP, as well as the FSP and QAPP, were prepared by the Environmental Design Section (EDS) personnel, Sacramento District, U. S. Army Corps of Engineers (USACE), under the supervision of Richard Meagher, P.E, Section Chief. The USACE project team is identified below. The USACE project manager is Peter Broderick. Key project contacts are:

Person	Responsibility
Chuck Richmond	Project Leader
Pamela Amie	Chemist
Donna Maxey	Industrial Hygienist
Bruce Van Etten	Engineering Technician
Tim Crummett	Geologist

Table 1-5: Remedial Investigation/1998 Removal Actions Recommendations

Building/ Facility	Recommendation From	Recommendation
210	1998 RA	No further government action.
250	RI	No further government action.
255	1998 RA	No Further government action.
390	RI	No further government action.
398	RI	No further government action.
430	RI	No further government action.
480	RI	No further government action.
510	RI	No further government action.
560/561	RI	No further government action.
720	RI	No further government action.
780	RI	No further government action.
816	1998 RA	No further government action.
822 (Formerly 823)	RI and1998 RA	Remove 12 cubic yards of contaminated soil.
827	RI	No further government action.
828	RI	No further government action.
832	1998 RA	No further government action.
1038A	RI	No further government action.
1058	RI	No further government action.
1180	RI	No further government action.
1128	1998 RA	No further government action.
1149	RI and 1998 RA	Remove 34 cubic yards of contaminated soil.
1151	RI and 1998 RA	Remove 12 cubic yards of contaminated soil.
1220	1998 RA	Remove debris in the sump. Backfill the sump with clean soil.
1245	RI	Dispose 5-gallon plastic bucket with contaminated soil.
1380	1998 RA and RI	Remove UST vent pipe on the Southwest corner of the building.
1450	RI	No further government action.
1600	RI	No further Government action.
1743	RI and 1998 RA	No further government action.
1750	1998 RA	No further government action.
1793	RI	No further government action.
1802	RI	No further government action.
1815	RI	No further government action.
2430	RI and 1998 RA	No further government action.
2580	1998 RA	No further government action.
2584	1998 RA	No further government action.
2585	1998 RA	No further government action.
ACFS	RI and 1998 RA	No further government action.
F Street Tanks	RI	No further government action.
F Street-Inside Taxiway Tanks	RI	No further government action.
Taxiway 4 Fuel Island	RI	Dispose piping removed during the RI.
Taxiway 3 and Runway 1 Fueling Area	RI	No further government action.
Ammo Clip Pile	RI	Dispose ammunition clips and shell casings.
Shooting-In Butts	RI	No further government action.
Sewage Lagoons	RI	No further government action.
Dry Cleaning Facilities	Other Sites	No further government action.

LEGEND: RI = Remedial Investigation, 2002 1998 RA = 1998 Removal Action (USTs and Oil Pits)

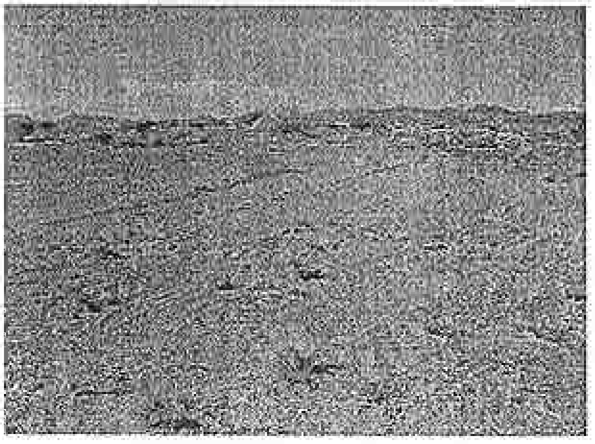
2.0 REMEDIAL ACTION SCOPE

2.1 Building 822, Administration Building

Building 822 was located on Silver Bow Street, east of Belmont Drive as shown in Figure 2-1. The building slab remains on the site. Photograph 2-1 shows the Building 822 site. This site was listed as Building 823 during the 1998 removal action. The location of the soil to be excavated and disposed of is shown in Figure 2-2.

The soil from 2-feet to 5-feet bgs and 10-feet square (approximately 11.1 cubic yards) shall be excavated and disposed. A minimum of five confirmatory samples, one taken from the bottom of the excavation and one taken from each sidewall of the excavation, shall be taken and analyzed for TPH-D and TPH-O (Method 8015B).

Native soil shall be used as backfill in the excavation. The backfill material shall be obtained from the south side of the Shooting-In-Butts as shown in Figure 1-2. The backfill shall be mounded approximately 6-inches to allow for future settlement.



Photograph 2-1: Building 822 Site

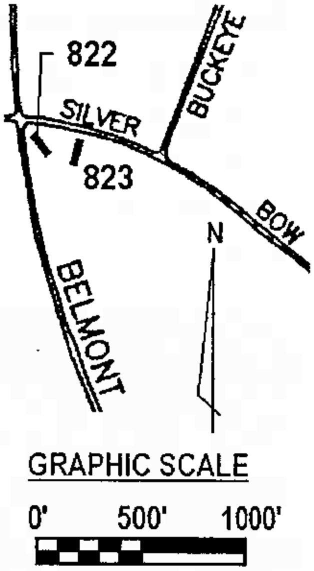


Figure 2-1: Building 822 Location

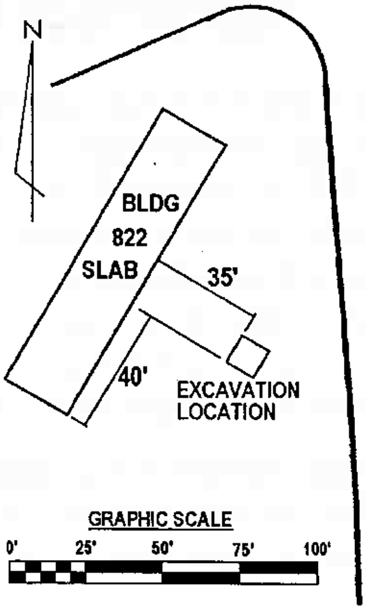


Figure 2-2: Building 822 Excavation Location

2.2 Building 1149, Bath House and Lavatory

Building 1149 was located on Victor Street within the former stockade area as shown in Figure 2-3. The building slab remains on the site. Photograph 2-2 shows the Building 1149 site. The location of the soil to be excavated and disposed is shown in Figure 2-4.

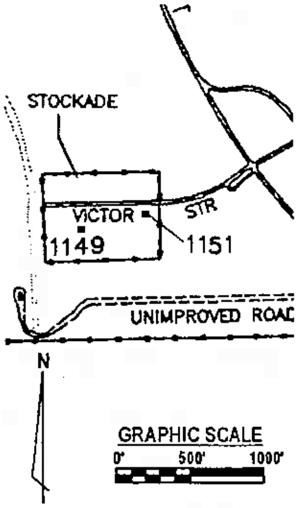
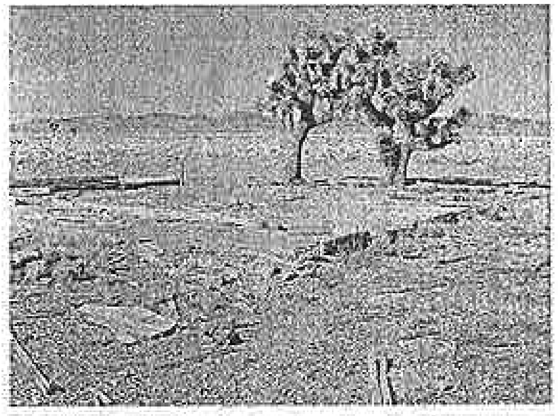


Figure 2-3: Buildings 1149 and 1151 Locations



Photograph 2-2: Building 1149 Site

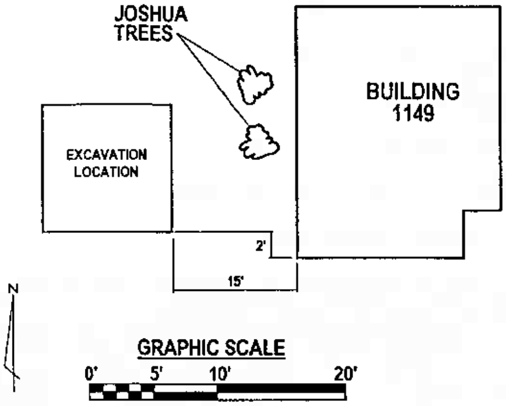


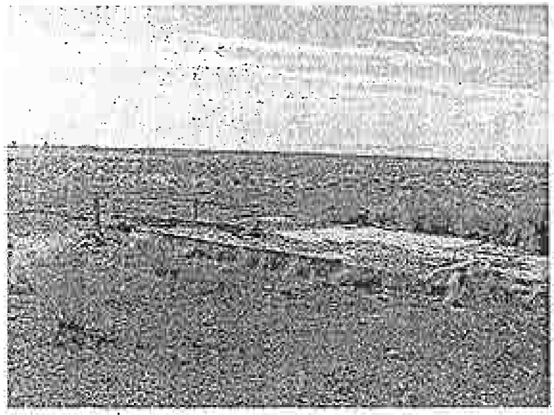
Figure 2-4: Building 1149 Excavation Location

The soil from 3-feet to 12-feet bgs, 10-feet square, (approximately 33.3 cubic yards) shall be excavated and disposed. A minimum of five confirmatory samples, one taken from the bottom of the excavation and one taken from each sidewall of the excavation, shall be taken and analyzed for TPH-D and TPH-O (Method 8015B).

Native soil shall be used as backfill in the excavation. The backfill material shall be obtained from the south side of the Shooting-In-Butts as shown in Figure 1-2. The backfill shall be mounded approximately 6-inches to allow for future settlement.

2.3 Building 1151, Bath House and Lavatory

Building 1151 was located on Victor Street within the former stockade area as shown in Figure 2-3. The slab remains on the site. Photograph 2-3 shows the Building 1151 site. The location of the soil to be excavated and disposed of is shown in Figure 2-5.



Photograph 2-3: Building 1151 Site

The soil from 3-feet to 12-feet bgs, 10-feet square, (approximately 33.3 cubic yards) shall be excavated and disposed. A minimum of five confirmatory samples, one taken from the bottom of the excavation and one taken from each sidewall of the excavation, shall be taken and analyzed for TPH-D and TPH-O (Method 8015B).

Native soil shall be used as backfill in the excavation. The backfill material shall be obtained from the south side of the Shooting-In-Butts as shown in Figure 1-2. The backfill shall be mounded approximately 6-inches to allow for future settlement.

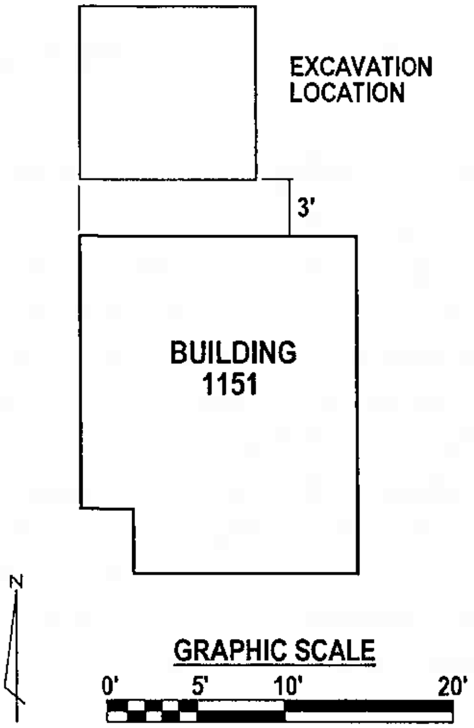


Figure 2-5: Building 1151 Excavation Location

2.4 Building 1220, Boiler House

Building 1220 was located in the Ammunition Storage Area on the north side of Sand Glass Road as shown in Figure 2-6. The building slab remains on the site.

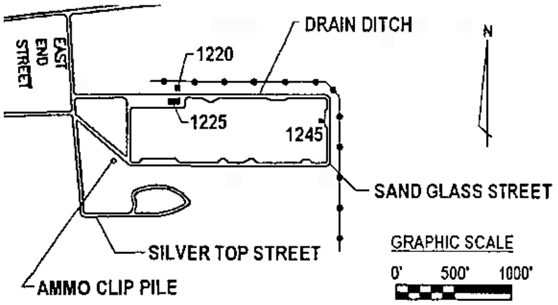
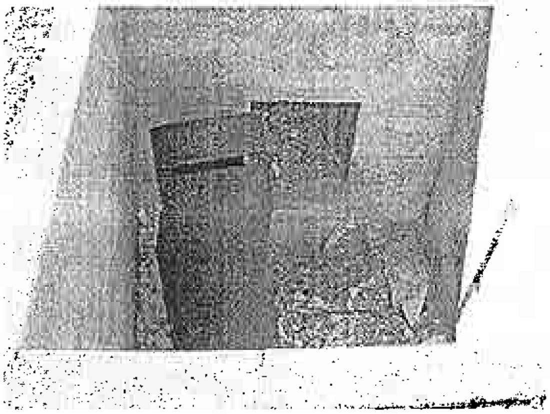


Figure 2-6: Building 1220, 1225, and 1245 and Ammo Clip Pile Locations



Photograph 2-4: Building 1220 Sump

Photograph 2-4 shows the Building 1220 sump with debris. The metal debris in the sump shall be disposed of. Both of the underground pipes that are connected to this sump shall be plugged with concrete for a distance of 12-inches (minimum). Following the installation of the concrete plug, the sump shall be backfilled to the top with native soil.

2.5 Building 1225, Ammo Assembly Shop

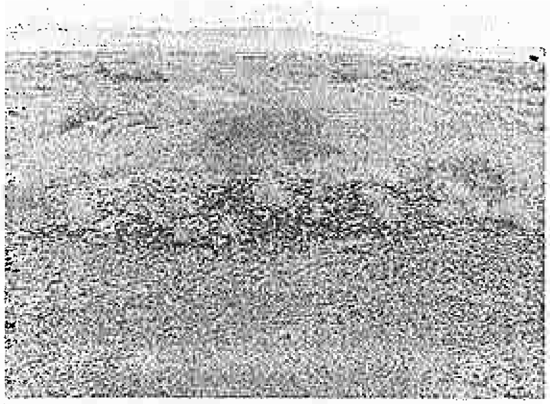
The shell of Building 1225 is located in the Ammunition Storage Area on the south side of Sand Glass Road as shown in Figure 2-6. Photograph 2-5 shows the sump near the front of the building. The soil and debris in the sump shall be disposed of. Both of the underground pipes that are connected to this sump shall be plugged with concrete for a distance of 12-inches (minimum). Following the installation of the concrete plugs, the sump shall be backfilled to the top with native soil.

Photograph 2-5: Building 1225 Sump

2.6 Building 1245, Timber Magazine Igloo

Building 1245 is located in the Ammunition Storage Area near Sand Glass Road in the Ammunition Storage Area as shown in Figure 2-6. The concrete slab remains on site. During the RI phase for this project, a stainless steel shovel was used to excavate ½-cubic yard of stained soil. The stained soil was deposited in a plastic bucket, the bucket sealed, and stored on the backside of the building slab for disposal during the RAP phase of this project. The bucket is not visible from the road. The bucket and the contaminated soil shall be disposed of with the soil from building 822, 1149, or 1151.

2.7 Ammo Clip Pile



Photograph 2-6: Ammo Clip Pile

The Ammo Clip Pile is located in the Ammunition Storage Area on the southwest side of a dirt road running between Sand Glass Street and East End Street as shown in Figure 2-6. Photograph 2-6 shows the Ammo Clip Site. The site is fairly flat. The Ammo Clip Pile consists of ammunition clips and shell casings. Disposal of this material includes removing the clips, shell casings, and soil to a depth of 4-inches in an area approximately 30-feet square. A visual search of the ground surface for a distance of 15-feet from the removal area shall be made. All clips and shell casings observed in this area shall be removed manually and disposed of. The edge of the 4-inch removal area shall be regarded leaving no sharp grade changes.

2.8 Building 390, Gas Station

Building 390 was located at the northeast corner of Midway and Silver Bow Street intersection as shown in Figure 2-7. The building slab remains on the site. Photograph 2-7 shows the Building 390 site. . During the Remedial Investigation (RI) at this site, two short 2-inch diameter pipes were removed from the ground and left on the building slab. These pipes shall be disposed of.

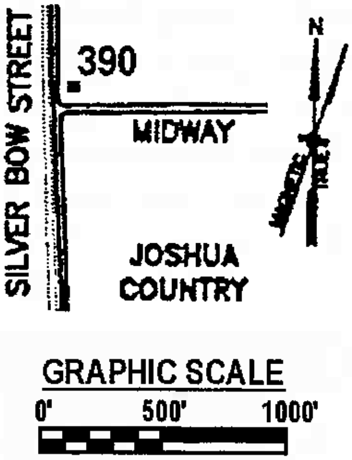
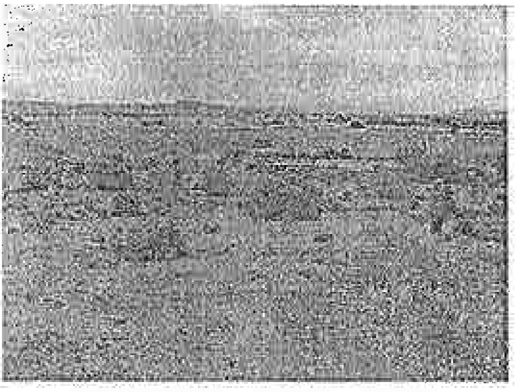


Figure 2-7: Building 390 Location



Photograph 2-7: Building 390 Site

2.9 Building 480, Recreation Building with Latrine

Building 480 was located at the southeast corner of Belmont Drive and E Street as shown in Figure 2-7. The building slab remains on the site. Photograph 2-7 shows the Building 480 site. During the Remedial Investigation (RI) at this site, two short 2-inch diameter water pipes were removed from the ground and left on the building slab. These pipes shall be disposed of.

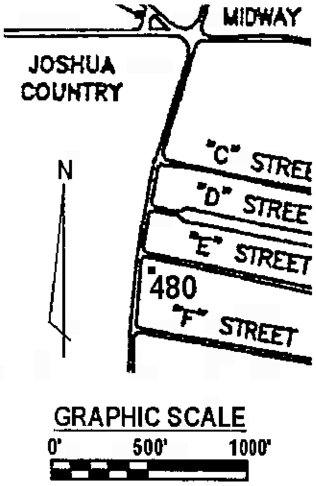


Figure 2-8: Building 480 Location

Photograph 2-8: Building 480 Site

2.10 Taxiway 4 Fuel Island

The Taxiway 4 Fuel Island is located to the west of Taxiway 4 as shown in Figure 2-9. Photograph 2-9 shows the Taxiway 4 Fuel Island site. During the RI at this site, two metal pipes (one 4-inch diameter, 6-feet long, and one 3-inch diameter pipe, 12-feet long) were removed and left on the site. These two pipes shall be disposed of.

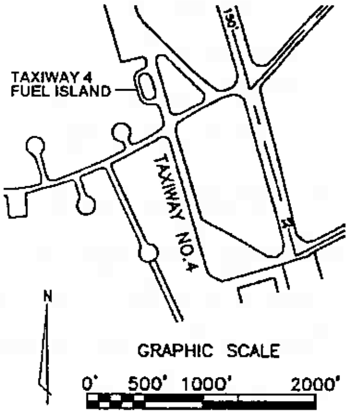


Figure 2-9: Taxiway 4 Fuel Island Location

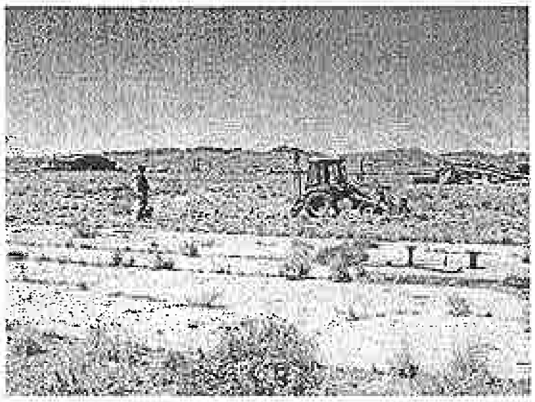


Figure 2-9: Taxiway 4 Fuel Island Site

2.11 Building 1380, Hangar

Building 1380 is located northeast of the junction of the Outside Taxiway and Taxiway Number 11 as shown in Figure 2-10. The hangar is presently used for storage of small private aircraft. A UST vent pipe on the southwest corner of the building is shown in Photograph 2-10.

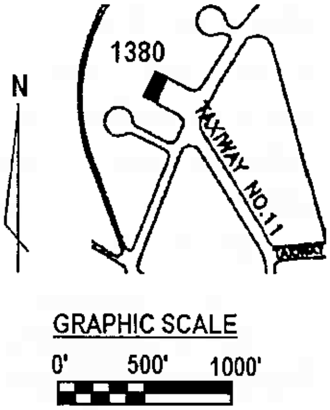
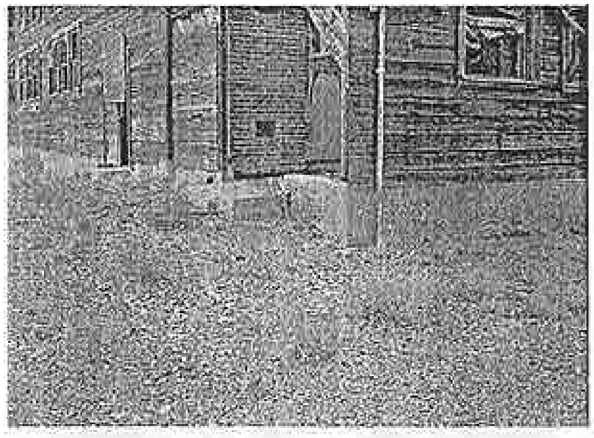


Figure 2-10: Building 1380 Location



Photograph 2-10: Southwest Corner of Building 1380

The vent pipe shall be removed from both the building and the ground and be disposed of. The underground portion of the pipe is 2 ½ to 3 feet in length. Native soil shall be used as backfill in the pipe excavation. The small amount of backfill shall be obtained from the area on the backside of the hangar. The backfill shall be mounded 3-inches to allow for future settlement.

2.12 Landfill Cover

The former landfill is located south of Taxiway 2 and west of the Runway 33 South Over-Run as shown in Figure 2-11. Photograph 2-11 and 2-12 show the landfill surface.

The native material to be used for construction of the landfill cover shall be taken from the south side of the Shooting-In-Butt. The location of the Shooting-In-Butt is shown in Figure 1-2.

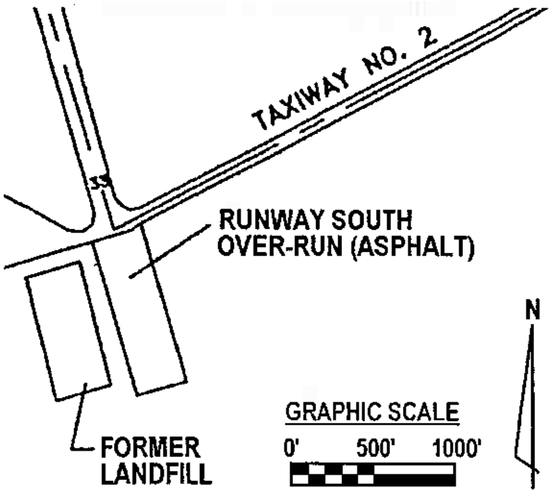
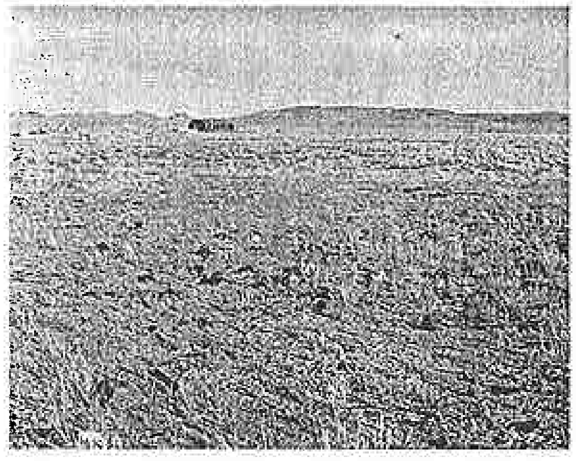
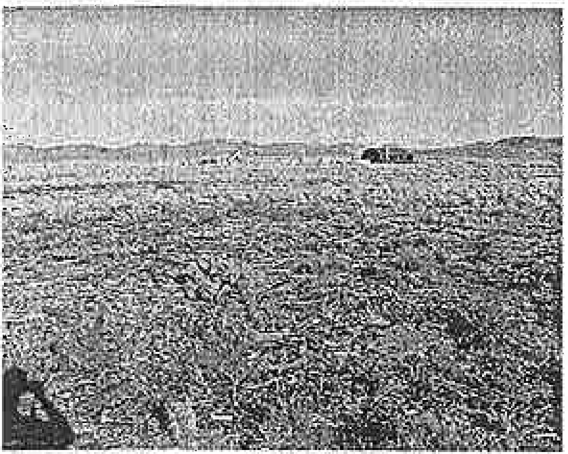


Figure 2-11, Former Landfill Location

Shrubs and debris taller than 8-inches shall be removed from the surface of the former landfill. Native material obtained from on base shall be used for the landfill cover. The native soil shall be placed in a single 12-inch thick loose lift. The landfill cover shall be transitioned for a distance of 10-feet from the edge from a thickness of 1-inch to 12-inches. The native material used in the landfill cover shall be rolled with heavy equipment on the project site to provide compaction to prevent the cover from eroding in the wind or eroding during a rainstorm. The cover shall not be over compacted to prevent native vegetation from growing. The finished grade of the landfill cover shall be in such a manner to prevent ponding of surface water.



Photograph 2-11: Former Landfill



Photograph 2-12: Former Landfill

3.0 REFERENCES

DERP-FUDS Program Manual (Official Interim Version), EC-200-3-7, U. S. Army Corps of Engineers, 30 September 1999.

Remedial Investigation Report, Tonopah Army Airfield, Tonopah, Nevada, U. S. Army Corps of Engineers, October 2002

Site Inspection Report, Tonopah Army Airfield, Tonopah, Nevada, U. S. Army Corps of Engineers, July 2002

Tonopah Army Air Field Preliminary Assessment, U. S. Army Corps of Engineers, May 2001

Tonopah Army Air Field, near Tonopah, Nevada, Basic Layout Plan, Drawing Number 145-13-349, January 1946.

ATTACHMENT A
FIELD SAMPLING PLAN

REMOVAL ACTION PLAN
FIELD SAMPLING PLAN
FORMER TONOPAH ARMY AIR FIELD
TONOPAH, NEVADA

Final

Prepared By:

US Army Corps
of Engineers ®
Sacramento District
Environmental Design Section

March 2003

EXECUTIVE SUMMARY

This Removal Action Plan (RAP) Field Sampling Plan (FSP) for Tonopah Army Air Field (TAAF) describes the activities to be accomplished at the twelve sites for the RAP. The twelve sites are Building 822 (Administration Building), Building 1149 (Bath House and Lavatory), Building 1151 (Bath House and Lavatory), Building 1220 (Boiler House), Building 1225 (Ammo Assembly Shop), Building 1245 (Timber Magazine Igloo), Building 390 (Gasoline Station), Building 480 (Recreation Building with Latrine), Taxiway 4 Fuel Island, the Ammo Clip Pile, Building 1380 (Hangar), and a landfill cover at the former landfill adjacent to the main runway south overrun. Sampling will be done at four of the sites. Samples will be collected from the excavations at Buildings 822, 1149, and 1151 and at the stained soil area behind Building 1245. A plastic bucket containing ½-cubic foot of contaminated soil from Building 1245 will be disposed. Piping remaining at Buildings 390 and 480 and the Taxiway 4 Fueling Island will be disposed. One pipe sticking out of the fuel island at the Taxiway 4 Fueling Island will be cut off and disposed. The concrete sumps at Buildings 1220 and 1225 will be cleaned out and backfilled with clean soil. The pipes connected to these two sups will be cleaned out and grouted closed. Ammunition clips and shell casings at the Ammo Clip Pile will be disposed. A UST vent pipe at the southwest corner of Building 1380 will be removed and disposed. A new landfill cover will be built on the existing landfill located adjacent to the main runway.

Redevelopment of the TAAF is part of the planned Nevada Science Corridor.

The U. S. Army Corps of Engineers (USACE) under the Formerly Used Defense Site (FUDS) Program prepared this RAP.

The RAP, with the concurrence of the Nevada Division of Environmental Protection (NDEP), will assist in the evaluation and closure of this FUDS site.

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ACRONYM LIST

ACM	Asbestos Containing Material
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
DOD	Department of Defense
EDS	Environmental Design Section
FSP	Field Sampling Plan
FUDS	Formerly Used Defense Sites
OSHA	Occupational Safety and Health Administration
PA	Preliminary Assessment
QAPP	Quality Assurance Project Plan
RA	Remedial Action
RAP	Remedial Action Plan
RI	Remedial Investigation
SI	Site Investigation
TAAF	Tonopah Army Air Field
TPH-D	Total Petroleum Hydrocarbons-Diesel Fuel
TPH-O	Total Petroleum Hydrocarbons-Motor Oil
USACE	U. S. Army Corps of Engineers
UST	Underground Storage Tank
WP	Work Plan

1. INTRODUCTION

1.1 Scope of Remedial Investigation

This Field Sampling Plan (FSP) describes the work to be performed for a Remedial Action Plan (RAP of the Former Tonopah Army Airfield (TAAF), a Formerly Used Defense Site (FUDS) six miles east of Tonopah, Nevada. The FSP presents the field procedures to be performed during this RAP. The sampling and analysis program includes site-specific objectives, sampling strategy and rationale, sampling locations, sample collection methods, and sample handling procedures.

The purpose of this RAP is to remove the known contamination at four sites, removal of debris at three sites, and removal of pipes at two sites. No groundwater sampling will be performed. The data collected will be used to confirm all of the contaminated soil above the action limits (1,000 mg/kg) for this facility has been removed and disposed.

The former TAAF is located six miles east of the city of Tonopah, Nye County, Nevada as shown in Figure 1-1. The TAAF base map is shown in Figure 1-2.

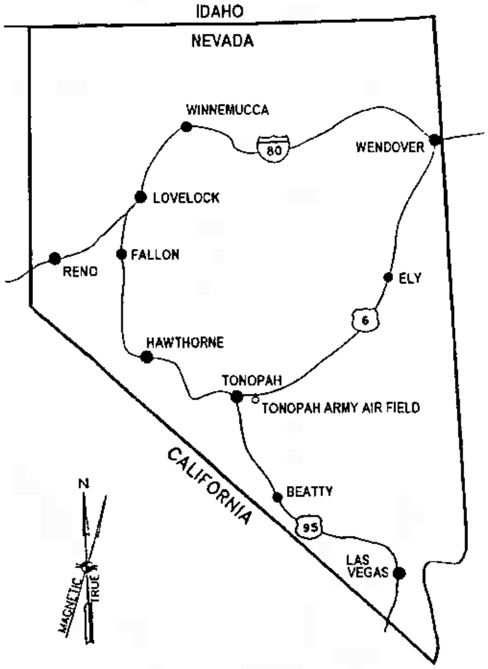


Figure 1-1: Vicinity Map

1.2 Remedial Action

USACE will conduct a Remedial Action (RA) at the twelve sites shown in Table 1-1. The RA is tentatively planned for fiscal year 2003.

TABLE 1-1: Remedial Action Plan Sites

Facility	Removal Action
Building 822, Administration Building	Remove and dispose 12 cubic yards of soil on the east side of the building slab. Backfill the excavation. Dispose two pipes left on the building slab during the RI.
Building 1149, Bath House and Lavatory	Remove and dispose 34-cubic yards of soil on the east side of the building. Backfill the excavation.
Building 1151, Bath House and Lavatory	Remove and dispose 12-cubic yards of soil on the south side of the building. Backfill the excavation.
Building 1220, Boiler House	Remove and dispose of debris in sump. Plug both pipes at the sump with concrete or grout. Backfill sump with clean soil.
Building 1225, Ammo Assembly Shop	Remove and dispose of debris in the sump. Plug both pipes to the sump with concrete or grout. Backfill sump with clean soil.
Building1245, Timber Magazine Igloo	Dispose 5-gallon bucket with contaminated soil.

TABLE 1-1: Remedial Action Plan Sites

Facility	Removal Action
Ammo Clip Pile	Remove Ammo clips and casings in an area 30-feet square and 4-inches deep.
Building 390, Gasoline Station	Dispose 2 pipes removed during the RI.
Building 480, Recreation Building with Latrine	Dispose 2 water pipes removed during the RI.
Taxiway 4 Fuel Island	Dispose of the piping left at the fuel island during the RI.
Building 1380, Hangar	Remove and dispose a UST vent pipe on the southwest corner of the building.
Former Landfill, located adjacent to the main runway south overrun	Construct a new landfill cover.

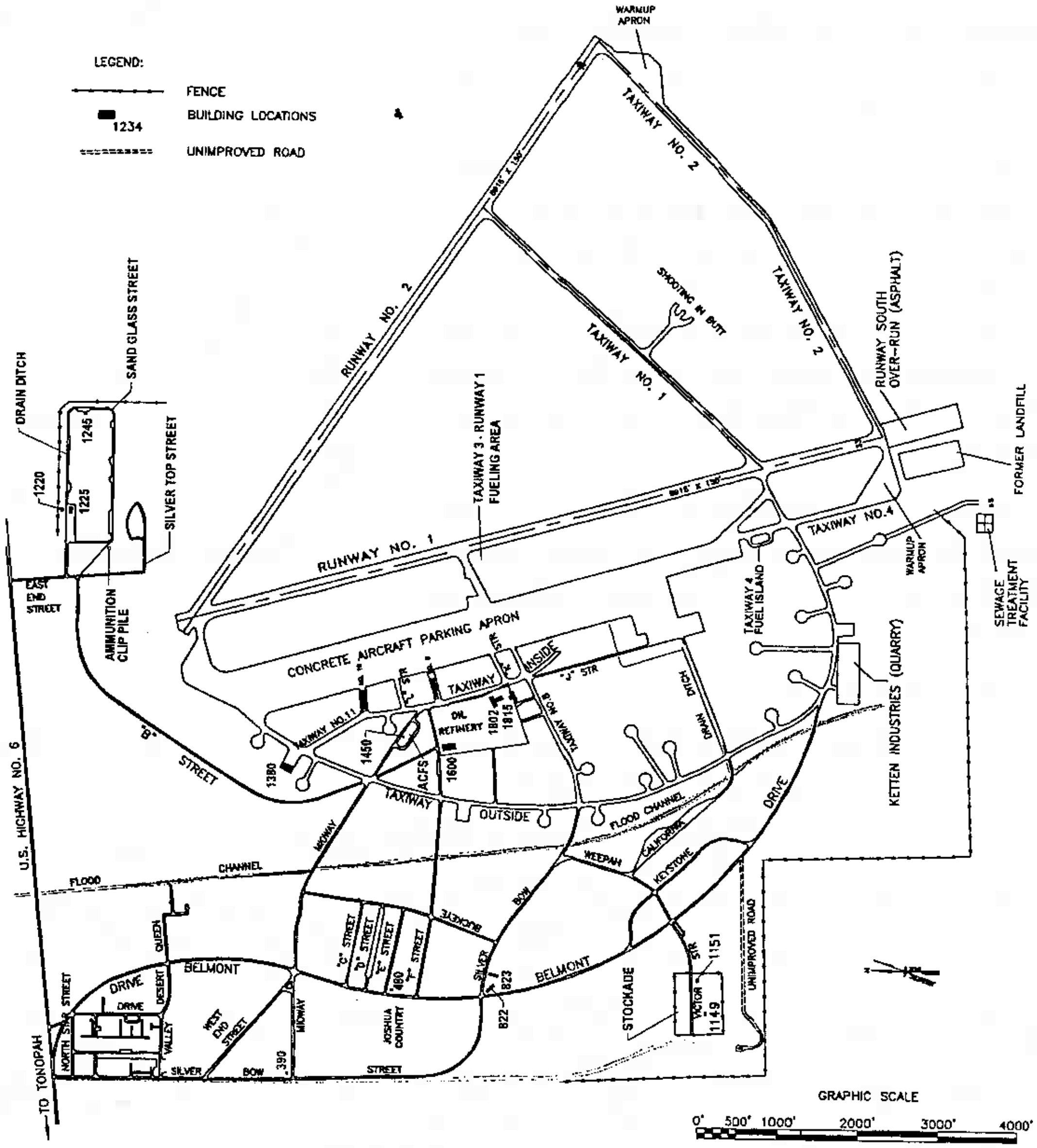


Figure 1-2: TAAF Base Map

1.3 Previous Investigations

1.3.1 1998 Removal Actions

USACE removed eleven concrete underground storage tanks (USTs), five metal USTs and four concrete oil pits in 1998. Samples were collected at all of the UST and oil pit sites. Table 1-2 summarizes the 1998 removal actions.

Table 1-2: Summary of the1998 Removal Actions

Underground Storage Tanks				
LOCATION	**SIZE**	**TYPE**	**QUANTITY**	**COMMENTS**
Building 823	5,000 gallons	Concrete	1	The east end sample exceeded action limits.
Building 1220	2,500 gallons	Concrete	1	Samples under action limits.
Building 2580	2,500 gallons	Concrete	1	Samples under action limits.
Building 1149	2,500 gallons	Concrete	1	The east end sample exceeded action limits.
Building 1151	2,500 gallons	Concrete	1	The south end sample exceeded action limits.
Building 1128	2,500 gallons	Concrete	1	Samples under action limits.
Building 816	2,500 gallons	Concrete	1	Samples under action limits.
Building 832	2,500 gallons	Concrete	1	Samples under action limits.
Building 1750	2,500 gallons	Concrete	1	Samples under action limits.
Building 1743	2,500 gallons	Concrete	1	Samples under action limits.
Midway Street	2,500 gallons	Concrete	1	Samples under action limits.
Building 2585	25,000 gallons	Metal	2	Samples under action limits.
Building 2430	3,000 gallons	Metal	1	A spill occurred during the UST removal.
Midway Street	25,000 gallons	Metal	2	Samples under action limits.
Oil Pits				
Building 1710	1' x 1' x 6'	Concrete	1	Samples under action limits.
Building 2430	1' x 1' x 6'	Concrete	1	Samples under action limits.
Building 1380	1' x 1' x 6'	Concrete	1	Samples under action limits.
Building 2584	5' x 6'	Concrete	1	Unknown depth, set in foundation. Samples under action limits.

1.3.2 Preliminary Assessment

On 26-27 June 2000, USACE personnel performed a Preliminary Assessment (PA) visit to TAAF. A report of findings as a result of this site visit was documented and substantiated in the Preliminary Site Assessment Report, dated July 2001. Based upon observations and findings at the selected forty-five sites, eleven sites were determined to require further evaluation per Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) criteria for Site Inspections (SI).

During the June 2000 site visit, several sites containing small amounts of asbestos containing material (ACM), roofing material and/or building siding tile, were observed. In accordance with EC-200-3-7, *DERP-FUDS Program Manual (Official Interim Version)*, 30 September 1999, Section 1, Paragraph 3.9.4 states; "that projects are ineligible, that include ACM or lead-based paint, containment, removal, and/or disposal actions, except as required to safely complete an approved project within Occupational Safety and Health Administration (OSHA) guidelines and DOD policy. Therefore, any ACM or lead-based paint observed during the site reconnaissance cannot be remediated using FUDS money". Table 1-3 summarizes the Preliminary Assessment.

Table 1-3: Summary of Preliminary Assessment Sites

Facility	Recommendation
Building 187, Heating Plant	Determine if USTs are present.
Building 189A, Fuel Oil Pump House	No further action.
Building 374, Grease Shack	No further action.
Building 382, Equipment and Repair Shop	No further action.
Building 390, Gas Station	No further action.
Building 391, Oil and Storage Building	No further action.
Building 394, Motor Repair Shop	No further action.
Building 398, Gasoline Building	Determine if USTs are present.
Building 517, Paint and Oil Storage	No further action.
Building 523, Motor Repair Shop	No further action.
Building 527, Grease and Oil Storage Building	No further action.
Building 529, Motor Repair Shop	No further action.
Building 529A, Oil Storage	No further action.
Building 551, Equipment and Repair Shop	No further action.
Facility 560, Fuel Oil Storage Tanks	No further action.
Building 561, Fuel Oil Pump House	No further action.
Building 1038A, Fuel Oil Pump Shed	Investigate pipes for possible USTs.
Building 1060A, Fuel Oil Pump House	No further action.
Building 1072, Paint, Oil, and Dope Building	No further action.
Building 1180, Chemical Storage Warehouse	No further action.
Building 1183, Poison Gas Shed	Characterize drum for disposal.
Building 1185, Gas Instruction Building	No further action.
Building 1225, Ammo Assembly Shop	Investigate perimeter drain, sump, and pipe under the street
Building 1230, AC Magazine	No further action.
Building 1235, Black Powder Igloo	Characterize stained soil for ammunition related chemicals. Geophysical investigation for potential buried munitions.
Building 1240, Chemical Warfare Building	No further action.
Building 1242, Chemical Warfare Building	No further action.
Building 1245, Timber Magazine Igloo	Characterize stained soil for ammunition related chemicals.
Building 1250, Strategic Storage Igloo	Characterize stained soils for ammunition related chemicals.
Building 1255, Warehouse Igloo	Characterize stained soils for ammunition related chemicals
Building 1260, Pyrotechnic Magazine	No further action.
Building 1265, Ammo Storage Magazine	No further action.
Building 1270, Ammo Storage Magazine	No further action.
Building 1796, Boiler House	No further action.
Building 1840, Motor Repair Shop	No further action.
Building 1850, Oil and Grease Storage	No further action.
Building 2091, Paint Storage Building	No further action.
Building 2095, Engine Cleaning Building	No further action.
Building 2432, Grease and Oil Storage	No further action.
Building 2580, Arms Cleaning Building	No further action.
Building 2581, Dope Shed	No further action.
Building 2584, Grease and Oil Storage	No further action.

Table 1-3: Summary of Preliminary Assessment Sites

Facility	Recommendation
Former Landfill	Determine vertical and horizontal extent of landfill. Verify types of waste disposed in this landfill.
Former Sewage Treatment Plant	No further action.
Building 430 UST	No further action.
Building 2430, Hangar	Sample native soil beneath removed UST for VOCs, SVOCs, and 13 priority pollutant metals.

1.3.3 Site Inspection

The Site Inspection (SI) was performed at the eleven sites selected. A magnetometer survey was performed at three sites (Buildings 187, 398, and 1038A) to determine the presence of USTs. Five of the sites (Buildings 1225, 1235, 1245, 1250, and 1255), where soil staining was noticeable were sampled and analyzed for potential soil contamination. The area located at Building 2430, where a UST was previously removed, was investigated for soil contamination. The landfill, located adjacent to the airfield, was examined to determine the contents and extent. Table 1-4 summarizes the Site Inspection.

Table 1-4, Summary of Site Inspection Sites

Building/Site	Site Recommendations
Building 187, Heating Plant	No further government action.
Building 398, Gasoline Building	Conduct an RI at this site
Building 1038A, Fuel Oil Pump Shed	Conduct an RI at this site.
Building 1183, Poison Gas Shed	No further government action.
Building 1225, Ammo Assembly Shop	Remove debris from the two sumps and connecting pipe during the Remedial Action phase. Fill in the pipe..
Building 1235, Black Powder Igloo	No further government action.
Building 1245, Timber Magazine Igloo	Remove 1 cubic foot of soil at this site as part of the RI.
Building 1250, Strategic Storage Igloo	No further government action.
Building 1255, Warehouse Igloo	No further government action.
Building 2430, Hangar	Conduct an RI at this site.
Former Landfill	Construct a new landfill cover over the entire landfill during the Remedial Action Phase.
Taxiway 4 Fuel Island	Determine if product or sludge remain in the fuel lines at the fuel island. Perform a magnetometer survey of the pipe leaving the excavation.

1.3.4 Remedial Investigation

USACE personnel performed the Remedial Investigation (RI) during July 2002 and September 2002. The RI was performed at twenty-nine sites.

A visual site inspection was performed at eighteen sites to determine if evidence of any UST existed at these sites. A visual site inspection was performed at one site to determine the amount of debris to be disposed. Hand excavation of ½ cubic yard of stained soil was performed at one site. This soil was placed in a plastic 5-gallon bucket, sealed and placed behind the rear of the building. Trenches were excavated and soil samples collected and analyzed at eight sites. Surface soil samples were collected and analyzed at one site. Pipes were removed from the ground for disposal during the RA at three of the previously mentioned sites.

Table 1-5 summarizes the Remedial Investigation sites.

TABLE 1-5: Summary of the Remedial Investigation Sites

Facility	Investigation
Facility 250, 2,500 Gallon Tank	Investigate the site for possible UST.
Building 398, Gasoline Building	Investigate the soil in the vicinity of the removed UST.
Building 430, School Building	Investigate the soil in the vicinity of the removed UST.
Building 480, Recreation Building With Latrine	Investigate the site for possible UST.
Building 510, Officer's Quarters	Investigate the site for possible UST.
Building1245, Timber Magazine Igloo	Remove ½ to 1 cubic foot of stained soil.
Building 2430, Hangar	Investigate excavated area for contamination from UST spill incident
Taxiway 4 Fuel Island	Investigate the soil in the depression, the fuel line leaving the west side of the pit and the fuel lines at the fuel island
Building 390, Gas Station	Investigate the site for possible UST.
Facility 560, Fuel Oil Storage Tanks	Investigate the soil in the vicinity of the removed USTs.
Building 561, Fuel Oil Pump House	Investigate the site for possible UST.
Facility 720, 2,500 Gallon Tank	Investigate the site for possible UST.
Building 1038a, Fuel Oil Pump Shed	Investigate the soil in the vicinity of the removed UST.
Facility 1058, Underground Oil Tank	Investigate the site for possible UST.
Building 1180, Chemical Storage Warehouse	Investigate the soil beneath the sump.
Building 1149, Bath House And Lavatory	Investigate the soil on the east side of the building.
Building 1151, Bath House And Lavatory	Investigate the soil on the south side of the building.
Building 823, Recreation Building	Investigate the soil on the east side of the building.
Facility 827, 250 Gallon Tank	Investigate the site for possible UST.
Facility 828, Elevated Oil Tank	Investigate the site for possible underground piping and equipment.
Facility 780, 7,500 Gallon Tank	Investigate the site for possible UST.
Facility 1793, Oil Tank	Investigate the site for possible UST.
Building 1743, Officer's Lavatory	Investigate the site for possible UST.
Sewage Treatment Facility	Investigate the soil at the bottom of the lagoons with piping not in present use.
ACFS	Investigate the site for possible UST.

1.4 Project Staffing

This FSP, as well as the Quality Assurance Protection Plan (QAPP), were prepared by the Environmental Design Section (EDS) personnel, Sacramento District, U.S. Army Corps of Engineers (USACE), under the supervision of Richard Meagher, P.E, Section Chief. The USACE project team is identified below. The USACE project manager is Peter Broderick. Key project contacts are:

Person	Responsibility
Chuck Richmond	Project Leader
Pamela Amie	Chemist
Donna Maxey	Industrial Hygienist
Bruce Van Etten	Engineering Technician
Tim Crummett	Geology

2. SAMPLING

This section provides the sample locations, number of samples, analytical methods, and the rationale for the sampling and analytical program. Investigation and sampling techniques and procedures are discussed in Section 4.0. Overall, the investigative approaches will include soil sampling.

During the performance of fieldwork, sampling locations and depths stated in this RAP may be adjusted and additional samples added based on field observations or conditions (e.g., if a strong odor is evident or is encountered before reaching the intended sampling depth).

2.1 Building 822, Administration Building

2.1.1 Site Description

Building 822 was located on Silver Bow Street, east of Belmont Drive as shown in Figure 2-1. The building slab remains on the site. Photograph 2-1 shows the Building 822 site. This site was listed as Building 823 during the 1998 removal action. The location of the soil to be excavated and disposed of is shown in Figure 2-2.

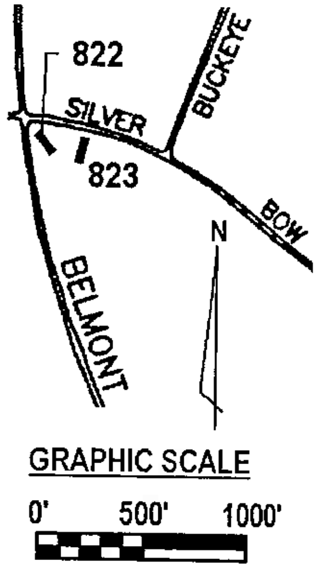
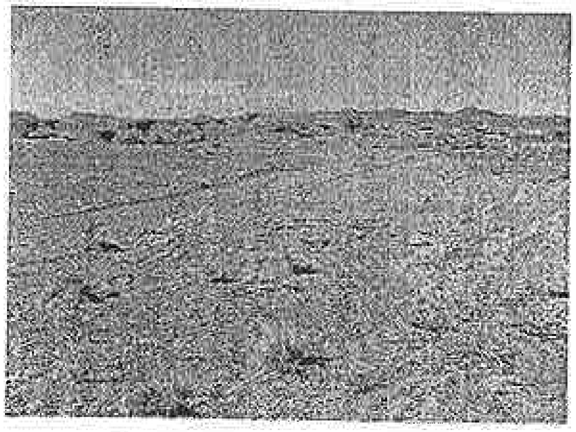


Figure 2-1: Building 822 Location



Photograph 2-1: Building 822 Site

The soil from 2-feet to 5-feet bgs and 10-feet square (approximately 11.1 cubic yards) shall be excavated and disposed. A minimum of five confirmatory samples, one taken from the bottom of the excavation and one taken from each sidewall of the excavation, shall be taken and analyzed for TPH-D and TPH-O (Method 8015B).

Native soil shall be used as backfill in the excavation. The backfill material shall be obtained from the south side of the Shooting-In-Butts as shown in Figure 1-2. The backfill shall be mounded approximately 6-inches to allow for future settlement.

2.1.2 Sampling Objectives

Investigate the soil at the east side of the former UST to verify all of the petroleum hydrocarbon contaminated soil has been removed.

2.1.3 Sampling

- Collect one confirmation sample from the bottom of the excavation and one confirmation sample from each of the excavation sidewalls to confirm all of the contaminated soil has been removed. The action level for this site is 1,000 mg/kg.
- Evaluate the results and recommend remedial activities or no further government action.

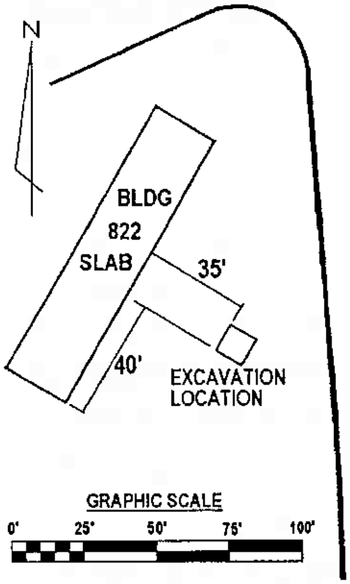
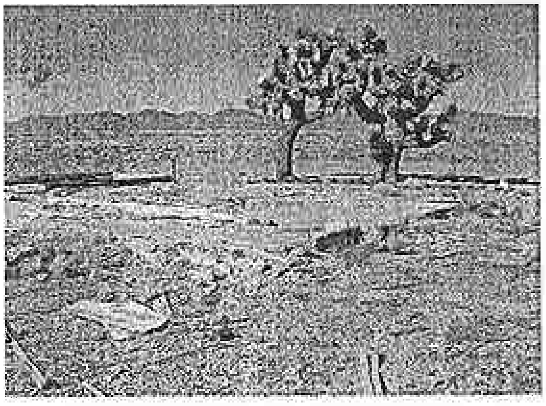


Figure 2-2: Building 822 Excavation Location

2.2 Building 1149, Bath House and Lavatory

2.2.1 Site Description

Building 1149 was located on Victor Street within the former stockade area as shown in Figure 2-3. The building slab remains on the site. Photograph 2-2 shows the Building 1149 site. The location of the soil to be excavated and disposed of is shown in Figure 2-4.



Photograph 2-2: Building 1149 Site

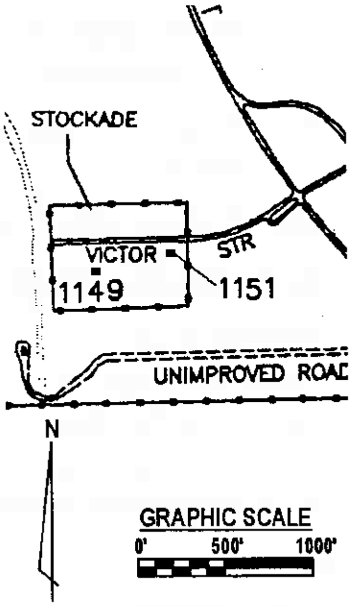


Figure 2-3: Buildings 1149 and 1151 Locations

The soil from 3-feet to 12-feet bgs, 10-feet square, (approximately 33.3 cubic yards) shall be excavated and disposed. A minimum of five confirmatory samples, one taken from the bottom of the excavation and one taken from each sidewall of the excavation, shall be taken and analyzed for TPH-D and TPH-O (Method

8015B). If any confirmatory sample analysis exceeds 1,000 mg/kg, additional soil shall be excavated and disposed of in accordance with Paragraph 2-4 of this report.

Native soil shall be used as backfill in the excavation. The backfill material shall be obtained from the south side of the Shooting-In-Butts as shown in Figure 1-2. The backfill shall be mounded approximately 6-inches to allow for future settlement.

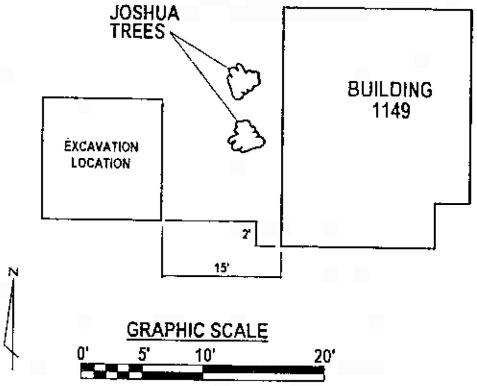


Figure 2-4: Building 1149 Excavation Location

2.2.2 Sampling Objectives

Investigate the soil at the east side of the former UST to verify all of the petroleum hydrocarbon contaminated soil has been removed.

2.2.3 Sampling

- Collect one confirmation sample from the bottom of the excavation and one confirmation sample from each of the excavation sidewalls to confirm all of the contaminated soil has been removed. The action level for this site is 1,000 mg/kg
- Evaluate the results and recommend remedial activities or no further government action.

2.3 Building 1151, Bath House and Lavatory

2.3.1 Site Description

Building 1151 was located on Victor Street within the former stockade area as shown in Figure 2-3. The slab remains on the site. Photograph 2-3 shows the Building 1151 site. The location of the soil to be excavated and disposed of is shown in Figure 2-5.

The soil from 3-feet to 6-feet bgs, 10-feet square, (approximately 11.1 cubic yards) shall be excavated and disposed. A minimum of five confirmatory samples, one taken from the bottom of the excavation and one taken from each sidewall of the excavation, shall be taken and analyzed for TPH-D and TPH-O (Method 8015B).

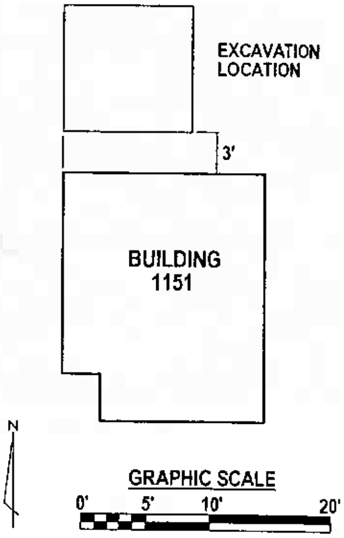
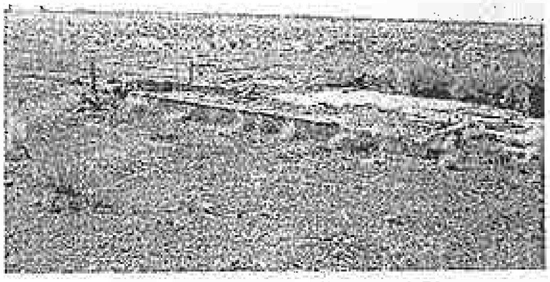


Figure 2-5: Building 1151 Excavation Location



Photograph 2-3: Building 1151 Site

Native soil shall be used as backfill in the excavation. The backfill material shall be obtained from the south side of the Shooting-In-Butts as shown in Figure 1-2. The backfill shall be mounded approximately 6-inches to allow for future settlement.

2.3.2 Sampling Objectives

Investigate the soil at the east side of the former UST to verify all of the petroleum hydrocarbon contaminated soil has been removed.

2.3.3 Sampling

- Collect one confirmation sample from the bottom of the excavation and one confirmation sample from each of the excavation sidewalls to confirm all of the contaminated soil has been removed. The action level for this site is 1,000 mg/kg
- Evaluate the results and recommend remedial activities or no further government action.

3. SITE SPECIFIC SAMPLING AND ANALYSIS PLANS

Investigative protocol, along with sampling techniques and procedures will be discussed in Section 4.0. Overall, investigative approaches will include soil sampling.

During the performance of fieldwork, sampling locations and depths stated in this RA may be adjusted, or additional samples added, based on field observations or conditions (e.g., if a strong odor is evident or is encountered before reaching the intended sampling depth).

TABLE 3-1: Summary of Proposed Analytical Parameters

SAMPLE IDENTIFICATION					ANALYTE PROGRAM	
SAMPLE LOCATION	**SAMPLE ID**	**SAMPLE DEPTH, FEET**	**MATRIX**	**CONTAINER TYPE/NUMBER**	**ANALYTE**	**METHOD**
822	TAAF-SS-822-B-5.0	5.0	Soil	1-Sleeve/sample (8 sleeves total)	TPH-D, TPH-O	EPA 8015B mod.
	TAAF-SS-822-S1-3.5	3.5				
(MS/MSD)	MS/MSD-1	3.5				
	TAAF-SS-822-S2-3.5	3.5				
	TAAF-SS-822-S3-3.5	3.5				
	TAAF-SS-822-S4-3.5	3.5				
(QC)	TAAF-SS-822-S14-3.5	3.5				
(Stockpile)	TAAF-SS-822-SP	-				
1149	TAAF-SS-1149-B-12.0	12.0	Soil	1-Sleeve/sample (7 sleeves total)	TPH-D, TPH-O	EPA 8015B mod.
	TAAF-SS-1149-S1-7.5	7.5				
	TAAF-SS-1149-S2-7.5	7.5				
	TAAF-SS-1149-S3-7.5	7.5				
(MS/MSD)	MS/MSD-2	7.5				
	TAAF-SS-1149-S4-7.5	7.5				
(Stockpile)	TAAF-SS-1149-SP	-				
1151	TAAF-SS-1151-B-6.0	6.0	Soil	1-Sleeve/sample (7 sleeves total)	TPH-D, TPH-O	EPA 8015B mod.
(QC)	TAAF-SS-1151-B1-6.0	6.0				
	TAAF-SS-1151-S1-3.5	3.5				
	TAAF-SS-1151-S2-3.5	3.5				
	TAAF-SS-1151-S3-3.5	3.5				
	TAAF-SS-1151-S4-3.5	3.5				
(Stockpile)	TAAF-SS-1151-SP	-				
1245	TAAF-SS-1245-B-0.5	0.5	Soil	1-Sleeve/sample (1 sleeve total)	TPH-D, TPH-O	EPA 8015B mod.

Table 3-2 Sample Container, Sample Size, Preservation, and Holding Time

Method	Containers and Sample Size	Chemical Preservation	Holding Time	Temperature Preservation
SW 8015B Modified (Diesel and Motor Oil)	1 - 2" x 6" stainless steel sleeve/ sample (23 sleeves total)	N/A	Extract within 14 days Analyze within 40 days	Cool 4°C

3.1 Field Replicates

3.1.1 Field Duplicates (QC Samples)

QC duplicate samples collected in the field will provide precision information for the entire measurement system, including sample acquisition, homogeneity, handling, shipping, storage, preparation, and analysis. The identity of these samples will be held blind to the analysts and laboratory personnel until the data are in deliverable form. Duplicate analyses will be performed on approximately 10% of the total investigative samples for each matrix. QC sample locations are defined in this FSP, however, the locations may be adjusted based on information determined in the field. Field screening tests will be used to assist in directing the location of QC samples to areas suspected to have the highest concentrations of the contaminants of interest. Duplicate samples will be analyzed by the laboratory for the same parameters as the primary sample (i.e., the sample that is being duplicated).

3.1.1.1 Matrix Spike/Matrix Spike Duplicates (MS/MSD)

A Matrix Spike (MS) is an environmental sample which known concentrations of analytes have been added. The MS is taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

A Matrix Spike Duplicate (MSD) is an environmental sample that is divided into two separate aliquots, each of which is spiked with known concentrations of analytes. The spiked aliquots are processed separately and the results compared to determine the effects of the matrix on the precision and accuracy of the analysis. Additional soil sample volumes will be collected in the field to perform MS/MSD analyses for each analytical method.

3.1.2 Blanks

3.1.2.1 Temperature Blanks

One temperature blank (water sample) will be included in each cooler and recorded on the chain-of-custody. The temperature blank will be packaged and handled in the same manner as the other samples to assure that it's temperature is representative of the samples in that cooler. The laboratory will use a calibrated thermometer to directly measure the temperature of this sample. The temperature reading from the temperature blank will be used to determine whether samples were stored under the appropriate thermal conditions. Temperature blanks will be used for all coolers containing samples requiring preservation at 4°C, ± 2°C.

4. SAMPLING EQUIPMENT AND PROCEDURES

The field methods to be employed during the RA sampling are detailed below. All fieldwork performed under this FSP will be conducted in accordance with the SSHP and the QAPP, both written specifically for this Study. All fieldwork will be performed in accordance with the National Environmental Policy Act (NEPA).

All soil sampling equipment will be dedicated equipment (used once and disposed).

4.1 Investigative Equipment and Procedures

4.1.1 Soil Sampling

A backhoe will be used to excavate and remove the contaminated soil. No personnel will enter any excavation greater than four feet in depth. When the excavation trench has reached its required depth, the backhoe bucket shall be used to collect soil for sampling.

The soil taken from the backhoe bucket shall be mixed and homogenized in a stainless steel bowl prior to soil samples being collected. One end of a stainless steel sleeve shall be covered with a Teflon sheet and a plastic cap placed over the sheet and sleeve to seal the end of the sleeve. A spoon will then be used to place soil from the bowl into the sleeve. When the sleeve is full of soil, the end shall be sealed as before.

Samples collected for laboratory analysis will be labeled as described in Section 5.0, sealed in zip-lock bags, and placed in ice-filled coolers. The samples will be sent to the laboratory daily by Federal Express under chain-of-custody.

4.2 Analytical Plan

The contaminants of concern (COC) to be analyzed were selected based on the Site Inspection analytical results. The COC list includes TPH-D and TPH-O and will be analyzed by the following methods:

> Total Petroleum Hydrocarbons as Diesel and Motor Oil by Method 8015B modified.

4.3 Decontamination of the Backhoe Bucket

Decontamination of the backhoe bucket should be executed immediately prior to the use of the bucket. Use a shovel to remove any large chucks of soil on the backhoe bucket. Disposable clean gloves will be worn while decontaminating the backhoe bucket

Deionized (DI) water will be stored in plastic containers and applied via pump sprayers or decanted directly from the storage container. The waste decontamination fluids will be collected and handled in accordance with Section 6.0.

The following steps will be used to decontaminate the backhoe bucket.

1) Wash with non-phosphate detergent,
2) Rinse with potable water,
3) Rinse with DI analyte free water,
4) Air dry.

5. SAMPLING DOCUMENTATION AND HANDLING

5.1 Sample Numbering System

A unique identification number will be assigned to each sample. The number is typically an alphanumeric sequence or integer that serves as an acronym to identify the sample.

The sample number shall follow the format TAAF-SS-BB-d, where SS indicates the sample media is a soil sample; BB is the site number, CC indicates the sample number, and d indicates the depth in feet. Sample number indicators are B and B1 for excavation bottom samples; S1, S2, S3, and S4 are for the four-sidewall samples.

Examples of the sample number system are:

Primary Sample:	TAAF-SS-822-S1-d.
Duplicate Sample:	TAAF-SS-822-S14-d (add 10 to the sample hole number)
Temperature Blank:	TAAF-TB-Sequential No.

5.2 Sample Labels

Its identification number references all information pertaining to a particular sample. It is recorded on the sample container, in the field logbook, on the sample chain-of-custody form and the drill log. Following sample collection, the sample label is completed in waterproof ink and secured to the sample container with clear tape.

Each sample collected at the site will be labeled with the following information:

- Sample Identification Number;
- Date and time of collection
- Name of person collecting the sample;
- Analysis requested;
- Preservation;
- Any other information pertinent to the sample.

5.3 Field Logbook

A field notebook bound with serially numbered pages will be used to record personnel on site, sample identification numbers, sampling date and time, and any significant observations or events during field activities. The project name, site location, sampling event, project leader, telephone number and address of contact office (should the book be misplaced or lost) will be listed in ink. The field notebook is intended to record events during sampling in sufficient detail to allow field personnel to reconstruct events that transpired during the project. Details of certain field activities, including trench logging and soil logging will be recorded on dedicated field forms. When data is recorded on such forms, a reference to the forms will be included in the field logbook.

The Project Leader, who will sign and date the notebook prior to initiation of fieldwork, will maintain the field notebook. If it is deemed necessary to transfer the logbook to alternative personnel during the course of fieldwork, the person relinquishing the logbook will sign and date the logbook at the time the logbook is transferred and the person receiving the logbook will do likewise. Crossing a line through the entry and entering the correct information will make corrections to erroneous data. The correction will be initialed and dated by the person making the entry. Unused portions of logbook pages will be initialed and dated by the person making the entry. Unused portions of logbook pages will be crossed out, signed, and dated at the end of each workday. Logbook entries must be dated, legible, in ink, and contain accurate documentation. Language used will be objective, factual, and free of personal opinions. Hypotheses for observed phenomena may be recorded. However, they must be clearly indicated as such and only relate to the subject observation.

The sample identification number, sample media, number of containers and laboratory analyses to be conducted will be recorded with the sample identification number in the field logbook and on the chain-of-custody form.

The date and time of sample preparation and collection, and the personnel who conducted sampling will be recorded with the sample identification number in the field logbook and on the chain-of custody form. The names of visitors and other persons on site will also be recorded in the field logbook. Sampling personnel will also record the ambient weather conditions and other conditions at the sampling location that may affect sample collection, the apparent representativeness of the sample, or sample analysis in the field logbook.

5.4 Sample Packaging and Shipping

Samples will be transported as soon as possible after sample collection to the primary laboratory for analysis. The following procedures are to be used when packing and transporting samples to the laboratory:

- Use waterproof metal or equivalent strength plastic ice chests or coolers.
- Package samples in individual plastic bags and place in cooler (sets of VOC samples from the same sample point may be packaged in the same bag).
- Package wet ice in double plastic bags and place bags around, among, and on top of the samples. The ice will be used to cool the samples.

- Fill cooler with additional ice for cushioning material.
- Place a temperature blank in the cooler to document the sample temperature when received by the laboratory.
- Put paperwork (chain-of-custody record, etc.) in a waterproof plastic bag and tape it to the inside lid of the cooler.
- Tape the cooler lid and drain shut with fiber-reinforced tape.
- Place two numbered and signed custody seals on cooler, one at the front right and one at the back left or side of the cooler (this depends upon whether the lid is "hinged" or "lift off" type).
- Attach completed shipping label to the top of cooler and ship following the carrier's instructions.

Sample coolers are typically shipped by overnight express carrier to the laboratory. A copy of the bill of lading (air bill) is to be retained and becomes part of the sample custody documentation. The laboratory should be notified in advance of all shipments, by telephone on the day of shipment and by advanced scheduling.

5.5 Chain-of-Custody Procedures

Custody of samples must be maintained and documented from the time of sample collection to completion of the analyses. Each sample will be considered to be in the sampler's custody, and the sampler will be personally responsible for the care and custody of the samples until they are delivered to the courier service for delivery to the laboratory. A sample is considered to be under a person's custody if:

- The sample is in the person's physical possession,
- The sample is in view of the person after that person has taken possession,
- The sample is secured by that person so that no one can tamper with the sample, or
- The sample is secured by that person in an area that is restricted to authorized personnel.

All samples will be accompanied to the laboratory by a chain-of-custody form, i.e. CESPK Form 111 (Appendix A, Field Documentation). The chain-of-custody form contains the following information:

- Project name,
- Sample numbers,

- Sample collection point,
- Date and time of collection of samples (these must match the date and time recorded on the sample label),
- Sample matrix description,
- Analyses requested for each sample,
- Preservation method,
- Number and type of containers used,
- Any special handling or analysis requirements,
- Signature of the person collecting the sample,
- Signature of persons involved in the chain of possession, and
- Names and telephone numbers of the project points of contact (POCs).

The chain-of-custody record forms will be filled out with ink. Prior to packaging samples for shipment, all samples should be double checked against the chain of custody form. When the samples are transferred from one party to another, the individuals will sign, date, and note the time on the form. A separate form will accompany each delivery of samples to the laboratory. The chain-of-custody form will be included in the cooler used for preservation and transport of the samples. The sampling personnel will retain a copy of the form.

6. REMEDIAL ACTION DERIVED WASTE

Excess soil sample materials shall be disposed into the stockpiled excavated soil from which it came from.

Wastewater derived from decontamination of the backhoe bucket shall be collected in 5-gallon plastic utility buckets. The water shall be analyzed for TPH using EPA Method 8015B for diesel fuel and motor oil. Disposal of this water will be determined based upon the results of the analysis.

Personal Protective Equipment (PPE), including nitrile gloves, will be handled as non-hazardous waste.

7. REFERENCES

American Society of Testing and Materials (ASTM), 1997, Standard Practice for Description and Identification of Soils (Visual Manual Procedure), D 2488-93.

Remedial Investigation Report, Tonopah Army Airfield, Tonopah, Nevada, U. S. Army Corps of Engineers, December 2002

Site Inspection Report, Tonopah Army Airfield, Tonopah, Nevada, U. S. Army Corps of Engineers, July 2002

Tonopah Army Air Field Preliminary Assessment, U. S. Army Corps of Engineers, May 2001

Tonopah Army Air Field, near Tonopah, Nevada, Basic Layout Plan, Drawing Number 145-13-349, January 1946.

ATTACHMENT B

QUALITY ASSURANCE PROJECT PLAN

REMOVAL ACTION PLAN

QUALITY ASSURANCE PROJECT PLAN

FORMER TONOPAH ARMY AIRFIELD

TONOPAH, NEVADA

Prepared by

US Army Corps of Engineers ®

Environmental Design Section
Sacramento District

March 2003

TABLE OF CONTENTS

LIST OF TABLES

APPENDIX A

APPENDIX B

LIST OF ACRONYMS AND ABBREVIATIONS

CCC	Calibration Check Compounds
CCV	Continuing Calibration Verification
CESPK	Corps of Engineers, Sacramento District
COPC	Contaminant of Potential Concern
COC	Chain of Custody
DL	Detection Limit
DQO	Data Quality Objectives
FID	Flame-ionization detector
GC	Gas Chromatograph
GC/MS	Gas Chromatography/Mass Spectrometry
IS	Internal Standard
IC	Ion Chromatograph
ICAL	Initial Calibration
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
MCLs	Maximum contaminant levels
MDL	Method Detection Limit
MS	Matrix Spike
MSD	Matrix Spike Duplicate
PARCC	Precision, Accuracy, Representativeness, Comparability, and Completeness
PID	Photo-ionization detector
PM	Program Manager
PQL	Practical Quantitation Limit
PRG	Preliminary Remediation Goal
QA	Quality assurance
QAC	Quality Assurance Chemist
QAPP	Quality Assurance Project Plan
QC	Quality control

RF	Response Factor
RPD	Relative percent different
RSD	Relative Standard Deviation
RT	Retention Time
SOPs	Standard operating procedures
SPCC	System Performance Check Compounds
TICs	Tentatively Identified Compounds
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
VOCs	Volatile organic compounds

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) presents functions, procedures, and specific quality assurance (QA) and quality control (QC) activities designed to achieve the data quality goals for investigating and characterizing the chemical and ammunition storage areas, maintenance buildings, and the former base landfill at the former Tonopah Army Air Field (TAAF). This project is a joint effort by the Environmental Design Section of the U.S. Army Corps of Engineers, Sacramento District (CESPK), and the Nevada Division of Environmental Protection (NDEP). This QAPP is prepared in accordance with EPA QA/R-5, EPA Requirements for Quality Assurance Project Plans for Environmental Operations.

1.1 Site Location and Project Objectives

The project objective is to identify potential contaminants of concern (COC) and areas where no further action required and to determine if a remedy is required at the areas of investigation. The site is located six miles east of the city Tonopah, Nevada. The site covers a total of 10, 433.62 acres in Nye County. The detailed objective is presented in Section 2.1 of Soil Sampling and Analytical Plan (USACE, July 2001).

1.2 QAPP Objectives and Use

To ensure proper characterization of the areas of concern under investigation standard procedures and specifications is established to ensure that comparable data are produced by all laboratories, and that data quality is consistently assessed and documented. The specific objectives are:

- Provide standardized references and quality specifications for all anticipated field sampling, analysis, and data review procedures required for the project sites;
- Provide guidance and criteria for selected field and analytical procedures; and
- Establish procedures for reviewing and documenting compliance with field and analytical procedures.

The fieldwork will include but are not limited to: soil sampling using a backhoe bucket, and shipping to offsite laboratory for analysis; and proper excavation closure.

1.3 Regulatory Agencies

Eric Noack
(775) 687-9393
Nevada Division of Environmental Protection
333 W. Nye Lane, Suite 138
Carson City, Nevada 89706-0851

2.0 PROJECT ORGANIZATION AND RESPONSIBILITIES

2.1 Corps of Engineers

The following Sacramento District, Corps of Engineers (CESPK) personnel has been assigned to accomplish the sampling design and execution required supporting this project. The project execution will be performed under the general supervision of Rick Meagher P.E., Chief of Environmental Design Section. The technical team consists of the following personnel:

Project Leader	Chuck Richmond	(916) 557-5381
Project Chemist	Pamela Amie	(916) 557-7811
Health & Safety	Donna Maxey	(916) 557-7437
Field Lead	Bruce VanEtten	(916) 557-5377
Field Tech	Tim Crummett	(916) 557-6942

USACE fax number: (916) 557-7465

2.2 Project Management

2.2.1 Project Leader

The Project Leader will be responsible for reviewing the sampling program and associated field activities, ensuring that all sampling activities conform to the QAPP. The Project Leader, who will be in the field to supervise and perform initial inspections of field activities, will oversee quality assurance of field activities. Prior to the start of field activities, preparatory meetings will be held with the field crew. Checklists will be used during field activities. If field conditions require modifications to protocol outlined in the SAP or if questions arise, the field crew will contact the Project Manager for direction. The Project Leader will be also responsible for overseeing review of the project program and subcontractors and their daily activities, supervising fieldwork, directing field crews, and the compilation of data. The Project Leader reports to the Section Chief.

2.2.2 Project Chemist

The Project Chemist will be expected to have a “hands on” role in management of project tasks associated with sampling and analysis. These tasks include:

- Coordination with the analytical laboratory to insure readiness to implement project specific requirements,

- Review of analytical data as it becomes available to insure conformance with quality standards, and
- Implementation of corrective actions in accordance with QAPP specifications when review of data uncovers deficiencies.

2.2.3 Health and Safety Manager

The certified industrial hygienist is responsible for the general health and safety plan development and training for field personnel. This individual is also responsible for ensuring that health and safety procedures are understood and followed by all field personnel, and for reporting and correcting any violations of policy or regulation.

2.2.4 Sampling Team Leader

The Sampling Team Leader will be responsible for quality assurance of field activities and for executing all work elements related to the sampling program, including documenting field activities, maintaining field notes and photographs, maintaining a record of onsite personnel and visitors, and implementing the sampling plan. The Project Leader will be the Sampling Team Leader. These tasks include:

- instruction of field personnel in sampling and preservation requirements,
- general oversight of field personnel involved in sampling activities

2.2.5 Field Crew

Field crew personnel will be responsible for performance of project mobilization, demobilization, sample collection and oversight. Field personnel will report to the Sampling Team Leader.

3.0 QUALITY OBJECTIVES FOR ENVIRONMENTAL DATA

3.1 Characteristics of Data Quality

The term "data quality" refers to the level of uncertainty associated with a particular data set. Data quality associated with environmental measurement is a function of the sampling plan rationale and procedures used to collect the samples, as well as of the analytical methods and instrumentation used in making the measurements. Uncertainty cannot be eliminated entirely from environmental data. However, quality assurance programs effective in measuring uncertainty in data are employed to monitor and control excursions from the desired data quality objectives. Sources of uncertainty that can be traced to the sampling component are poor sampling plan design, incorrect sample handling, faulty sample transportation, and inconsistent use of standard operating procedures. The most common sources of uncertainty that can be traced to the analytical component of the total measurement system are problems associated with calibration and contamination.

The purpose of this QAPP is to ensure that the data collected are of known and documented quality and useful for the purposes for which they are intended. The procedures described are designed to obtain data quality indicators for each field procedure and analytical method. Data quality indicators include the PARCC parameters (i.e., Precision, Accuracy, Representativeness, Comparability, and Completeness). To ensure that quality data continues to be produced, systematic checks must show that test results and field procedures remain reproducible and that the analytical methodology is actually measuring the quantity of analytes in each sample.

A laboratory certified by the State of California will generate all laboratory chemical data. Laboratories must have an in-place program for data reduction, validation, and reporting as discussed in Section 7.0. The reliability and credibility of analytical laboratory results can be corroborated by the inclusion of a program of scheduled replicate analyses, analyses of standard or spiked samples, and analysis of split samples with QA laboratories for some projects. Regularly scheduled analyses of known duplicates, standards, and spiked samples are a routine aspect of data reduction, validation, and reporting procedures.

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3.3 Data Quality Objectives

To generate data that will meet the project objectives, it is necessary to define the types of decisions that will be made, identify the intended use of the data, and design a data collection program. Data Quality Objectives (DQO) is defined as an integrated set of thought processes, which define data quality requirements, based on the intended use of the data. Data Quality Objectives are necessary in obtaining sufficient data of known defensible quality for the intended use. The DQO process will assist in determining the appropriate quantitation, detection, and reporting limits, analytical methods, and sample handling procedures.

All data that will be collected for this project will be definitive data. Definitive data measures organics/inorganic using EPA procedures and should produce data that can be used in risk assessment, site characterization, alternative evaluation, engineering design, and monitoring during implementation. The data obtained will conform to the quality control requirements specified in the following text and the tables accompanying this document.

This investigation is driven by the need to identify potential contaminants of concern in the 11 investigation areas and determine if a remedy is required at each site. The key decisions to be made from this sampling are (a) whether contamination from specific compounds exists in the soil and exceeds the action levels and (b) whether, as a consequence of exceeding these values, a remedy will be required.

The uncertainty of the analytical measurements as related to decision making is in large part mandated by the testing requirements of the State of Nevada, and can be expressed through the Data Quality Indicators. An additional component of uncertainty exists in the manner in which the samples are to be taken. The practical field sampling uncertainties include:

- misidentification of "hot" soil samples, or missing them entirely in the sparse number of confirmatory samples in the excavations;
- field heterogeneity at the level of the individual sampling jar; and
- contamination of one set of samples from equipment used for another excavation.

Field sampling uncertainty will be addressed by taking care to identify (within the limits of the equipments and the screening technique) most contaminated samples; by taking care to minimize volatile loss during sample tube or jar filling; and by appropriate decontamination procedures. The nature of this decision is not sensitive to cross-contamination as a risk-based decision would be during a Remedial Investigation.

Field and laboratory heterogeneity are addressed semi-quantitatively by the scheme of QC and QA sampling.

The QA/QC evaluation of the laboratory data will determine whether the data meet the requirements of the QAPP and will include an evaluation of the laboratory data, performed per the analytical methods. Specific QA measurements will be addressed to satisfy the QA objectives. These measurements include precision, accuracy, representativeness, completeness, and comparability. These will be discussed in greater detail in Section 10.0.

Data Quality Objectives specific to analytical chemistry requirements are:

- Total petroleum hydrocarbons-gasoline (C8-C12), diesel (C12-C24) and motor oil (C24-C36) by Method 8015B modified;

The summary of analytical methods is present in Table 3-1.

Table 3-1: Summary of Analytical Strategy

Analytes	Preparatory Methods	Analytical Methods
Diesel (C12-C24)	SW3510C, SW3630C	SW 8015B Modified
Motor Oil (C24-C36)	SW3510C, SW3630C	SW 8015B Modified

4.0 SAMPLE ACQUISITION, CUSTODY, MANAGEMENT, AND DECONTAMINATION

4.1 Soil Sample Collection Requirement and Techniques

Soil will be removed from the backhoe bucket and placed in stainless steel bowls. . The observations and results of the field screening will be recorded on trench logs. An example trench log is presented in Appendix A. Soil samples for laboratory analysis will be collected from a bowl and placed in a stainless steel sleeve of six inches in length. Samples to be analyzed for TPH-Diesel and TPH-Motor Oil will be contained in the sleeve. All reusable equipment that comes into contact with the soil will be decontaminated prior to the sampling. Labels will be affixed to the sleeve bearing job designation, time, sample location, sample depth interval, sample number, date sampled, and the name of the sampler. The sampler will be packaged in individual plastic bags and place in a cooler maintained at 4 ± 2 °C for shipping to laboratory.

4.2 Sample Acquisition

4.2.1 Field Log Book

A field notebook bound with serially numbered pages will be used to record sample identification numbers, chain-of-custody numbers, and any significant observations or events. The project name, project number, site location, sampling event, project manager, telephone number and address of contractor office (should the book be misplaced or lost) will be listed in ink. The field notebook is intended to record events during sampling activities in sufficient detail to allow field personnel to reconstruct events that transpired during the project. The Project Leader, who will sign and date the notebook prior to initiation of fieldwork, will maintain the field notebook. If it is necessary to transfer the logbook to alternative personnel during the course of fieldwork, the person relinquishing the logbook will sign and date the logbook at the time the logbook is transferred and the person receiving the logbook will do likewise. Crossing a line through the entry and entering the correct information shall make corrections to erroneous data. The correction shall be initialed and dated by the person making the entry. Unused portions of logbook page will be crossed out, signed, and dated at the end of each workday. Logbook entries must be dated, legible, in ink, and contain accurate documentation. Language used shall be objective, factual, and free of personal opinions. Hypotheses for observed phenomena may be recorded, however, they must be clearly indicated as such and only relate to the subject observation.

The specific sampling location of each sample is recorded with each sample identification number in the field logbook and on the sample chain-of-custody form. The type of sample media is recorded with the sample identification number in the field logbook and on the chain-of-custody form. Laboratory analyses to be conducted on the sample are recorded with the sample identification number in the field logbook and on the chain-of-custody form.

The date and time of sampling preparation and collection, and personnel who conducted sampling are recorded with the sample identification number in the field logbook and on the chain-of-custody form. The names of visitors and any other persons on site are also recorded in the field logbook. Sampling personnel will also record the ambient weather conditions and other conditions at the sampling location that may affect sample collection, the apparent representativeness of the sample, or sample analysis in the field logbook.

4.2.2 Sample Identification

A unique identification number will be assigned to each sample. This number is typically an alphanumeric sequence or integer that serves as an acronym to identify the sample. Specific sample identification procedures will follow the strategy as outlined within the project specific Field Sampling Plan. Specific sample identification procedures will follow a basic strategy as outlined below:

Primary Samples: Project ID - Matrix Code - Sample Location - Depth in feet

Duplicate Sample: Project ID - Matrix Code - Sample Location - QC Sample Number

The sample's identification number references all information pertaining to a particular sample. It is recorded on the sample container, in the field logbook, and on the sample chain-of-custody form. Following sample collection, the sample label is completed in waterproof ink and secured to the sample container with clear tape wider than the label itself. MS/MSD volumes will be indicated on the COC as well as within the sample numbering sequence. The sample number will be a parent sample number + the suffix "AMS" or "AMSD"

Each sample collected at the site will be labeled with the following information:

- Sample identification number;
- Sample location;
- Date and time of collection;

- Initials of person collecting the sample;
- Analysis requested;
- Preservation;
- Any other information pertinent to the sample.

4.2.3 Sample Containers

A complete set of sampling containers will be prepared for each sample in advance of the sampling event. Containers will be labeled with the date, sample number, project name, sampler's name, and parameters for analysis and preserved as required. The required sample containers, preservatives and storage requirements for the analyses are presented in Table 4-1.

Table 4-1: Sample Container, Sample Size, Preservation, and Holding Time

Method	Containers and Sample Size	Chemical Preservation	Holding Time	Temperature Preservation
SW 8015B Modified (Diesel and Motor Oil)	1 2" x 6" stainless steel sleeve	N/A	14 days to extraction, 40 days after extraction	cool 4°C

4.3 Sample Custody Procedures

4.3.1 Field Custody

Custody of samples must be maintained and documented from the time of sample collection to completion of the analyses. Each sample will be considered to be in the sampler's custody, and the sampler will be personally responsible for the care and custody of the samples until they are delivered to the courier service for delivery to the laboratory. A sample is considered to be under a person's custody if:

- The sample is in the person's physical possession;
- The sample is in view of the person after that person has taken possession;
- The sample is secured by that person so that no one can tamper with the sample;
- That person in an area that is restricted to authorized personnel secures the sample.

All samples will be accompanied to the laboratory by a chain-of-custody form i.e. CESPK Form 111 or equivalent. The chain-of-custody form contains the following information:

- Project name;
- Sample numbers;
- Sample collection point;
- Sampling date;
- Time of collection of samples (this time must match the time recorded on the sample label);
- Sample matrix description;
- Analyses requested for each sample;
- Preservation method;
- Number and type of containers used;
- Any special handling or analysis requirements.
- Signature of person collecting the samples;
- Signature of persons involved in the chain of possession.

The chain-of-custody record forms will be filled out with ink. When the samples are transferred from one party to another, the individuals will sign, date, and note the time on the form. A separate form will accompany each delivery of samples to the QA laboratory. The chain-of-custody form will be included in the cooler used for preservation and transport of QA samples. Sampling personnel will retain a copy of the form.

4.3.2 Chain of Custody Procedures:

All samples will be accompanied to the laboratory by a chain-of-custody form. The chain-of-custody form contains the following information:

- Project name,
- Sample numbers,
- Sample collection point,
- Sampling date,
- Time of collection of samples (COC sample time must match label sample time),
- Sample matrix description,

- Analyses requested for each sample,
- Preservation method,
- Number and type of containers,
- Any special handling or analysis requirements,
- Signature, date and time of person collecting samples (when initialing and relinquishing COC),
- Signature, date and time of person receiving samples (when receiving COC),
- All transfers of custody of the samples will record signatures, dates and times of responsible individuals involved with the transportation of samples to the laboratory.

The chain-of-custody record forms will be filled out in ink. When the samples are transferred from one party to another, all individuals will sign, date and note the time on the chain-of-custody form. A separate form for each cooler of samples will accompany each delivery of samples to the laboratory. The sampling personnel will retain a copy of the chain-of-custody form after custody transfer.

4.3.3 Laboratory Custody

All samples received at the laboratory will be carefully checked for label identification, and complete, accurate chain-of-custody documentation. The condition of the samples will be checked, and the ambient temperature in the cooler and the temperature blank will be measured immediately after the cooler is opened. These results will be recorded on the Cooler Receipt Form. Photographs are recommended to document the condition of samples if significant out-of-control conditions are noted at the time of sample receipt.

4.4 Sample Management

4.4.1 Packing

Samples will be transported as soon as possible after sample collection to the laboratory for analysis. The following procedures are to be used when packing and transporting samples to the laboratory:

- Use waterproof metal or equivalent strength plastic ice chests or coolers;
- Package samples in individual plastic bags and place in cooler (sets of VOC

samples may be packaged in the same bag);

- Package wet ice in plastic bags and place bags around, among, and on top of the samples;
- Fill cooler with cushioning material;
- Put paperwork (chain-of-custody record, etc.) in a waterproof plastic bag and tape it to the inside lid of the cooler;
- Tape the cooler lid and drain shut with fiber-reinforced tape;
- Place two numbered and signed custody seals on cooler, one at the front right and one at the back left of cooler;
- Put "This Side Up" and "Fragile" labels on all sides of any cooler containing glass bottles;
- Attach completed shipping label to the cooler and ship following the carrier's instructions.

4.4.2 Shipping

Overnight express carrier typically ships sample coolers to the laboratory. A copy of the bill of lading (air bill) is to be retained and becomes part of the sample custody documentation. The laboratory should be notified in advance of all shipments preferably by advanced scheduling and by telephone on the day of shipment.

4.5 Project Laboratories

The sample will be sent to a State of California certified laboratory. Address and point of contact are listed below:

Applied P & Ch Laboratory
13760 Magnolia Avenue
Chino, CA 91710
POC: Eric Wendland Email: ericw@apclab.com
Phone: (909) 590-1828 ext 104
Fax: (909) 590-1498

4.6 Decontamination of Non-Disposable Sampling Equipment

During sampling activities, appropriate decontamination measures will be taken to minimize sample contamination between samples. These procedures will be consistent with those outlined in "Test Methods for Evaluating Solid Waste-Physical/Chemical Methods" (U.S. EPA SW-846, 3rd ed.). The decontamination procedure for sampling equipment will incorporate the washing steps outlined below. Water that has been laboratory certified to be free of the contaminants of concern above the level of detection for the relevant analyses for this project may be substituted as an alternative for reagent grade type II water.

All sampling equipment (excluding disposable equipment) used in the collection of samples will be decontaminated as described in the following paragraphs. Decontamination should be executed immediately prior to equipment use, except for sample sleeves, which may be decontaminated previously and wrapped in aluminum foil. Whenever this is not possible or practical, measures will be taken to ensure that contamination of clean equipment will not occur. Clean disposable nitrile gloves that do not degrade when exposed to the selected decontamination solvent(s) will be worn while decontaminating sampling equipment and tools. Equipment used during sampling for organic parameters should not be allowed to contact plastic during or after decontamination and clean sampling equipment will not be placed on the ground or other contaminated surfaces prior to use.

Aqueous based rinses are the first steps in the decontamination process. Aqueous rinses are followed by pesticide grade methanol. Pesticide grade methanol and organic free water will be stored in either glass or Teflon containers and applied via Teflon squeeze bottles or decanted directly from their storage containers. The waste decontamination fluids will be collected and handled in accordance with applicable state and local regulations as described in the Field and Sampling Plan for this site.

The decontamination procedure is as follows:

- pre-rinse to dislodge soil or waste sample remains
- non-phosphate detergent wash and tap water rinse
- distilled water
- air dry
- wrap equipment completely with aluminum foil (shiny side out) and place in a plastic bag to prevent contamination if equipment is to be stored or transported

As an alternative to use of reagent grade water, analytical data (certificates of analysis) may be used to indicate that deionized water used for the final rinse, is free of the contaminants of concern for this project above the level of detection for the relevant analyses.

5.0 ANALYTICAL METHODS AND CALIBRATION

This section contains brief descriptions of preparation and analytical methods that will be used to analyze soil samples collected for this project. Calibration procedures are described for the common analyses for which the samples will be submitted.

Unless authorized by the Project Chemist, the most current promulgated method shall be utilized. If during the course of a project, it becomes necessary to apply a different practical quantitation limit because of changes in instrument capabilities, the Project Chemist will be notified and approval will be obtained in instances where higher practical quantitation limits result. Methodology references contain specific QC criteria associated with the particular methods. These specific requirements include calibration and QC samples, and are described in detail within the methods. Daily performance tests and demonstrations of precision and accuracy are required.

The laboratory methods identified in this document were published by the United States Environmental Protection Agency (U.S. EPA) in *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods SW-846*, Third Edition (November 1986; Revision 1, July 1992; and Revision 2, November 1992, Update I, August 1993, Update II, September 1994, Update III, 1998). Additional methods identified are published in *Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater* (U.S. EPA, 1985), and *U.S. EPA Methods for Analysis of Water and Wastes* (U.S. EPA, 1979). Preservation and holding times for these analytical procedures are presented in Table 4-1. Appendix (A) summarizes the calibration and the internal quality control procedures, the quantitation limits and the QC control limits of the methods that will be used for this project.

5.1 Laboratory Methodology

The laboratory will receive samples for each unique sample location. The samples will be identified on the chain-of-custody record.

5.1.1 Sample Preparation and Analytical Methods-Organic

The following sections briefly summarize the sample preparation and analytical methods to be performed for the determination of organic analytes.

5.1.1.1 Method SW-5030: Purge-and-Trap and Extraction for Volatile Organics in Soil

Method SW-5030 is used to determine the concentration of volatile organic compounds

(VOCs) in aqueous or solid matrices. It is based on a purge-and-trap gas chromatographic procedure. The success of this method depends on the level of interference in the sample. A direct purge-and-trap procedure is performed for water samples. An inert gas is bubbled through the sample at ambient temperature to transfer the volatile components to the vapor phase. The vapor is swept through a sorbent column where the volatile components are trapped. After purging is completed, the sorbent column is heated and backflushed with inert gas to desorb the components onto a gas chromatographic column for analysis.

5.1.1.2 Method 3550: Sonication Extraction

Method 3550 is a procedure for extracting nonvolatile and semivolatile organic compounds from solids such as soils, wastes, and sludges. The sonication process ensures intimate contact of the sample matrix with the extraction solvent. A weighted portion of the solid material is mixed with the anhydrous sodium sulfate, ground to form a free-flowing powder, and then dispersed into the methylene chloride. The extract is separated from the sample by vacuum or gravity filtration, or centrifugation, and then dried with anhydrous sodium sulfate and concentrated to an appropriate volume for analysis.

5.1.1.3 Method 8015B Modified: Total Petroleum Hydrocarbons

SW-8015B Modified is used to determine the total petroleum hydrocarbons (TPH) quantitated as gasoline and diesel as described by the California DHS LUFT Manual (October 1989).

5.1.1.3.1 Extractable

Extractable TPH component, diesel is first extracted via Method 3510 (separatory funnel) for water-based matrices. Methylene chloride is used as the extracting solvent. Typically, one liter of water is extracted and concentrated in volume. Analysis is accomplished on a GC equipped with a capillary or megabore column and FID detector. For this project diesel #2 and motor oil are contaminates of concern.

Identification and quantitation of TPH components (both 8015B mod. methods) is based on pattern recognition techniques and requires a greater degree of analytical judgment than other GC methods. The TPH chromatograms consist of groups of peaks that have a general shape or pattern and fall within a noted carbon range (i.e., number of carbon atoms in the molecule). Gasoline and diesel fuel will be used to calibrate the instruments and determine response factors for quantitation of sample results. No second-column confirmation will be performed because identification is based on pattern recognition and not retention time (where false positives due to interference are likely). In addition, motor oil will be analyzed as identification standard for chromatographic pattern recognition, i.e., the resulting patterns and carbon ranges will be used to compare to sample chromatograms for identification. The sample results will be reported as gasoline, diesel fuel, or motor oil according to the closest matching carbon range. The concentrations are determined by quantitating the sample against either gasoline (Method 8015M-purgeable) or diesel (Method 8015M-extractable). Often, unknown or un-calibrated hydrocarbons are encountered; therefore, the concentration reported is considered estimated. Carbon ranges and significant deviations of the pattern from the patterns of reported analytes will be described in the analytical report.

Analyte	Carbon Range for Quantitation
Diesel range organics	C12 - C24
Motor Oil	C24 - C36

Quantitation of both standards and samples will be performed by adding the area from all peaks from the baseline to the height of the peaks. In cases where the range of the pattern in the sample extends outside of the gasoline, diesel fuel, or lubricating oil standard ranges, the area throughout the range of the sample pattern should be quantitated (relative to gasoline or diesel) and reported as the Analyte (gasoline, diesel, motor oil etc.) closest in carbon range to the sample pattern. The GC will be calibrated via the external standard technique. The average response factor is used for quantitation.

5.1.1.4 <u>Method SW-8260B</u>: Volatile Organics by Capillary Column GC, GC/MS

Method 8260B is used to determine volatile organic compounds in a variety of matrices. The volatile compounds are introduced into the gas chromatograph by the purge-and-trap method or by direct injection. Purged sample components are trapped in a tube containing suitable sorbent materials. When purging is complete, the sorbent tube is heated and backflushed with helium to desorb trapped sample components. The analytes are desorbed directly to a large bore capillary or cryofocused on a capillary pre-column before being flash evaporated to a narrow bare capillary for analysis. The column is temperature programmed to separate the analytes, which are then detected with a mass spectrophotometer interfaced to the gas chromatograph.

5.2 Sample Preparation and Analysis Methods-Inorganic

The following sections briefly summarize the sample preparation and analysis methods to be performed for the determination of inorganic analytes.

5.2.1. Method SW-3050: Acid Digestion of Sediments, Sludges, and Soils

This digestion procedure is used for the preparation of aqueous samples that contain suspended solids for analysis by furnace atomic absorption spectroscopy (GFAA). A mixture of nitric acid and the material to be analyzed is refluxed in a covered Griffin beaker or equivalent. This step is repeated with additional portions of nitric acid until the digestate is light in color or until its color has stabilized. The digestate is then cooled and brought to a low volume with dilute nitric acid such that the final dilution contains 3% (v/v) nitric acid. If the sample contains suspended solids, it must be centrifuged, filtered, or allowed to settle before it could be placed in the graphite tube.

6.0 QUALITY ASSURANCE AND QUALITY CONTROL PROCEDURES

6.1 Calibration Procedures and Frequency

6.1.1 Laboratory Instruments and Equipment

All instruments and equipment that may be utilized from sample custody to sample disposition are to be listed on an inventory, which includes the names, quantity, and model number. This inventory shall be documented in the Field Sampling Plan or Laboratory Quality Assurance Plan. The laboratory shall maintain a stock of spare parts and consumables for all analytical equipment. Routine preventive maintenance procedures are outlined in laboratory-specific SOPs and summarized in Table 9-1. Maintenance performed on each piece of equipment is documented in the maintenance notebook. The frequency of routine procedures will vary depending on the production workload and the types of samples analyzed. The approximate frequency of procedures is also outlined in Table 9-1. The primary laboratory should operate backup instrumentation for most of its analytical equipment in the event of instrument failure.

6.1.1.1 Standard and Reagent Preparation

A critical element in the generation of quality data is the purity/quality and tractability of the standard solutions and reagents used in the analytical operations. The preparation and maintenance of standards and reagents will be performed per the specified analytical methods presented in Section 5.0. The laboratory shall continually monitor the quality of reagents and standard solutions through a series of well-documented standard operating procedures (SOPs). In general, SOPs for standards preparation should incorporate the following items:

- Documentation and labeling of date received, lot number, date opened, and expiration date;
- Documentation of tractability;
- Preparation, storage, and labeling of stock and working solutions; and
- Establishing and documenting expiration dates and disposal of unusable standards.

Primary reference standards and standard solutions used by the laboratory are to be obtained from the National Institute of Standards and Technology, or other reliable commercial sources to ensure the highest purity possible. All standards and standard solutions shall be catalogued to identify the supplier, lot number, purity/concentration, receipt/preparation date, preparer's name, method of preparation, expiration date, and all other pertinent information included in the specific SOP.

Standard solutions and reagents are validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard using a standard prepared at a different time, concentration or source. Reagents are examined for purity by subjecting an aliquot or subsample to the analytical method in which it will be used; for example, every lot of dichloromethane (for organic extractables) is analyzed for undesirable contaminants prior to use in the laboratory. Stock and working standards are checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change in concentration. Care is to be exercised in the proper storage and handling of standard solutions, and all containers are labeled as to compound, concentration, solvent, expiration date, and preparation data (initials of the preparer/date of preparation).

6.1.1.2 Instrument Calibration and Tuning

All instruments and equipment used during sample analysis are operated, calibrated, and maintained according to the manufacturer's guidelines and recommendations, as well as criteria set forth in the applicable analytical methodology references. Personnel properly trained in these procedures will perform operation, calibration, and maintenance. Laboratory capabilities will be demonstrated initially for instrument and reagent/standards performance as well as accuracy and precision of analytical methodology.

Calibration of instruments is required to ensure that the analytical system is operating correctly and functioning at the proper sensitivity to meet established reporting limits. Each instrument will be calibrated with standard solutions appropriate to the type of instrument and the linear range established for the analytical method presented in Section 6.0. The frequency of calibration and calibration verification and the concentration of calibration standards are determined by the manufacturer's guidelines and the analytical method. Calibration procedures for all instruments are summarized in the method specific tables in section 5.0. All samples must be bracketed by passing calibration check samples. Failure to bracket all samples with acceptable calibration checks will result in the reanalysis of affected samples.

6.1.1.3 Gas Chromatography/Mass Spectrometry (GC/MS)

Each day prior to analysis of samples, the instrument is tuned with bromofluorobenzene for volatile compounds or other tune criteria as specified by the method used. Mass spectral peaks must conform both in mass numbers and relative intensity to method specified requirements before analyses can proceed.

The instrument is then calibrated for all target compounds. An initial calibration curve is produced to define the working range to establish criteria for identification. All GC/MS instruments are calibrated at five different concentrations for analytes of interest, using the procedures outlined in SW-846. Method system performance check compounds (SPCC's) must show a minimum mean response factor and calibration check compounds CCCs must show an RSD less than the method specified standard for the initial calibration to be considered valid. On a daily basis, SPCC=s must meet the same criteria relevant for the initial calibration and method (CCC) must show a minimum percent drift relative of the expected concentration of the CCC to be considered valid. This initial calibration is evaluated on a daily basis to ensure that the system is within calibration. If the daily standard does not meet the established criteria, the system is recalibrated.

Following a successful tune, the initial five-point calibration is verified by a single midrange concentration standard. The SPCC's and CCC's are used to check response factors for adequacy and consistency against required limits before analyses can proceed. This initial calibration can be utilized as long as the daily calibration remains valid. A successful calibration verification is followed by a method blank analysis. All target analytes in the method blank must be below one-half the quantitation limit before analyses can proceed.

6.1.1.4 Gas Chromatography

The field of chromatography involves a variety of instrumentation and detection systems. While calibration standards and acceptance criteria vary depending on the type of system and analytical methodology required for a specific analysis, the general principles of calibration apply uniformly. As outlined in EPA SW-846 procedures, each chromatographic system is calibrated prior to performance of analyses using five concentrations by external standard technique for all columns. The lowest calibration standard shall be within a factor of two relative to the reporting limit, and the others corresponding to the expected range of concentrations or defining the working range of the detector. This is done on each quantitation column and each instrument at the beginning of the contract period and each time a new column is installed. The results are used to determine a calibration curve and response factors for each analyte. Initial calibration consists of determining the working range, establishing limits of detection, and establishing retention time windows. The calibration is checked on a daily basis to ensure that the system remains within specifications. For specific instructions regarding the requirements for second column confirmation, see the method tables in Section 5.0.

Continuing calibration standards are analyzed to check the linearity of the initial calibration curve at the beginning and end of each analytical run. Calibration checks are also performed for overall system performance and for retention time shifts, as specified in SW-846. Individual and standard mixes are analyzed to establish response factors and absolute retention time. The response factors and retention times are verified throughout the analytical run and at the end of the analytical sequence. Each analyte must be within its retention time window or corrective action shall taken by the analyst. For GC analyses conducted on this project, the response factor must agree with the factor determined during the initial 5-point calibration within 15% for quantitation analysis utilizing SW-846 methodology.

The instrumental detection limit, the linear range of the instrument, and interference effects must be established for each individual analyte on that particular instrument. The linear range is verified at the time of the analysis by analyzing the calibration standard as a sample, the results of which must be within 15% of its true value. The calibration is verified initially prior to sample analysis using an independent second source standard. Continuing calibration checks are analyzed after every 10 samples using a midrange calibration check standard and must be within 15% of the expected value. Calibration blanks are analyzed after all calibration check standards and must be with three standard deviations of the mean blank value and less than one-half the reporting limit.

6.1.1.5 Graphite Furnace Atomic Absorption Spectroscopy

The instrument must be calibrated and checked for contamination before each set of samples. An initial calibration (ICAL) consists of a minimum of a blank and three calibration standards. The least concentrated standard will be at a concentration corresponding to the QPL. The remaining standards will define the working range of the instrument. A linear regression fit of the calibration data must yield a correlation coefficient must be at least 0.995. Failure to meet these criteria will require recalibration and possible preparation of a new set of standards. Prior to sample analysis, an initial calibration verification (ICV), consisting of a second source standard, and an initial calibration blank (ICB) will be analyzed to verify the quantitation and to detect any contamination. A continuing calibration verification (CCV) at a mid-curve concentration and CCB will be analyzed very 10 samples and at the end of analytical sequence. If the CCV value varies from the predicted concentration by more than + 10% then the analysis must be stop. The problem must be identified and corrected, and rerun the impacted samples. All samples must be bracketed by calibration standards the meet the stated criteria.

6.2 Corrective Action

The Project Leader is responsible for initiating corrective action and for implementation of all corrective actions with respect to the field sampling operations. The laboratory QA Director in consultation with the Project Chemist is responsible for implementing corrective actions in the laboratory. It is their combined responsibility to see that all analytical and sampling procedures are followed as specified and that the data generated meet the acceptance criteria. Corrective action procedures are summarized for each method in section 5.0.

Corrective actions for the laboratory may include, but are not limited to:

- Reanalyzing samples;
- Correcting laboratory procedures;
- Recalibrating instruments using freshly prepared standards;
- Replacing solvents or other reagents that give unacceptable blank values;
- Training laboratory personnel in correct sample preparation and analysis procedures; and
- Accepting data with an acknowledged level of uncertainty.

Whenever corrective action is deemed necessary, the primary Laboratory Director will ensure that the following steps are taken:

- The problem is defined;
- The cause of the problem is investigated and determined;
- Appropriate corrective action is determined; and
- Corrective action is implemented and its effectiveness verified.

6.3 Documentation

All calibration information, instrument maintenance and repair are recorded by the laboratory on appropriate forms developed for SW-846 procedures. Out-of-control analyses are generally described on a QA/QC discrepancy form and submitted to the laboratory supervisor for corrective action. Copies are distributed to the laboratory QA coordinator and laboratory director for approval, and to the case file. The calibration information is filed with the raw data in the reports area.

7.0 DATA REDUCTION, VALIDATION AND REPORTING

7.1 Laboratory

7.1.1 Data Reduction and Validation

All analytical data generated within the laboratories shall be reviewed prior to report generation to assure the validity of the reported data. The data validation process consists of data generation, reduction, and three levels of documented review. In each stage, the review process will be documented by the signature of the reviewer and the date reviewed.

The analyst who generates the analytical data will have the prime responsibility for the correctness and completeness of the data. All data will be generated and reduced following protocols specified in laboratory SOPs. Each analyst will review the quality of his or her work based on an established set of guidelines outlined in the SOPs. The analyst will review the data package to ensure that:

- The correct samples were analyzed and reported in appropriate units;
- Preservation and holding time requirements were met;
- Sample preparation information is correct and complete;
- Appropriate SOPs have been followed;
- Analytical results are correct and complete;
- QC samples are within established control limits;
- Blanks are within appropriate QC limits;
- Special sample preparation and analytical requirements have been met; and
- Documentation is complete (e.g., all anomalies in the preparation and analysis have been documented, anomaly forms are complete; holding times are documented, etc.).

The data reduction and validation steps shall be documented, signed and dated by the analyst. The analyst will then pass the data package to an independent reviewer, who will perform an independent review of the data package. This review is also to be conducted according to an established set of guidelines and to be structured to ensure that:

- Calibration data are scientifically sound, appropriate to the method, and completely documented;

- QC samples are within established guidelines;
- Qualitative identification of sample components is correct;
- Quantitative results are correct;
- Documentation is complete and correct (e.g., anomalies in the preparation and analysis have been documented; anomaly forms are complete; holding times are documented, etc.);
- The data are ready for incorporation into the final report; and the data package is complete and ready for data archive.

The review is to be structured so that all calibration data and QC sample results are reviewed and all of the analytical results from 10% of the samples are checked back to the bench sheet. If no problems are found with the data package, the review is complete. If any problems are found with the data package, an additional 10% of the samples will be checked to the bench sheet. This process will continue until no errors are found or until the data package has been reviewed in its entirety.

Data reviews shall be documented and the signature of the reviewer and the date of review recorded. The reviewed data are then approved for release and a final report is prepared. Before the report is released to the client, the data are reviewed for completeness and to ensure that the data meet the overall objectives of the project. This review is typically done by the Program Administrator.

Each step of this review process involves evaluation of data quality based on both the results of the QC data and the professional judgement of those conducting the review. This application of technical knowledge and experience to the evaluation of the data is essential in ensuring that data of high quality are generated consistently.

7.1.2 Data Reporting

At the conclusion of all analytical work for this project, the primary laboratory will submit a comprehensive certificate of analysis. The final certificates of analysis will be submitted no later than 21 days after the last sample has been submitted to the laboratory for the project. All samples shall be reported in a legally defensible package.

The data package for organics analyses will consist of a case narrative, chain-of-custody documentation, cooler receipt form, summary of results for environmental samples, summary of QA/QC results, and the data. Legible copies of all data will be organized systematically on numbered pages. The data for compound identification and quantitation must be sufficient to support all results presented in other sections of the data package. This section of the data package will include legible copies of the data for environmental samples (arranged in increasing order of field ID), and instrument calibration, QA/QC analyses, sample extraction and cleanup logs, instrument analysis logs for each instrument used. Instrument analysis logs are particularly important because they provide the basic link between all sample analyses and QC information (calibration, matrix spike, etc.). Instrument analysis logs for all instruments used for sample data for each analysis will include measurement printouts and quantitation reports for each instrument used.

Raw data will be available for further inspection, if required, and maintained in the central job file. All records related to the analytical effort are maintained at the primary laboratory in secured filing cabinets (i.e., cost information, scheduling, and custody). All records are maintained for five years after the final report is issued. Types of records to be maintained for the project include the following:

- Chain-of-custody records, including: information regarding the sampler's name, date of sampling, type of sampling, location of sampling, location of sampling station, number and type of containers used, signature of sampler relinquishing samples to non-contract personnel (e.g., Federal Express agent) with the date and time of transfer noted, signature of primary laboratory sample custodian receiving samples with date and time noted;
- Cooler receipt form documenting sample conditions upon arrival at the laboratory.
- Any discrepancy/deficiency report forms due to problems encountered during sampling, transportation, or analysis;
- Sample destruction authorization forms containing information on the manner of final disposal of samples upon completion of analysis;
- All laboratory notebooks including raw data readings, calibration details, QC checks, etc;
- Hard copies of data system printouts (chromatograms, mass spectra, ICP data files, etc.); and
- Tabulation of analytical results with supporting quality control information.

7.1.2.1 Case Narrative

The case narrative will be written and the release of data will be authorized by the laboratory director or his/her designee. Items to be included in the case narrative are the field sample ID with the corresponding laboratory ID, parameters analyzed for in each sample and the methodology used (EPA method numbers or other citation), detailed description of all problems encountered and corrective actions taken, discussion of possible reasons for out-of-control QA/QC results, and observations regarding any occurrences which may affect sample integrity or data quality.

7.1.2.2 Chain-of-Custody Documentation

Legible copies of chain-of-custody forms for each sample will be maintained in the data package. Cooler log-in sheets will be associated with the corresponding chain-of-custody form. Any integral laboratory-tracking document will also be included.

7.1.2.3 Summary of Environmental Results

For each environmental sample analysis, this summary shall include field ID and corresponding laboratory ID, sample matrix, date of sample extraction (if applicable), date and time of analysis, identification of the instrument used for analysis, instrument specifications, weight or volume of sample used for analysis/extraction, dilution or concentration factor used for the sample extract, method detection limit or sample quantitation limit, definitions of any data qualifiers used, and analytical results.

7.1.2.4 Summary of QA/QC Results

The following QA/QC results will be presented in summary form. Details specified in Section 7.1.2.3 also will be included for the summary of QA/QC results. Acceptance limits for all categories of QC criteria will be provided with the data.

7.1.2.4.1 Organic Analyses (General)

The summary of QA/QC results for organic analyses will include:

- Initial Calibration - The concentrations of the standards used for analysis and the date and time of analysis. The response factor, percent relative standard deviation (%RSD), and retention time for each analyte (as applicable, GC and GC/MS analyses) will be included in initial calibration summaries. A statement should also be made regarding the samples or dates for which a single initial calibration applies.

- Daily Calibration and Mid-level Standard - The concentration of the calibration standard used for daily calibration and/or the mid-level calibration check will be reported. The response factor, percent difference, and retention time for each analyte will be reported (GC and GC/MS). Daily calibration information will be linked to sample analyses by summary.

- Method Blank Analyses - The concentrations of any analytes found in method blanks will be reported even if detected amounts are less than the PQL. The environmental samples and QA/QC analyses associated with each method blank will be stated.

- Surrogate Standard Recovery - The name and concentration of each surrogate compound added will be detailed. The percent recovery of each surrogate compound in the samples, method blanks, matrix spike/matrix spike duplicates and other QA/QC analyses will be summarized with sample IDs such that the information can be linked to sample and QA/QC analyses.

- Precision and Accuracy - For matrix spike/matrix spike duplicate analyses the sample results, spiked sample results, percent recovery, and RPD with the associated control limits will be detailed. For laboratory duplicate analyses the RPD between duplicate analyses will be reported as applicable. For laboratory QC check and/or LCS analyses the percent recovery and acceptable control limits for each analyte will be reported. All batch QC information will be linked to the corresponding sample groups.

- Compound Identification (GC, GC/MS): The retention times and the concentrations of each analyte detected in environmental and QC/QC samples will be reported for both primary and confirmation analyses.

- Method Detection Limit (MDL): The MDL study result sheet will have laboratory heading, instrument identification, analysis date, spike level, average recovery, standard deviation and calculated MDL for each analyte.

In addition, the summary of QA/QC results for organic analyses will include the following information relating specifically to the method used.

7.1.2.4.2 GC Analyses

This section of the data package will include legible copies of the data for environmental samples (arranged in increasing order of field ID, primary and confirmation analyses). The raw data for each analysis will include chromatograms (with target compound, internal standard, and surrogate compounds labeled by name) with a quantitation report and/or area printout.

7.1.2.4.3 Inorganic Analyses

The summary of QA/QC results for the inorganic analyses will include:

- Initial Calibration: The source of the calibration standards, true value concentrations, found concentrations, the percent recovery for each element analyzed, and the date and time of analysis will be reported.
- Continuing Calibration Verification: The source of the calibration standard, true value concentrations, found concentrations, the percent recovery for each element analyzed, and the date and time of analysis will be reported.
- Method Blank Analyses: The concentrations of any analytes found in initial calibration, continuing calibration blank, and in the preparation blank will be reported. The date and time of analysis also will be reported.
- Precision and Accuracy - Matrix Spikes and Sample Duplicates: For matrix spike analyses, the sample results, spiked sample results, percent recovery, spiking solution used, and the control range for each element will be detailed. For post digestion spikes, the concentrations of the spiked sample, the sample result, the spiking solution added, and recovery and control limits will be detailed. For laboratory duplicates, the original concentration, duplicate concentration, relative percent difference, and control limits will be detailed. Date and time for all analyses will be recorded.
- Precision and Accuracy - Laboratory Control Samples: The source of the laboratory control sample, true value concentrations, found concentrations, percent recovery for each element analyzed, and the date and time of analysis will be reported.
- Method of Standard Additions (MSA): This summary must be included when MSA analyses are required for analysis by Graphite Furnace AA. The absorbance values and the corresponding concentration values, the final analyte concentrations, and correlation coefficients will be reported for all analyses. Date and time of analysis will be recorded for all analyses.
- Method Detection Limit (MDL): The MDL study result sheet will have laboratory

heading, instrument identification, analysis date, spike level, average recovery, standard deviation and calculated MDL for each analyte.

The Project Chemist will review and discuss the data usability and precision. The laboratory data will be validated using guideline as shown in Table B of Appendix A. The validation guidelines are based on EPA SW-846 methods and the EPA National Functional Guidelines for Organic and Inorganic Data Review of 1998.

7.2 Field Activities

7.2.1 Data Reduction

Field screening information that is read directly from the field instruments are:

- Total volatile organic vapor concentration, from organic vapor analyzers.

All field screening and data reduction information is recorded by the field staff in the project field logbook or, when required by specific projects, on dedicated forms.

Data reduction for background levels of total volatile organic vapors is conducted by the field staff. This operation is conducted by subtracting the background level from the apparent measured level (note, however, that background data reduction is not conducted on jarred or bagged headspace samples).

7.2.2 Data Integrity

Integrity of information and data on field activities shall be maintained by the Project Leader. Integrity of the field sample custody is accomplished by the field staff, according to the sample custody procedures discussed in Section 5.0. This information is generated in the field and recorded in the project field logbook and on the sample chain-of-custody form, shall be verified before sample shipping, and confirmed at the laboratory upon their receipt of the samples.

Integrity of daily field instrument calibrations is accomplished by the field staff and the Project Leader according to instrument calibration procedures provided by the manufacturers. The equipment manager shall be informed of instrument calibration problems so that he may initiate instrument replacement and repair. The equipment manager is also responsible for acquisition and storage of calibration standards, preventive maintenance, and periodic manufacturers calibration of field instruments. Integrity of field data calculations and documentation entries is the responsibility the field staff and the Project Leader.

7.2.3 Data Validation

Validation of information and data on field activities shall be conducted as a QC procedure by the Project Leader. The Project Manager shall review laboratory results and field data before allowing use for conducting the site assessment of contaminant distributions and magnitudes. The field instrument QC measurements will be reviewed to assure the accuracy and precision of the field screening measurements. This information is used to qualify the field screening results. Field logbooks and chain-of-custody forms shall be crosschecked to each other and to the laboratory results to assure conformity of sample identification numbers. This information is compared to results of duplicate and blank samples, and to information on field conditions at the time of sample collection in order to qualify the sample analytical results.

7.2.4 Data Storage

Field and laboratory data shall be stored in hard copy and floppy disk format (when applicable) as part of the project file. This information is retained in the project file until project completion and closeout. Upon project closeout, all records shall be archived for permanent storage.

8.0 FIELD AND LABORATORY QUALITY CONTROL CHECKS

8.1 Field Quality Control Checks

Quality control checks in the field will include the collection of field QC samples and QC checks of field screening instruments. These QC checks are described below.

8.1.1 Field Duplicates (QC Samples)

Duplicate samples collected in the field provide precision information for the entire measurement system including sample acquisition, homogeneity, handling, shipping, storage, preparation, and analysis. The identity of these samples is held blind to the analysts and laboratory personnel until the data are in deliverable form. Duplicate analyses will be performed on approximately 10% of the total investigative samples for each matrix. QC sample location sites will be based on information collected in the field. Historic information, photo-ionization detector (PID) readings and other field screening tests may be used to assist in directing the location of QC samples to sites suspected to be highest in the analyte of interest. The duplicate sample will be analyzed by the laboratory for the same parameters of the primary sample (i.e., the sample, which is being duplicated).

8.1.2 Trip Blanks

Trip blanks are prepared in the laboratory, shipped with the sample containers to the site, and are kept with the investigative samples throughout the sampling event. They are then packaged for shipment with the other samples and submitted for analysis. A trip blank will be included with each shipment of water samples requiring volatile analysis. Trip blanks will be analyzed for the same volatile methods as the primary samples. However, no trip blanks are planned for collection for this sampling event.

8.1.3 Rinsate Samples (Equipment Blanks)

Contamination of samples introduced by equipment can be detected by means of analyzing a rinsate sample. The absolute rate of rinsate blanks will be determined as a function of data quality objectives and stated in the project specific Field Sampling Plan. Normally a rinsate blank will be collected for each method sampled per day. Rinsate blanks will be collected for all non-disposable or non-dedicated sampling equipment after decontamination has been performed. Rinsate blanks will be obtained with reagent grade water that is determined to be free of the analyte of concern. A certificate of analysis must be obtained for every batch of water used for rinsate blanks.

8.1.4 Temperature Blanks

A sample container (40 ml VOA) of water should be labeled as a temperature blank and included in each shipment and recorded on the Chain-of-Custody. The temperature blank should be packaged and handled in the same manner as other samples in order to assure that its temperature is representative of the samples in that shipment. The laboratory will use a calibrated thermometer to directly measure the temperature of this sample. This temperature reading will determine whether the samples were stored under the appropriate thermal conditions as described in Table 4-1.

8.1.5 Quality Control Checks of Field Instruments

Proper measurement of accuracy and precision of field instruments is verified by daily instrument calibration and QC checking procedures described in Section 5.0. This information is recorded in the field logbook. This information is reviewed daily by the Project Leader who audits the accuracy and precision of the field screening instruments.

8.2 Laboratory Quality Control Checks

The Project Laboratories will have a QA/QC program that monitors data quality with internal QC checks. Internal QC checks are used to answer two questions:

1) Are laboratory operations in control, (i.e., operating within acceptable QC guidelines), during data generation?
2) What effect does the sample matrix have on the data being generated? The first question can be answered in the Laboratory Performance QC Manual. Laboratory Performance QC is based on the use of a standard, control matrix to generate precision and accuracy data that are compared, on a daily basis, to control limits. This information, in conjunction with method blank data, is used to assess daily laboratory performance.

The second question is addressed with Matrix-Specific QC. Matrix-Specific QC is based on the use of an actual environmental sample for precision and accuracy determinations and commonly relies on the analysis of matrix spikes and matrix spike duplicates. This information, supplemented with field blank results, is used to assess the effect of the matrix and field conditions on analytical data.

Laboratory Performance QC will be provided as a standard part of every routine analysis. Matrix-Specific QC will be required in per the guidance documents presented in section 5.0. A brief summary of the required QC samples follows. The type and frequency of QC samples performed by the laboratory will be according to the specified analytical method.

8.2.1 Analytical Batch (Preparation Batch)

The analytical batch is defined as a preparation batch. The analytical batch will not exceed 20 samples and is defined as a set of samples that are extracted/analyzed concurrently or sequentially. Significant gaps (greater than two hours) in the analytical sequence will result in the termination of the previous sequence and the initiation of a new analytical sequence. The analytical batch shall be analyzed sequentially on a single instrument. The practice of "holding a batch open" and performing a single set of batch QC samples for all analyses performed during that period is unacceptable.

The Laboratory shall, as a minimum, analyze internal QC samples at the frequency specified by the method and in this QAPP for all analytical methods. These QC samples for each analytical batch shall include method blanks (MB), MS/MSD analyses, and laboratory control samples (LCS). Definitions for the QC samples described above are provided in Chapter One, Update III to EPA SW-846. The matrix used for LCS analyses shall be reagent grade water for aqueous analyses and reagent sand for soil/sediment matrices.

Second column confirmation for all GC sample analyses involving identification of discrete peaks with detected concentrations will be required, as per the methods. Second column confirmation is not required for concentrations reported between the MDL and the PQL.

8.2.2 Blanks

Two types of blanks routinely analyzed in the laboratory are method blanks and reagent blanks. Method blanks and reagent/solvent blanks are used to assess laboratory procedures as possible sources of sample contamination.

X Method or preparation blanks for all samples consist of deionized water or reagent sand that is subjected to the entire analytical procedure, including extraction, distillation, digestion, etc., as appropriate for the analytical method being utilized. One method blank will be analyzed for each analytical batch (minimum of one per day, one every 12 hours for GC/MS analyses).

X Reagent/solvent blanks consist of individual reagents or solvents subjected to the entire analytical procedure as appropriate for the analytical method being utilized. The blanks are only used if contamination problems are indicated by the method blank or if a new lot of materials are being checked before use.

As part of the standard QC program, a method blank is analyzed with every batch of samples processed. A method blank consists of reagents specific to the method, which are carried through every aspect of the procedure, including preparation, clean up, and analysis. The results of the method blank analysis are evaluated, in conjunction with other QC information, to determine the acceptability of the data generated for that batch of samples. If the blank does not meet acceptance criteria, the source of contamination will be investigated and appropriate corrective action will be taken and documented. Investigation includes an evaluation of the data to determine the extent and effect of the contamination on the sample results. Corrective actions may include reanalysis of the blank and/or repreparation and reanalysis of the blank and all associated samples. No method blank may exhibit a detected concentration greater than the reporting limit. However, exceptions may be made when the analyte is not detected in the related sample. No exceptions will be made for common laboratory contaminants.

For organic and metals analyses, method blank results are reported with each set of sample results. Sample results are not corrected for blank contamination unless required by the analytical method.

8.2.3 Laboratory Control Samples

Laboratory control samples (LCS) are used as a means of evaluating the efficacy of the analytical process. As discussed above, LCS is used to generate precision and accuracy data that are compared, on a daily basis, to control limits. Laboratory control samples are subjected to the entire sample procedure, including extraction, digestion, etc., as appropriate for the analytical method utilized. They are generally introduced into an analytical batch (20 samples) immediately before extraction or analysis. LCS samples will be performed for both inorganic and organic laboratory methods.

8.2.4 Matrix Spikes and Matrix Spike Duplicates

A Matrix Spike (MS) is an environmental sample to which known concentrations of analytes have been added. The MS is taken through the entire analytical procedure and the recovery of the analytes is calculated. Results are expressed as percent recovery. The MS is used to evaluate the effect of the sample matrix on the accuracy of the analysis.

A Matrix Spike Duplicate (MSD) is a duplicate of the environmental sample described above, each of which is spiked with known concentrations of analytes. The two spiked samples are processed separately and the results compared to determine the effects of the matrix on the precision and accuracy of the analysis. Results are expressed as relative percent difference (RPD) and percent recovery (%R).

8.2.5 Surrogate Recoveries and Standard Additions

Surrogates are organic compounds which are similar to the analytes of interest in chemical behavior, but which are not normally found in environmental samples. Surrogates are added to samples to monitor the effect of the matrix on the accuracy of the analysis. Results are reported in terms of percent recovery. Laboratories routinely add surrogates to samples requiring GC or GC/MS analysis and report these surrogate recoveries to the client. The laboratory does not control its operations based on surrogate recoveries in environmental samples. The surrogate recoveries are primarily used by the laboratory to assess matrix effects. However, obvious problems with sample preparation and analysis (e.g. evaporation to dryness, leaking septum, etc.) which can lead to poor surrogate spike recoveries must be ruled out prior to attributing low surrogate recoveries to matrix effects.

Standard Additions is the practice of adding a series of known amounts of an analyte to an environmental sample. The fortified samples are then analyzed and the recovery of the analytes calculated. The practice of standard addition is generally used with metal and wet chemistry to determine the effect of the sample matrix on the accuracy of the analyses.

8.2.6 Calibration Standard

A calibration standard is prepared in the laboratory by dissolving a known amount of a purchased pure compound or standard mix in an appropriate matrix. The final concentration calculated from the known quantities is the true value of the standard. The results obtained from these standards are used to generate a standard curve and thereby quantify the compound in the environmental sample. A minimum of three calibration standards will be used to generate a standard curve for all analyses. For organic analyses, a five-point calibration curve is used.

8.2.7 Reference Standard

A reference standard is prepared in the same manner as a calibration standard or may be obtained from EPA. A reference standard is obtained from a source independent of the source of the calibration standard. The concentration of the known quantity is the "true" value of the standard. A reference standard is not carried through the same process used for the environmental samples, but is analyzed without digestion or extraction. A reference standard result is used to validate an existing concentration calibration standard file or calibration curve. The reference standard can provide information on the accuracy of the instrumental analytical method independent of various sample matrices.

8.2.8 Laboratory Performance Evaluation Samples

At a minimum the contract laboratory will participate in the following performance evaluation programs:

- California Department of Toxic Substance Control performance evaluation program
- USACE performance evaluation program

The performance evaluation samples associated with these programs are single blind (prepared by the laboratory from ambulated standards) and are associated with the regular laboratory audits performed by the referenced agencies.

9.0 PREVENTIVE MAINTENANCE

9.1 Preventive Maintenance of Field Screening Instruments

Most field instruments designed for field use operate by solid-state circuitry. Little preventive maintenance of the instruments is required, other than cleaning. Each field screening instrument has its own log book that is carried in the instrument case. Preventive maintenance actions, with the exception of battery recharging, are documented in each instrument's logbook by the equipment manager or the person conducting the maintenance in the field. Maintenance procedures for some common field instruments are described below. Specific preventive maintenance procedures will be described in SOPs.

9.1.9 FID

Preventive maintenance of the flame-ionization detector (FID) is conducted by the manufacturer at six to nine month intervals. Other preventative maintenance measures are battery charging and cleaning of the instrument.

9.1.10 PID

Preventive maintenance of the PID consists of battery charging and cleaning of the instrument. Cleaning of the ultraviolet (UV) lamp and the ion chamber is conducted on an as-needed basis, whenever the instrument behaves erratically, or shows unstable, drifting, or non-repeatable readings.

9.2 Preventive Maintenance of Laboratory Instruments

To minimize downtime and interruption of analytical work, preventive maintenance is routinely performed on each analytical instrument. Each laboratory shall have detailed SOPs on file that describes preventive maintenance procedures and schedules. All service and maintenance will be conducted by qualified laboratory staff or under service agreement with the manufacturer or their approved agent. All repairs, adjustments, and calibrations will be documented in a maintenance notebook or data sheet that will be maintained in a permanent file. The instrument notebook will clearly document the date, the problem description, corrective action taken, results of actions, and the name of the person performing the work. Table 9-1 lists common laboratory preventative maintenance parameters for laboratory instrumentation.

Table 9-1: Routine Laboratory Instrument Maintenance

Instrument	Operation	Frequency
Gas Chromatography	Change septum	Daily when used
	Change injection port liner	Daily when used
	Change column	As needed (when standard response decreases or sample carryover is noted approximately monthly)
	Bake detectors	As needed (when standard response decreases or sample carryover is noted approximately monthly)
GC/MS	Clean source	As needed (show reduced sensitivity)
Graphite Furnace Atomic Absorption Spectrometer	arm up instrument for 30 min.	Daily when used
	Digital readout values checked; check gas flows, cell alignment, wavelength, Photo multiplier voltage and lamp voltage	Daily when used
	Tygon tubing replaced	Quarterly or as needed
	Change graphite tubes and contact rings	Daily, as needed or when used
	Replace optical lens	6 months, or if deterioration is observed
Ion Chromatograph	Check filter (inlet)	Weekly
	Flush column	After each sample
	Check bed support	When specifications are off
	Clean cells	When specification are off
Balances	Calibrate by manufacturer	Annually / verify monthly
Ovens/Refrigerators	Check temperature	Daily

10.0 LABORATORY PROCEDURES USED TO ASSESS DATA QUALITY AND DETERMINE SENSITIVITY

10.1 Data Quality Assessment

The effectiveness of a QA program is measured by the quality of data generated by the laboratory. Data quality is judged in terms of its PARCC parameters as presented in Section 3.0. These terms are described as follows:

10.1.1 Precision

Precision is a measure of the reproducibility of analyses under a given set of conditions. Precision can be assessed by replicate measurements of duplicate control samples, reference materials, or environmental samples. The routine comparison of precision is measured by the relative percent different (RPD) between duplicate control sample measurements with control limits established at plus three standard deviations from the mean RPD of historical duplicate control sample data. The overall precision of a sampling event has a sampling and an analytical component. The following QC data will be collected to determine sampling and analytical precision:

- Laboratory Control Standards and duplicates (LCD/LCSD) as well as matrix spikes and matrix spike duplicates (MS/MSD) will be used as a measure the precision of the analytical process for organic analyses. LCS/LCSD and/or MS/MSD samples will be run on each batch of samples up to a maximum of 20.
- Field duplicate samples, submitted to the laboratory "blind", measure the precision of the entire measurement system including sampling and analytical procedures. Field duplicate samples will be collected at a rate of 1 per 10 primary samples.
- Laboratory duplicates will be performed for every inorganic analytical batch. The maximum size of each batch shall not exceed 20 samples.

Precision is frequently determined by comparison of replicates. The standard deviation of "n" measurements of "x" is commonly used to estimate precision. Standard deviation is calculated as follows:

$$S =$$

Where a quantity "x" (e.g., a concentration) is measure "n" times.

The relative standard deviation, which expresses standard deviation as a percentage of the applied in the case of n = 2).

$$\mathrm{RSD} = 100\ (s/\bar{x})$$

mean, is generally useful in the comparison of three or more replicates (although it may be RSD= 100 (s/)

Where: RSD = relative standard deviation

s = standard deviation

= mean

$$\mathrm{RPD} = \frac{|D_1 - D_2|}{(D_1 + D_2)} \text{ x } 200$$

In the case of duplicates, the RPD between the two samples may be used to estimate precision where:

RPD = *absolute relative percent difference*

D_1 = *first sample value*

D_2 = *second sample value (duplicate)*

Note: If the laboratory determines that failure to meet QC criteria for accuracy or precision is a result of objectively verifiable matrix effects, no further re-extractions will be required. However, the narrative must contain an explicit description of the laboratory's rationale in this regard with reference to objectively verifiable features of raw data. The sufficiency of the laboratory's explanation will be determined by the Project Manager or an appointed representative.

10.1.2 Accuracy

Accuracy is a determination of how close the measurement is to the true value. Accuracy can be assessed using laboratory control samples, standard reference materials, or spiked environmental samples. Unless specified otherwise in special contracts, the laboratory shall monitor accuracy by comparing laboratory control sample results with control limits established at plus or minus three standard deviation units from the mean of historical laboratory control sample results. The accuracy of the data submitted for this project will be assessed in the following manner:

- Accuracy for each sample will be checked by calculating surrogate percent recoveries, as applicable.
- The percent recovery of matrix spikes, matrix spike duplicates, and/or laboratory control samples will be calculated.
- The level of target compounds that are found (if any) in laboratory method blanks will be checked. If a target compound is found above the practical quantitation limit in the method blank corresponding to a batch of samples and the same target compound is found in a sample, the data will not be background subtracted but will be flagged to indicate the result in the blank.

Accuracy is presented as percent recovery. Since accuracy is often determined from spiked samples, laboratories commonly report accuracy as

$$\%\ \text{Recovery}\ \frac{R}{S}\ \text{x}\ 100$$

Where: S = *spiked concentration*

R = *reported concentration*

Note: If the laboratory determines that failure to meet QC criteria for accuracy or precision is a result of objectively verifiable matrix effects, no further re-extractions will be required. However, the narrative must contain an explicit description of the laboratory's rationale in this regard with reference to objectively verifiable features of raw data. The sufficiency of the laboratory's explanation will be determined by the Project Manager or an appointed representative.

10.1.3 Representativeness

Representativeness is a qualitative parameter that reflects the extent to which a given sample is characteristic of a given population at a specific location or under a given environmental condition. Representativeness is best satisfied by making certain that sampling locations are selected properly, a sufficient number of samples are collected, and an appropriate sampling technique is employed. Variations at a sampling point will be evaluated based on the results of field duplicates. Some samples may require analysis of multiple phases to obtain representative results. Analytical data should represent the sample analyzed regardless of the heterogeneity of the original sample matrix. Sample representativeness will also be evaluated on the basis of results from method blanks and trip blanks.

10.1.4 Completeness

Completeness is a measure of the amount of valid data obtained from a measurement system compared with the amount that was expected to be obtained under normal conditions. To be considered complete, the data set must contain all analytical results and data specified for the project. In addition, all data are compared to project requirements to ensure that specifications were met. Completeness is evaluated by comparing the project objectives to the quality and quantity of the data collected to determine if any deficiencies exist. Missing data can result from any number of circumstances ranging from sample acquisition and accessibility problems to sample breakage and rejection of analytical data because of quality control deficiencies. Completeness will be quantitatively assessed as the percent of controlled QC parameters that are within limits. The requirement for completeness for all QC parameters except holding times will be 80%. The requirement for holding times will be 100%. Any deviations are reported in the report narrative.

The percent completeness for each set of samples can be calculated as follows:

$$\textit{Completeness} = 100 \text{ x (valid data obtained)/(total data planned)}$$

10.1.5 Comparability

Comparability expresses the confidence with which one data set can be compared to another data set measuring the same property. To ensure comparability, field procedures will be standardized and field operations will adhere to standard operating procedures. Laboratory data comparability will be assured by use of established and approved analytical methods, consistency in the basis of analysis (wet weight, volume, etc.), and consistency in reporting units (ppm, ppb, etc.). Analysis of standard reference materials will follow USEPA or other standard analytical methods, which utilize standard units of measurement, methods of analysis, and reporting format.

10.2 Sensitivity

10.2.1 Method Detection Limit (MDL)

The method detection limit (MDL) is the lowest concentration at which a specific analyte in a matrix can be measured and reported with 99-percent confidence that the analyte concentration is greater than zero. MDLs are experimentally determined and verified for each target analyte of the method. Each individual instrument will maintain a current MDL study. MDLs are based on the results of seven matrix spikes at the estimated MDL and are statistically calculated in accordance with the Title 40, Code of Federal Regulations Part 136 (40 CFR 136), Appendix B. The standard deviation of the seven replicates is determined and multiplied by 3.143 (i.e., the 99-percent confidence interval from the one-sided student t-test). The MDLs are updated annually and whenever significant instrument maintenance is performed (i. e., GS Column, AA lamp, etc.)

10.2.2 Practical Quantitation Limit (PQL)

The practical quantitation limits PQL is three to ten times multiplier of the MDL and is the lowest level for quantitation decisions based on individual measurements for a given method and representative matrix. The PQL may be based on a project-specific reporting limit, a regulatory action level, or the laboratory's determined reporting limit. All detected results above the MDL but below the PQL, are qualified with a "J" flag. The "J" flag will denote the sample results as below the PQL and as qualitative, estimated concentrations.

If dilution to bring the reported concentration of a single compound of interest within the linear range of the calibration, results in non-detect values for all other analytes with detected concentrations in the initial sample analysis, the results of the original run and the dilution will be reported with appropriate notations in the narrative of the report. Matrix effects (i.e., highly contaminated samples requiring dilution for analysis, dilution to bring detected levels within the range of calibration, and matrix interference requiring elevation of detection limits) will be considered in assessing compliance with the requirements for sensitivity. The PQLs required by this project are listed in the method specific tables in section 5.0 of this document.

11.0 CORRECTIVE ACTION FOR UNACCEPTABLE QUALITY CONTROL DATA

11.1 Field Activities

All technical staff will be responsible for reporting all suspected technical nonconformance by initiating a nonconformance report of any issued deliverable or document. All staff will be responsible for reporting all suspected QA nonconformance by initiating a nonconformance report.

The Project Leader will be responsible for ensuring that corrective actions for nonconformance are implemented by:

- Evaluating all reported nonconformance;
- Controlling additional work on nonconforming items;
- Determining disposition or action to be taken;
- Maintaining a log of nonconformance;
- Reviewing nonconformance reports;
- Evaluating disposition or action taken;
- Ensure nonconformance reports are included in the final site documentation in document control.

Any staff member who discovers or suspects a nonconformance, which is an identified or suspected deficiency in an approved document, is responsible for initiating a nonconformance report. The Project Leader will ensure that no additional work, which is dependent on the nonconforming activity, is performed until the nonconformance report is corrected. The Project Leader will also be responsible for carrying out corrective action as initiated by the program QA manager. Each nonconformance report will be evaluated and the disposition and action taken will be recorded.

11.2 Laboratory

When errors, deficiencies, or out-of-control situations exist, the QA program provides systematic procedures, called "corrective actions", to resolve problems and restore proper functioning to the analytical system (see section 5.0).

Laboratory personnel are alerted that corrective actions may be necessary if:

- QC data are outside the acceptable windows for precision and accuracy;
- Blanks, duplicate control samples or single control samples contain contaminants above acceptable levels;
- Undesirable trends are detected in spike recoveries or RPD between duplicates;
- There are unusual changes in detection limits;
- Deficiencies are detected by the QA department during internal or external audits or from the results of performance evaluation samples; or
- Inquiries concerning data quality are received from clients.

Corrective action procedures are often handled at the bench level by the analyst, who reviews the preparation or extraction procedure for possible errors, checks the instrument calibration, spike and calibration mixes, instrument sensitivity, and so on. If the problem persists or cannot be identified, the matter is referred to the laboratory supervisor, manager and/or QA department for further investigation. Once resolved, full documentation of the corrective action procedure is filed with the project records.

11.3 Non-routine Occurrence Reports

The laboratory will send written reports of all significant non-routine occurrence events to the project chemist within 48 hours of occurrence of non-routine events for laboratory work. These reports will identify:

- the problem,
- corrective actions taken,
- verbal / written instructions from the USACE project chemist regarding re-extraction and reanalysis of project samples and/or other applicable corrective actions to be taken.

Significant events are occurrences impacting on cost of work, schedule of work, and quality of environmental analytical data.

12.0 REFERENCES

12.1 Environmental Protection Agency (EPA)

Test Methods for Evaluating Solid Waste, USEPA SW-846, Third Edition, (Update III), June 1998.

EPA Requirements for Quality Assurance Project Plans and Environmental Data Operations, EPA QA/R-5, Draft Interim Final, August 1994.

Guidance for the Data Quality Objectives Process, USEPA QA/G4, Final, September 1994.

National Functional Guidelines for Inorganics Data Review, USEPA Contract Laboratory Program, EPA 540/R-94/013.

National Functional Guidelines for Organic Data Review, USEPA Contract Laboratory Program, EPA 540/R-94/012.

12.2 U.S. Army Corps of Engineers (USACE)

Chemical Data Quality Management for Hazardous Waste Remedial Activities, Engineering Regulation 1110-1-263, October 1990.

Requirements for the Preparation of Sampling and Analysis Plans, Engineering Manual EM 200-1-3, 1998.

APPENDIX A

TABLE A-1A
Summary of Calibration and Internal Quality Control Procedures for SW 8015B Modified Total Petroleum Hydrocarbons

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW 8015B Modified	Total Petroleum Hydrocarbons	ICAL five point minimum	Initially and as required	% RSD ≤ 20% or r ≥ 0.95	1) Check Calculation 2) Recalibrate as necessary
		ICV	Daily, prior to sample analysis	▯25% difference from expected concentration	1) Check Calibration 2) Rerun ICV 3) Recalibrate as necessary
		CCV	After every 10 samples and end of sequence	▯15% differnece from expected concentration	1) Check Calibration 2) Rerun ICV 3) Reanalyze samples subsequent to failed CCV 4) Recalibrate as necessary
		Calibration blanks (ICV, CCB)	After each ICV and CCV	<½ PQL of applicable table	1) Rerun blank once 2) Clear system 3) Reanalyze samples back to last clear blank
		Method Blank	1 per analytical batch, not to exceed 10 samples	All analysis < ½ PQL of applicable table	1) Check calculations 2) Reanalyze blank if passes, report 3) If sample reaults are ND, no action 40 reextract and reanalyze all samples <10X the blank contamination 5) Report blank results down to the MDL

TABLE A-1A (continued)
Summary of Calibration and Internal Quality Control Procedures for SW 8015B Modified Total Petroleum Hydrocarbons

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW 8015B Modified	Total Petroleum Hydrocarbons	MS and MSD (level of spike must be less than the mid-level standard of the calibration curve)	1 MS/MSD per preparation batch	Recovery and RPD within project limits	1) Evaluate for supportable matrix effect 2) If no interference is evident, reextract and reanalyze the MS/MSD once 3) If still out, report both sets of data
		LCS (prepared with second source standard)	LCS per preparation batch	Recovery within project limits sees applicable table	1) Check calculations 2) Reanlayze LCS, if passes, report 3) If still out, reextract and reanalyze LCS and its associated samples
			Every sample, method blank, and standard	See applicable table	

Table A-1B
SW 8015B Modified Total Petroleum Hydrocarbons Quantitation Limits

Parameter	Analytical Method	Analyte	Water (mg/L)	Soil (mg/Kg)
Total Petroleum Hydrocarbons Motor Oil	8015B Modified	Gasoline (C8 - C12)	0.05	1
		Diesel (C12 - C24)	0.05.	1*
		Motor Oil (C24 – C36)	0.25	1*

Note: PQL values for soil are based on dry weight.

Table A-1C
SW 8015B Modified Total Petroleum Hydrocarbons Laboratory Control Limits for Laboratory Control Sample, Matrix Spike, Matrix Spike Duplicate, and Surrogates

Parameter	Water		Soil	
	% Recovery	RPD	% Recovery	RPD
LCS				
Gasoline Range Surrogate: 4-BFB	75-125	< 25	65-135	< 35
Diesel and Motor Oil Ranges Surrogate: o-Terphenyl	75-125	< 25	65-135	< 35
Matrix Spike/ Matrix Spike Duplicate				
Gasoline Range Surrogate: 4-BFB	75-125	< 25	65-135	< 35
Diesel and Motor Oil Ranges Surrogate: o-Terphenyl	75-125	< 25	65-135	< 35

TABLE A-2A

Summary of Calibration and Internal Quality Control Procedures for SW 8620B Volatile Organic Compounds

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action^a
SW 8260B	Volatile Organics	Check of mass spectral on intensities using BFB	Once per 12-hour shift	Ion abundance criteria as described in Method SW-8260	1) Reanalyze BFB 2) Adjust MS tune until analysis of BFB passes specifications
		Five point calibration (for all analytes)	Biannually or when calibration verification fails	1) SPCC average RF: chloromethane ▯ 0.10 1,1-dichloroethane ▯ 0.10 bromoform > 0.10 chlorobenzene ▯ 0.30 1,1,2,2-tetrachloroethane ▯ 0.30 2) RSD ▯ 30% for CCC RFs	Repeat concentrations not meeting acceptance criteria
		ICV	Daily, prior to sample analysis	± 25% difference	1) Check Calculation 2) Rerun ICV 3) Recalibrate as necessary
		CCV	After every 12 hours.	RF ≥ 0.30 (0.1 for bromoform, chloromethane and 1,1-DCA) for SPCCs; % D ≤ 20% for CCCs.	1) Check Calculation 2) Rerun ICV 3) Reanalyze samples subsequent to failed CCV 4) Recalibrate as necessary
		Method Blank	1 per analytical batch, not to exceed 20 samples	All analytes < 2 PQL	1) Check calculations 2) Reanalyze blank, if passes, report. 3) If sample results are ND, no action. 4) Reextract and reanalyze all samples < 10X the blank contamination. 5) Report blank results down to the MDL.

TABLE A-2A (Continued)

Summary of Calibration and Internal Quality Control Procedures for SW 8620B Volatile Organic Compounds

Analytical Method	Applicable Parameter	Quality Control Check	Minimum Frequency	Acceptance Criteria	Corrective Action[a]
SW 8260B	Volatile Organics	LCS (prepared with second source standard)	LCS per preparation batch	Recovery within project limits sees applicable Table.	1) Check calculations 2) Reanalyze LCS, if passes, report. 3) If still out, reextract and reanalyze LCS and its associated samples.
		MS and MSD (level of spike must be less than the mid-level standard of the calibration curve)	1 MS/MSD per preparation batch	Recovery and RPD within project limits see applicable Table.	1) Evaluate for supportable matrix effect 2) If no interference is eviden eextract dnd reanalyze MS/MSD once. 3) If still out report both sets of data.
		LCS (prepared with second source standard)	LCS per preparation batch	Recovery within project limits see applicable Table.	1) Check calculations 2) Reanalyze LCS, if passes, report. 3) If still out, reextract and reanalyze LCS and its associated samples.
		Surrogate Spike	Every sample, method blank, and standard.	See applicable Table.	

Table A-2B
SW 8260B Volatile Organic Compounds - Quantitation Limits

Analyte	**Water**	**Soil**	**Analyte**	**Water**	**Soil**
	PQL (ug/L)	**PQL (ug/Kg)**		**PQL (ug/L)**	**PQL (ug/Kg)**
Acetone	20	40	1,2-dichloropropane	10	20
Benzene	10	5	Cis-1,3-dichloropropene	10	20
Bromodichloromethane	10	20	Trans-1,3-dichloropropene	10	20
Bromoform	10	20	Ethylbenzene	10	5
Bromomethane	10	20	2- Hexanone (MEK)	10	20
2-butanone (MEK)	10	20	Methylene Chloride	10	20
Carbon disulfide	10	20	4-methyl-2-pentanone (MIBK)	10	20
Carbon tetrachloride	10	20	Methyl tertiary butyl ether (MTBE)	10	20
Chlorobenzene	10	20	Styrene	10	20
Chloroethane (ethyl chloride)	10	20	1,1,2,2-tetrachloroethane	10	20
Chloroform	10	20	Tetrachloroethyene	10	20
Chloromethane	10	20	Toluene	10	5
Dibromochloromethane	10	20	1,1,1-trichloroethane	10	20
1,2-Dichlorobenzene	10	20	1,1,2-trichloroethane	10	20
1,3-Dichlorobenzene	10	20	Trichloroethene	10	20
1,4-Dichlorobenzene	10	20	Trichlorofluoromethane (Freon 11)	10	20
Dichlorodifluoromethane (Freon 12)	10	20	1,1,2-Trichloro-1,2,2-trifluoroethane (Freon 113)	10	20
1,1-Dichloroethane	10	20	Vinyl acetate	10	20
1,2-Dichloroethane (DCA)	10	20	Vinyl chloride	10	20
1,1-Dichloroethene	10	20	Xylenes (total, all isomers)	10	5
1,2-Dichloroethene (total)	10	20			

Note: PQL values for soil are based on dry weight.

Table A-2C
RECOVERY LIMITS FOR VOLATILE ORGANIC COMPOUNDS ANALYSIS BY SW-8260B
SURROGATE RECOVERY LIMITS

Compound	% Recovery	
	Water	Soil
Toluene-d_8	75-125	65-135
4-Bromofluorobenzene	75-125	65-135
1,2-Dichloroethane-d_4	75-125	65-135

Table A-2D
Laboratory Control Limits for Laboratory Control Sample, Matrix Spike, Matrix Spike Duplicate, and Surrogates

Parameter	Water		Soil	
	% Recovery	RPD	% Recovery	RPD
1,2-Dichloroethane	75-125	25	65-135	35
Tetrachloroethylene	75-125	25	65-135	35
Benzene	75-125	25	65-135	35
Methyl Tertiary Butyl Ether(MTBE)	75-125	25	65-135	35
Toluene	75-125	25	65-135	35
Chlorobenzene	75-125	25	65-135	35

APPENDIX B