GW-52

Amended Investigation and Monitoring Plan

March 2013

ENERGY TRANSFER PARTNERS

Transwestern Pipeline Company

March 27, 2013

Mr. Glenn von Gonten
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New Mexico Oil Conservation Division
1220 South St. Francis Drive
Santa Fe, New Mexico 87505

Mr. Dave Cobrain
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New Mexico Environment Department
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Santa Fe, New Mexico 87505-6313

RE: Amended Investigation Work Plan and Groundwater Monitoring Plan
Roswell Compressor Station No. 9 Remediation Site
Transwestern Pipeline Company, LLC
Roswell, Chavez County, New Mexico
NMOCD Case # GW-052 / EPA ID NO. NMD986676955

Dear Mr. von Gonten and Mr. Cobrain:

On March 13, 2013, the New Mexico Environment Department (NMED) issued a Stipulated Order (Order) to Transwestern Pipeline Company, LLC (Transwestern) that governs corrective action activities conducted within the Project Area at Transwestern's Roswell Compressor Station No. 9. In addition, the Order indicates that the New Mexico Oil Conservation Division (NMOCD) will continue to be the lead agency for the project with the NMED providing additional review.

In accordance with the terms of Section V.D. and IX.B of the Order, a proposed scope of work is presented in the attached Amended Investigation Work Plan and Groundwater Monitoring Plan (IWP & MWP) for your review and approval. This document discusses the work items (i.e., installation and sampling of monitoring wells) required to conduct investigative activities downgradient of northern well, MW-26, and plug and abandonment of monitoring and multi-phase extraction (MPE) wells. Additionally, this *IWP* presents a proposed schedule to implement these work items.

If you have any questions or comments regarding this document, please do not hesitate to contact me at 210.870.2725 (office) or 281.740.0494 (cell).

Sincerely,

SBoultinghouse

Stacy Boultinghouse, PG(Texas 4889)
Environmental Specialist
Transwestern Pipeline Company, LLC

Attachment: Amended Investigation Work Plan and Groundwater Monitoring Plan

Xc:	Larry Campbell	Transwestern Pipeline Company (electronic via email)
	Thaddeus Kostrubala	New Mexico State Land Office (electronic via email)
	Tim Gum	NMOCD Artesia District Office (w/o attachment)

AMENDED
INVESTIGATION WORK PLAN AND GROUNDWATER MONITORING PLAN
ROSWELL COMPRESSOR STATION NO. 9
6381 NORTH MAIN STREET
ROSWELL, CHAVES COUNTY, NEW MEXICO
EPA ID NO. NMD986676955

PREPARED FOR:

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EarthCon Project No. 02.20120037.00

March 2013

Amended
Investigation Work Plan and
Groundwater Monitoring Plan
Roswell Compressor Station No. 9
6381 North Main Street
Roswell, Chaves County, New Mexico
EPA ID No. NMD986676955

Prepared For:

Transwestern Pipeline Company, LLC
711 Louisiana, Suite 900
Houston, TX 77002

March 29, 2013

EarthCon Project No. 02.20120037.00

EarthCon Consultants, Inc. is submitting to Transwestern Pipeline Company, LLC (Transwestern) this Investigation Work Plan and Groundwater Monitoring Plan Report for the Roswell Compressor Station No. 9 in Chaves County, New Mexico. This report has been prepared for the exclusive use of and reliance by Transwestern, and may not be relied upon by any other person or entity without the express written authorization of EarthCon. Any reliance, use, or re-use of this document (or the opinions, findings, conclusions, or recommendations if any represented herein), by parties other than those expressly authorized by EarthCon is at the sole risk of those parties. This report was prepared by or performed under the direction of the EarthCon Professionals listed below and approved by Transwestern.

Signed:

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Date: March 29, 2013

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EXECUTIVE SUMMARY

On behalf of Transwestern Pipeline Company, LLC., this document is being prepared as an *Amended Investigation Work Plan and Groundwater Monitoring Plan* (*IWP & GMP*) prepared by EarthCon Consultants, Inc. (EarthCon) for the northeastern corner and northern and eastern adjacent off-site lands at the Transwestern Pipeline Compressor Station No. 9 (also known as the Roswell Compressor Station) property located at 6381 North Main Street in Roswell, New Mexico. Transwestern Pipeline Company, LLC (Transwestern) owns the compressor station property, adjacent to the east of U.S. Highway 285; comprised of approximately 77 acres. In addition, Transwestern leases approximately 30 acres to the adjacent north and east of the Property from State Trust Lands.

The Facility is located in a rural area north of the City of Roswell, New Mexico. The property is bounded on the west by U.S. Highway 285 and in all other directions by State Trust Lands.

For the purposes of this *IWP*, the term "Facility" will be used to denote the entire compressor station while the term "Project Area" will be used to refer to the northeastern corner of the compressor station (approximately 3.5 acres) and the adjacent northern and eastern lands leased from the State of New Mexico Trust (approximately 30 acres).

On March 13, 2013, the New Mexico Environment Department (NMED) issued a Stipulated Order (Order) that governs corrective action activities conducted within the Project Area. Therefore, the proposed scope of work discussed in this *IWP & GWP* will be conducted in accordance of the terms of this Order and the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD) requirements. The Order indicates that the OCD will continue to be the lead agency for the project with the NMED providing additional review. The Environmental Consulting Team for Transwestern conducting this scope of work consists of EarthCon in the capacity of project management and reporting and Cypress Engineering Services, Inc. (CES) conducting field services.

The primary constituent-of-concern (COC) detected in groundwater within the Project Area is benzene. Additional COCs include toluene, ethylbenzene, xylenes (total), 1,1-dichloroethane (1,1-DCA) and 1,1-dichloroethene (1,1-DCE). In October 2012, laboratory results for groundwater samples indicated all of these COCs were measured at concentrations above the New Mexico Water Quality Control Commission (NMWQCC) standards, except for 1,1-DCA.

The purpose of this *IWP* is to document on-site and off-site investigative activities conducted to-date, present the COCs detected on the project area, discuss the remediation system currently in operation, document the work items (i.e., installation and sampling of monitoring wells) required to conduct investigative activities downgradient of MW-26, and plug and abandonment of monitoring and multi-phase extraction (MPE) wells. Additionally, this *IWP* presents a proposed schedule to implement these work items.

The focus of this *IWP* is in the vicinity of MW-26, which has historically had detections of 1,1-DCA and exceedances of 1,1-DCE above the NMWQCC standards. Downgradient monitoring wells are proposed to define the northern limit of the 1,1-DCE plume in the uppermost aquifer. Based on a plume stability evaluation conducted in 2012, several wells are no longer necessary for continued remediation activities and are proposed for plugging and abandonment. These wells include unimpacted, uppermost aquifer monitoring wells beyond the limit of the defined benzene groundwater plume, two deep, unimpacted bedrock wells, and several MPE wells. These wells include monitoring wells that have been documented to be below the NMWQCC criteria for a number of sampling events and MPE wells that are now located outside the historic groundwater plume within the Project Area.

1.0 INTRODUCTION

This document is an *Amended Investigation Work Plan* and *Groundwater Monitoring Plan* (*IWP & GWP*) prepared by EarthCon Consultants, Inc. (EarthCon) for the Transwestern Pipeline Company, LLC (Transwestern) Roswell Compressor Station No. 9 property located at 6381 North Main Street in Roswell, New Mexico (**Figure 1-1**, Site Location Map). For the purposes of this *IWP*, the term "Facility" will be used to denote the entire compressor station and "Project Area" will be used to refer to the northeastern corner of the compressor station and the adjacent land leased from the State of New Mexico Trust.

The Facility has been operating since the 1960s, and operations include natural gas compression and gas transmission line maintenance. The Facility is currently active. Until approximately 1986, transmission line maintenance waste and certain other wastes were discharged to earthen surface impoundments, referred to as Pit No. 1 and Pit No. 2 (Pits), located in the northeastern corner of the Facility (**Figure 2-2**, Project Area). The former Pits have previously been excavated and backfilled. Additionally, the former Pits and surrounding area are included in continuing corrective action.

Reportedly, wastes discharged to the former Pits contained petroleum hydrocarbons, volatile and semi-volatile organic compounds and metals. Investigations conducted at the Facility, starting in the early 1990s, identified the presence of these constituents in soil and groundwater beneath the Project Area. Corrective actions implemented at the Facility include: removal of waste from the former Pits and backfilling with clean soil (conducted in 2001); installation of a soil and groundwater remediation system (completed in 2002 / 2003), and continued operation of the remediation system, including monitoring and maintenance since March 2003. In addition, soil vapor and groundwater sampling and analysis have been conducted to assess system performance. Since 2004, these activities have been documented in annual reports submitted to the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD).

A soil vapor extraction (SVE) system was installed in 2002 / 2003 consisting of nine SVE wells, 37 Multi-Phase Extraction (MPE) wells, associated conveyance piping, and two Baker Furnace thermal oxidizer units. The SVE system was started-up on March 10, 2003. Installation of a second phase of the remediation system was completed in December 2003 with the installation of 15 pneumatic recovery pumps, water treatment equipment, and an irrigation system. Discharge Permit Modification (GW-052) was issued on June 16, 2003 for the discharge of treated groundwater. In late 2003 / 2004, a 210-barrel aboveground storage tank was introduced into the

system to act as a surge tank. The surge tank was installed between the recovery wells and the oil/water separator. Due to clogging issue, the oil/water separator was later removed from the treatment train. The surge tank provides two benefits: 1) provides for gravity separation of recovered liquids into two phases, a hydrocarbon phase and a water phase and 2) it allows more control of the flow rate into the oil/water separator. In addition, two granulated activated carbon (GAC) units were installed in series between the air stripper and the irrigation water tank to provide additional treatment of recovered groundwater. The modified recovery, treatment, and irrigation system was finally started-up for continuous operation on April 15, 2004 and has operated continuously since with the exception of brief shutdowns for repairs and maintenance. Remediation system figures are contained in **Appendix A.**

On March 13, 2013, the New Mexico Environment Department (NMED) issued a Stipulated Order (Order) that governs activities conducted within the Project Area. Therefore, the proposed scope of work discussed in this *IWP & GWP* will be conducted in accordance of the terms of this Order and OCD requirements. The Order indicates that the OCD will continue to be the lead agency for the project with the NMED providing additional review. The Project Team for Transwestern conducting this scope of work consists of EarthCon in the capacity of project management and reporting, with Cypress Engineering Services, Inc. (CES) conducting field services.

The purpose of the additional investigations proposed in this *IWP* is to delineate the northern extent of the groundwater plume identified in the Project Area, plug and abandonment (P&A) of several monitoring wells that have no current or future value (these wells do not exhibit detectable concentrations of the constituents-of-concern (COCs)) and P&A of MPE wells outside of the area impacted by the current groundwater plume. Finally, this *IWP* also summarizes the ongoing groundwater monitoring program for the Project Area.

This *IWP* is divided into eight major sections. **Section 1** contains introductory material. **Section 2** contains background information for the project. **Section 3** contains information on the regional setting of the Facility, results of subsurface investigations, and surface and subsurface conditions at the Project Area. **Section 4** summarizes the proposed scope of services for this project and **Section 5** details the field activities that will be conducted. **Section 6** discusses the anticipated monitoring and sampling program to be implemented after the investigation activities are completed. **Section 7** contains a proposed schedule for project activities and **Section 8** contains references cited in the text of this *IWP*. Tables, figures, and appendices follow the text of the *IWP*.

2.0 BACKGROUND

2.1 Site Description

The Facility is an active gas compression station located approximately 8 miles north of the city center of Roswell, New Mexico along the eastern side of U.S. Highway 285. The Facility is situated on approximately 77 acres of land in Sections 21 and 28 (T9S R24E), Chaves County, New Mexico (**Figure 1-1**). The Facility is privately owned by Transwestern, while the remainder of Sections 21 and Section 28 are State Trust Land (Glenn, 1993). The Facility is specifically located in the SW¼ of the SW¼ of Section 21 (less West ±47.98 feet) and in the NW¼ of the NW¼ of Section 28 (less West ±47.98 feet) of Township 9S and Range 24E.

Site access is via U.S. Highway 285, and the entire Facility is secured by a chain-link fence with locked gates. The Project Area is secured by a barbed wire fence. Additionally, Transwestern leases approximately 30 acres to the north, east and southeast of the Project Area/Facility on the New Mexico State Land Office (SLO) State Trust Land for remediation and monitoring purposes (**Figure 1-2**). A majority of the off-site wells are located within a fenced perimeter. The following is pertinent information regarding the Facility (DBS&A, 1997):

Facility name	Transwestern Pipeline Company Compressor Station No. 9 (aka Roswell Compressor Station)
Facility address	Transwestern Pipeline Company, LLC 6381 North Main Street P.O. Box 1717 Roswell, New Mexico 88202-1717
Telephone number	(575) 625-8022
EPA I.D. number	NMD986676955
County and state	Chaves County, New Mexico
Facility legal description	SW1/4 of the SW1/4 of Section 21, T9S R24E, NW1/4 of the NW1/4 of Section 28, T9S R24E
Latitude/Longitude of former Pits	Pit 1: N33°30'54" / W104°30'55" Pit 2: N33°30'55" / W104°30'55"
Facility elevation	Approximately 3610 feet above sea level

The Facility is located along the Transwestern natural gas pipeline that extends from Texas to the Arizona/California border. Natural gas is to and from the east through two 24-inch, bidirectional pipelines, the West Texas Lateral and the Panhandle Lateral, and enters and exits to the northwest through two 30-inch pipelines. The primary function of the compressor station is to boost the pressure of the natural gas stream by means of compressors powered by natural gas internal combustion engines. Additionally, the Facility conducts gas transmission line maintenance operations which generate waste hydrocarbons, including condensate, pigging and other wastes, which were historically discharged to the former Pits (DBS&A, 1994). Wastes generated by current maintenance activities are discharged to aboveground storage tanks at the Facility.

The Facility also includes a building that houses the district offices for Transwestern's New Mexico operations, along with an engine room, ancillary equipment, pig launcher and pigging waste handling facilities, and other ancillary buildings, including a warehouse and a repair shop (**Figure 2-1**).

Office buildings and other structures are mainly located in the western and central portions of the property. Remediation system equipment, recovery wells, and monitoring wells are located either on the northeast portion of the Facility and within its fence, or offsite within a fenced area on land leased from the New Mexico SLO.

2.2 Site History

Section III.O of the order indicates that work already satisfactory completed prior to the date of the Order may be used to fulfill the requirements of the Order. **Table 2.1** outlines the key operational, investigative and remedial events that have occurred at the Facility pertaining to the Project Area.

2.3 Conceptual Site Model

2.3.1 Overview

Figure 2-3 is a Conceptual Site Model (CSM) of the PSH and COC sources, migration pathways and potential receptors within the Project Area. The COCs, noted in soil and groundwater detected in the Project Area are the result of historic releases and are not related to current operations. Further discussion of the CSM is included in the following sections of this *IWP.*

2.3.2 Source Areas

The primary source areas are two former Pits in the northeastern corner of the Facility (**Figure 2-2**, Project Area). These former Pits allowed seepage of condensate to occur under the pits into the underlying soil and groundwater. Secondary sources of COCs include impacted subsurface soil and PSH.

2.3.3 Constituents-of-Concern

Table 2.2 documents the initial COC determination for the Project Area with associated remedial objectives. Past activities within the Project Area have focused upon the volatile organic compounds (VOCs) included on the COC list. A MPE system has been in-place within the Project Area since 2003-2004. In October 2012, laboratory results for groundwater samples indicated benzene, toluene, xylenes, total and 1,1-DCE were measured at concentrations above the New Mexico Water Quality Control Commission (NMWQCC) standards.

2.3.4 Extent of COCs in Soil

The former Pits have been excavated including waste removal and backfilling with clean soil in 2002; however, soils beneath the former Pits were found to be affected with petroleum hydrocarbons. Sidewall samples collected from each Pit excavation location indicate that the excavation successfully removed near surface soils to an acceptable concentration of Total Petroleum Hydrocarbons (TPH). Beneath the former Pits, the vertical extent of impacted soils extends from the bottom of the excavation to the uppermost aquifer at approximately 60 feet below ground surface (bgs). Due to local soil heterogeneities, it appears that VOCs have spread out along preferential pathways on top of the clay lenses at the 30- to 40-foot depth, prior to continued downward migration to the uppermost aquifer (DBS&A, 1997). The estimated areal extent of VOCs in the soil can be seen on **Figure 2-4**, Maximum Concentration of TPH in Soil.

2.3.5 Extent of COCs in Groundwater

Groundwater in the Project Area is impacted from the historic use of the former Pits, and exhibits both PSH and dissolved-phase constituents. Impacted groundwater has also been documented on off-site State-Owned land to the north and east of the northeastern corner of the Facility.

The direction of groundwater flow at the location of the former Pits is towards the north and southeast, in general relation to the topography of the Project Area. Because the former Pits are located at the northeast corner of the Facility, contaminated groundwater has migrated offsite in both flow directions (DBS&A, 1996; CES, 2010).

In 2003, the measurable thickness of PSH, present in 11 wells and the absence of PSH in all other monitoring wells, was estimated to cover an area of approximately 3.3 acres with an average PSH thickness of 1.62 feet (**Figure 2-5**). In 2012, the measurable thickness of PSH present in 14 wells was estimated to cover an area of approximately 1.7 acres with an average PSH thickness of 1.46 feet (**Figure 2-6**). The lateral extent of PSH over the last 10 years in the uppermost aquifer has decreased by 49.5%, decreasing to the north and south of the source areas as a result of the groundwater recovery, treatment and irrigation system that has been in operation since 2003/2004 (**Figure 2-7**).

The lateral extent of VOCs in the groundwater has decreased from 1996 to 2012. The benzene plume in 1996 (**Figure 2-8**) covered an area of 8.7 acres with an average plume concentration of 355 micrograms per liter (µg/L) and in 2012 (**Figure 2-9**) encompasses a large area and a small area totally approximately 4.2 acres with an average plume concentration of 133 µg/L, exceeding the NMWQCC standard of 10 µg/L. **Figure 2-10** depicts the differences in benzene concentrations and lateral extent during this 17-year period.

The BTEX plume in 1996 (**Figure 2-11**) as compared to 2012 (**Figure 2-12**) is similar to the benzene plume with the area of BTEX-impacted groundwater decreasing from 8.9 to 4.4 acres (one large and one small area) and an average concentration decreasing from 369 to 285 µg/L. **Figure 2-13** depicts the differences in BTEX concentrations and lateral extent during this 17-year period.

The 1,1-DCA plume in 1997 (**Figure 2-14**) as compared to 2012 (**Figure 2-15**) has slightly increased in size from 0.06 to 0.13 acres in an area concentrated at MW-20 and migrating to MW-26. The average concentration has remained constant during that period, ranging from 6.3 µg/L in 1997 to 5.5 µg/L in 2012; all concentrations below the NMWQCC standard of 25 µg/L. **Figure 2-16** depicts the differences in 1,1-DCA concentrations and lateral extent during this 16-year period.

The 1,1-DCE plume dynamics mirrors the 1,1-DCA plume dynamics. The 1,1-DCE plume in 1997 (**Figure 2-17**) as compared to 2012 (**Figure 2-18**) has increased in size from 0.46 to 1.6 acres in an area concentrated at MW-20 and migrating to MW-26. The average concentration has remained constant, ranging from 14.8 µg/L in 1997 to 12.2 µg/L in 2012, exceeding the NMWQCC standard of 5 µg/L. **Figure 2-19** depicts the differences in 1,1-DCE concentrations and lateral extent during this 16-year period.

2.3.6 COC Migration

Based on quarterly and semi-annual groundwater monitoring events, COC migration has occurred to the north and east of the location of former Pit 2 and to the northeast, east and southeast of the location of former Pit 1. Benzene is the most mobile COC in the Project Area; migrating approximately 865 feet southeast of the location of former Pit 1 to MW-34 (see **Figure 2-8**).

2.3.7 Receptors

Potential exposure to chemicals in environmental media depends on a number of factors related to the physical characteristics of a facility and its surroundings, including its location, surrounding land use, surface topography, drainage patterns, hydrogeology, geology, meteorology, and vegetation. Other factors include the current and possible future uses of the property, which determine the types of activities that might occur at the facility, the degree to which the facility is accessible to the general public, the amount and types of soil cover, and the mechanisms that might result in migration of chemicals to on-site populations.

In the case of the Project Area, the land use at the Facility is commercial/industrial and likely to remain commercial/industrial. The land immediately surrounding the Facility is undeveloped New Mexico SLO State Trust Land that extends across 17 sections in Township 9S and Range 24E. The land use beyond the SLO land is agricultural, commercial and residential based on a review of historical and recent aerial photographs and Chaves County Assessor's office tax plats. Agricultural properties are located to the southwest, west, north and northeast of the Facility. Commercial properties are located to the south and southeast along Highways 285 and 70 and residential properties are located no closer than 1.5 miles to the

northeast and generally lie approximately 3 miles to the south along the northern peripheries of the City of Roswell.

Residential use of the Facility or the adjacent properties impacted by the release is unlikely as:

1) The Facility is a major gas compression station that moves gas to and from Texas and New Mexico across the southwestern United States to California.

2) The area surrounding the Facility is mostly undeveloped State Trust Lands with scattered commercial and industrial businesses and this use is also unlikely to change to residential use.

3) There is currently only one groundwater supply well within one-half mile of the Project Area; completed in the San Andres Formation (regional aquifer). This well is located on the Facility, upgradient from shallow, impacted groundwater. This bedrock water supply well completion is greater than 140 feet below the impacted alluvium water-table aquifer. The alluvium aquifer under the Project Area and adjacent property is believed to be limited in lateral and vertical extent and not in communication with the lower bedrock aquifer. Refer to **Appendix B** for Banks Environmental Water Well Report documenting water wells within a two-mile radius of the Project Area.

Given these conditions and the lack of a complete groundwater pathway or the presence of residential receptors, on-site commercial/industrial workers and construction workers are considered as the most likely potentially exposed populations. As impacted soil from the two former Pits has been removed and the Pits backfilled with clean fill material, vapor intrusion and ingestion of impacted groundwater remain as potential exposure pathways of concern.

Vapor intrusion may be of concern in regards to excavation activities conducted in the vicinity of the Project Area, or within any buildings located near the Project Area. In terms of excavation activities, the depth of the impacted soil and the PSH layer make worker exposure during excavation unlikely. Additionally, during excavations in the vicinity of pipelines and/or compressor stations, air monitoring

is commonly conducted on the airspace and risks abated if detected. Therefore, worker exposure via this pathway is unlikely.

In regards to vapor intrusion into buildings, the only building in the Project Area is the metal building that houses the controls and materials for the remediation system. Access to this building is limited and the doors to the building are commonly left open when individuals are present. Therefore, worker exposure via this pathway is unlikely.

Groundwater in an alluvial aquifer is an impacted receptor in the vicinity of the two former Pits. However, the groundwater is not utilized as a drinking source. Additionally, Transwestern owns a portion of the plume area and has leased water rights on the adjacent State Land. Therefore, current or future worker exposure via ingestion of groundwater is unlikely.

Lastly, there appears to be no ecological receptors that would be impacted by the release from the former Pits. Affected surface soils were removed and replaced with clean backfill, affected groundwater is present at a depth of over 50 feet bgs and based on the shallow nature of the nearby intermittent drainage way, there is limited potential for groundwater to discharge into surface water or sediments within the intermittent drainage way. Given the depths of the impacted soil and groundwater beneath the Project Area, the release from the former Pits does not appear to be a threat to ecological receptors.

3.0 SITE CONDITIONS

3.1 Surface Conditions

The Facility is located approximately 7 miles west of the Pecos River within the Pecos Valley drainage basin (**Figure 1-1**). The entire area west of the Pecos River is generally referred to as the West Pecos Slope (Kelley, 1971), which rises westward from elevations of about 3,300 feet mean sea level (MSL) at the Pecos River to over 10,000 feet MSL in the Capitan Mountains some 50 miles to the west. Local topography is generally of low relief.

The mean annual precipitation as measured at the Roswell Municipal Airport for a 23-year period was 9.82 inches (DBS&A, 1997). The majority of the precipitation occurs in July and August during frequent summer thunderstorms (DBS&A, 1997). Tributary surface streams drain

west to east toward the Pecos River; however, the drainage near the Project Area are commonly dry, and only flow on an intermittent basis. The depths of the remaining impacts to soil and groundwater and the lack of consistent surface water indicate that the release from the former Pits is unlikely to have impacted surface water.

3.2 Subsurface Conditions

The Facility lies within the northernmost portion of the Roswell hydrologic basin. The basin is structurally controlled by eastward-dipping carbonate and evaporates sequences of Permian age which were uplifted during the Tertiary period during the development of the Sacramento and Guadalupe Mountains along the western margin of the basin (Kelley, 1971). Eastward flowing tributaries originating in the western highlands have deposited Quaternary alluvium over the Permian age rocks west of the Pecos River.

Because the average dip of the Permian rocks is greater than the slope of the land surface, progressively younger units are encountered eastward toward the Pecos River. Several prominent northeast trending ridges and hills interrupt the gently sloping plains near the Facility. These structures are narrow fault zones referred to as the Border Hills, Six-Mile Hill, and the Y-O faulted anticlines.

The stratigraphic units of importance with regard to water resources are, in ascending order, the San Andres Formation (Permian), the Artesia Group (Permian), and the undifferentiated Quaternary valley fill alluvium. **Figure 3-1** shows the generalized stratigraphy in the vicinity of the Facility. Groundwater is produced from both a shallow water-table aquifer (alluvium) and a deeper artesian aquifer that includes the two bedrock units (Welder, 1983). The deep bedrock aquifer is commonly known as the Roswell artesian aquifer. According to the State Engineer Office (SEO), approximately 400,000 acre-feet of water are pumped annually from the two aquifers of the Roswell hydrologic basin (DBS&A, 1992). The two aquifers are separated by a semi-confining layer, but are connected where the carbonate aquifer rises structurally to meet the shallow aquifer. Both aquifers are recharged along surface exposures on the slopes to the west and are believed to discharge to the Pecos River at the eastern margin of the basin.

The Quaternary valley fill in the Roswell area was deposited by shifting streams flowing from the west toward the Pecos River. The valley fill consists of poorly to moderately consolidated deposits of gravel, sand, and clay which mantle the underlying Permian rocks. The thickness of

alluvial sediments varies considerably from one locality to another because of the irregular bedrock erosional surface upon which the alluvium was deposited. In some areas the alluvial fill is moderately well cemented (DBS&A, 1997).

The thickness of the shallow alluvial aquifer is shown on **Figure 3-5** for the northern portion of the Roswell Basin. Lyford (1973) developed the thickness (isopach) map after examination of drill cuttings from 225 wells penetrating the valley fill. Lyford's map indicates that the alluvium near the Facility is generally less than 50 feet thick. In other areas, however, the thickness can exceed 250 feet thick where the alluvium fills depressions in the underlying bedrock surface. SEO well records from 1992 indicate that the alluvium near the Facility is approximately 70 feet thick (DBS&A, 1992).

The alluvial sediments underlying the Facility, as observed in borings drilled during several investigations, consist predominantly of interbedded cobbles, gravel, sand, silt, and clay to depths of approximately 70 feet bgs (DBS&A, 1997). The finer-grained zones form lenticular beds which appear to be discontinuous across the Facility. Some of the alluvial deposits are firmly cemented in some places. These lithologic descriptions are consistent with Lyford's descriptions of the valley fill (DBS&A, 1997). Generalized hydrogeologic cross sections of the sediments underlying the former Pits are depicted on **Figure 3-2**; Cross Section A - A' is constructed along an east-west line (**Figure 3-3)** and Cross Section B - B' is constructed along a north-south line (**Figure 3-4)**.

The hydrogeology underlying the Facility is as follows:

- From ground surface to depths of approximately 30 to 35 feet bgs, brown gravelly sands and clays are present. Perched water has occasionally been encountered within the bottom few feet of this interval (DBS&A, 1997).
- At depths of approximately 35 to 60 feet bgs, light brown to reddish-colored interbedded silts, sands, and clays are encountered. The fine-grained clay lenses serve as perching layers for the downward moving fluids and likely represent interfingering deposits of limited lateral extent (DBS&A, 1997).
- At depths of approximately 60 to 70 feet bgs, saturated silty sands and sands are present. This zone is referred to as the uppermost aquifer (DBS&A, 1997).
- At approximately 70 feet bgs, red plastic clay is present. This unit probably represents the transition from the Quaternary alluvium to the Permian-age bedrock of the Artesia Group (DBS&A, 1997).

- At approximately 92 feet bgs, the upper boundary of the San Andres Formation is indicated by SEO well records for wells near the Facility (DBS&A, 1997); however the top of a water-bearing zone on the Project Area has been encountered at depths of 122 to 152 feet bgs and appears to be within the Artesia Group.
- Based on MW-23D, drilled to a depth of 194 feet bgs, the water-bearing limestone unit of the San Andres Formation is not encountered until 175 feet bgs on the Project Area.

The principal water-bearing zones of sands and gravels are separated by less permeable lenses of silt and clay. According to Welder (1983), one to five water-bearing zones exist within the valley fill, and in many areas the alluvium is hydraulically connected to the upper bedrock units of the Artesia Group. The perimeter of the shallow alluvial aquifer is generally bounded by a margin of less permeable alluvium. Shallow groundwater conditions in the alluvium at the Project Area are shown on the groundwater surface elevation map of the Uppermost Aquifer, measured on October 15. 2012 (**Figure 3-6**).

Poor water quality is encountered in the shallow alluvial aquifer from slightly south of the Facility northward and is due to the presence of gypsum beds of the Fourmile Draw member at the base of the alluvium. Because of the poor water quality and the low yields, most wells completed in the shallow alluvium are used primarily as livestock water supplies. In general, the chloride content of water in the shallow aquifer increases from west to east and ranges from 20 milligrams per liter (mg/L) to 3700 mg/L (Welder, 1983). The presence of gypsum beds results in objectionably high calcium and sulfate concentrations in the shallow alluvial aquifer in the vicinity of the Facility and northward (DBS&A, 1997). Sulfate concentrations are typically in the range of 2,000 to 3,000 mg/L, which is approximately equal to the equilibrium saturation concentration for groundwater in direct contact with gypsum ($CaSO_4 \cdot 2H_20$). Thus, background sulfate concentrations in this area are four to five times above the NMWQCC groundwater standard for sulfate of 600 mg/L (DBS&A, 1997). The poor water quality in the alluvium is consistent with the high total dissolved solids (TDS) concentrations reported for groundwater from the on-site monitoring wells (DBS&A, 1997).

4.0 SCOPE OF WORK

The scope of work for this project includes the following tasks:

- Placement of four, 70-foot deep monitoring wells north of MW-26 to monitor horizontal groundwater conditions and delineate COCs in that direction (**Figure 2-2**);

- P&A of nine shallow monitoring wells, two deep monitoring wells and six MPE wells in the Project Area that either no longer exhibit COCs above the remedial objectives, or are no longer within the area of groundwater impacted by COCs (**Figure 2-2**);
- Continued groundwater monitoring/sampling for remedial system effectiveness and plume stability in the Project Area;
- Reporting results of the field investigation activities; and,
- Continue reporting results of groundwater monitoring/sampling.

If during the course of site activities it becomes apparent that additional tasks will be required, the *IWP & GWP* will be amended and the tasks preformed in accordance with the methods and standards contained within this document.

5.0 INVESTIGATIVE METHODS

The current groundwater monitoring network consists of 34 wells completed within the uppermost aquifer and three wells completed within the deeper regional aquifer (**Figure 2-2**). Proposed modifications to the groundwater monitoring system, to include well installations and P&A, will be submitted to the State Engineer and the OCD for review and approval prior to commencement of field operations. Four additional monitoring wells are currently proposed to the north of MW-26, to define the extent of COCs in the uppermost aquifer in that direction. Wells no longer required for monitoring the Project Area (including nine shallow monitoring wells and two deep monitoring wells) will be P&A in accordance with the appropriate procedures. Finally, Transwestern proposes to abandon six MPE wells in Circuit A as the wells at these locations no longer exhibit PSH or concentrations of COCs that cannot be addressed by natural attenuation.

5.1 Soil Boring and Sampling

Table 5.1 summarizes the locations of the borings for the proposed monitoring wells. **Figure 2-2** illustrates those locations, as well as those monitoring wells and MPE wells proposed for P&A. The proposed borings will be advanced using nominal 6-inch hollow stem augers (HSA) to an approximate depth of 70 feet below grade (bg), or ten feet below the water table. As these locations are outside of the source areas and expected to be borings not impacted by COCs, the locations will

be direct bored to 50 feet bg. Soil samples will be collected from approximately 50 feet bg to the bottom of the boring on a continuous basis in order to log the aquifer in these locations.

The HSA continuous flight auger consists of a hollow, steel shaft with a continuous, spiraled steel flight welded onto the exterior site of the stem. The stem is connected to an auger bit and, when rotated, transports cuttings to the surface. The hollow stem of the auger allows drill rods, split-spoon core barrels, Shelby tubes, and other samplers to be inserted through the center of the auger so that samples may be retrieved during the drilling operations.

The augers also act to temporarily case the borehole, so that the well screen and casing (riser) may be inserted down through the center of the augers once the desired depth is reached, minimizing the risk of possible collapse of the borehole. A bottom plug or pilot bit can be fastened onto the bottom of the augers to keep out most of the soils and/or water that have a tendency to clog the bottom of the augers during drilling. Drilling without a center plug is acceptable provided that the soil plug, formed in the bottom of the auger, is removed before sampling or installing well casings. The soil plug can be removed by washing out the plug using a side discharge rotary bit, or by drilling out the plug with a solid-stem auger bit sized to fit inside the hollow augers. In situations where heaving sands are a problem, potable water may be poured into the augers to equalize the pressure so that the inflow of formation materials and water will be held to a minimum when the bottom plug is removed.

Drilling equipment will be in good working condition and capable of performing the assigned task. Drilling equipment will be properly decontaminated before drilling the first boring, and prior to drilling each subsequent boring. Downhole sampling equipment will be decontaminated between each discrete sampling interval.

If conditions arise or are encountered that do not allow the advancement of borings to the depths approved by the OCD and NMED or sampling at locations specified in this *IWP*; then as early as practicable the OCD and NMED will be notified and alternative actions will be discussed between the parties.

The drilling and sampling will be accomplished under the direction of a qualified engineer or geologist who will maintain a detailed log of the materials and conditions encountered in each boring. Both sample information and visual observations of the cuttings and core samples will be recorded on the boring log. Known site features and/or site survey grid markers will be used as references to locate each boring prior to surveying the location as described in **Section 5.3** of this

IWP. The boring locations will be measured to the nearest foot, and locations will be recorded on a scaled site map upon completion of drilling activities.

Relatively undisturbed discrete soil samples will be obtained below 50 feet bg during the advancement of each boring for the purpose of logging and field screening purposes. A decontaminated split-spoon sampler lined with brass sleeves, a coring device, or other method approved by the OCD and NMED will be used to obtain samples during the drilling of each boring. One soil sample will be collected at the soil-water interface and submitted for laboratory analytical testing for VOCs using EPA Method SW846-8260B.

Samples obtained from all exploratory borings will be visually inspected and the soil or rock type classified in general accordance with ASTM (American Society for Testing and Materials) D2487 (Unified Soil Classification System) and D2488 and/or AGI (American Geological Institute) Methods for soil and rock classification. Detailed logs of each boring will be completed in the field by a qualified engineer or geologist. Additional information, such as the presence of water-bearing zones and any unusual or noticeable conditions encountered during drilling, will be recorded on the logs. Field boring logs and field well construction diagrams will be submitted to the OCD and NMED as a portion of a site-specific investigation, remediation, and/or monitoring report.

Samples obtained from the borings will be screened in the field for evidence of the potential presence of COCs. Field screening results will be recorded on the exploratory boring logs. Field screening results will be used as a general guideline to confirm the nature and extent of possible COCs in soil from samples previously obtained from the Project Area.

The primary screening methods to be used will include the following: (1) visual examination and (2) headspace vapor screening for VOCs. Visual screening will include examination of soil samples for evidence of staining caused by petroleum-related compounds or other substances that may cause staining of natural soils.

Headspace vapor screening targets VOCs and involves placing a soil sample in a plastic sample bag or a foil sealed container allowing space for ambient air. The container will be sealed and then shaken gently to expose the soil to the air trapped in the container. The sealed container will be allowed to rest for a minimum of 5 minutes while vapors equilibrate. Vapors present within the sample bag's headspace will then be measured by inserting the probe of the instrument in a small opening in the bag or through the foil. The maximum value and the ambient air temperature will be recorded on the field boring log for each sample. The monitoring instruments will be calibrated

to the manufacturer's standard for instrument operation. A photo-ionization detector (PID) equipped with a 10.6 or higher electron volt (eV) lamp or combustible gas indicator will be used for VOC field screening.

Field screening results are site- and boring-specific and the results vary with instrument type, the media screened, weather conditions, moisture content, soil type, and type of contaminant; therefore, all conditions capable of influencing the results of field screening will be recorded on the field logs. The conditions potentially influencing field screening results will be submitted to the OCD and NMED as part of the site-specific investigation, remediation and/or monitoring reports.

Soil from drilling cuttings and samples will be handled and disposed of in an appropriate manner. As these boring locations are outside of the area impacted by COCs, cuttings from the top 50 feet of the borings will be collected and spread in the area around the boring. Cuttings and samples from below 50 feet bg will be placed on and covered by plastic, or contained in a 55 gallon drum, at the boring location. A waste characterization sample will be collected from each soil pile and analyzed for toxicity characteristic leaching procedure (TCLP) VOCs. These soils may be spread around the boring location if VOCs are not detected, or disposed of in an appropriate manner if VOCs are detected depending upon the results of the laboratory analyses.

5.2 Monitoring Well Installation and Development

Table 5.2 summarizes the construction details for the four proposed monitoring wells. Groundwater monitoring wells will be constructed in a manner that will yield groundwater samples, last the duration of the project, and not serve as a conduit for contaminants to migrate between different stratigraphic units or aquifers. The design and construction of groundwater monitoring wells will generally comply with the guidelines established in various EPA RCRA guidance, including, but not limited to:

1. U.S. EPA, RCRA Groundwater Monitoring: Draft Technical Guidance, EPA/530-R-93-001, November 1992;
2. U.S. EPA, RCRA Groundwater Monitoring Technical Enforcement Guidance Document, OSWER-9950.1, September 1986; and,
3. Aller, L., Bennett, T.W., Hackett, G., Petty, R.J., Lehr, J.H., Sedoris, H., Nielsen, D.M., and Denne, J.E., Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells, EPA 600/4-89/034, 1989.

The borehole will be bored, drilled, or augered as close to vertical as possible, and checked with a plumb bob, level, or appropriate downhole logging tool. Using a 6-inch ID HSA, a minimum two-inch annular space is available between the casing and the HSAs. The two-inch annular space around the casing will allow the filter pack, bentonite seal, and annular grout to be placed at an acceptable thickness. Also, the two-inch annular space will allow up to a 1.5-inch outer diameter tremie pipe to be used for placing the filter pack, bentonite seal, and grout at the specified intervals.

It may be necessary to overdrill the borehole so that any soils that have not been removed (or that have fallen into the borehole during augering or drill stem retrieval) will fall to the bottom of the borehole below the depth where the filter pack and well screen are to be placed. Normally, three to five feet is sufficient for overdrilling shallow wells. Deep wells may require deeper overdrilling. The borehole may also be overdrilled to allow for an extra space for a well sump to be installed. If the borehole is overdrilled deeper than desired, it may be backfilled to the designated depth with bentonite pellets or the filter pack. Immediately prior to well construction, the total depth of the borehole will be determined using a weighted steel tape or tag line.

In accordance with the design of past monitoring wells on the Facility, the proposed monitoring wells will be constructed of 2-inch diameter schedule 40 PVC pipe and will include, in ascending order, a flush-threaded silt trap (sump) at the bottom, 15 to 30 feet of flush-threaded 0.010-inch machine-slotted PVC screen, and blank casing from the top of the screen to ground surface. No more than 15 feet of screen will be installed below the water table.

The well casings (riser assembly) will be secured to the well screen by flush-jointed threads or other appropriate connections and placed into the borehole and plumbed by the use of centralizers, a plumb bob, or a level. No petroleum-based lubricating oils or grease will be used on casing threads. Teflon tape or Teflon “O” rings may be used to insure a tight fit and minimize leakage. No glue of any type will be used to secure casing joints.

Before the well screen and casings are placed at the bottom of the borehole, at least six inches of filter material will be placed at the bottom to serve as a firm footing. The string of well screen and casing will then be placed into the borehole and plumbed. If centralizers are used, they will be placed below the well screens and above the bentonite annular seals so that the placement of the filter pack, overlying bentonite seal, and annular grout will not be hindered. If installing the well screen and casings through hollow-stem augers, the augers will be slowly extracted as the filter pack, bentonite seal, and grout are tremied or poured into place. The gradual extraction of the

augers allows the materials being placed in the augers to flow out of the bottom of the augers into the borehole.

Once the well casing has been lowered to the bottom of the borehole, a filter pack consisting of 12-20 silica sand will be poured down the annulus of the auger in a maximum of 3-foot lifts. This will ensure at least two inches of filter pack material is installed between the well screen and the borehole wall. After each 3-foot interval is filled, the augers will be pulled up approximately the same distance. This procedure will be repeated until the filter pack level is approximately 2 feet above the top of the screened section. The filter pack will be installed in a manner that prevents bridging and particle-size segregation. Filter packs placed below the water table will be installed by the tremie pipe method. Filter pack materials will not be poured into the annular space unless the well is shallow (e.g., less than 30 feet deep) and the filter pack material may be poured continuously into the well without stopping.

The precise volume of filter pack material required will be calculated and recorded before placement, and the actual volume used will be determined and recorded during well construction. Any significant discrepancy between the calculated and actual volume will be documented in the field notebook.

The annular space between the well casing and the borehole will be properly sealed to prevent cross-contamination of samples and the groundwater. The materials used for annular sealants will be chemically inert with respect to the highest concentration of chemical constituents expected in the groundwater at the Project Area. The permeability of the sealing material will be one to two orders of magnitude lower than the least permeable parts of the formation in contact with the well. The precise volume of annular sealants required will be calculated and recorded before placement, and the actual volume will be determined and recorded during well construction. Any significant discrepancy between the calculated volume and the actual volume will be documented in the field notebook.

The annular seal on top of the filter pack will consist of a high solids (10-30 percent) bentonite material in the form of bentonite pellets, granular bentonite, or bentonite chips. The bentonite seal will be placed in the annulus through a tremie pipe if the well is deep (greater than 30 feet), or by pouring directly down the annulus in shallow wells (less than 30 feet). If the bentonite materials are poured directly down the annulus (which is an acceptable method only in wells less than 30 feet deep), a tamping device will be used to ensure that the seal is emplaced at the proper depth and the bentonite has not bridged higher in the well casing. The bentonite seal will be placed

above the filter pack a minimum of two feet vertical thickness. The bentonite seal will be allowed to completely hydrate in conformance with the manufacturer's specifications prior to installing the overlying annular grout seal. The time required for the bentonite seal to completely hydrate will differ with the materials used and the specific conditions encountered, but generally a minimum of four to 24 hours is required.

A grout seal will be installed on top of the filter pack annular seal. The grout seal may consist of a high solids (30 percent) bentonite grout, a neat cement grout, or a cement/bentonite grout consisting of approximately 3 percent bentonite by weight. The grout will be pumped under pressure (not gravity fed) into the annular space by the tremie pipe method, from the top of the filter pack annular seal to within a few feet of ground surface. The tremie pipe will be equipped with a side discharge port (or bottom discharge for grouting at depths greater than 100 feet) to minimize damage to the filter pack or filter pack annular bentonite seal during grout placement. The grout seal will be allowed to cure for a minimum of 24 hours before the concrete surface seal and surface pad are installed at the ground surface. All grouts will be prepared in accordance with the manufacturer's specifications. High solids (30 percent) bentonite grouts will have a minimum density of ten pounds per gallon (as measured by a mud balance) to ensure proper setup. Cement grouts will be mixed using six and one-half to seven gallons of water per 94-pound bag of Type I Portland cement. Bentonite (five to ten percent) may be added to delay the setting time and reduce the shrinkage of the grout.

Monitoring wells will be completed as flush-mounted wells. A surface seal will be installed over the grout seal and extended vertically up the well annulus to the land surface. The lower end of the surface seal will extend a minimum of one foot below the frost line to prevent damage from frost heaving. The composition of the surface seal will be neat cement or concrete. A three-feet wide, four-inch thick concrete surface pad will be installed around the well at the same time the protective structure such as a utility vault or meter box is installed around the well casing. The surface pad will be sloped so that drainage will flow away from the utility vault and off the pad. A minimum of one inch of the finished pad will be below grade or ground elevation to prevent washing and undermining by soil erosion. In addition, measures will be taken to prevent the accumulation of surface water in the protective structure and around the well intake. These measures include, but are not limited to, outfitting the protective structure with a steel lid or manhole cover that has a rubber seal or gasket, and ensuring that the bond between the cement surface seal and the protective structure is watertight.

A bolted down flush-mounted lid will be installed above the well casing (riser) to prevent damage or unauthorized entry. A cap will be placed on the well riser to prevent tampering or the entry of foreign materials.

Monitoring wells will be developed to create a filter pack around the well screen, correct damage to the formation caused by drilling, remove fine particles from the formation near the borehole, and assist in restoring the natural water quality of the aquifer in the vicinity of the well. Newly installed monitoring wells will not be developed for at least 48 hours after the surface pad and outer protective casing are installed, allowing sufficient time for the well materials to cure before the development procedures are initiated. A new monitoring well will be developed until the column of water in the well is free of visible sediment, and the pH, temperature, turbidity, and specific conductivity have stabilized. If the water remains turbid, continuous flushing over a period of several days may be necessary to complete the well development. If the well is pumped dry, the water level will be allowed to sufficiently recover before the next development period is initiated. Well development methods and equipment that alter the chemical composition of the groundwater will not be used.

If water is introduced to a borehole during well drilling and completion, then the same or greater volume of water will be removed from the well during development. In addition, the volume of water withdrawn from a well during development will be recorded. Water from development activities will be collected from each developed well and placed in the surge tank for the MPE system, with the water treated through air stripping and discharged through the irrigation system.

All information on the design, construction, and development of each monitoring well will be recorded in a field notebook and presented on a boring log, a well construction log, and/or well construction diagram. The well construction log and well construction diagram will include the following information:

1. Well name/number;
2. Date/time of well construction;
3. Borehole diameter and well casing diameter;
4. Well depth;
5. Casing length;
6. Casing materials;
7. Casing and screen joint type;
8. Screened interval(s);

9. Screen materials;
10. Screen slot size and design;
11. Filter pack material and size;
12. Filter pack volume (calculated and actual);
13. Filter pack placement method;
14. Filter pack interval(s);
15. Annular sealant composition;
16. Annular sealant placement method;
17. Annular sealant volume (calculated and actual);
18. Annular sealant interval(s);
19. Surface sealant composition;
20. Surface seal placement method;
21. Surface sealant volume (calculated and actual);
22. Surface sealant interval;
23. Surface seal and well apron design and construction;
24. Well development procedure and turbidity measurements;
25. Well development purge volume(s) and stabilization parameter measurements;
26. Type and design and construction of protective casing;
27. Well cap and lock;
28. Ground surface elevation;
29. Survey reference point elevation on well casing;
30. Top of monitoring well casing elevation; and,
31. Top of protective steel casing elevation.

5.3 Surveying

The surface coordinates and elevation of each boring, the top of each monitoring well casing, and the ground surface at each monitoring well location; and the locations of other pertinent structures will be determined by a registered New Mexico professional land surveyor in accordance with the State Plane Coordinate System (NMSA 1978 47-1-49-56 (Repl. Pamp. 1993)). Surveying will be conducted in accordance with Sections 500.1 through 500.12 of the Regulations and Rules of the Board of Registration for Professional Engineers and Surveyors Minimum Standards for Surveying in New Mexico. Horizontal positions will be measured to the nearest 0.1 ft, and vertical elevations will be measured to the nearest 0.01 ft. Site map(s), certified by a registered New

Mexico professional land surveyor will be prepared, presenting all surveyed locations and elevations including relevant site features and structures for submittal with all associated reports to the OCD and NMED.

5.4 Groundwater Gauging and Sampling

The four proposed monitoring wells will be included within the amended *Groundwater Monitoring Plan (GWMP)* for the Project Area outlined in **Section 6.0** of the *IWP*. Groundwater levels and PSH thickness measurements will be obtained upon well installation and during the biannual sampling events conducted in April and October of each year. Measurement data and the date and time of each measurement will be recorded in the field notebook and on a site monitoring data sheet. The depth to groundwater and PSH thickness levels will be measured to the nearest 0.01 ft. The depth to groundwater and PSH thickness will be recorded relative to the surveyed top of casing or other surveyed datum. A corrected water table elevation will be provided in wells containing PSH by adding 0.76 times the measured PSH thickness to the calculated water-table elevation. The 0.76 is the true specific gravity of the PSH based on analysis. Groundwater and PSH levels will be measured in all wells within 48 hours of the start of obtaining water-level measurements. Automated and manual extraction of PSH and water from recovery wells, observation wells, and collection wells will be discontinued for 48 hours prior to the measurement of groundwater levels and PSH thickness.

Each monitoring well to be sampled will be purged prior to sampling in order to ensure that formation water is being sampled. The NMED requires that water chemistry stabilization will be determined by monitoring, at a minimum, general chemistry parameters: groundwater pH, specific conductance, dissolved oxygen concentrations, oxidation-reduction potential (ORP) and temperature during purging of groundwater. Field water-quality parameters will be compared to historical data to determine if the measurements are indicative of formation water.

The volume of groundwater purged, the instruments used, and the readings obtained at each interval will be recorded on the field-monitoring log. Water samples may be obtained from the well after the measured parameters of the purge water have stabilized to within ten percent for three consecutive measurements. Well purging may also be conducted in accordance with the NMED's Position Paper Use of Low-Flow and other Non-Traditional Sampling Techniques for RCRA Compliant Groundwater Monitoring (October 30, 2001, as updated). A written request

for a variance from the described methods of well purging for individual wells may be submitted to the OCD and NMED for approval no later than 90 days prior to scheduled sampling activities.

Groundwater samples will initially be obtained from newly constructed monitoring wells no later than five days after the completion of well development. The monitoring wells scheduled for sampling during a groundwater sampling event will be sampled within 15 days of the start of the monitoring and sampling event. All requests for variances from the groundwater sampling schedule will be submitted to the OCD and NMED in writing, at least 30 days prior to the start of scheduled monitoring and sampling events.

Groundwater samples will be analyzed for BTEX using EPA Method SW846-8021B for all monitoring wells with the exception of seven wells (MW-20, MW-22, MW-26 and MW-39 - MW-42) which will be analyzed for VOCs using EPA Method SW846-8260B. General chemistry parameters are not part of the current groundwater monitoring program and will only be sampled on an as-needed basis with prior notification and approval from the OCD and NMED.

Groundwater samples will be obtained using methods approved by the NMED within 24 hours of the completion of well purging. The groundwater samples will be transferred to the appropriate, clean, laboratory-prepared containers provided by the analytical laboratory. Sample handling, chain-of-custody, and decontamination procedures will be established for reusable water sampling equipment as described in the Quality Assurance Project Plan (QAPP) contained in **Appendix C**.

Purged groundwater and decontamination water will be collected and placed in the surge tank for the remediation system prior to treatment by that system. Disposable materials will be handled as described in **Appendix C**.

At a minimum, the following procedures will be used when collecting groundwater samples during investigation, corrective action, and monitoring activities:

1. Neoprene, nitrile, or other protective gloves will be worn when collecting samples. New disposable gloves will be used to collect each sample;
2. Samples collected for chemical analysis will be transferred into clean sample containers supplied by the project analytical laboratory. Sample container volumes and preservation methods will be in accordance with the most recent standard EPA and industry accepted practices for use by accredited analytical laboratories. Sufficient sample volume will be obtained for the laboratory to complete the method-specific quality control (QC) analyses on a laboratory-batch basis; and,

3. Sample labels and documentation will be completed for each sample. Immediately after the samples are collected, they will be stored in a cooler with ice or other appropriate storage method until they are delivered to the analytical laboratory. Standard chain-of-custody procedures, as described in **Appendix C**, will be followed for all samples collected. Samples will be submitted to the laboratory with enough time to allow the laboratory to conduct the analyses within the method holding times. Groundwater will be submitted to the laboratory within 48 hours after their collection.

Sample container shipment procedures will include the following:

1. Individual sample containers will be packed to prevent breakage and transported in a sealed cooler with ice or other suitable coolant or other EPA or industry-wide accepted method. The drainage hole at the bottom of the cooler will be sealed and secured in case of sample container leakage. Temperature blanks will be included with each shipping container;
2. Each cooler or other container will be delivered directly to the analytical laboratory via bus service from Roswell to Albuquerque, New Mexico;
3. Glass bottles will be separated in the shipping container by cushioning material to prevent breakage;
4. Plastic containers will be protected from possible puncture during shipping using cushioning material;
5. The chain-of-custody form and sample request form will be shipped inside the sealed storage container to be delivered to the laboratory;
6. Chain-of-custody seals will be used to seal the sample-shipping container in conformance with EPA protocol; and,
7. Signed and dated chain-of-custody seals will be applied to each cooler prior to transport of samples from the Facility.

Water from groundwater sampling activities will be collected from each sampled well and either discharged in an area away from the well (if the well has historically been unimpacted) or placed in the surge tank for the MPE system, with the water treated through air stripping and discharged through the irrigation system.

5.5 Monitoring and Recovery Well Abandonment

Table 5.3 is a table listing the proposed locations and rational for wells to be P&A in the Project Area. Proposed wells to be P&A include nine shallow monitoring wells: MW-5, MW-6, MW-8, MW-9, MW-18, MW-19, MW-31, MW-36 and MW-38 at total well depths ranging from 68 feet to 79 feet below ground surface (bgs); two deep monitoring wells: MW-23D and MW-25D at total well depths of 176 and 150 feet bgs, respectively; and six MPE wells: MPE-1 through MPE-6 at total well depths ranging from 71.7 to 78.3 feet bgs.

P&A methods and certification will be conducted in accordance with Rules and Regulations Governing Well Driller Licensing; Construction, Repair and Plugging of Wells [19.27.4 NMAC].

Notification of monitoring well P&A will require a well abandonment plan submitted to the OCD and NMED and intent to P&A monitoring wells will also require a separate notification to the New Mexico State Engineers Office. All notifications are to be submitted no less than 30 days prior to the date the wells are removed from the monitoring program.

The preferred method for well abandonment is to completely remove the well casing and screen from the borehole, overdrill the borehole, and backfill with a cement or bentonite grout, neat cement, or concrete. For wells with small diameter casing, abandonment may be accomplished by overdrilling the well with a large diameter hollow-stem auger. After the well has been overdrilled, the well casing and grout may be lifted from the ground with a drill rig, and the remaining filter pack can be drilled out. The open borehole can then be pressure grouted via a tremie pipe from the bottom of the borehole to the ground surface. After the grout has cured, the top two feet of the borehole may be filled with concrete to insure a secure surface seal.

Several other well abandonment procedures are available for wells with larger diameter screens and casings and may be used as necessary. One method is to force a drill stem with a tapered wedge assembly or a solid-stem auger into the well casing and pull the casing out of the ground. However, if the casing breaks or the well cannot be pulled from the ground, the well will have to be grouted in place. To abandon a well in place, a tremie pipe will be placed at the lowest point in the well (at the bottom of the screen or in the well sump). The entire well is then pressure grouted from the bottom of the well upward. The pressurized grout will be forced out through the well screen into the filter pack and up the inside of the well casing sealing off all breaks and holes in the casing. Once the well is grouted, the casing is cut off even with the ground surface and covered with concrete.

If a PVC well cannot be abandoned due to internal casing damage (e.g., the tremie pipe cannot be extended to the bottom of the screen), it may be necessary to drill out the casing with a roller cone or drag bit using the wet rotary drilling method, or grind out the casing using a solid-stem auger equipped with a carbide tooth bit. Once the casing is removed, the open borehole can be cleaned out and pressure grouted from the bottom of the borehole upward.

Every attempt will be made to remove the entire riser pipe and screen at each well location; however, a field determination will be made for an alternative P&A method if total well removal is not possible.

5.6 Quality Assurance/Quality Control

Appendix C contains a site-specific *Quality Assurance Project Plan* (*QAPP*) for the project for CES and selected laboratories. The *QAPP* has been previously submitted to OCD for similar work conducted by CES at the Project Area.

5.7 Health and Safety

Appendix D contains a site-specific *Health and Safety Plan* (*HSP*) for the project. The *HSP* includes the tasks proposed for this *IWP*.

6.0 MONITORING AND SAMPLING PROGRAM

6.1 Monitoring and Sampling Plan

The current groundwater monitoring network consists of 34 wells completed within the uppermost aquifer and three wells completed within the deeper regional aquifer (**Figure 2-2**). Wells deemed not to be of further use for monitoring the Project Area will be P&A to include nine shallow monitoring wells and two deep wells. Additionally four wells will be completed in the uppermost aquifer to the north of MW-26. The future proposed monitoring well network will consist of 29 uppermost aquifer wells. A Site Investigation Report will be submitted per the requirements of the Stipulated Final Order, Section IX.C documenting the results of these activities.

Table 6-1 summarizes the existing groundwater monitoring program for the Project Area. Operation, maintenance and monitoring of the MPE system will be discussed in an *Amended*

Remedial Action Plan (RAP) to be submitted under separate cover. Monitoring and sampling of the monitoring well network will continue on a semi-annual basis according to the processes previously approved by OCD. Groundwater, vapor, and remediation system monitoring will be documented in an annual report completed per the requirements of the Order, Section IX.D.

6.2 Data Management

Data management for the project will be coordinated by EarthCon. Reduced data will be presented in a tabular format containing both current and historical data. Data fields will be added to the tables as new data are generated during gauging and sampling activities. Site maps will be updated to reflect additional monitoring wells and soil borings. Potentiometric surface maps will be generated for each groundwater monitoring event. Results of groundwater monitoring events summarizing the previous year's semi-annual remediation system and groundwater monitoring will be submitted to OCD and the NMED on an annual basis no later than March 15 of each year.

7.0 SCHEDULE

Figure 7-1 documents the proposed schedule for the project. Installation of the proposed monitoring wells, plug and abandonment of monitoring and MPE wells, and changes to the semi-annual groundwater monitoring plan will be implemented upon approval of this *IWP* by OCD and NMED.

8.0 REFERENCES

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APPENDICES

Please refer to the remaining volumes of this *IWP* for the appropriate appendices.

Tables

TABLE 2.1
HISTORICAL KEY DATES
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

Date	Key Event
1960	Compressor station constructed.
August 1960	First reported use of a surface impoundment (Pit 2) in the northeast corner of the Facility.
1977	Pit 2 backfilled prior to February 23, 1977 (date of aerial photo).
1983	Pit 1 was taken out of service no later than November 1983.
June 1986	Pit 1 backfilled.
1986	Last remaining surface impoundment was backfilled.
January 9, 1990	Soil-gas studies indicate the presence of 1,1,1-TCA and PCE gases in the on-site and off-site subsurface.
1992	NMED was contacted after chlorinated VOCs were detected in soil-gas in the vicinity of the surface impoundments during a site investigation conducted in 1990.
July 1992	First monitoring wells installed at the Facility.
February 25, 2002	Removal of soil from Pits 1 and 2 began.
March 11, 2002	Soil removal from Pits 1 and 2 was completed.
November 2002 - March 2003	A remediation system was installed to include: nine SVE wells, 37 MPE wells and associated air extraction blowers and thermal oxidation treatment units, pneumatic pumps for water and PSH recovery and associated oil-water separator and tray air stripper treatment units.
March 10, 2003	The remediation system began continuous operation.

TABLE 2.2
INITIAL COC DETERMINATION
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

Class	Constituent	NMWQCC Criteria
BTEX (µg/L)	Benzene	10.0
	Toluene	750.0
	Ethylbenzene	750.0
	Xylenes (total)	620.0
Other VOCs (µg/L)	Methyl ethyl ketone (2-butanone)	none
	1,1-Dichloroethane	25.0
	1,2-Dichloroethane	10.0
	1,1-Dichloroethene	5.0
	1,2-Dichloroethene	none
	1,2,4-Trimethylbenzene	none
SVOCs (µg/L)	PAHs (Total Naphthalene + monomethylnaphthalenes)	30.0
	4-Methylphenol (p-Cresol)	none
Major Ions (mg/L)	TDS	1000.0
	Chloride	250.0
	Sulfate	600.0
	Nitrate (NO_2/NO_3 - $N_{,total)}$	10.0
	Calcium	none
	Potassium	none
	Magnesium	none
	Sodium	none
	Total Alkalinity (as $CaCO_3$)	none
Metals (mg/L)	Arsenic	0.1
	Barium	1.0
	Cadmium	0.01
	Chromium	0.05
	Copper	1.0
	Iron	1.0
	Lead	0.05
	Manganese	0.2
	Mercury	0.002
	Selenium	0.05
	Silver	0.05
	Zinc	10.0
	Aluminium	5.0

TABLE 5.1
SUMMARY OF PROPOSED SOIL BORINGS AND SOIL SAMPLING
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL CHAVES COUNTY, NEW MEXICO

Well ID	BTEX	Selected VOCs	Selected SVOCs	Major Ions	Metals
MW-39	X	X	X	X	X
MW-40	X	X	X	X	X
MW-41	X	X	X	X	X
MW-42	X	X	X	X	X

TABLE 5.2
SUMMARY OF PROPOSED MONITORING WELL CONSTRUCTION DETAILS
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

Well ID	Estimated Latitude [a]	Estimated Longitude [a]	Est. Ground Surface Elevation (feet MSL)	Estimated Total Well Depth (feet bgs)[1]	Estimated Top Screen (feet bgs)	Estimated Bottom Screen (feet bgs)	Estimated Bottom Seal/Top Filter Pack (feet bgs)	Estimated Top Bentonite Seal (feet bgs)
MW-39	33.541410°	-104.529190°	3606	66.0	44.0	64.0	42.0	39.0
MW-40	33.529540°	-104.484880°	3606	66.0	44.0	64.0	42.0	39.0
MW-41	33.498270°	-104.485680°	3611	71.0	49.0	69.0	47.0	44.0
MW-42	33.488990°	-104.533300°	3602	62.0	40.0	60.0	38.0	35.0

NOTES:

bgs - Below Ground Surface
MSL – Mean Sea Level
[a] - Latitude and Longitude locations are estimated from Google Earth.
[1] - Proposed total well depth (TD) should be at least 10 feet below the water table and include a minimum of six-inches of filter pack material placed under the bottom of the well screen.

TABLE 5.3
SUMMARY OF PROPOSED MONITORING LOCATIONS AND RATIONALE
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

Well ID	Estimated Latitude [a]	Estimated Longitude [a]	Estimated Total Well Depth (feet bgs)[1]	Comments
MW-39	33.541410°	-104.529190°	66	Located 75 ft North of MW-26 (impacted well) to delineate the downgradient limit of the dissolved-phase groundwater plume to the North.
MW-40	33.529540°	-104.484880°	66	Located 200 ft North of MW-26 to define clean location outside the limits of the dissolved phase plume.
MW-41	33.498270°	-104.485680°	71	Located 112 ft Northeast of MW-26 to delineate the downgradient limit of the dissolved-phase groundwater plume to the Northeast.
MW-42	33.488990°	-104.533300°	62	Located 112 ft Northwest of MW-26 to delineate the downgradient limit of the dissolved-phase groundwater plume to the Northwest.

bgs - Below Ground Surface

[a] - Latitude and Longitude locations are estimated from Google Earth.

[1] - Proposed total well depth (TD) should be at least 10 feet below the water table and include a minimum of six-inches of filter pack material placed

TABLE 6.1
MONITORING AND SAMPLING PLAN
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

	Analytical Requirements					
Well ID	1st Semiannual Event	2nd Semiannual Event	Date of Most Recent Sample	Benzene (ppb) Most Recent Sample	Consecutive Events < NMWQCC Standard	Status
MW-1	---	---	na	na	na	P&A
MW-1B	---	---	na	na	na	
MW-2	---	---	na	na	na	
MW-3	---	---	09/16/08	<1	20	
MW-5	---	---	03/23/99	<1	10	P&A
MW-6	---	---	03/23/99	<1	10	P&A
MW-7	---	---	09/11/08	<1	21	
MW-8	---	---	03/25/99	<1	9	P&A
MW-9	---	---	03/24/99	<1	9	P&A
MW-10	---	---	09/16/08	<1	18	
MW-11	---	---	09/11/08	<1	18	
MW-12	---	---	10/21/12	2300.00	0.00	
MW-13	---	BTEX	10/19/12	<1	15	
MW-14	---	BTEX	10/19/12	<1	5	
MW-15	---	---	09/11/08	<1	18	
MW-16	BTEX	BTEX	10/21/12	1000	0	
MW-17	---	---	09/11/08	<1	18	
MW-18	---	---	03/24/99	<1	7	P&A
MW-19	---	---	03/24/99	<1	8	P&A
MW-20	VOCs	VOCs	10/19/12	<1	6	
MW-21	---	BTEX	10/25/12	<1	15	
MW-22	VOCs	VOCs	10/21/12	<1 (DCE)	28	
MW-23D	---	BTEX	12/14/12	<1	1	P&A
MW-24D	---	BTEX	12/14/12	9.6	0	
MW-25D	---	BTEX	12/14/12	<1	17	P&A
MW-26	VOCs	VOCs	10/19/12	<1.0	18	
MW-27	---	---	na	na	na	
MW-28	---	---	09/10/08	<1	12	
MW-29	BTEX	BTEX	10/21/12	<1	4	
MW-30	---	---	09/16/08	<1	12	
MW-31	---	---	09/10/08	<1	9	P&A
MW-32	BTEX	BTEX	10/19/12	<1.0	2	
MW-33	---	---	09/10/08	<1	9	
MW-34	BTEX	BTEX	10/19/12	140	0	
MW-35	BTEX	BTEX	10/21/12	<1	21	
MW-36	---	---	03/11/09	<1	12	P&A
MW-37	---	---	03/11/09	<1	12	

TABLE 6.1
MONITORING AND SAMPLING PLAN
TRANSWESTERN ROSWELL COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

MW-38	---	---	03/11/09	<1	12	P&A
MW-39	NA	NA	NA	NA	NA	Proposed
MW-40	NA	NA	NA	NA	NA	Proposed
MW-41	NA	NA	NA	NA	NA	Proposed
MW-42	NA	NA	NA	NA	NA	Proposed

Notes:
1) nd - non-detect
2) na - not available; sample not collected or analysis not requested
3) VOCs - Volatile Organic Compounds by EPA Method 8260
4) BTEX - by EPA Method 8260

At all wells to be sampled, field parameters will include: dissolved oxygen, pH, temperature and electrical conductivity.

Figures

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

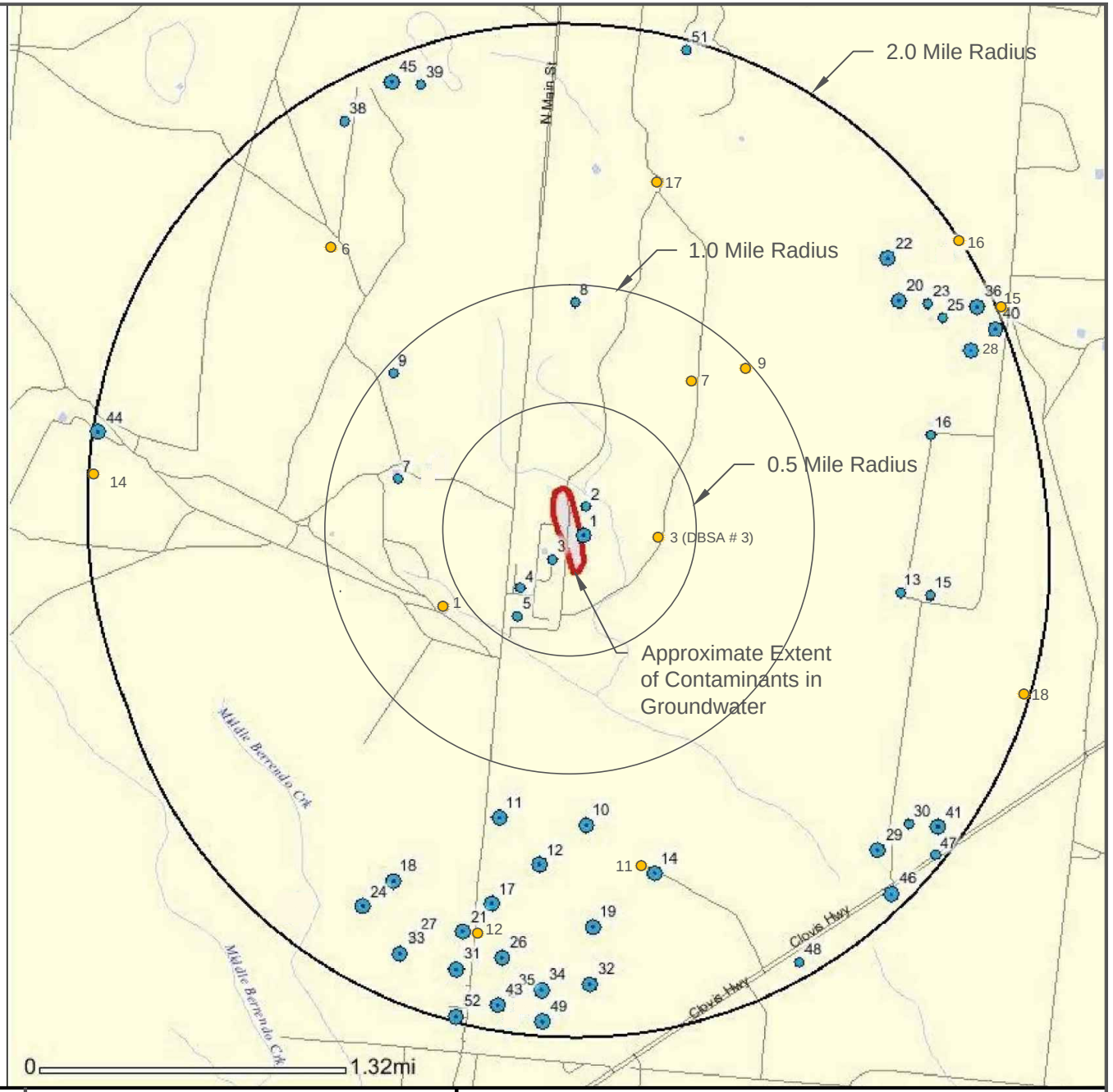
PROJECT NUMBER: 02.2012037.00

EARTHCON®

EARTHCON CONSULTANTS INC.
14405 WALTERS RD, SUITE 700
HOUSTON, TX 77014

SITE LOCATION

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	12/12	1-1



N
W E
S

LEGEND

- Wells from Daniel B. Stephens & Associates, Inc., Corrective Action Plan for Roswell Compressor Station No. 9 Surface Impoundments, Figure 2-5, January 31, 1997.
- Wells from Banks Environmental Data, Water Well Report, October 31, 2012.

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COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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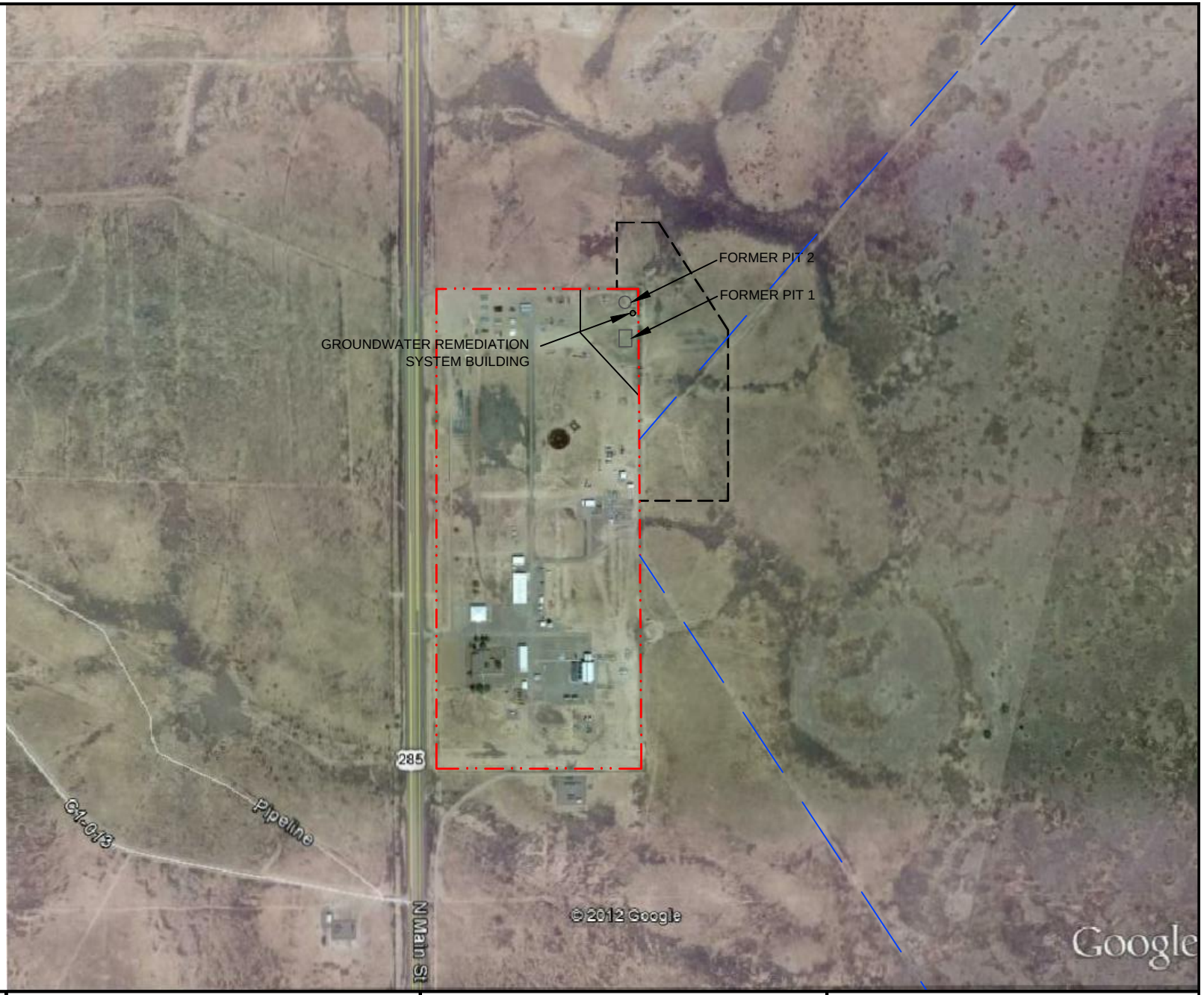
AREA MAP

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	03/13	1-2



LEGEND

- PROPERTY BOUNDARY
- NM STATE LAND
- PIPELINE

SCALE
FEET

0 200 400 800

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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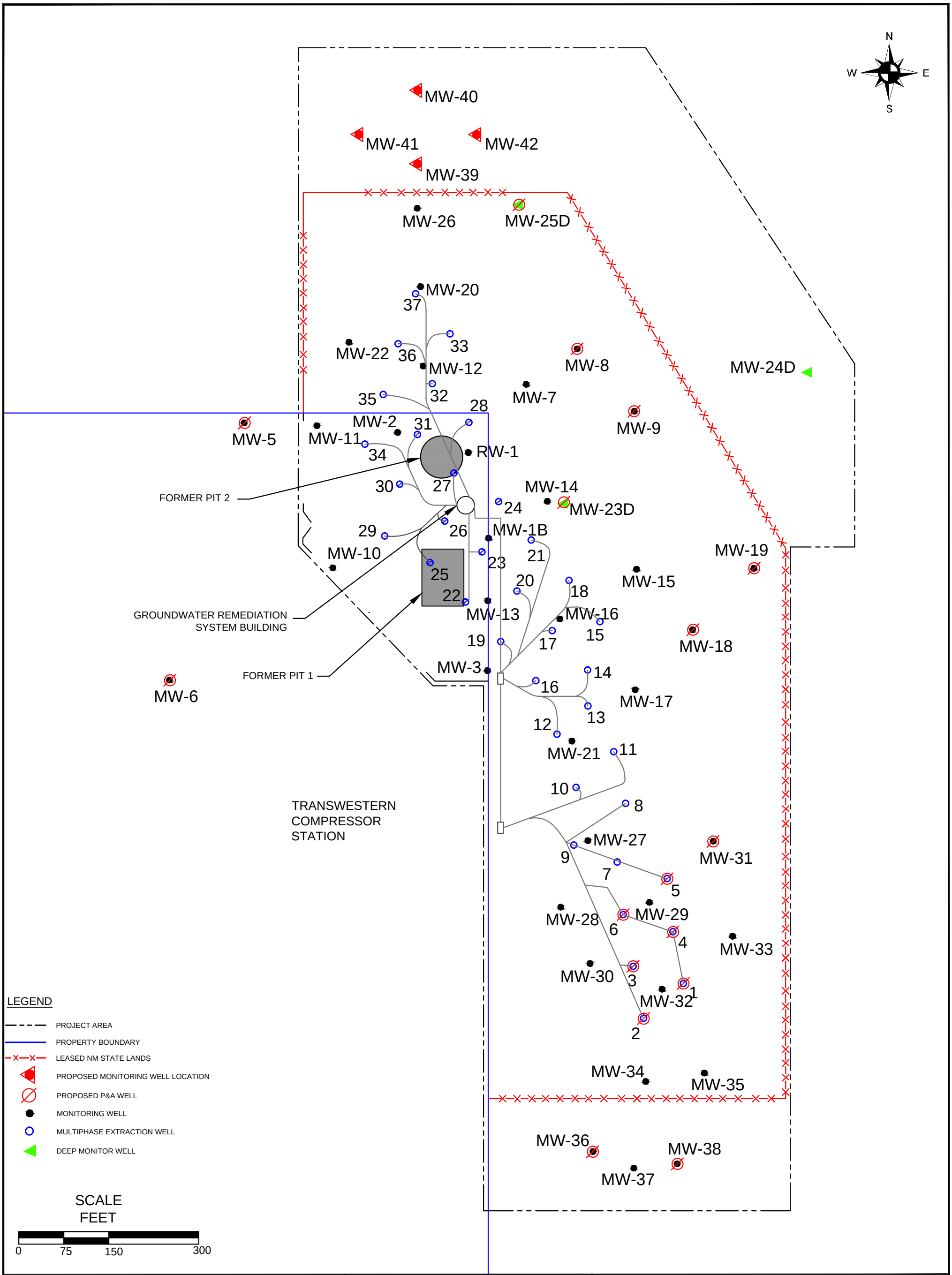
SITE MAP

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	2/13	2-1



TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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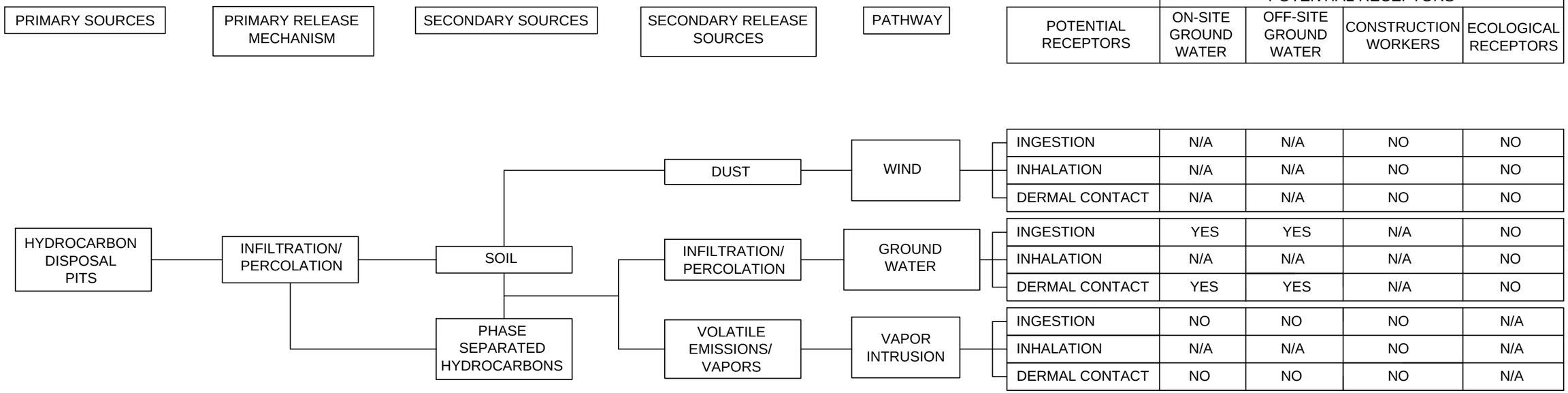
PROJECT AREA

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	03/13	2-2



POTENTIAL RECEPTORS	ON-SITE GROUND WATER	OFF-SITE GROUND WATER	CONSTRUCTION WORKERS	ECOLOGICAL RECEPTORS
INGESTION	N/A	N/A	NO	NO
INHALATION	N/A	N/A	NO	NO
DERMAL CONTACT	N/A	N/A	NO	NO
INGESTION	YES	YES	N/A	NO
INHALATION	N/A	N/A	N/A	NO
DERMAL CONTACT	YES	YES	N/A	NO
INGESTION	NO	NO	NO	N/A
INHALATION	N/A	N/A	NO	N/A
DERMAL CONTACT	NO	NO	NO	N/A

NOTES:
1) YES - Potential Complete Pathway
2) NO - Incomplete Potential Pathway
3) Groundwater within the Project Area not used for drinking water
4) No ecological receptors present
5) No impacted surface soil on-site, pits were previously backfilled with clean fill material

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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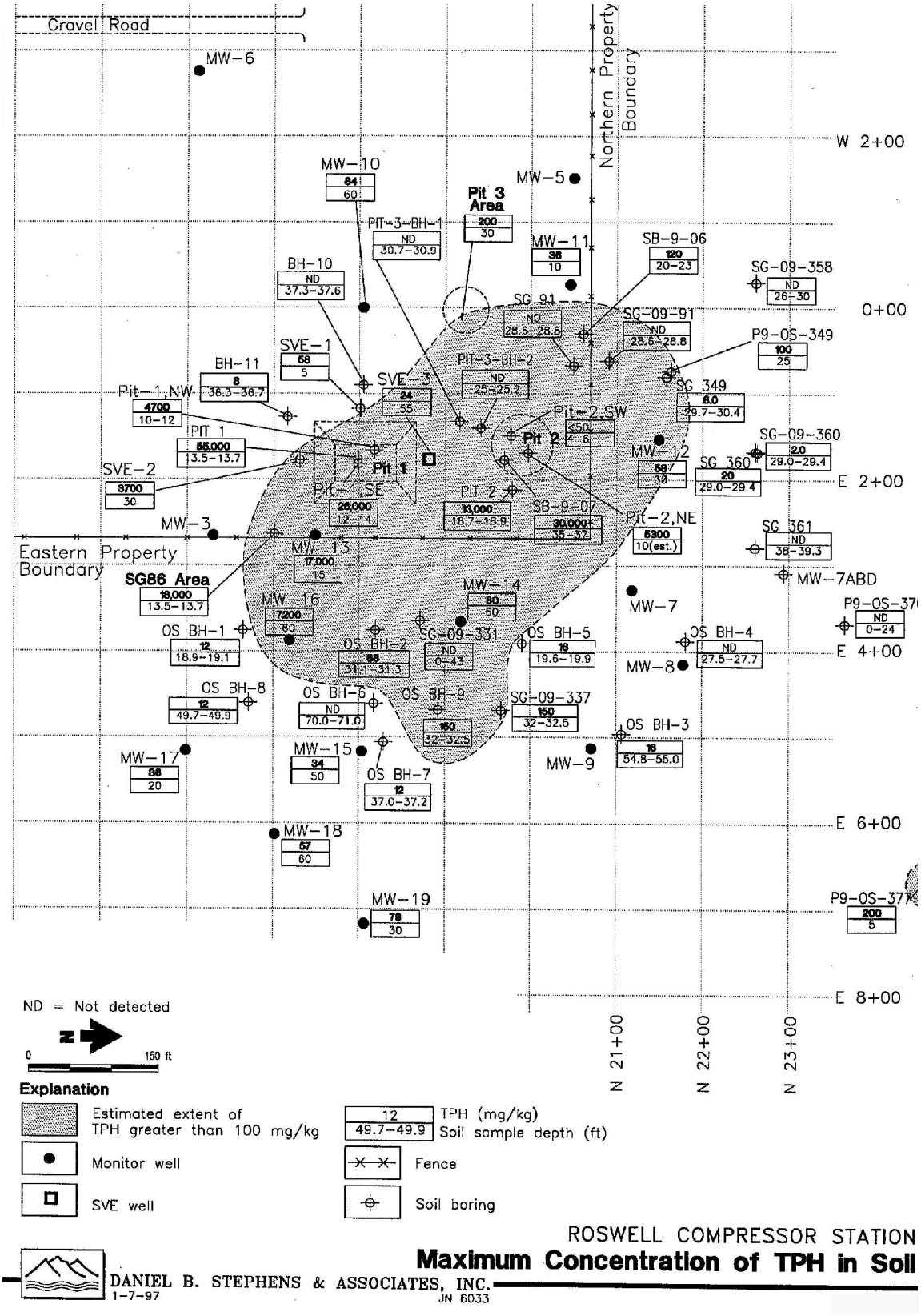
CONCEPTUAL SITE MODEL
OVERVIEW

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	3/13	2-3



ROSWELL COMPRESSOR STATION

Maximum Concentration of TPH in Soil

DANIEL B. STEPHENS & ASSOCIATES, INC.
1-7-97
JN 6033

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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EXTENT OF CONSTITUENTS IN SOIL

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	2/13	2-4

LEGEND

MW-4 [300] — Monitoring Well and PSH (inches)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

Plume Characteristics

Estimated Plume Area: 3.3 Acres

Average Thickness in Wells with PSH: 1.62 ft

SCALE

0 FT 150 FT 300 FT

PSH (ft)

0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6

MW-6
MW-5
MW-11
MW-10
MW-22
MPE-34
MPE-29
MPE-35
MW-2 [2.41]
MPE-30
MPE-36
MPE-37
MW-26
MW-12
MW-20
MPE-25
MPE-26
MPE-27
MPE-31
MPE-33 [1.63]
MPE-22
MPE-23
MW-1B [4.78]
MPE-28 [1.88]
MW-3
MW-13
MPE-19
[3.67]
MPE-24
MW-25D
MPE-20
MW-7
MPE-21
MPE-16
MPE-17 [6.89]
[4.64]
[3.81]
MW-14
MW-23D
MPE-9 [2.69]
MW-28
MPE-12
MW-21
MPE-10
MW-8
MW-27 [3.1]
MW-30
MPE-13
MW-16 [4.7]
MPE-18
MW-36
MPE-14
MPE-11
MPE-15
MPE-7
MPE-6
MPE-8
MW-17
MW-15
MW-9
MW-37
MPE-3
MW-34
MPE-2
MW-29
MW-32
MPE-5
MPE-4
MW-38
MPE-1
MW-18
MW-35
MW-31
MW-33
MW-19
MW-24D

OFF-SITE FENCE LINE

Roswell Station Remediation Site
Transwestern Pipeline Company, LLC
Chaves County, New Mexico

EARTHCON℠
Environmental Challenges
BUSINESS SOLUTIONS

PSH Thickness in Wells - 2003

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-5
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 [300] — Monitoring Well and PSH (inches)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

Plume Characteristics

Estimated Plume Area: 1.7 Acres

Average Thickness in Wells with PSH: 1.46 ft

SCALE

0 FT 150 FT 300 FT

PSH (ft)

0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6

MW-6 MW-5 MW-11 MW-10 MW-22 MPE-34 MPE-29 MPE-35 MW-2 MPE-30 MPE-36 MPE-31 [0.54] MW-12 [0.95] MPE-37 MW-26 MW-20 MPE-22 MPE-25 MPE-26 MPE-27 MPE-33 MW-3 MW-13 MPE-19 MPE-23 [2.01] [0.5] [0.76] MPE-28 MW-1B [2.33] MPE-24 [6.75] MPE-20 MW-7 MW-25D MPE-12 MPE-16 [2.52] MPE-17 [0.82] [0.86] MPE-21 [0.015] MW-21 MW-14 MW-28 MPE-9 MPE-10 [0.85] MPE-18 MW-8 MW-30 MW-27 [0.23] MPE-13 [0.36] MW-16 MW-23D MW-36 MPE-11 MPE-14 MPE-15 MPE-6 MPE-8 MW-17 MW-15 MW-9 MW-37 MW-34 MPE-2 MPE-3 MPE-7 MW-29 MW-32 MPE-4 MPE-5 MW-38 MPE-1 MW-18 MW-35 MW-31 MW-33 MW-19 MW-24D

OFF-SITE FENCE LINE

Roswell Station Remediation Site
Transwestern Pipeline Company, LLC
Chaves County, New Mexico

EARTHCON℠
Environmental Challenges
BUSINESS SOLUTIONS

PSH Thickness in Wells - 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-6
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 [300] — Monitoring Well and PSH (inches)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

Plume Characteristics

Estimated Decrease in Plume Area: 49.5 %

Average Decrease in Thickness in Wells with PSH: 10 %

SCALE

0 FT 150 FT 300 FT

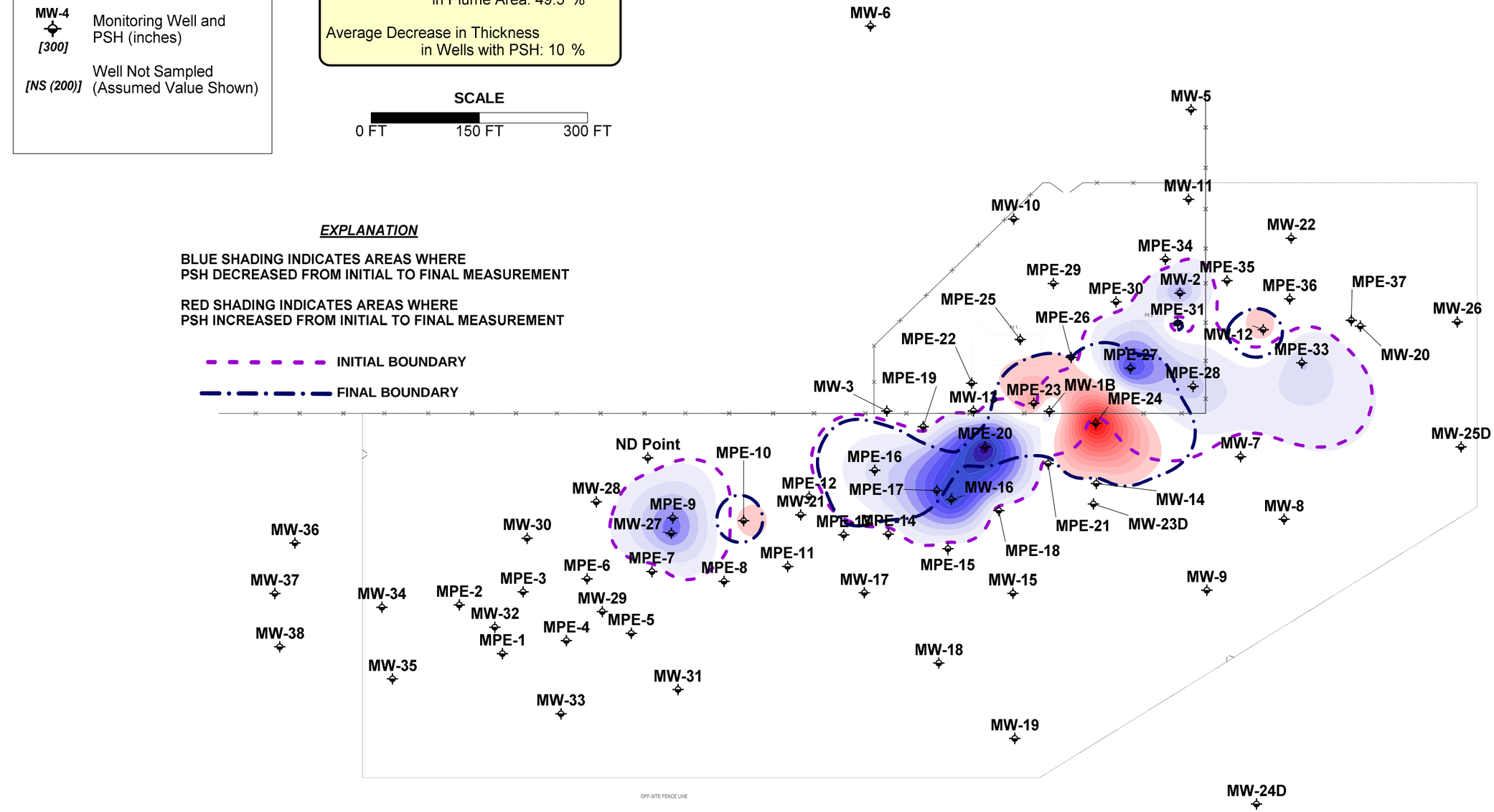
EXPLANATION

BLUE SHADING INDICATES AREAS WHERE PSH DECREASED FROM INITIAL TO FINAL MEASUREMENT

RED SHADING INDICATES AREAS WHERE PSH INCREASED FROM INITIAL TO FINAL MEASUREMENT

INITIAL BOUNDARY

FINAL BOUNDARY



PSH Change (ft)

-6 -5.5 -5 -4.5 -4 -3.5 -3 -2.5 -2 -1.5 -1 -0.5

0.5 1 1.5 2 2.5 3 3.5 4 4.5 5 5.5 6

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Chaves County, New Mexico

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BUSINESS SOLUTIONS

PSH Thickness Difference 2003-2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-7
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 8.7 Acres

Plume Average Concentration: 355 µg/l

Plume Mass: 50.1 lbs.

Concentration (µ/l)

5 25 50 100 500 1,000 2,000 3,000 4,000 5,000

SCALE

0 FT 125 FT 250 FT

MW-6 [<1]
MW-5 [<1]
MW-11 [<1]
MW-10 [2]
MW-22 [NS]
MW-2 [NS]
MPE-34
MPE-29
MPE-35
MPE-36
MPE-30
MPE-37
MW-12 [760]
MPE-31
MW-26 [NS]
MPE-25
MW-20 [NS]
MPE-26
MW-13 [4,600]
MPE-27
MW-1 [NS]
MW-3 [<1]
MPE-22
MPE-33
MPE-28
MPE-23
MW-1B [NS]
MPE-24
MPE-19
MPE-20
MW-25D [NS]
MW-7 [<1]
MPE-16
MPE-17
MPE-21
MW-21 [NS (270)]
MW-16 [NS]
MPE-12
MW-14 [2]
MW-28 [NS]
MPE-9
MPE-10
MPE-18
MW-8 [<1]
MW-36 [NS]
MW-30 [NS]
MW-27 [NS]
MPE-14
MW-23D [NS]
MPE-6
MPE-11
MPE-15
MPE-13
MPE-3
MPE-7
MW-15 [4]
MW-9 [<1]
MW-37 [NS]
MW-34 [NS (170)]
MPE-2
MW-29 [NS (590)]
MPE-8
MW-17 [<1]
MW-32 [NS (897)]
MPE-5
MW-38 [NS]
MPE-4
MW-18 [NS]
MW-35 [NS]
MPE-1
MW-31 [NS]
MW-33 [NS]
MW-19 [2]
MW-24D [NS]

OFF-SITE FENCE LINE

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Transwestern Pipeline Company, LLC
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Benzene Plume - 1996

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-8
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 4.26 Acres

Plume Average Concentration: 133 µg/l

Plume Mass: 9.25 lbs.

Concentration (µ/l)

5 25 50 100 500 1,000 2,000 3,000 4,000 5,000

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 [NS]
MW-5 [NS]
MW-11 [NS]
MW-10 [NS]
MW-22 [<1]
MW-2 [NS]
MPE-34
MPE-29
MPE-35
MPE-36
MPE-30
MPE-37
MW-12 [2,300]
MW-26 [<1]
MPE-25
MPE-31
MW-20 [<1]
MPE-26
MW-13 [<1]
MPE-27
MW-1 [NS]
MPE-33
MW-3 [NS]
MPE-22
MPE-28
MPE-23
MW-1B [NS]
MPE-24 [3,000]
MPE-19
MPE-20
MW-25D
MW-7 [NS]
MPE-16 [2,700]
MPE-17
MPE-21
MW-16 [1,000]
MW-21 [<1]
MPE-12
MW-14 [<1]
MW-28 [<1]
MPE-9
MPE-10
MPE-18
MW-8 [NS]
MW-30 [NS]
MW-27 [NS]
MPE-14
MW-23D
MW-36 [NS]
MPE-6
MPE-13
MPE-15
MPE-11
MPE-3
MPE-7
MW-17 [NS]
MW-15 [NS]
MW-9 [NS]
MW-37 [NS]
MW-34 [187]
MPE-2
MPE-8
MW-29 [<1]
MW-32 [<1]
MW-38 [NS]
MPE-5
MPE-4
MW-35 [<1]
MPE-1
MW-18 [NS]
MW-31 [NS]
MW-33 [NS]
MW-19 [NS]
MW-24D

OFF-SITE FENCE LINE

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Benzene Plume - 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-9
DRAWN: KG	FILE NAME:	SCALE:	

EXPLANATION

BLUE SHADING INDICATES AREAS WHERE CONCENTRATIONS DECREASED IN 2012 VS 1996

RED SHADING INDICATES AREAS WHERE CONCENTRATIONS INCREASED IN 2012 VS 1996

1996 PLUME BOUNDARY

2012 PLUME BOUNDARY

LEGEND

MW-4 Monitoring Well

Concentration (µ/l)

-5,000 -4,000 -3,000 -2,500 -2,000 -1,500 -1,000 -500 -100 -50 -5 5 50 100 500 1,000 1,500 2,000 2,500 3,000 4,000 5,000

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 MW-5 MW-11 MW-10 MW-22 MW-2 MPE-34 MPE-29 MPE-35 MPE-38 MPE-30 MPE-37 MW-12 MW-26 MPE-31 MPE-25 MW-20 MW-13 MPE-26 MPE-27 MW-1 MPE-33 MW-3 MPE-22 MPE-28 MPE-23 MW-1B MPE-24 MPE-19 MW-25D MPE-20 MW-7 MPE-16 MPE-17 MPE-21 MW-21 MW-16 MW-14 MPE-12 MW-28 MPE-18 MW-8 MPE-9 MPE-10 MW-23D MW-36 MW-30 MPE-14 MW-27 MPE-15 MPE-13 MPE-11 MPE-6 MW-37 MPE-3 MPE-7 MW-17 MW-15 MW-9 MPE-8 MW-34 MPE-2 MW-29 MW-32 MW-38 MPE-5 MW-18 MPE-4 MW-35 MPE-1 MW-31 MW-33 MW-19 MW-24D

OFF-SITE FENCE LINE

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Benzene Plume Difference 1996 vs. 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-10
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 8.9 Acres

Plume Average Concentration: 369 µg/l

Plume Mass: 53.5 lbs.

Concentration (µ/l)

5 25 50 100 500 1,000 2,000 3,000 4,000 5,000

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 [<5]
MW-5 [<5]
MW-11 [<5]
MW-10 [<5]
MW-22 [NS]
MW-2 [NS]
MPE-34
MPE-29
MPE-35
MPE-36
MPE-30
MPE-37
MW-12 [822]
MPE-31
MW-26 [NS]
MPE-25
MPE-26
MW-13 [4,784]
MPE-27
MW-1 [NS]
MW-20 [NS]
MW-3 [<5]
MPE-22
MPE-33
MPE-23
MW-1B [NS]
MPE-28
MPE-19
MPE-24
MPE-20
MW-25D [NS]
MW-7 [<5]
MPE-16
MPE-17
MPE-21
MW-21 [NS (290)]
MW-16 [NS]
MW-14 [<5]
MW-28 [NS]
MPE-12
MPE-18
MPE-9
MPE-10
MW-8 [<5]
MW-36 [NS]
MW-30 [NS]
MW-27 [NS]
MPE-14
MW-23D [NS]
MPE-6
MPE-15
MPE-11
MPE-13
MW-37 [NS]
MPE-3
MW-15 [16]
MPE-7
MW-17 [<5]
MW-9 [<5]
MW-34 [NS (170)]
MPE-2
MPE-8
MW-29 [NS (676)]
MW-32 [NS (945)]
MW-38 [NS]
MPE-5
MPE-4
MW-35 [NS]
MPE-1
MW-18 [NS]
MW-31 [NS]
MW-33 [NS]
MW-19 [<5]
MW-24D [NS]

OFF-SITE FENCE LINE

Roswell Station Remediation Site
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Chaves County, New Mexico

EARTHCON℠
Environmental Challenges
BUSINESS SOLUTIONS

BTEX Plume - 1996

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-11
DRAWN:	FILE NAME:	SCALE:	
KG			

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 4.36 Acres

Plume Average Concentration: 285 µg/l

Plume Mass: 20.2 lbs.

Concentration (µ/l)

5 25 50 100 500 1,000 2,000 3,000 4,000 5,000

SCALE

0 FT 125 FT 250 FT

MW-6 [NS]
MW-5 [NS]
MW-11 [NS]
MW-10 [NS]
MW-22 [<1]
MW-2 [NS]
MPE-34
MPE-29
MPE-35
MPE-36
MPE-30
MPE-37
MW-12 [9,300]
MW-26 [<1]
MPE-25
MPE-31
MW-20 [<1]
MPE-26
MW-13 [<1]
MPE-27
MW-1 [NS]
MPE-22
MPE-33
MW-3 [NS]
MPE-23
MW-1B [NS]
MPE-28
MPE-24 [8,420]
MPE-19
MPE-20
MPE-21
MW-25D
MW-7 [NS]
MPE-16
MPE-17
MW-16 [3,620]
MW-21 [<1]
MPE-12
[6,780]
MW-14 [<1]
MW-28 [<1]
MPE-9
MPE-10
MPE-18
MW-8 [NS]
MW-36 [NS]
MW-30 [NS]
MW-27 [NS]
MPE-14
MW-23D
MPE-15
MPE-6
MPE-11
MPE-13
MW-37 [NS]
MPE-3
MPE-7
MPE-8
MW-17 [NS]
MW-15 [NS]
MW-9 [NS]
MW-34 [187]
MPE-2
MW-29 [<1]
MW-32 [<1]
MPE-5
MW-38 [NS]
MPE-4
MW-35 [<1]
MPE-1
MW-18 [NS]
MW-31 [NS]
MW-33 [NS]
MW-19 [NS]
MW-24D

OFF-SITE FENCE LINE

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BUSINESS SOLUTIONS

BTEX Plume - 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-12
DRAWN: KG	FILE NAME:	SCALE:	

EXPLANATION

LEGEND

MW-4 Monitoring Well

BLUE SHADING INDICATES AREAS WHERE CONCENTRATIONS DECREASED IN 2012 VS 1996

RED SHADING INDICATES AREAS WHERE CONCENTRATIONS INCREASED IN 2012 VS 1996

1996 PLUME BOUNDARY

2012 PLUME BOUNDARY

Concentration (µ/l)

-5,000 -4,000 -3,000 -2,500 -2,000 -1,500 -1,000 -500 -100 -50 -5 5 50 100 500 1,000 1,500 2,000 2,500 3,000 4,000 5,000

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 MW-5 MW-11 MW-10 MW-22 MW-2 MPE-34 MPE-29 MPE-35 MPE-36 MPE-30 MPE-37 MW-26 MW-12 MPE-31 MPE-25 MPE-26 MW-20 MW-13 MPE-27 MW-1 MPE-22 MPE-33 MW-3 MPE-23 MW-1B MPE-28 MPE-24 MPE-19 MPE-20 MPE-21 MW-25D MW-7 MPE-16 MPE-17 MW-16 MW-21 MW-14 MPE-12 MW-28 MPE-9 MPE-10 MPE-18 MW-8 MW-23D MW-30 MW-27 MPE-14 MW-36 MPE-15 MPE-11 MPE-13 MPE-6 MW-15 MW-37 MPE-3 MPE-7 MW-17 MW-9 MW-34 MPE-2 MPE-8 MW-29 MW-32 MW-38 MPE-5 MW-18 MPE-4 MW-35 MPE-1 MW-31 MW-33 MW-19 MW-24D

OFF-SITE FENCE LINE

Roswell Station Remediation Site
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Chaves County, New Mexico

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BTEX Plume Difference 1996 vs. 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-13
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 0.06 Acres

Plume Average Concentration: 6.3 µg/l

Plume Mass: 0.01 lbs.

Concentration (µ/l)

5 10 15 20 25 30 35 40 45 50

SCALE

0 FT 125 FT 250 FT

MW-6 [<5]
MW-5 [<5]
MW-11 [<5]
MW-10 [<5]
MW-22 [<5]
MW-2 [NS]
MPE-34
MPE-35
MPE-29
MPE-36
MPE-30
MPE-37
MW-12 [<5]
MW-26 [NS]
MPE-25
MPE-31
MW-20 [10]
MPE-26
MW-13 [<5]
MPE-27
MW-1 [NS]
MW-3 [<5]
MPE-22
MPE-33
MPE-28
MPE-23
MW-1B [NS]
MPE-24
MPE-19
MPE-20
MW-25D [NS]
MW-7 [<5]
MPE-16
MPE-17
MPE-21
MW-21 [<5]
MW-16 [NS]
MPE-12
MW-14 [<5]
MW-28 [NS]
MPE-18
MPE-9
MPE-10
MW-8 [<5]
MPE-14
MW-30 [NS]
MW-27 [NS]
MW-23D [<5]
MW-36 [NS]
MPE-15
MPE-13
MPE-11
MPE-6
MPE-3
MW-15 [<5]
MW-37 [NS]
MPE-7
MW-17 [<5]
MW-9 [<5]
MPE-2
MPE-8
MW-34 [NS]
MW-29 [NS]
MW-32 [NS]
MPE-5
MW-38 [NS]
MPE-4
MW-18 [<5]
MW-35 [NS]
MPE-1
MW-31 [NS]
MW-33 [NS]
MW-19 [<5]
MW-24D [NS]

OFF-SITE FENCE LINE

Roswell Station Remediation Site
Transwestern Pipeline Company, LLC
Chaves County, New Mexico

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Environmental Challenges
BUSINESS SOLUTIONS

1,1-DCA Plume - 1997

DESIGNED: KG	CHECKED: JR	DATE: March 11, 2013	FIGURE NO. 2-14
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 0.134 Acres

Plume Average Concentration: 5.51 µg/l

Plume Mass: 0.012 lbs.

Concentration (µ/l)

5 25 50 100 500 1,000 2,000 3,000 4,000 5,000

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 [NS]
MW-5 [NS]
MW-11 [NS]
MW-10 [NS]
MW-22 [<1]
MW-2 [NS]
MPE-34
MPE-29
MPE-35
MPE-36
MPE-30
MPE-37
MW-12 [NS]
MW-26 [6.7]
MPE-25
MPE-31
MW-20 [4.8]
MPE-26
MW-13 [NS]
MPE-27
MW-1 [NS]
MW-3 [NS]
MPE-22
MPE-33
MPE-23
MW-1B [NS]
MPE-28
MPE-24
MPE-19
MPE-20
MW-25D [NS]
MW-7 [NS]
MPE-16
MPE-17
MPE-21
MW-21 [NS]
MW-16 [NS]
MPE-12
MW-14 [NS]
MW-28 [NS]
MPE-9
MPE-10
MPE-18
MW-8 [NS]
MW-30 [NS]
MPE-14
MW-27 [NS]
MW-23D [NS]
MW-36 [NS]
MPE-15
MPE-13
MPE-11
MPE-6
MPE-3
MW-15 [NS]
MW-37 [NS]
MPE-7
MW-17 [NS]
MW-9 [NS]
MPE-2
MW-34 [NS]
MPE-8
MW-29 [NS]
MW-32 [NS]
MPE-5
MW-38 [NS]
MPE-4
MW-18 [NS]
MW-35 [NS]
MPE-1
MW-31 [NS]
MW-33 [NS]
MW-19 [NS]
MW-24D [NS]

OFF-SITE FENCE LINE

Roswell Station Remediation Site
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Chaves County, New Mexico

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Environmental Challenges
BUSINESS SOLUTIONS

1,1-DCA Plume - 2012

DESIGNED: KG	CHECKED: JR	DATE: March 11, 2013	FIGURE NO. 2-15
DRAWN: KG	FILE NAME:	SCALE:	

LEGEND

MW-4 Monitoring Well

EXPLANATION

BLUE SHADING INDICATES AREAS WHERE CONCENTRATIONS DECREASED IN 2012 VS 1996

RED SHADING INDICATES AREAS WHERE CONCENTRATIONS INCREASED IN 2012 VS 1996

1997 PLUME BOUNDARY

2012 PLUME BOUNDARY

Concentration (µ/l)

-75 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 5 10 15 20 25 30 35 40 45 50 75

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 MW-5 MW-11 MW-10 MW-22 MW-2 MPE-34 MPE-29 MPE-35 MPE-36 MPE-30 MW-12 MPE-37 MW-26 MPE-25 MPE-31 MW-20 MW-13 MPE-26 MPE-27 MW-1 MW-3 MPE-22 MPE-33 MPE-23 MW-1B MPE-28 MPE-24 MPE-19 MPE-20 MW-25D MW-7 MPE-16 MPE-17 MPE-21 MW-21 MW-16 MPE-12 MW-14 MW-28 MPE-9 MPE-10 MPE-18 MW-8 MW-36 MW-30 MW-27 MPE-14 MW-23D MPE-13 MPE-15 MPE-11 MPE-6 MW-37 MPE-3 MPE-7 MW-17 MW-15 MW-9 MW-34 MPE-2 MPE-8 MW-29 MW-32 MW-38 MPE-5 MW-18 MPE-4 MW-35 MPE-1 MW-31 MW-33 MW-19 MW-24D

OFF-SITE FENCE LINE

Roswell Station Remediation Site
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Chaves County, New Mexico

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BUSINESS SOLUTIONS

1,1-DCA Plume Difference 1997 vs. 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-16
DRAWN:	FILE NAME:	SCALE:	
KG			

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 0.46 Acres

Plume Average Concentration: 14.8 µg/l

Plume Mass: 0.11 lbs.

Concentration (µ/l)

5 10 15 20 25 30 35 40 45 50

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 [<5]
MW-5 [<5]
MW-11 [<5]
MW-10 [<5]
MW-22 [<5]
MW-2 [NS]
MPE-34
MPE-29
MPE-35
MPE-36
MPE-30
MPE-37
MW-12 [<5]
MW-26 [NS (<1)]
MPE-25
MPE-31
MW-20 [86]
MW-13 [<5]
MPE-26
MPE-27
MW-1 [NS]
MW-3 [<5]
MPE-22
MPE-33
MPE-23
MW-1B [NS]
MPE-28
MPE-24
MPE-19
MPE-20
MW-25D [NS]
MW-7 [<5]
MPE-16
MPE-17
MPE-21
MW-21 [<5]
MPE-12
MW-16 [NS]
MW-14 [<5]
MW-28 [NS]
MPE-9
MPE-10
MPE-18
MW-8 [<5]
MW-36 [NS]
MW-30 [NS]
MPE-14
MW-27 [NS]
MW-23D [<5]
MPE-15
MPE-13
MPE-11
MPE-6
MPE-3
MW-15 [<5]
MW-37 [NS]
MPE-2
MPE-7
MPE-8
MW-17 [<5]
MW-9 [<5]
MW-34 [NS]
MW-29 [NS]
MW-32 [NS]
MPE-5
MW-38 [NS]
MPE-4
MW-18 [<5]
MW-35 [NS]
MPE-1
MW-31 [NS]
MW-33 [NS]
MW-19 [<5]
MW-24D [NS]

OFF-SITE FENCE LINE

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1,1-DCE Plume - 1997

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-17
DRAWN:	FILE NAME:	SCALE:	
KG			

LEGEND

MW-4 [300] — Monitoring Well and Concentration (ug/l)

[NS (200)] — Well Not Sampled (Assumed Value Shown)

✚ — Center of Plume Mass

Plume Characteristics

Plume Area: 1.61 Acres

Plume Average Concentration: 12.2 µg/l

Plume Mass: 0.322 lbs.

Concentration (µ/l)

5 10 15 20 25 30 35 40 45 50

SCALE

0 FT 125 FT 250 FT

MW-6 [NS]
MW-5 [NS]
MW-11 [NS]
MW-10 [NS]
MW-22 [1.1]
MW-2 [NS]
MPE-34
MPE-35
MPE-29
MPE-36
MPE-30
MPE-37
MW-12 [NS]
MW-26 [54.7]
MPE-31
MPE-25
MW-20 [7.7]
MPE-26
MW-13 [NS]
MPE-27
MW-1 [NS]
MW-3 [NS]
MPE-22
MPE-33
MPE-28
MPE-23
MW-1B [NS]
MPE-24
MPE-19
MPE-20
MW-25D [NS]
MPE-16
MPE-17
MPE-21
MW-7 [NS]
MW-21 [NS]
MW-16 [NS]
MPE-12
MW-14 [NS]
MW-28 [NS]
MPE-9
MPE-10
MPE-18
MW-8 [NS]
MPE-14
MW-30 [NS]
MW-27 [NS]
MW-23D [NS]
MW-36 [NS]
MPE-15
MPE-13
MPE-11
MPE-6
MPE-3
MW-15 [NS]
MW-37 [NS]
MPE-7
MW-17 [NS]
MW-9 [NS]
MPE-2
MPE-8
MW-34 [NS]
MW-29 [NS]
MW-32 [NS]
MPE-5
MW-38 [NS]
MPE-4
MW-18 [NS]
MW-35 [NS]
MPE-1
MW-31 [NS]
MW-33 [NS]
MW-19 [NS]
MW-24D [NS]

OFF-SITE FENCE LINE

Roswell Station Remediation Site
Transwestern Pipeline Company, LLC
Chaves County, New Mexico

EARTHCON℠
Environmental Challenges
BUSINESS SOLUTIONS

1,1-DCE Plume - 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-18
DRAWN:	FILE NAME:	SCALE:	
KG			

EXPLANATION

BLUE SHADING INDICATES AREAS WHERE CONCENTRATIONS DECREASED IN 2012 VS 1996

RED SHADING INDICATES AREAS WHERE CONCENTRATIONS INCREASED IN 2012 VS 1996

1997 PLUME BOUNDARY

2012 PLUME BOUNDARY

LEGEND

MW-4 Monitoring Well

Concentration (µ/l)

-75 -50 -45 -40 -35 -30 -25 -20 -15 -10 -5 5 10 15 20 25 30 35 40 45 50 75

SCALE

0 FT 125 FT 250 FT

W S N E

MW-6 MW-5 MW-11 MW-10 MW-22 MW-2 MPE-34 MPE-29 MPE-35 MPE-36 MPE-30 MPE-37 MW-26 MW-12 MPE-25 MPE-31 MW-20 MW-13 MPE-26 MPE-27 MW-1 MW-3 MPE-22 MPE-33 MPE-28 MPE-23 MW-1B MPE-24 MPE-19 MPE-20 MPE-21 MW-25D MW-7 MW-21 MPE-16 MPE-17 MW-16 MPE-12 MW-14 MW-28 MPE-9 MPE-10 MPE-18 MW-8 MW-36 MW-30 MW-27 MPE-14 MW-23D MPE-13 MPE-15 MPE-11 MPE-6 MW-37 MPE-3 MPE-7 MW-17 MW-15 MW-9 MW-34 MPE-2 MPE-8 MW-29 MW-32 MW-38 MPE-5 MPE-4 MW-18 MW-35 MPE-1 MW-31 MW-33 MW-19 MW-24D

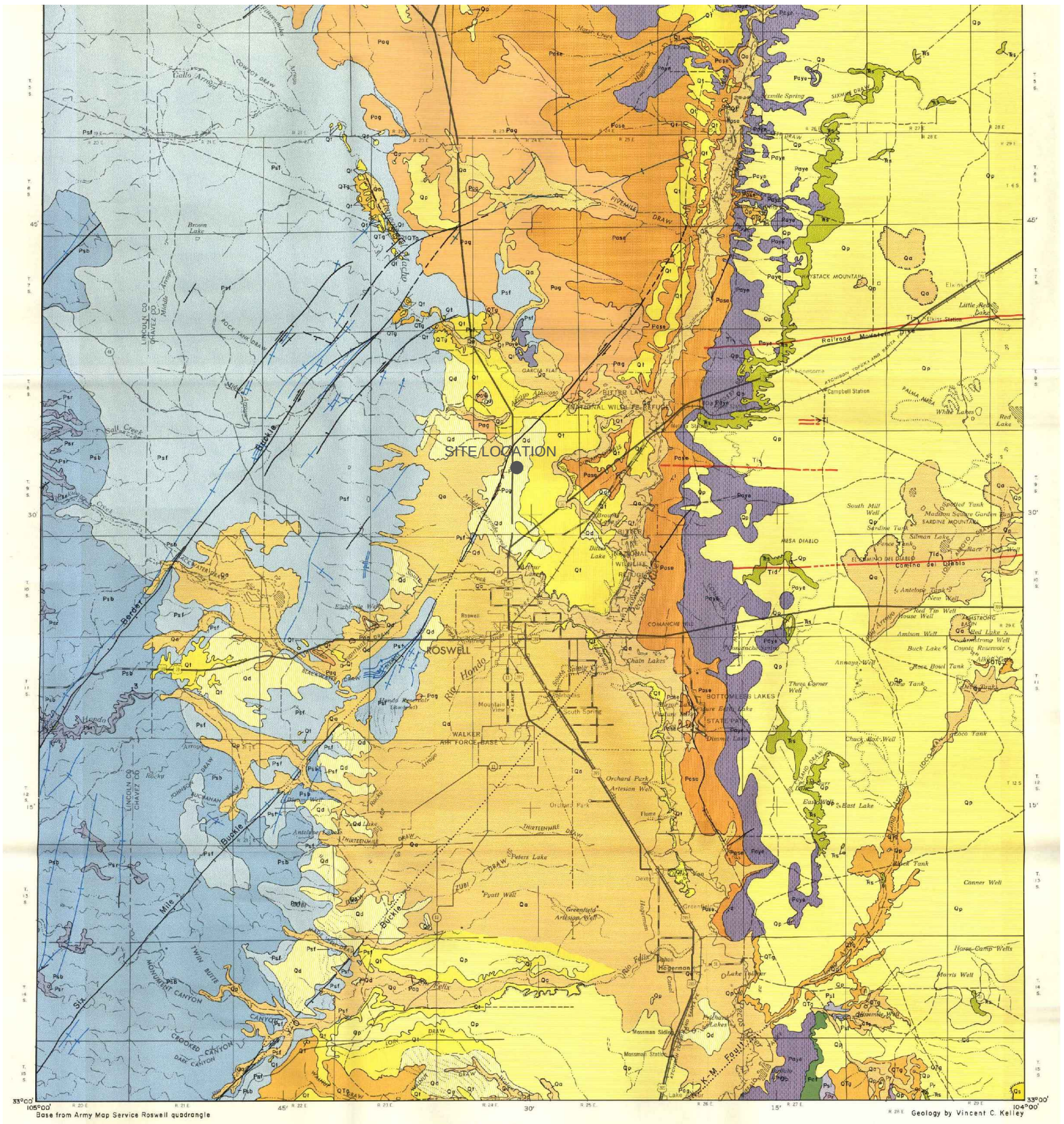
OFF-SITE FENCE LINE

Roswell Station Remediation Site
Transwestern Pipeline Company, LLC
Chaves County, New Mexico

EARTHCON℠
Environmental Challenges
BUSINESS SOLUTIONS

1,1-DCE Plume Difference 1997 vs. 2012

DESIGNED:	CHECKED:	DATE:	FIGURE NO.
KG	JR	March 11, 2013	2-19
DRAWN:	FILE NAME:	SCALE:	
KG			



EXPLANATION

SEDIMENTARY ROCKS

Surficial Deposits
Qa, alluvium of stream and valley bottoms; Qs, caliche soil; Qe, blow sand and dunes; Ql, landslides; Qd, disturbed gravel, etc. affected by collapse; Qtr, travertine spring deposits; Qt, terrace gravel; Qp, pediment gravel; Qc, caliche

Gatuna Formation (QTg)
Red, tan, and buff sand, gravel, and mudstone

Cub Mountain Formation (TKc)
Purplish mudstone and buff, conglomeratic sandstone

Mesaverde Group (Kmv)
Olive-drab to black shale, grayish sandstone, and coal

Mancos Shale (Km)
Black shale, local sandstone, and limestone

Dakota Sandstone (Kd)
Gray to white sandstone, local shale, and conglomerate

Chinle Formation (Rc)
Reddish-brown mudstone

Santa Rosa Formation (Rs)
Brown, buff, and red sandstone; local conglomerate

Dewey Lake Formation (Pd)
Tan-brown, clean sandstone

Rustler Formation (Pr, Pru, Prl)
Dolomite, gypsum, and reddish sandstone; Pru, upper member; Prl, lower member

Salado Formation (Psl)
Gypsum, dolomite, mudstone, and orange-red, collapsed, recrystallized, residual breccia

Castile Formation (Pc, Pcu, Pcl)
Gypsum, anhydrite and limestone; Pcu, upper member; Pcl, lower member

TRIASSIC — CRETACEOUS — TERTIARY — QUATERNARY

Tansill Formation (Pat)
Dolomite intertonguing northward into gypsum

Yates Formation (Pay, Paye)
Pay, limestone, sandstone, and dolomite southward; Paye, gypsum, dolomite, and siltstone northward

Seven Rivers Formation (Pas, Pase)
Pas, limestone and dolomite southward; Pase, gypsum, mudstone and thin dolomite northward

Queen and Grayburg Formations (Paq, Paqq)
Paq, Queen Formation; dolomite and sandstone southward; gypsum and mudstone northward; Pag, Grayburg Formation; sandstone and dolomite southward; gypsum, red sandstone, and local dolomite northward; Paqq, Queen and Grayburg Formations undivided in north and locally elsewhere

Artesia Group

Capitan Limestone (Pec)

Bell Canyon Formation (Pbc)
Basin-facies limestone and sandstone

Goat Seep Formation (Pgs)
Massive dolomite

San Andres Formation (Psf, Psb, Psr)
Psf, Fourmile Draw Member; Psb, Bonney Canyon Member; Psr, Rio Bonito Member; Psg, Glorieta Sandstone

Yeso Formation (Py)
Tan, yellow and rusty sandstone, red mudstone, dolomite, and gypsum

PERMIAN

Precambrian rocks, undivided (Pe)
Granite, syenite, and gneiss

PRECAMBRIAN

IGNEOUS ROCKS

Sierra Blanca Volcanic Group (Tsb)
Andesitic to rhyolitic breccia, tuff, and flows

Dikes, sills, stocks, and laccoliths (Ti, Tis, Tig, Tir, Tim, Tid)
Ti, not identified; Tis, syenite or latite; Tig, granite or aplite; Tir, rhyolite; Tim, monzonite; Tid, diorite or diabase

TERTIARY

Contact
Dashed where approximately located; dotted where concealed

Key bed or zone within a formation

High-angle fault
Dot on downthrown side; arrows show apparent or inferred lateral shift; dashed where approximately located; dotted where concealed

Anticline
Showing trace of axial plane

Syncline
Showing trace of axial plane

Traces of anticlinal and synclinal bends

Attitude of beds
horizontal — vertical — inclined

Line of measured section

Tie leader
Connects outcrops of equivalent rocks

Lines of slump
In gravel, caliche, evaporites, or other rocks due to flowage or collapse

Small salt piercements and related sinks
Contain cores of Triassic, Dewey Lake, Rustler, or San Andres Formations which are not shown

INDEX MAP OF NEW MEXICO

GEOLOGY OF THE ROSWELL REGION

by Vincent C. Kelley 1971

5 0 5 10 15 20 Miles

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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EARTHCON CONSULTANTS INC.
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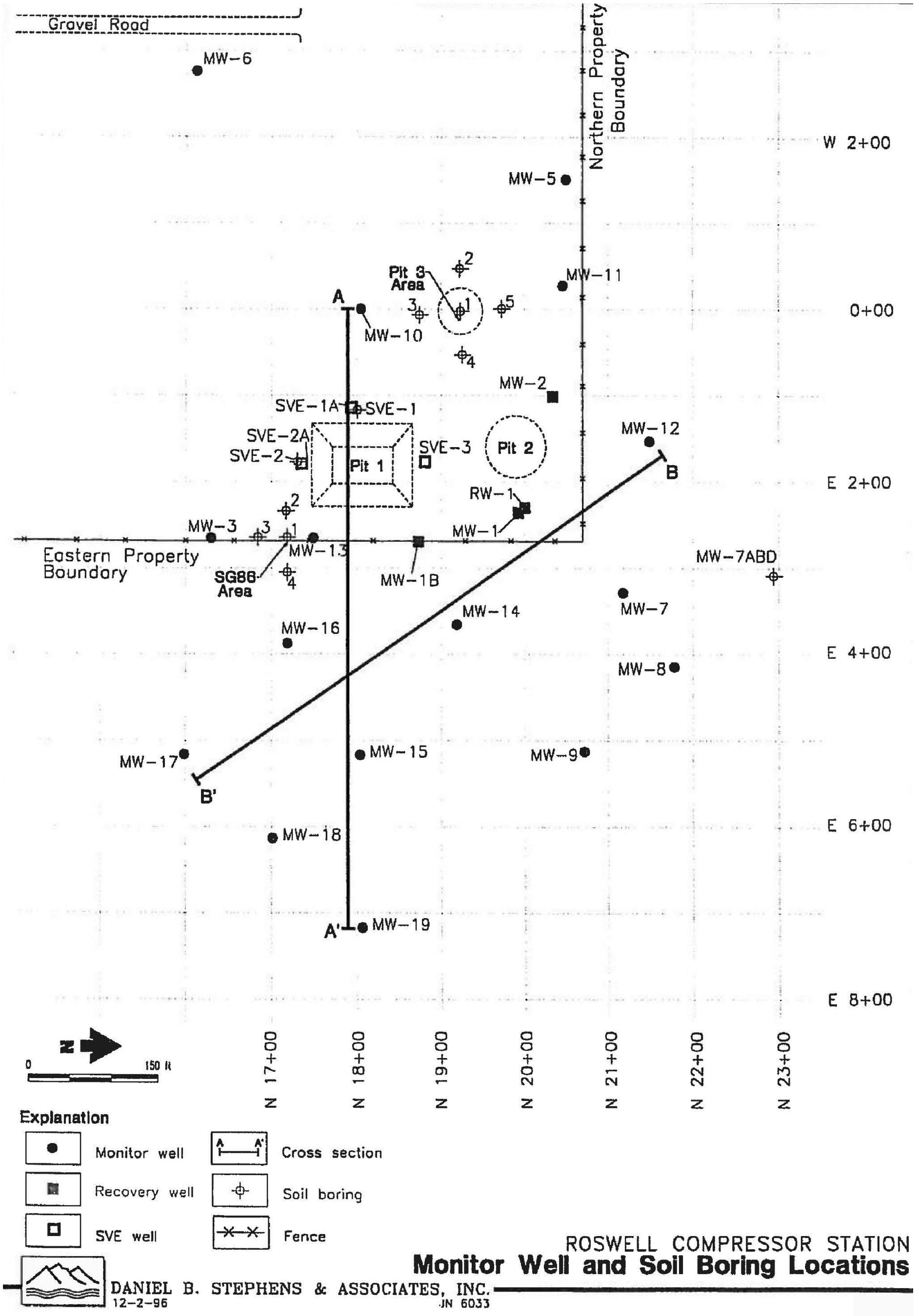
HOUSTON, TX 77014

REGIONAL GEOLOGICAL MAP

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	3/29/2013	3-1



ROSWELL COMPRESSOR STATION

Monitor Well and Soil Boring Locations

DANIEL B. STEPHENS & ASSOCIATES, INC.

12-2-96

JN 6033

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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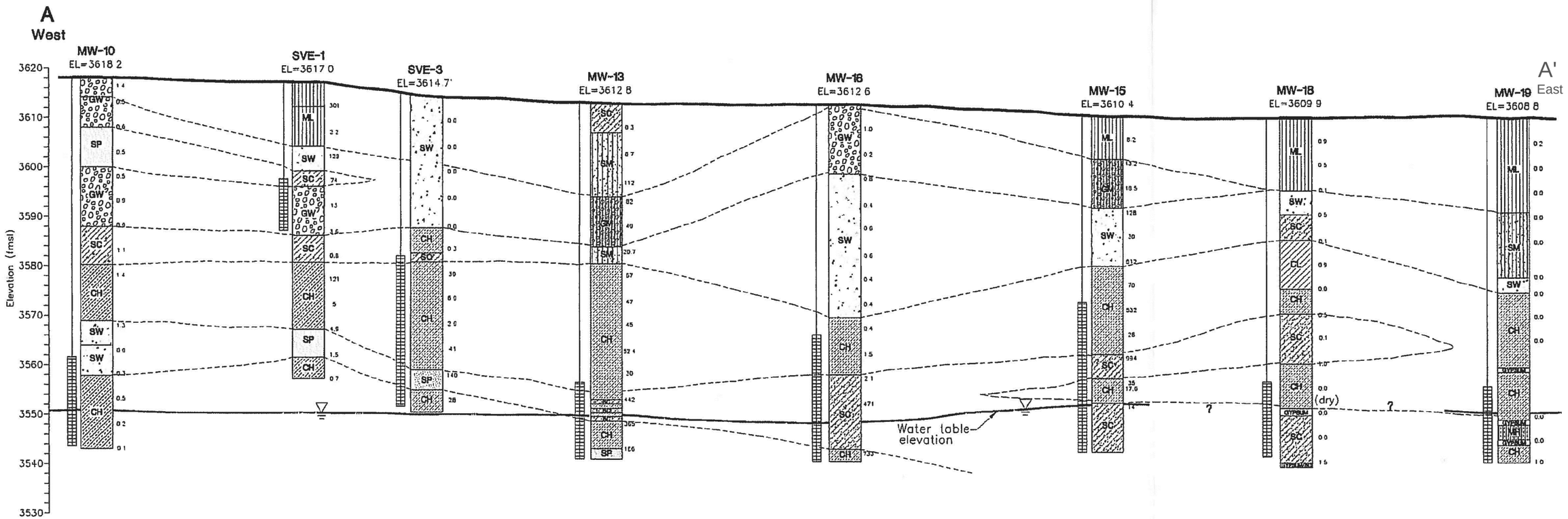
CROSS-SECTION LOCATION MAP

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	3/29/2013	3-2



Horizontal Scale: 1" = 50'
Vertical Scale: 1" = 20'

- Ground surface
- Well screen
- Water table elevation (fmsl)
- 39 — Organic vapor meter reading (ppmv)
- Approximate contact between soil types
- GYPSUM — Gypsum
- GW — Gravel, well graded, gravel–sand mixture, little or no fines
- GM — Silty gravels, gravels–sand–silty mixtures
- SW — Well graded sands, gravelly sand, little or no fines
- SP — Poorly graded sands, gravelly sands, little or no fines
- SM — Silty sands, sand–silt mixtures
- SC — Clayey sands, sand–clay mixtures
- ML — Inorganic silts and very fine sands, rock flour, silt or clayey fine sands, or clayey silt with slight plasticity
- MH — Elastic silts, sandy silts, and clayey silts with low to moderate plasticity
- CH — Inorganic clays of high plasticity

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ROSWELL COMPRESSOR
Hydrogeologic Cross Section

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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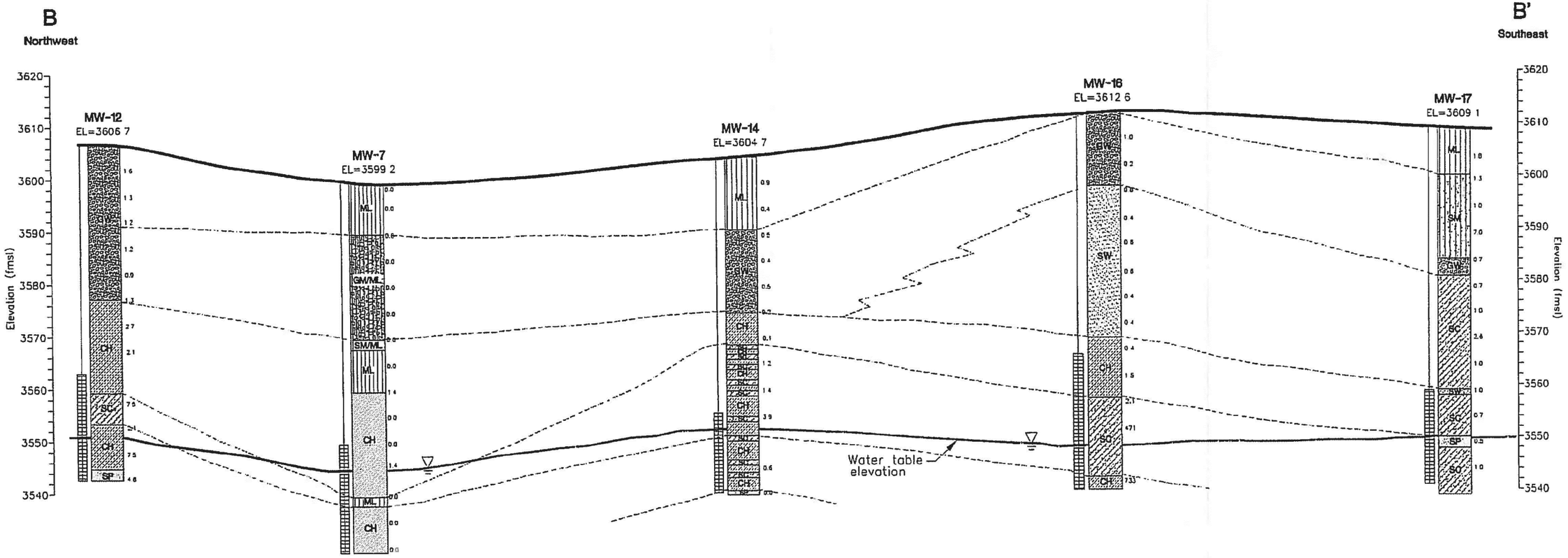
CROSS-SECTION A-A'

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	3/29/2013	3-3



Horizontal Scale: 1" = 50'
Vertical Scale: 1" = 20'

- Ground surface
- Well screen
- Water table elevation (fmsl)
- 7 5 — Organic vapor meter reading (ppmv)
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- ML — Inorganic silts and very fine sands, rock flour, silt or clayey fine sands, or clayey silt with slight plasticity
- CH — Inorganic clays of high plasticity

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ROSWELL COMPRESSOR STATION
Hydrogeologic Cross Section B-B'

TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9
ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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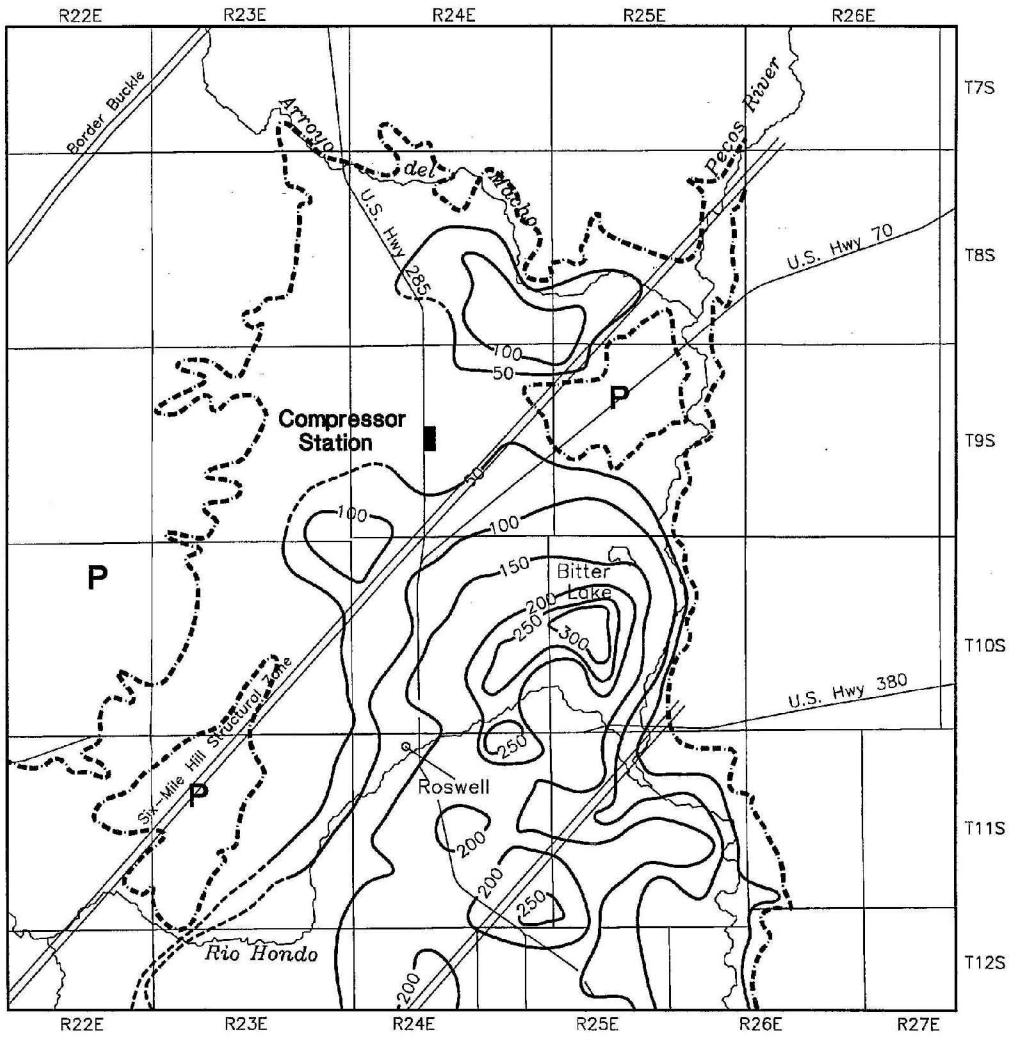
CROSS-SECTION B-B'

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	3/29/2013	3-4



Sources: Kelley, 1971; Lyford, 1973

N

0 5 miles

Explanation

- Thickness of valley fill alluvium (ft)
- Approx. surface contact between Permian rocks and valley fill alluvium
- P — Outcrop area of Permian rocks

DANIEL B. STEPHENS & ASSOCIATES, INC.
12-19-96 JN 6033

ROSWELL COMPRESSOR STATION
Appoximate Thickness of Shallow Alluvial Aquifer

ROSWELL, CHAVES COUNTY
NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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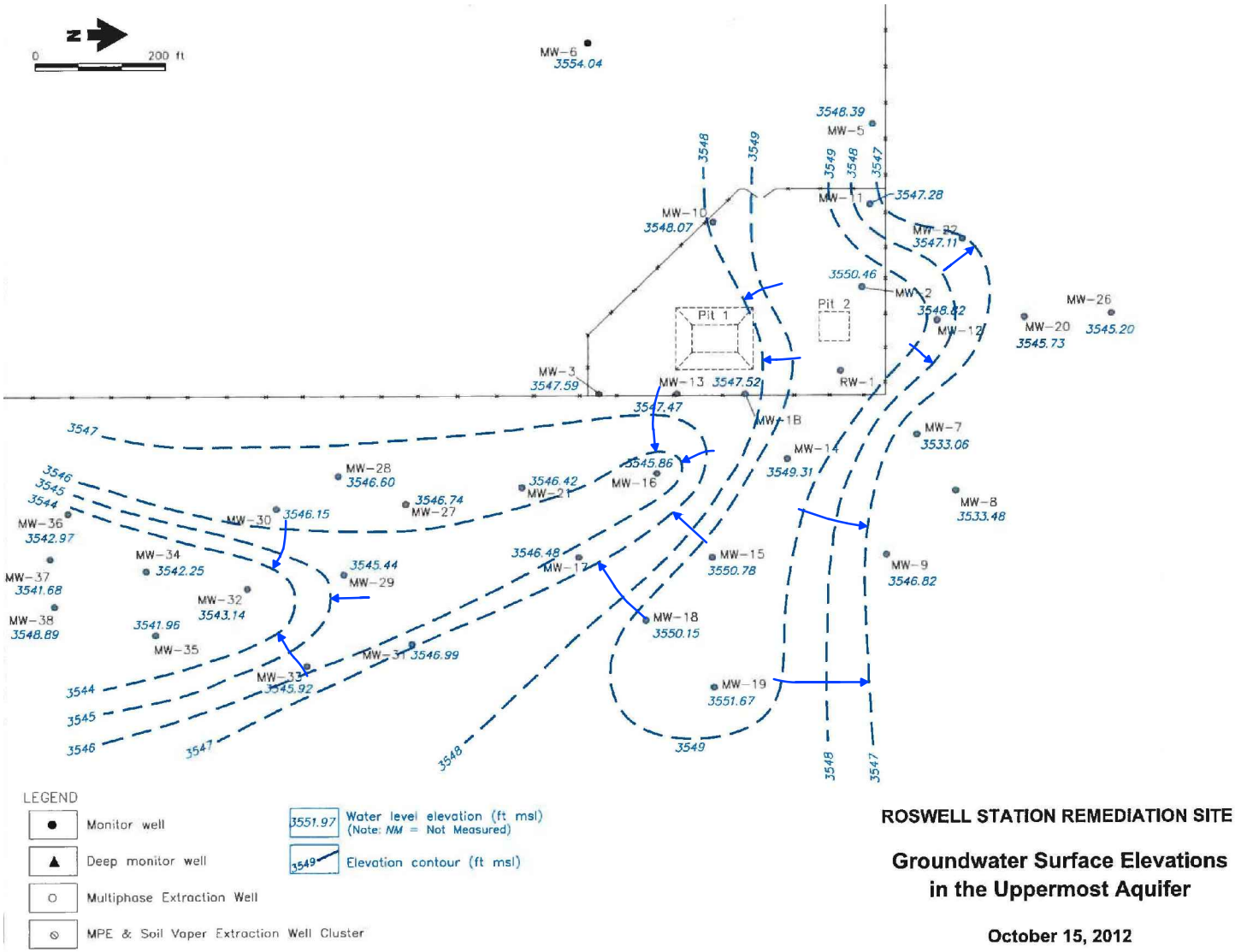
APPROXIMATE THICKNESS OF SHALLOW ALLUVIAL AQUIFER

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	3/29/2013	3-5



TRANSWESTERN PIPELINE COMPANY
COMPRESSOR STATION NO. 9

ROSWELL, CHAVES COUNTY, NEW MEXICO

PROJECT NUMBER: 02.20120037.00

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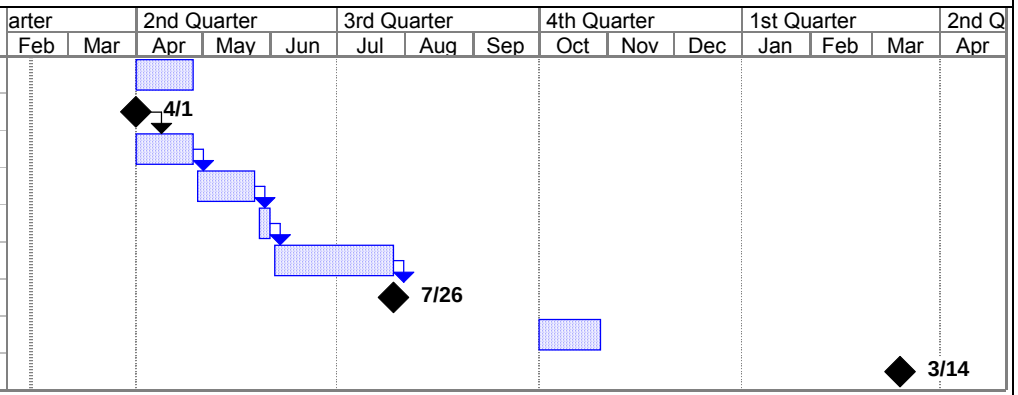
2012 GROUNDWATER SURFACE ELEVATIONS IN THE UPPERMOST AQUIFER (MODIFIED CES MAP WITH FLOW LINES)

DRAWN:	CHECKED:	DATE:	FIGURE:
CMF	KG	3/29/2013	3-6

Figure 7-1
Project Schedule
Transwestern Compressor Station No. 9
Roswell, New Mexico

ID	Task Name	Duration	Start
1	April Groundwater Sampling	20 days	Mon 4/1/13
2	IWP Approval	0 days	Mon 4/1/13
3	Permitting and Mobilization	20 days	Mon 4/1/13
4	Drilling, Well PNA and Installation	20 days	Mon 4/29/13
5	New Well Sampling	5 days	Mon 5/27/13
6	Data Analysis and Report Preparation	40 days	Mon 6/3/13
7	Site Investigation Report Submittal	0 days	Fri 7/26/13
8	October Groundwater Sampling	20 days	Tue 10/1/13
9	Annual Report Submittal	0 days	Fri 3/14/14



Project: Roswell No. 9 Schedule
Date: Tue 2/12/13

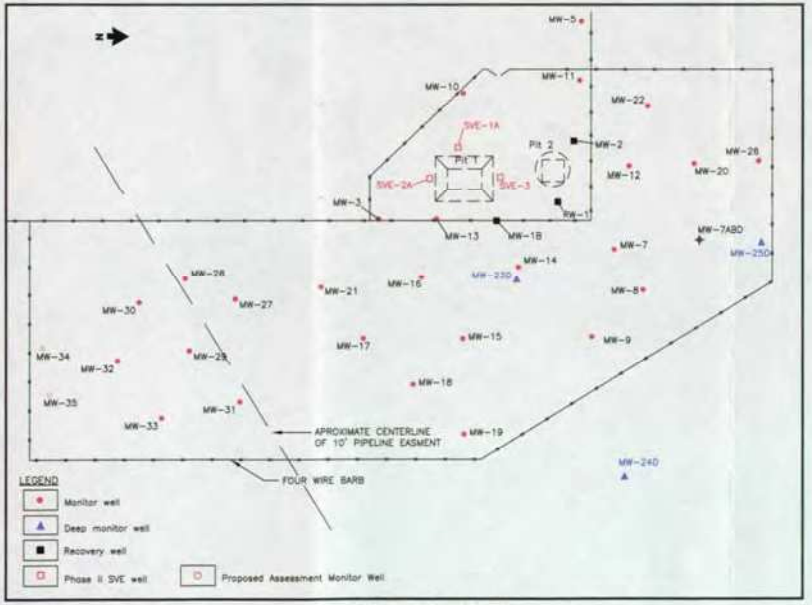
Task
Split
Progress
Milestone
Summary
Project Summary
External Tasks
External Milestone
Deadline

Appendix A

Remediation System Figures

INDEX OF DRAWINGS

Dwg.	Description
	Cover Sheet
G-1	Index of Drawings, Vicinity Map, Site Location Map, and Site Layout Map
G-2	Geologic Cross Section
G-3	Areal Extent of Impacted Groundwater
C-1	Multi-Phase Extraction Well Field Layout
C-2	Trenching/Conveyance Piping Plan
C-3	Equipment Compound Detail
C-4	Equipment Building Details
C-5	Equipment Building Details
C-6	Well Head Details
C-7	Trenching Details
C-8	Manifold Details
P-1	Process Flow Diagram
P-2	SVE System Process and Instrumentation Diagram
P-3	Total Fluids Process and Instrumentation Diagram
E-1	Electrical Details – One Line Diagram



SITE LAYOUT MAP

SITE LOCATION MAP

VICINITY MAP
NOT TO SCALE

REVISIONS

NO.	DATE	BY	REMARKS

Tetra Tech EM Inc.

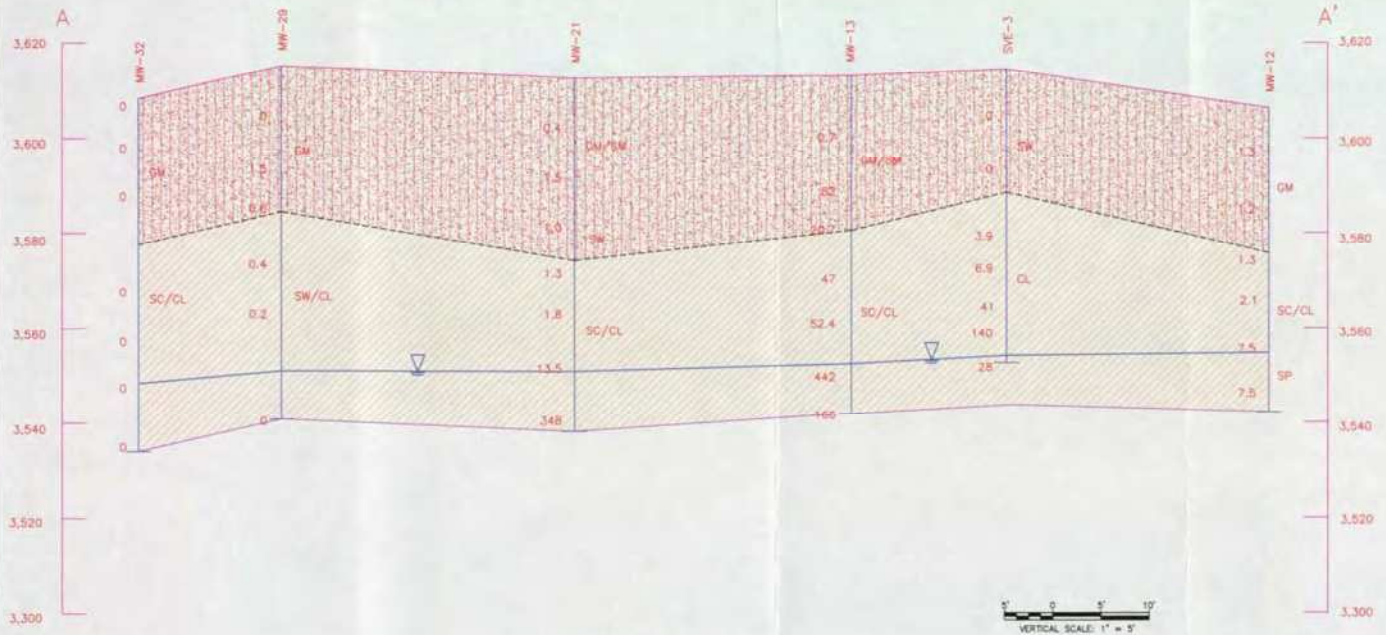
DESIGNED BY: JS | RE-CHECKED BY:
DRAWN BY: RM | APPROVED BY:
CHECKED BY: RM | DATE:

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Index of Drawings, Vicinity Map, Site Location Map, and Site Layout Map

PROJECT NUMBER
P-202203

DRAWING NO.
G-1



5' 0 5' 10'
VERTICAL SCALE: 1" = 5'

25' 0 25' 50'
HORIZONTAL SCALE: 1" = 25'

LEGEND

GM	SILTY SAND
SW	WELL GRADED SAND
SM	SILTY SAND
SC	CLAYEY SAND
CL	CLAY
▽	POTENTIOMETRIC SURFACE ELEVATION
———	APPROXIMATE CONTACT BETWEEN SOIL TYPES

HEATED HEADSPACE READING (ppmv) — 47 — GM / CL — USCS SOIL CLASSIFICATION

REVISIONS

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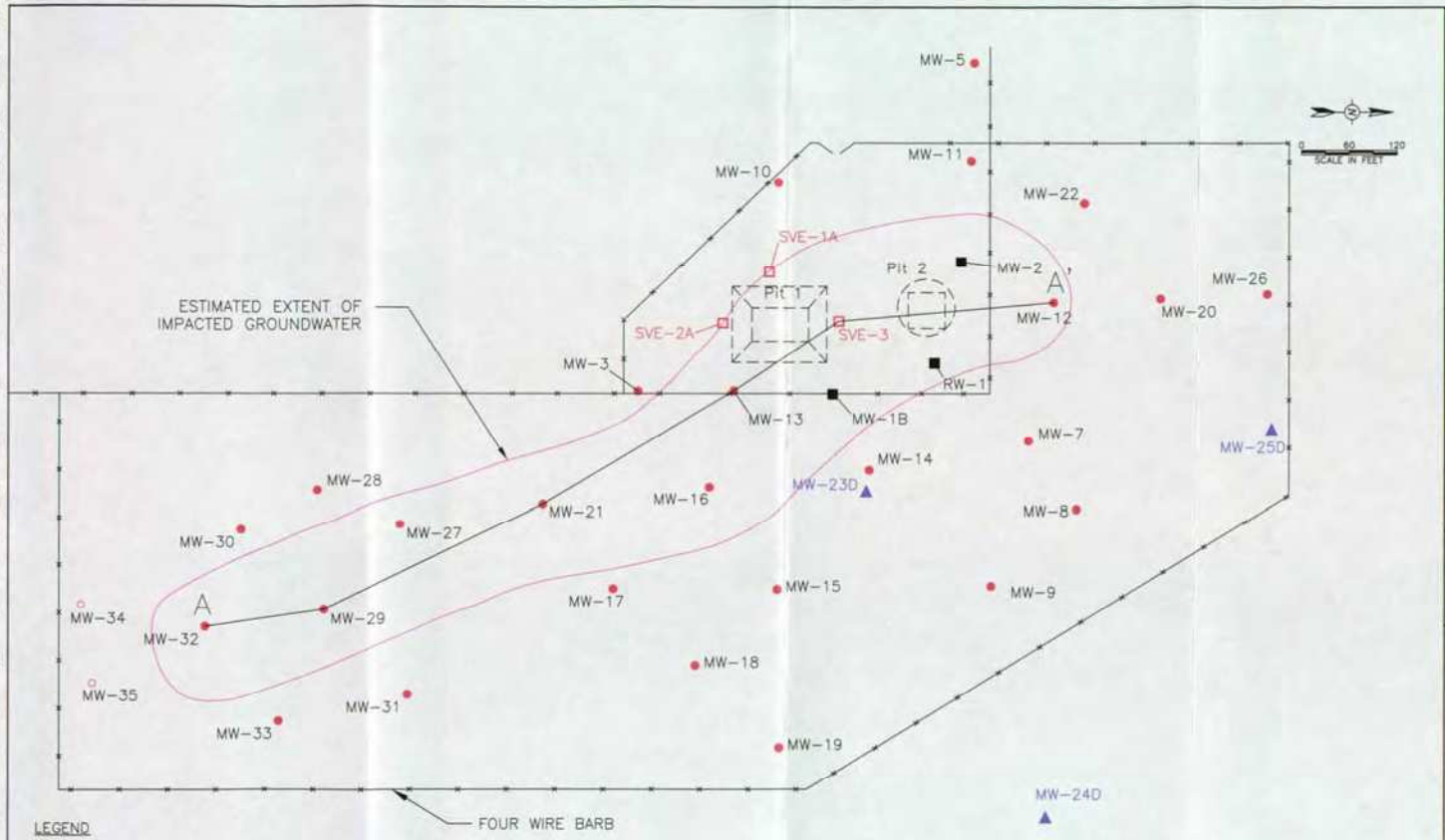
ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Geologic Cross Section

PROJECT NUMBER: P-202203
DRAWING NO.: G-2



REVISIONS

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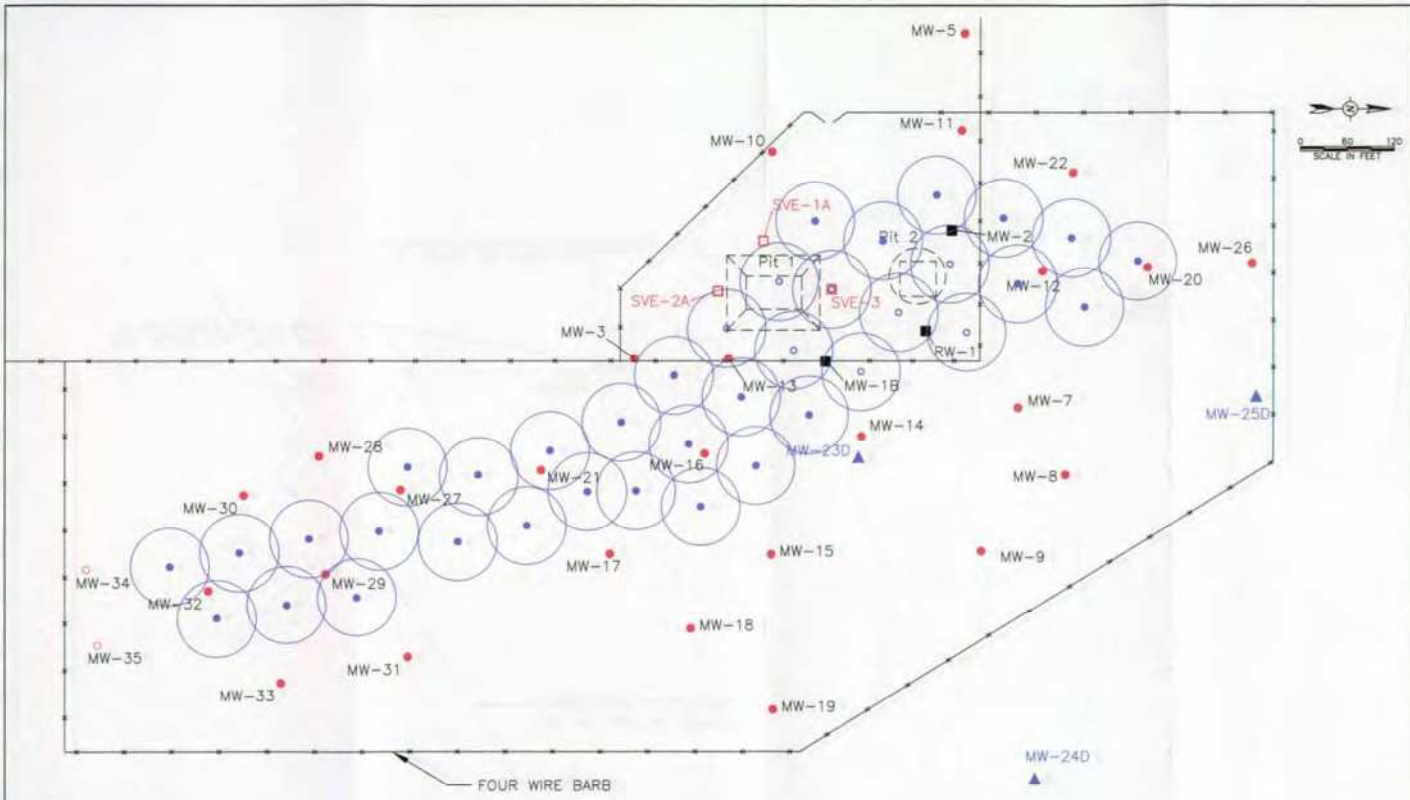
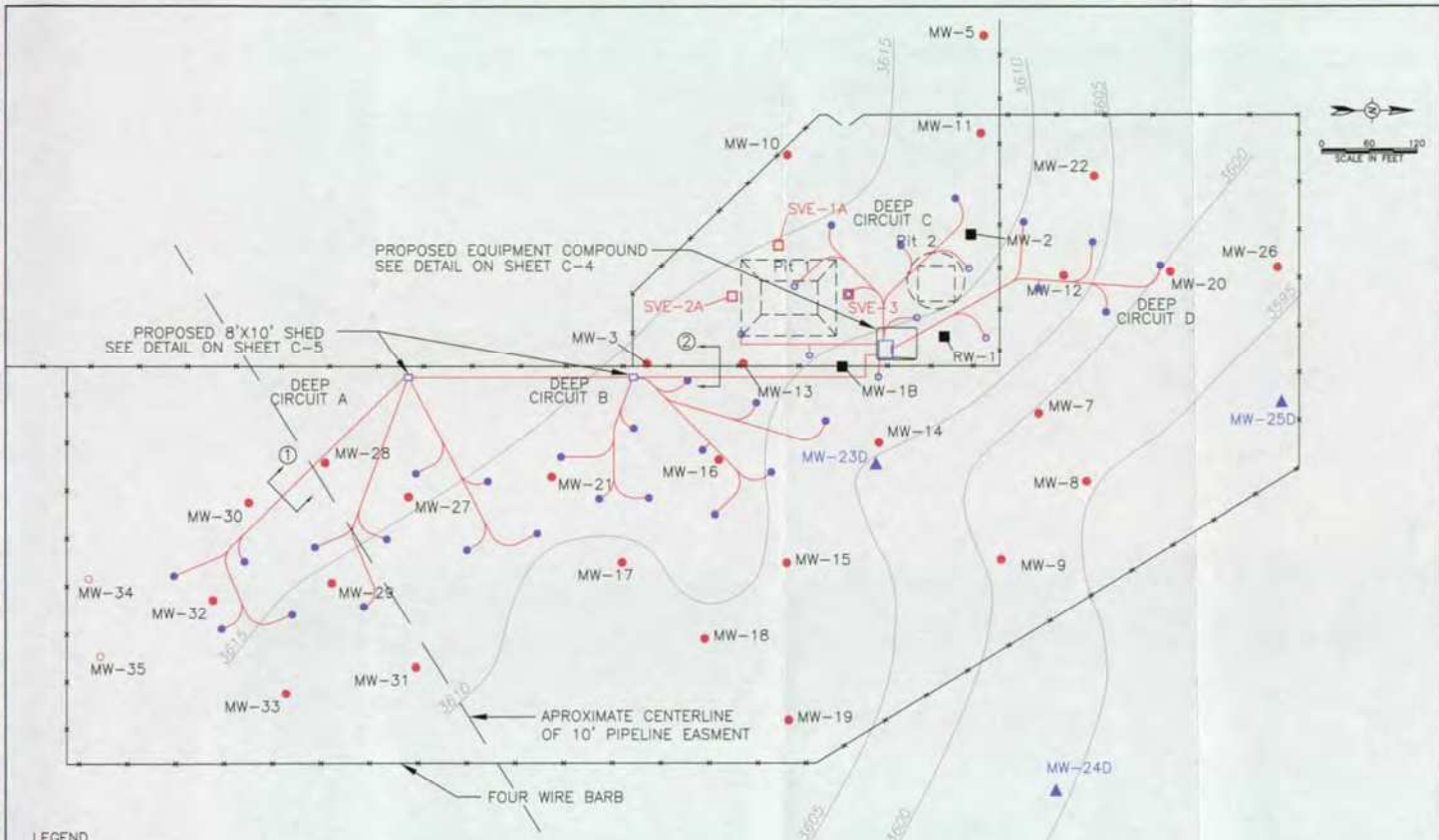
ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Areal Extent of Impacted Groundwater

PROJECT NUMBER: P-202203

DRAWING NO.: G-3


MW-5
MW-10
MW-11
MW-22
SVE-1A
Pit 2
MW-2
MW-26
Pit 1
MW-12
MW-20
SVE-2A
SVE-3
MW-3
RW-1
MW-13
MW-1B
MW-7
MW-25D
MW-14
MW-28
MW-23D
MW-21
MW-16
MW-27
MW-8
MW-30
MW-17
MW-15
MW-9
MW-34
MW-29
MW-32
MW-18
MW-35
MW-31
MW-33
MW-19
MW-24D
FOUR WIRE BARB
0 60 120
SCALE IN FEET
LEGEND
Monitor Well
Deep Monitor Well
Recovery Well
Phase II SVE Well
Proposed Assessment Monitor Well
50 ft Radius of Influence
Multi Phase Extraction Well
Multi Phase Extraction and Shallow SVE Well
REVISIONS
Tetra Tech EM Inc.
ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO
Multi Phase Extraction Well Field Layout
P-202203
C-1



REVISIONS

Tetra Tech EM Inc.

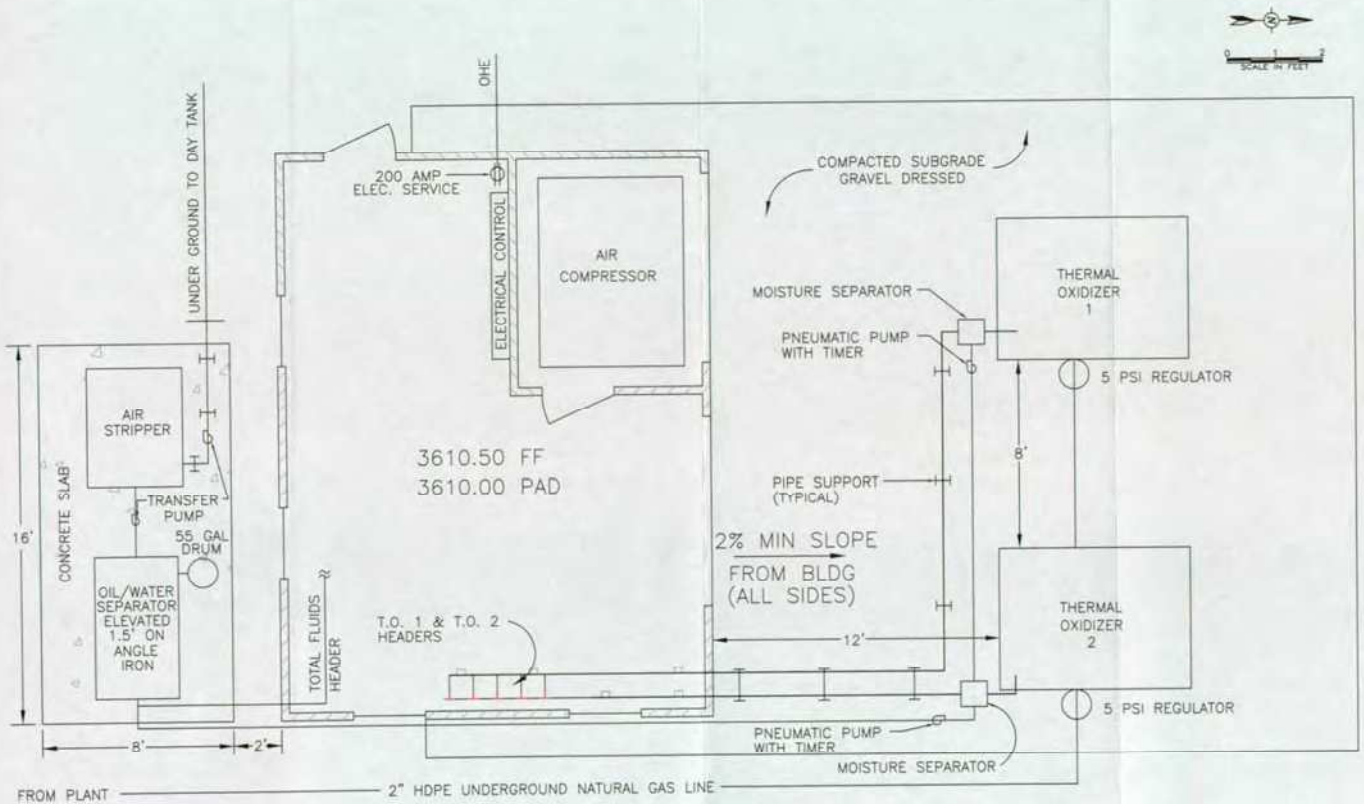
DESIGNED BY: JS
DRAWN BY: JN
CHECKED BY: JN
RE-CHECKED BY:
APPROVED BY:
DATE:

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Trenching/Conveyance Piping Plan

PROJECT NUMBER
P-202203

DRAWING NO.
C-2



EQUIPMENT COMPOUND DETAIL (PLAN)
NTS

REVISIONS

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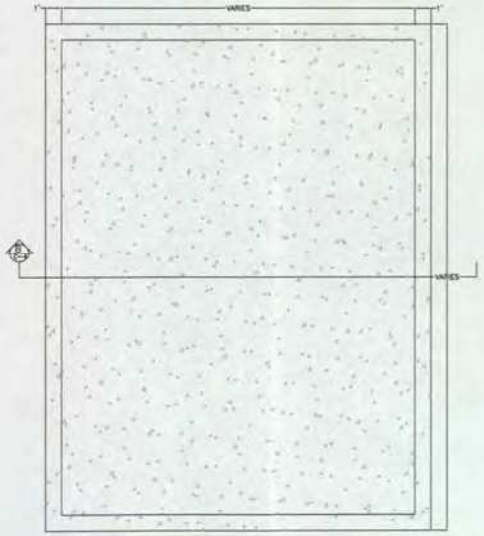
ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Equipment Compound Detail

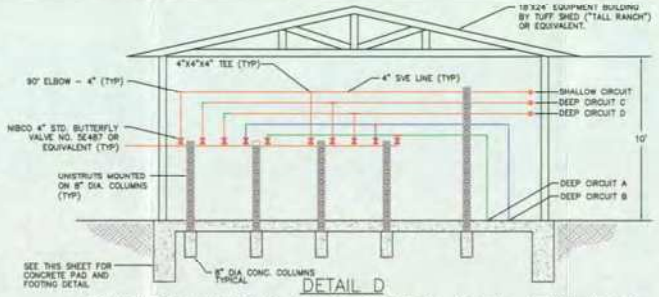
PROJECT NUMBER
P-202203

DRAWING NO.
C-3

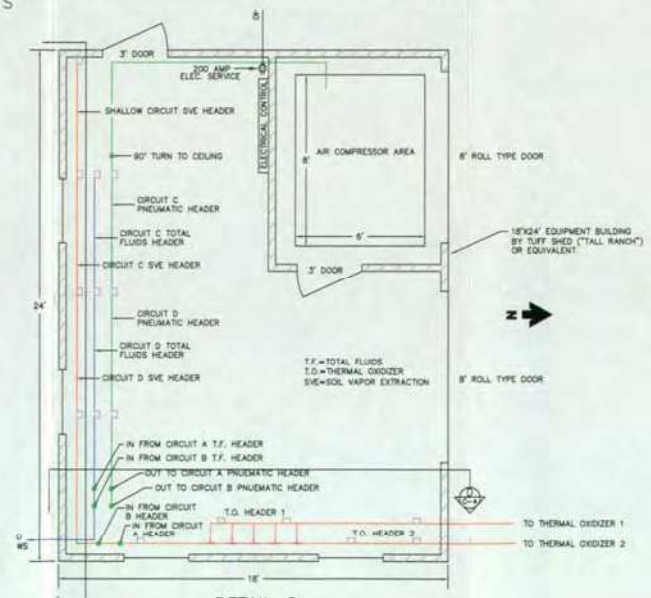
DETAIL B
CONCRETE PAD CROSS SECTION DETAIL
NTS



DETAIL A
CONCRETE PAD DETAIL
NTS



DETAIL D
EQUIPMENT BUILDING CROSS SECTION DETAIL (EAST WALL)
NTS



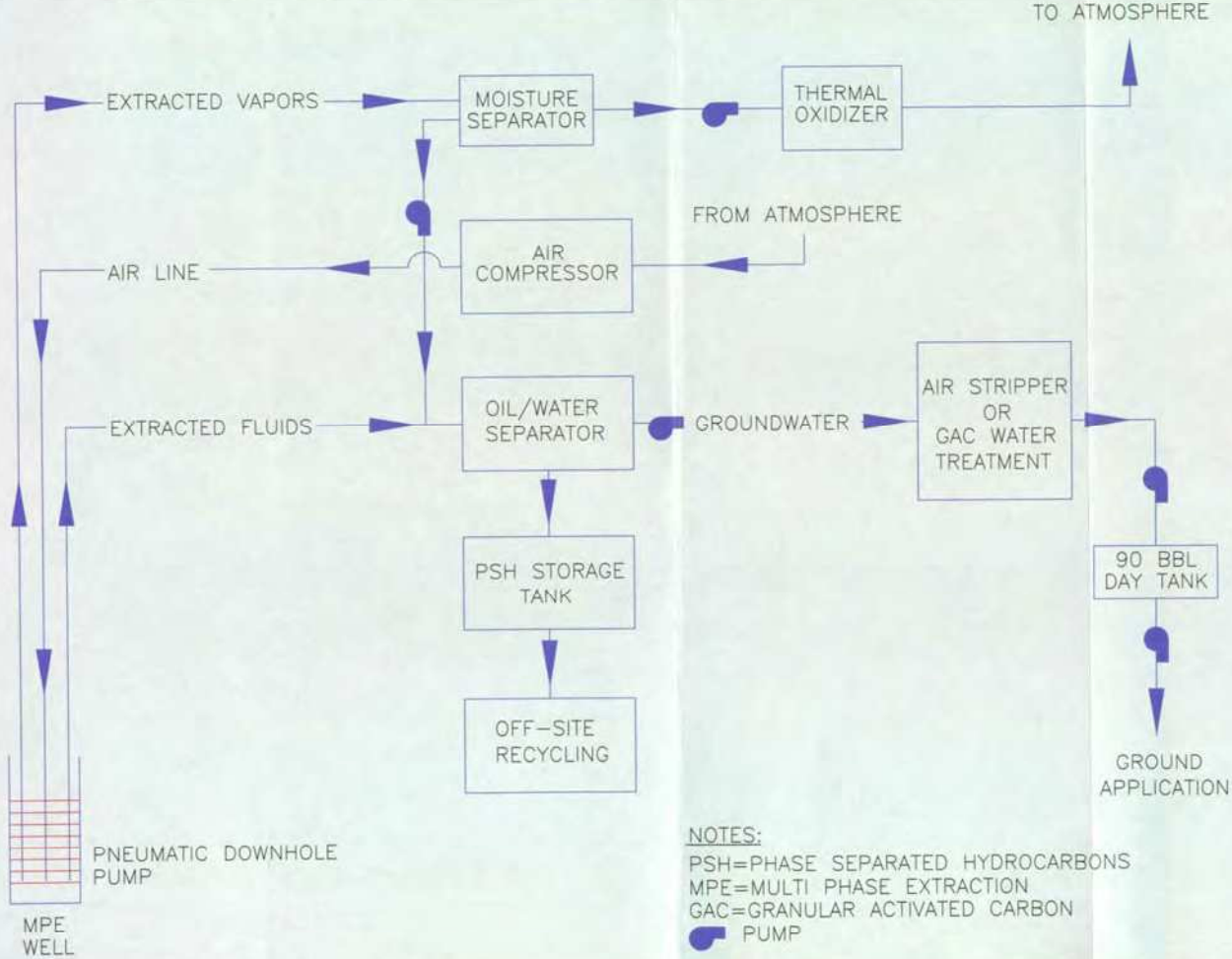
DETAIL C
EQUIPMENT BUILDING PLAN VIEW DETAIL
NTS

Tetra Tech EM Inc.

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Equipment Compound Details

WORK ASSIGNMENT NO.: P-202203
DRAWING NO.: C-4



REVISIONS

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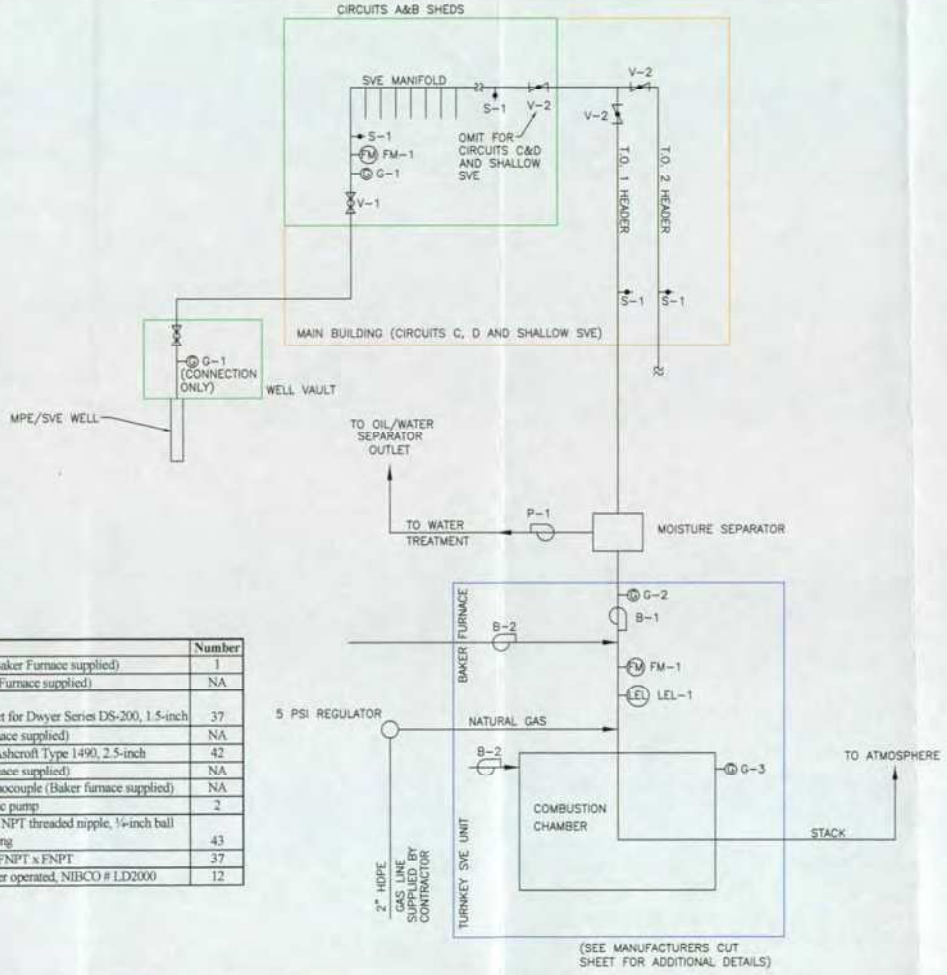
ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

PROCESS FLOW DIAGRAM

PROJECT NUMBER: P-202203

DRAWING NO.: P-1



Symbol	Description	Number
B-1	Blower, SVE extraction, (Baker Furnace supplied)	1
B-2	Dilution air blower (Baker Furnace supplied)	NA
FM-1	Pitot tube access, thred-o-let for Dwyer Series DS-200, 1.5-inch	37
FM-2	Air flow meter (Baker Furnace supplied)	NA
G-1	Diaphram vacuum gauge, Ashcroft Type 1490, 2.5-inch	42
G-2	Vacuum gauge (Baker Furnace supplied)	NA
G-3	Combustion chamber thermocouple (Baker furnace supplied)	NA
P-1	WILDEN oil-less pneumatic pump	2
S-1	Vapor sample tap, brass, ¼ NPT threaded nipple, ⅛-inch ball valve, and ⅛-hose barb fitting	43
V-1	Ball valve, 1.5-inch, PVC, FNPT x FNPT	37
V-2	Butterfly valve, 4-inch, lever operated, NIBCO # LD2000	12

Tetra Tech EM Inc.

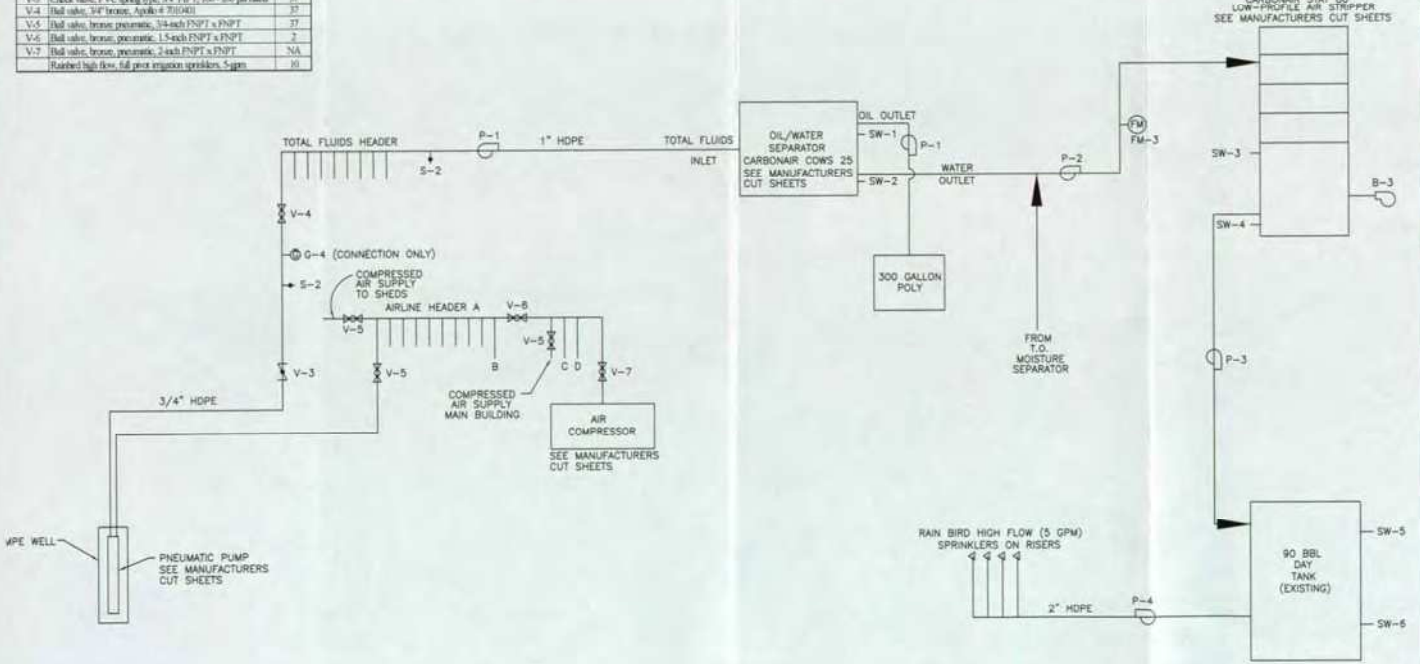
DESIGNED BY: JS
DRAWN BY: RM
CHECKED BY: RM
RE-CHECKED BY:
APPROVED BY:
DATE:

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

SVE SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM

WORK ASSIGNMENT NO.: P-202203
DRAWING NO.: P-2

Symbol	Description	Number
B-3	5-HP, 300 cfm 30 TEFC blower (Carbonair supplied)	NA
FM-3	Totalizing flow meter, water , Hayes 1-inch	1
P-1	Wilden oil-less pneumatic pump	1
P-2	Transfer pump, Meyers CT (Carbonair supplied)	NA
P-3	Transfer pump, 1-HP, 230V, 3-0, 20 gpm (Carbonair supplied)	NA
P-4	Irrigation pump, Sta-Rite DHG, 2HP, high head	1
S-2	Sample tap, total fluids line, stainless steel petcock	38
SW-1	High level switch, O/W S, (Carbonair supplied)	NA
SW-2	Low level switch, O/W S, (Carbonair supplied)	NA
SW-3	High level switch, A/S, (Carbonair supplied)	NA
SW-4	Low level switch, A/S, (Carbonair supplied)	NA
SW-5	High level switch, day tank, contractor supplied	1
SW-6	Low level switch, day tank, contractor supplied	1
V-3	Check valve, PVC spring type, 3/4" FIPT, 100 - 200 psi rated	37
V-4	Ball valve, 3/4" bronze, Apollo # 70H401	37
V-5	Ball valve, bronze, pneumatic, 3/4-inch FNPT x FNPT	37
V-6	Ball valve, bronze, pneumatic, 1.5-inch FNPT x FNPT	2
V-7	Ball valve, bronze, pneumatic, 2-inch FNPT x FNPT	NA
	Rainbird high flow, full pivot irrigation sprinklers, 5-gpm	10



Tetra Tech EM Inc.

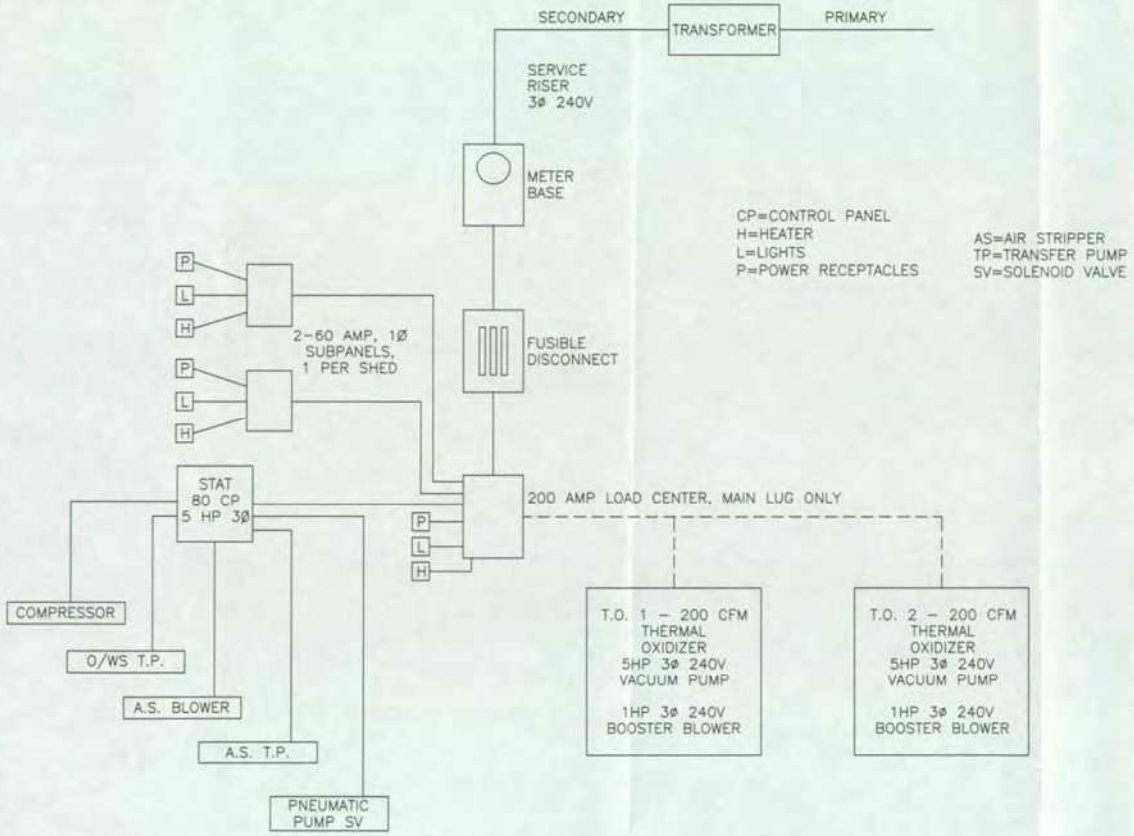
DESIGNED BY: JS
DRAWN BY: RM
CHECKED BY: RM
RE-CHECKED BY:
APPROVED BY:
DATE:

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

TOTAL FLUIDS SYSTEM PROCESS AND INSTRUMENTATION DIAGRAM

WORK ASSIGNMENT NO.: P-202203

DRAWING NO.: P-3



ELECTRICAL DETAILS

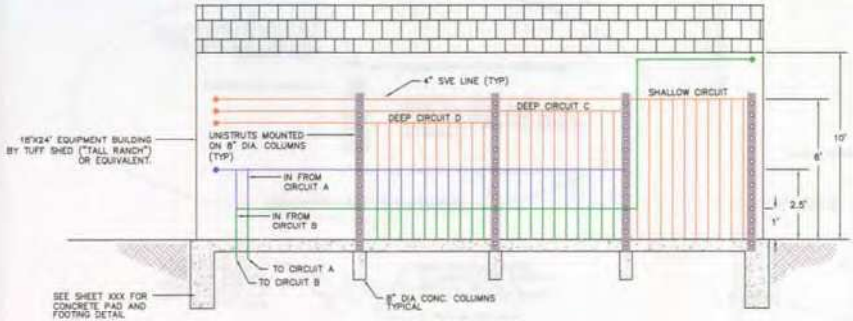
Tetro Tech EM Inc.

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

ELECTRICAL DETAILS
ONE-LINE DIAGRAM

WORK ASSIGNMENT NO.: P202203

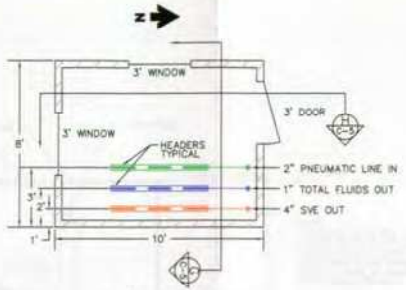
DRAWING NO.: E-1



DETAIL E

EQUIPMENT BUILDING CROSS SECTION DETAIL (SOUTH WALL)

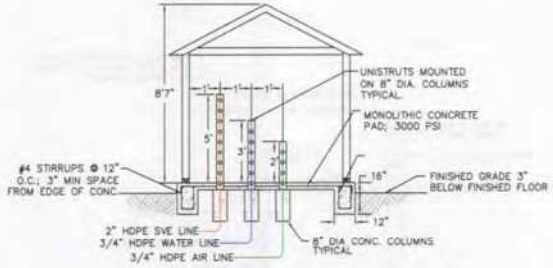
NTS



DETAIL F

EQUIPMENT SHED PLAN VIEW DETAIL

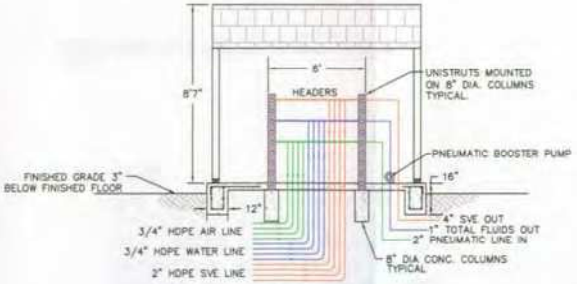
NTS



DETAIL G

EQUIPMENT SHED CROSS SECTION DETAIL (SOUTH WALL)

NTS



DETAIL H

EQUIPMENT SHED CROSS SECTION DETAIL (EAST WALL)

NTS

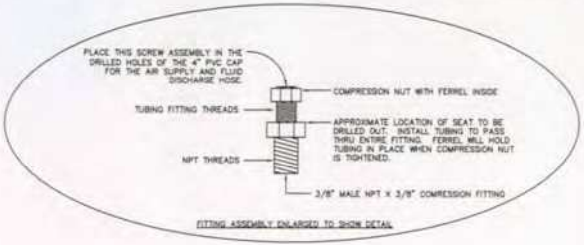
Tetra Tech EM Inc.

DESIGNED BY: JS
DRAWN BY: DN
CHECKED BY: DN
RE-CHECKED BY:
APPROVED BY:
DATE:

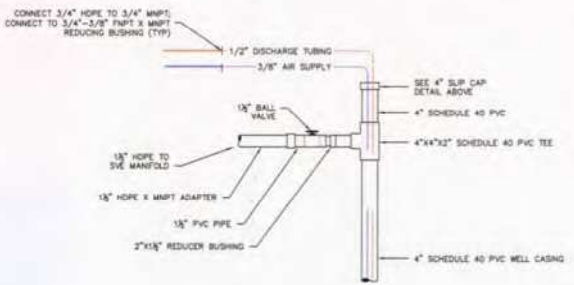
ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Equipment Building Details

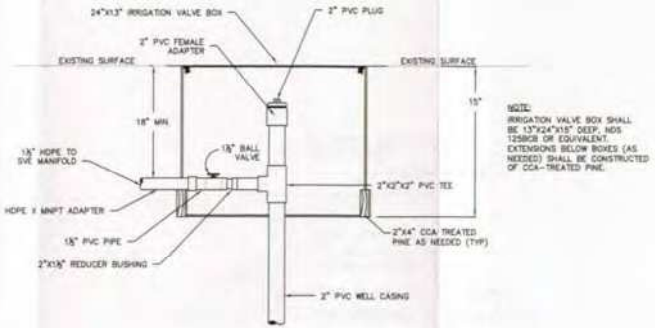
WORK ASSIGNMENT NO.
P-202203
DRAWING NO.:
C-5



4" PVC SLIP CAP AND FITTING ASSEMBLY DETAIL
NTS



DEEP SVE WELLHEAD DETAIL
NTS



SHALLOW SVE WELLHEAD DETAIL
NTS

NOTE:

MPE WELL HEADS HOUSED IN 17"X30"X18" DEEP VALVE BOX, NDS 126BCB OR EQUIVALENT. EXTENSIONS BELOW BOXES (AS NEEDED) SHALL BE CONSTRUCTED OF CCA-TREATED PINE.

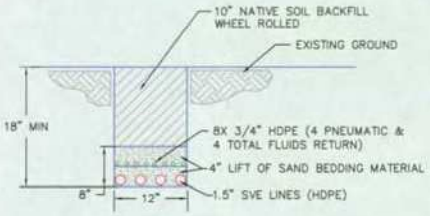
Tetra Tech EM Inc.

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

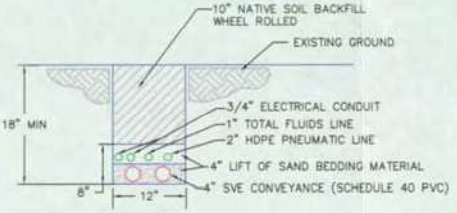
Well Head Details

WORK ASSIGNMENT NO.: P-202203

DRAWING NO.: C-6



DETAIL 1–TYPICAL
NTS



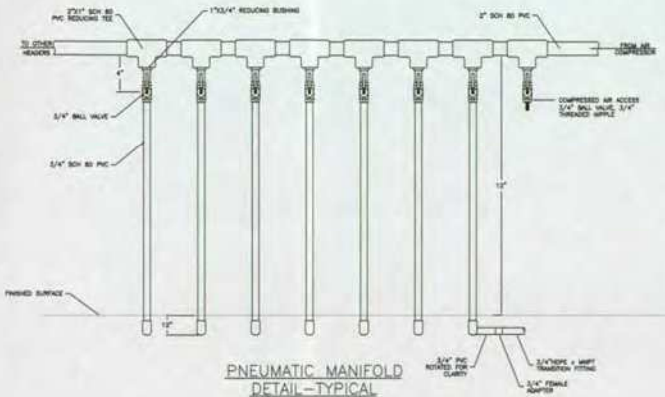
DETAIL 2–TYPICAL
NTS

Tetra Tech EM Inc.

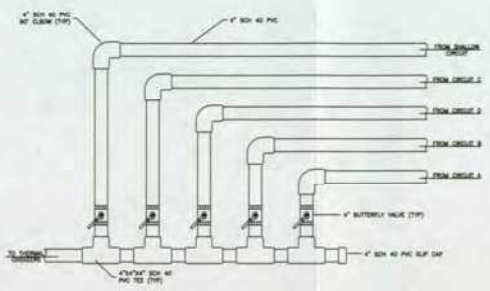
ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

Trenching Details

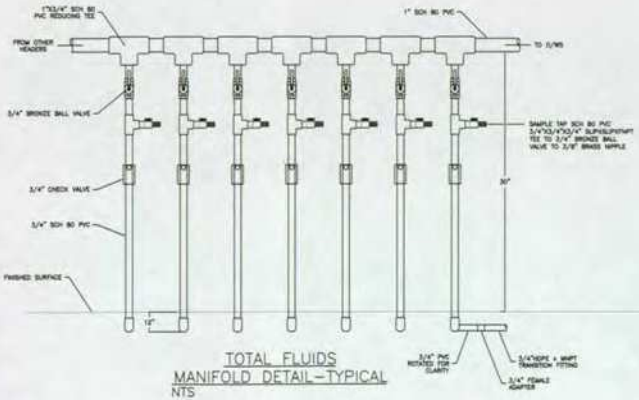
WORK ASSIGNMENT NO.: P-202203
DRAWING NO.: C-7



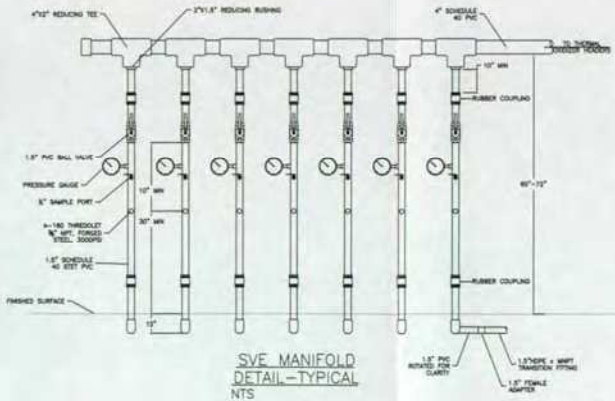
PNEUMATIC MANIFOLD DETAIL–TYPICAL
NTS



THERMAL OXIDIZER MANIFOLD DETAIL–TYPICAL
NTS



TOTAL FLUIDS MANIFOLD DETAIL–TYPICAL
NTS



SVE MANIFOLD DETAIL–TYPICAL
NTS

Tetra Tech EM Inc.

DESIGNED BY: JS
DRAWN BY: EM
CHECKED BY: RM

RE-CHECKED BY:
APPROVED BY:
DATE:

REV. DATE

ROSWELL COMPRESSOR STATION
ROSWELL, NEW MEXICO

MANIFOLD DETAILS

WORK ASSIGNMENT NO.:
P202203

DRAWING NO.:
C-8

Appendix B

Banks Environmental Water Well Report

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Water Well Report™

Wednesday, October 31, 2012

CLIENT
EARTHCON CONSULTANTS, INC. 4800 Sugar Grove Blvd. Suite 390 Stafford, TX 77477

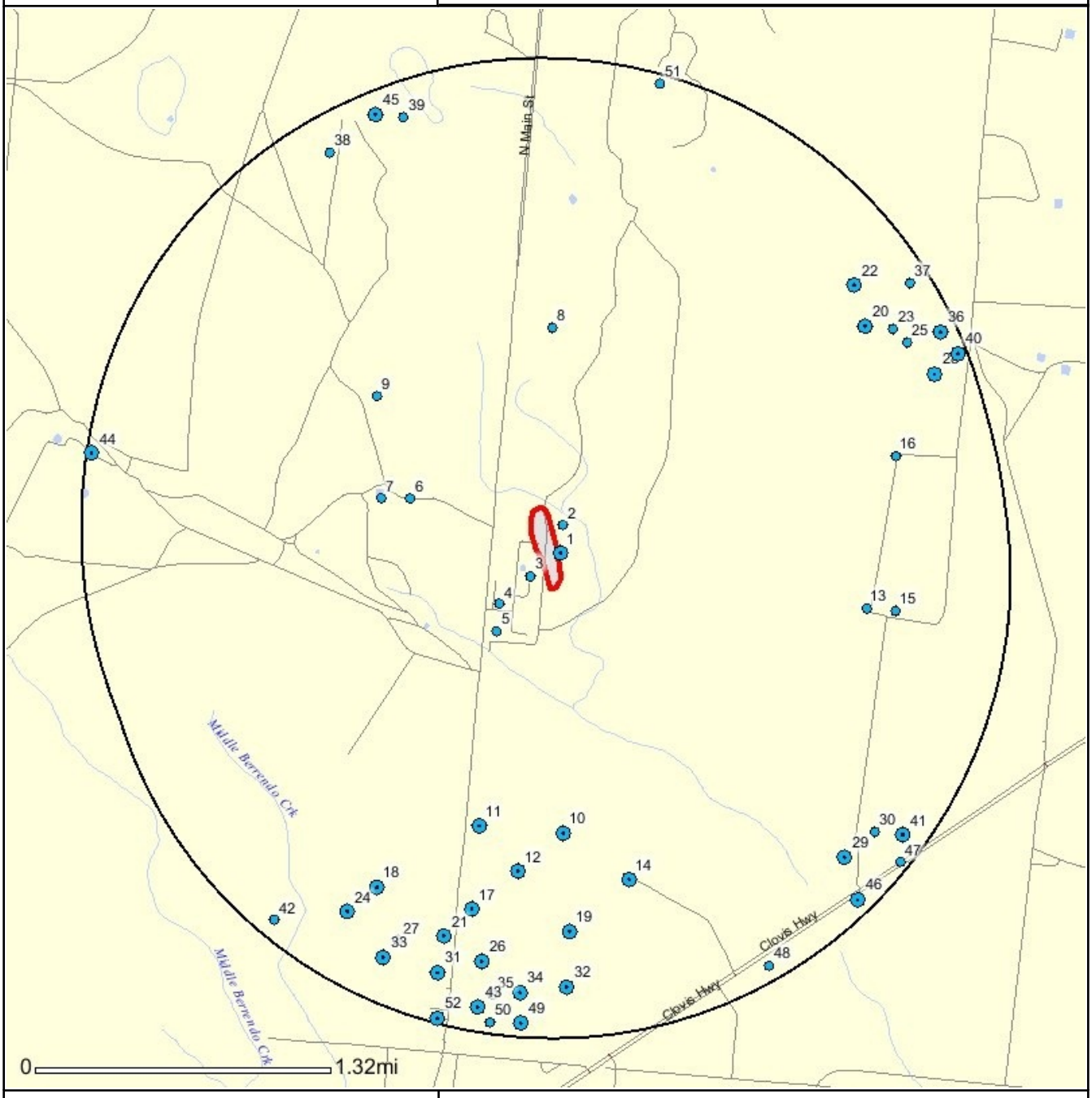
SITE
Transwestern Pipeline Roswell Compressor Station Chaves County, NM PO #: 212037.00 ES #: 102753 BISMap #: 103112-13073

1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512.478.0059 FAX 512.478.1433 E-mail banks@banksinfo.com

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Water Well Report™

Map of Wells within 2 Mile(s)



- Site
- Well
- Cluster
- Limited Access Hwy
- Primary Highway
- Secondary Highway
- Roads
- Railroad
- County
- State
- Urban Area
- Water Bodies

One inch = 0.75 miles

Transwestern Pipeline Roswell Compressor Station

N

Banks Environmental Data
1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512-478-0059 FAX 512-478-1433

BANKS ENVIRONMENTAL DATA
A DIVISION OF THE BANKS GROUP

Water Well Report™

DETAILS

Map #	Source ID	Owner of Well	Type of Well	Depth Drilled	Completion Date	Longitude	Latitude	Driller's Log
1	144653	TRANSWESTERN PIPELINE COMPANY	Not Reported			-104.51396	33.51433	N/A
1	144654	TRANSWESTERN PIPELINE COMPANY	Not Reported			-104.51396	33.51433	N/A
2	144655	TRANSWESTERN PIPELINE COMPANY	Not Reported			-104.514	33.51614	N/A
3	RA-2479	Dr. Connor	N/A	138	12/1/1947	-104.51611	33.51263	View
4	191948	PECOS VALLEY ARTESIAN CONSERVA	Not Reported			-104.5183	33.5107	View
5	185743	TRANSWESTERN PIPELINE CO.	Not Reported			-104.51831	33.5089	N/A
6	RA-3423	Oscar White	N/A	370		-104.52592	33.51693	View
7	NA	Oscar White	Irrigation	110	12/1/1947	-104.52813	33.51677	View
8	185772	MICHAEL C. BUNKER	Not Reported	100		-104.51621	33.52877	N/A
9	123353	SALT CREEK FARM AND RANCH	IRRIGATION	370	12/31/1947	-104.52919	33.52331	N/A
10	224710	JIMMY PERKINS	Not Reported	157	11/4/2006	-104.51173	33.49631	N/A
10	RA-11052	Bettina Perkins and Jimmy Perkins	Domestic	157	11/4/2006	-104.51149	33.49638	View
11	220210	ANGELA SALAZAR	MULTIHOUSEHOLD	487	7/7/2006	-104.51823	33.49628	N/A
11	RA-10975	Angelo Salazar	Other	487	7/7/2006	-104.51801	33.49645	View
12	187401	ARTHUR H. EVANS	Not Reported			-104.51494	33.4936	N/A
12	127109	H.L. DEERING	Not Reported	250		-104.51494	33.4936	N/A
12	147004	GLENN AND MARY TRUITT	Not Reported	350		-104.51494	33.4936	N/A
13	189037	JACK H HAGELSTEIN	Not Reported			-104.49005	33.5126	N/A
14	126503	DAVID STETTER	DOM & STK	125	8/11/1992	-104.50624	33.49366	N/A
14	RA-8073	David Stetter	Domestic	125	8/11/1992	-104.50634	33.49373	View
15	184308	MICHAEL & VICKI SMITH	Not Reported			-104.48783	33.51262	N/A
16	176415	MARSHALL N. DECKER CHARITABLE	Not Reported			-104.48891	33.52257	N/A
17	RA-10096	Mark Waltmire	Domestic	210	10/13/2003	-104.5181	33.49087	View
17	171737	MARK WALTMIRE	DOMESTIC	210	10/13/2003	-104.51821	33.49088	N/A
18	RA-?	Martin & Martin	Domestic	116	9/10/1954	-104.52565	33.4917	View
18	128837	MARTIN & MARTIN	DOMESTIC ONE HOUSEHOLD	116	9/14/1954	-104.5258	33.49173	N/A
19	183641	H.L. DEERING	Not Reported	450		-104.51054	33.49002	N/A
19	123235	JOHNNY L. SANDOVAL	Not Reported	125	10/8/1992	-104.51054	33.49002	N/A
19	123768	JOHNNY L. SANDOVAL	Not Reported	125	9/29/1992	-104.51054	33.49002	N/A
19	125476	A. C. STOWELL	Not Reported			-104.51054	33.49002	N/A
19	129468	DONALD E. BECKER, JR.	DOMESTIC ONE HOUSEHOLD	197		-104.51054	33.49002	N/A

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BANKS ENVIRONMENTAL DATA
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Water Well Report™

DETAILS

Map #	Source ID	Owner of Well	Type of Well	Depth Drilled	Completion Date	Longitude	Latitude	Driller's Log
20	173065	Not Reported	Not Reported			-104.49222	33.53076	N/A
20	123050	JARRED HESTAND	Not Reported	380	1/1/1947	-104.49222	33.53076	N/A
20	128747	J.P. MC LEAN	IRRIGATION	380	1/1/1947	-104.49222	33.53076	N/A
21	RA-9759A	Al Seminatore	Domestic	300	1/4/2001	-104.52016	33.48898	View
21	150635	PAT SEMINATORE	DOMESTIC ONE HOUSEHOLD	300	7/12/1999	-104.52035	33.48906	N/A
22	128099	JOE P. MCLEAN	Not Reported	415	5/20/1960	-104.49355	33.5333	N/A
22	127966	JOE P. MCLEAN	Not Reported	417	5/20/1960	-104.49355	33.5333	N/A
22	127818	Not Reported	IRRIGATION	380	3/18/1959	-104.49355	33.5333	N/A
22	RA-3957	Joe P. McLean	Domestic	415	5/20/1960	-104.49337	33.53334	View
22	RA-3957	Joe P. McLean	Domestic	375	1/16/1959	-104.49343	33.53347	View
23	149484	MICHAEL H. MAGEE	DOMESTIC ONE HOUSEHOLD	180	5/27/1999	-104.49007	33.53075	N/A
24	188882	H.L. DERRING	Not Reported			-104.52776	33.48997	N/A
24	151560	D.D. SARTIN	Not Reported	300		-104.52776	33.48997	N/A
25	RA-3120	J.P. McLean	Irrigation	210	3/18/1959	-104.48888	33.52996	View
26	125637	MYRON WARBOYS	Not Reported	382	1/11/1972	-104.51817	33.48729	N/A
26	RA-5705	Myron Warboys	Domestic	382	1/11/1972	-104.51801	33.48736	View
26	RA-6900	W.H. Hygron	Domestic	385	10/7/1982	-104.51707	33.48757	View
26	126638	AUTOMATIC VENDING	Not Reported	385	10/7/1984	-104.51708	33.4882	N/A
27	RA-9759B	Pat Seminatore	Domestic	300	7/12/1999	-104.52368	33.48845	View
28	RA-3121	Michael D. Smith	Irrigation	250	4/13/2005	-104.48654	33.52808	View
28	129291	MICHAEL D.& VICKI L. SMITH	IRRIGATION	250	4/13/2005	-104.48654	33.52808	N/A
29	186804	Not Reported	Not Reported	370	12/21/1979	-104.48999	33.49646	N/A
29	127452	ELLA MCLEAN	Not Reported	370	12/21/1979	-104.48999	33.49646	N/A
29	RA-6518	Ella McLean	Domestic	370	12/27/1979	-104.48978	33.49659	View
30	183688	ELLA S. MCLEAN	Not Reported			-104.48783	33.49828	N/A
31	236811	GEORGE A KENNARD	DOMESTIC	193	12/18/2008	-104.52037	33.48657	N/A
31	RA-11330	George A Kennard	Domestic	193	12/18/2008	-104.52024	33.48663	View
32	RA-8080	Johnny Sandoval	Domestic	125	10/8/1992	-104.51037	33.48643	View
32	RA-8075	Johnny Sandoval	Domestic	125	9/29/1992	-104.51029	33.48657	View
33	211969	JIM CLARK	DOMESTIC	360	11/10/2005	-104.52469	33.48723	N/A
33	RA-10794	Jim Clark	Domestic	360	11/10/2005	-104.52454	33.48726	View
34	RA-8992	Paufilo Villalobos	Domestic	125	5/30/1995	-104.51389	33.48578	View
34	128537	WILLIAM PERKINS	Not Reported			-104.51488	33.48642	N/A
35	186130	ROSWELL WOOL & MOHAIR	Not Reported	27		-104.51599	33.4855	N/A
36	238435	MICHAEL SMITH	DOMESTIC/STOCK	280	5/25/2009	-104.48638	33.53083	N/A
36	RA-11361	Michael Smith	Domestic	280	5/25/2009	-104.48625	33.53107	View

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BANKS ENVIRONMENTAL DATA
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Water Well Report™

DETAILS

Map #	Source ID	Owner of Well	Type of Well	Depth Drilled	Completion Date	Longitude	Latitude	Driller's Log
37	RA-3957	Joe P. McLean	Domestic	415	5/20/1960	-104.48908	33.53379	View
38	127334	OSCAR D. WHITE	72-12-1 LIVESTOCK WATERING	200	4/25/1960	-104.53458	33.53869	N/A
39	174911	CLINTON KEY	Not Reported	130		-104.52919	33.54141	N/A
40	237305	MICHAEL SMITH	DOMESTIC/STOCK	250	6/10/2008	-104.48507	33.52939	N/A
40	RA-11341	Michael Smith	Domestic	250	6/10/2008	-104.48488	33.52954	View
40	RA-11339	Michael Smith	Domestic	130	5/8/2008	-104.48488	33.52954	View
41	185915	ELLA MCLEAN	Not Reported			-104.48568	33.49827	N/A
41	171587	JOE B. MCCLEAN	Not Reported			-104.48568	33.49827	N/A
42	165327	Not Reported	Not Reported	300	7/12/1999	-104.5333	33.48899	N/A
43	RA-10488	Chad Chappell	Domestic	220	2/1/2004	-104.51587	33.48392	View
43	186325	RAY L. ATCHISON	Not Reported			-104.51706	33.48461	N/A
44	123781	Not Reported	IRRIGATION	546	1/8/1948	-104.55071	33.51793	N/A
44	127819	Not Reported	IRRIGATION	540	9/3/1954	-104.55071	33.51793	N/A
45	210409	CLINTON KEY	Not Reported	118	4/14/2006	-104.53135	33.54142	N/A
45	RA-10745	Clinton Key	Domestic	118	4/14/2006	-104.53123	33.54151	View
46	RA-7723	Kurt Pfeiffer	Domestic	176	7/1/1989	-104.48866	33.4938	View
46	125312	KURT PFEIFFER	Not Reported	176	7/1/1989	-104.48888	33.4938	N/A
47	171586	JOE B. MCCLEAN	Not Reported			-104.48564	33.4965	N/A
48	246139	BILLY HELLUMS	Not Reported			-104.49499	33.48902	N/A
49	126948	PAUFILO VILLALOBOS	D&S	125	5/30/1995	-104.5138	33.48373	N/A
49	RA-8992	Paufilo Villalobos	Domestic	190	12/15/1995	-104.51364	33.48385	View
50	197747	CHAD CHAPPELL	Not Reported	220	2/1/2004	-104.516	33.4837	N/A
51	128114	BERT FRENCH MARLEY	IRRIGATION	190	12/1/1947	-104.50973	33.54512	N/A
52	RA-3497	J.M. Sartin	Irrigation	150	11/18/1955	-104.52007	33.48364	View
52	128991	I.M. SARTIN	Not Reported	150	11/18/1955	-104.52031	33.48368	N/A

1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512.478.0059 FAX 512.478.1433 E-mail banks@banksinfo.com

Ra-2479

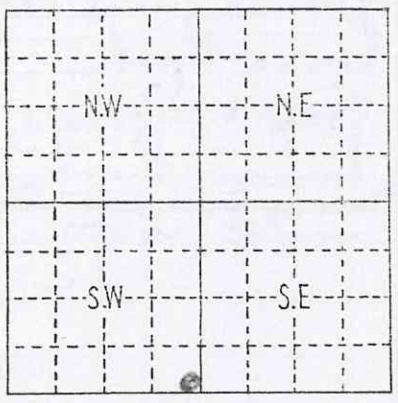
Connor #1
South Well

WELL RECORD

File No. RA2479

INSTRUCTIONS: This form should be typewritten, and filed in the office of the State Engineer, (P.O. Box 1079) Santa Fe, New Mexico, unless the well is situated in the Roswell Artesian Basin, in which case it should be filed in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.

Sec. 1



(Plat of 640 acres)
Locate Well Accurately

Owner of well Dr. Connor

Street and Number .....

Post Office .....

Well was drilled under Permit No. RA-2479 and

is located in the SE ¼ SW ¼ SW ¼ of Section 21

Township 9S, Range 24E

Drilling Contractor Cecil Ledbetter

Street and Number .....

Post Office .....

Drilling was commenced Dec. 1 19 47 Drilling was completed Dec. 12 19 47

Elevation at top of casing in feet above sea level .....

State whether well is shallow or artesian Artesian

Total depth of well ..... feet.

Sec. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from ..... to ....., Thickness in feet ....., Formation .....

No. 2, from ..... to ....., Thickness in feet ....., Formation .....

No. 3, from ..... to ....., Thickness in feet ....., Formation .....

No. 4, from ..... to ....., Thickness in feet ....., Formation .....

No. 5, from ..... to ....., Thickness in feet ....., Formation .....

Sec. 3 RECORD OF CASING

DIAMETER IN INCHES	POUNDS PER FOOT	THREADS PER INCH	NAME OF MANUFACTURER	FEET OF CASING	TYPE OF SHOE	PERFORATED FROM	PERFORATED TO	PURPOSE
10 3/4				63				

Sec. 4 RECORD OF MUDDING AND CEMENTING

DIAMETER OF HOLE IN INCHES	NUMBER OF SACKS OF CEMENT	METHODS USED	SPECIFIC GRAVITY OF MUD	TONS OF CLAY USED

Sec. 5 PLUGGING RECORD OF OLD WELL

Well is located in the ..... ¼ ..... ¼ ..... ¼ of Section ....., Township .....,

Range ..... Name of plugging contractor .....

Street and Number ..... Post Office .....

Tons of clay used ..... Tons of roughage used ..... Type of roughage .....

..... Was plugging approved by Artesian Well Supervisor .....

Cement plugs were placed as follows:

No. 1 was placed at ..... feet Number of sacks of cement used .....

No. 2 was placed at ..... feet Number of sacks of cement used .....

No. 3 was placed at ..... feet Number of sacks of cement used .....

No. 4 was placed at ..... feet Number of sacks of cement used .....

No. 5 was placed at ..... feet Number of sacks of cement used .....

(OVER)

Ra 2479

9.24.21.334

Sec. 6

LOG OF WELL

FROM (depth in feet)	TO (depth in feet)	THICKNESS IN FEET	CLASSIFICATION OF FORMATION
0	2	2	Soil
2	20	18	Adobe & gyp
20	35	15	Gravel & clay (water)
35	60	25	Conglomerate
60	75	15	gravel with water
75	90	15	lime Rock
90	115	25	Clay & Gravel
115	120	5	Lime Rock
120	130	10	Honeycombed rock with water
130	138	8	" " "

I, ...do solemnly swear that, to the best of my knowledge and belief, the foregoing information is a true and correct record of the well for which report is hereby made, insofar as can be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this ..... Signed Chas. Tebbetts

day of ....., A. D., 19..... Position .....

.....

Notary Public Street and Number .....

FIELD ENGR. LOG

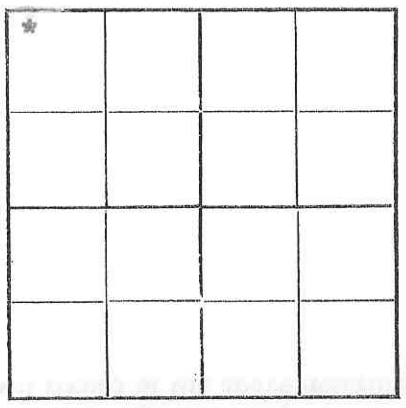
Form WR-23

STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1



(Plat of 640 acres)

(A) Owner of well Pecos Valley Artesian Conservancy Dist.

Street and Number P. O. Box 1346

City Roswell, State New Mexico

Well was drilled under Permit No. RA-5540 and is located in the

NW ¼ NW ¼ NW ¼ of Section 28 Twp. 9 S Rge. 24 E

(B) Drilling Contractor P.V.A.C.D. License No. WD 190

Street and Number same as above

City State

Drilling was commenced September 17, 19 69

Drilling was completed October 23, 19 69

Elevation at top of casing in feet above sea level Total depth of well 352 feet

State whether well is shallow or artesian artesian Depth to water upon completion

May 24, 1979 WL 90' PVACD

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	92	240	148	Rough Rock
2	249	352	103	Water Rock (rough)
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
9-5/8	32		0	240	240	Halliburton	None	

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
0	240	12¼	220	150	Denton Well Cementing Co.

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

STATE ENGINEER OFFICE

Date Received OCT 30 1969

File No. RA-5540 Use Recorder Location No. 9.24.28.1113

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	8	8		Soil
8	18	10		Sand-Gravel
18	43	25		Clay
43	52	9		Clay & Gravel
52	68	16		Clay & Gyp Rock
68	92	24		Redbed - Gyp Rock
92	150	58		Rough Rock (lost circulation)
150	235	85		1 and 2 foot Drops
235	249	14		Lime (set casing 240')
249	282	33		Lime (water rock)
282	288	6		Hard Lime
288	315	27		Lime (water rock)
315	319	4		Hard Lime
319	352			Lime Rock (water rock)

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

Charles R Wyche
Well Driller

Charles R. Wyche, Supt.

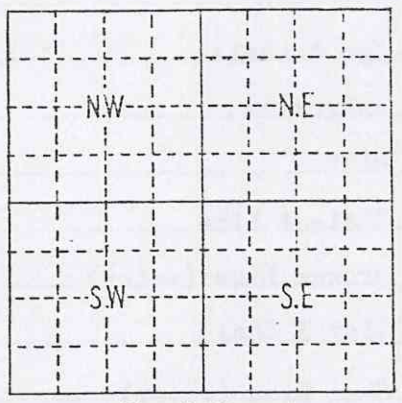
RA-3423

WELL RECORD

File No. _____

INSTRUCTIONS: This form should be typewritten, and filed in the office of the State Engineer, (P.O. Box 1079) Santa Fe, New Mexico, unless the well is situated in the Roswell Artesian Basin, in which case it should be filed in the office of the Artesian Well Supervisor, Roswell, New Mexico. Section 5 should be answered only if an old artesian well has been plugged. All other sections should be answered in full in every case, regardless of whether the well drilled is shallow or artesian in character. This report must be subscribed and sworn to before a Notary Public.

Sec. 1



(Plat of 640 acres)
Locate Well Accurately

Owner of well Oscar White

Street and Number 400 N. Kentucky,

Post Office Roswell, New Mexico

Well was drilled under Permit No. ..... and

is located in the NW ¼ SE ¼ ¼ of Section 20

Township 9, Range 24

Drilling Contractor Conrad Keyes

Street and Number .....

Post Office .....

Drilling was commenced ..... 19.... Drilling was completed ..... 19....

Elevation at top of casing in feet above sea level .....

State whether well is shallow or artesian .....

Total depth of well ..... feet.

Sec. 2 PRINCIPAL WATER-BEARING STRATA

No. 1, from ..... to ....., Thickness in feet ....., Formation .....

No. 2, from ..... to ....., Thickness in feet ....., Formation .....

No. 3, from ..... to ....., Thickness in feet ....., Formation .....

No. 4, from ..... to ....., Thickness in feet ....., Formation .....

No. 5, from ..... to ....., Thickness in feet ....., Formation .....

Sec. 3 RECORD OF CASING

DIAMETER IN INCHES	POUNDS PER FOOT	THREADS PER INCH	NAME OF MANUFACTURER	FEET OF CASING	TYPE OF SHOE	PERFORATED FROM	PERFORATED TO	PURPOSE

Sec. 4 RECORD OF MUDDING AND CEMENTING

DIAMETER OF HOLE IN INCHES	NUMBER OF SACKS OF CEMENT	METHODS USED	SPECIFIC GRAVITY OF MUD	TONS OF CLAY USED

Sec. 5 PLUGGING RECORD OF OLD WELL

Well is located in the .....¼.....¼.....¼ of Section ....., Township .....,

Range ..... Name of plugging contractor .....

Street and Number .....Post Office .....

Tons of clay used ..... Tons of roughage used..... Type of roughage.....

.....Was plugging approved by Artesian Well Supervisor.....

Cement plugs were placed as follows:

No. 1 was placed at ..... feet Number of sacks of cement used .....

No. 2 was placed at ..... feet Number of sacks of cement used .....

No. 3 was placed at ..... feet Number of sacks of cement used .....

No. 4 was placed at ..... feet Number of sacks of cement used .....

No. 5 was placed at ..... feet Number of sacks of cement used .....

(OVER)

RA-3423 9.24.20.410

Sec. 6

LOG OF WELL

FROM (depth in feet)	TO (depth in feet)	THICKNESS IN FEET	CLASSIFICATION OF FORMATION
0 - 12			Soil
12 - 45			Red Sandy clay
45 - 85			Red Sandy Clay
85 -115			Gyp (water)
115 - 130			Anhydrite
130 - 142			Gyp & shale
142 - 165			Anhydrite
165 - 175			Lime
175 - 180			Shale & Lime
180 - 220			Broken Lime (water)
220 - 226			Clay & Shale
226 - 254			Sand Lime (water)
254 - 263			Yellow clay
263 - 285			Broken Lime
285 - 288			Sandy Lime (water
288 - 300			Broken Lime
300 - 335			Sandy Lime
335-340			Broken Lime(water)
340-~~367~~ 360			~~Broken Lime~~ Gray lime
360 - 367			Broken Lime (water)
367 - 370			Gray Lime
	Set 156 ' 9" 10" casing		
	Set 170' 6" 8¼"casing perforated		

I, ...do solemnly swear that, to the best of my knowledge and belief, the foregoing information is a true and correct record of the well for which report is hereby made, insofar as can be determined from all available records.

SUBSCRIBED AND SWORN TO BEFORE ME this ... Signed .....

day of ....., A. D., 19..... Position .....

.....
Notary Public Street and Number .....

My Commission Expires ..... Post Office .....

TD18a

FE-1 State of New Mexico
State Engineer

WELL SCHEDULE

Source of data: Obser [X] Owner [ ] Other _____ RLB-CS, 372 NE Cor.

Date April 12 19 48 Record by Minton

LOCATION: County CHAVES Map 81.4.4

OWNER OSCAR WHITE

DRILLER Conrad Keyes Completed Dec. 19 47

TOPO SITUATION FLAT _____ Topo spot Elev 3633

DEPTH 150 370 ft [X] Rept [ ] Meas Use IRR

CASING 10 5/8 in to _____ ft Log _____

PUMP: Type TURBINE Make PEERLESS RLB 1-14-59

Ser.no./model _____ Size of dischg 8 in.

PRIME MOVER: Make US MOTORS HP 30

Ser.no. _____ Power/Fuel ELEC

PUMP DRIVE: [ ] Gear Head [ ] Belt Head [ ] Pump Jack

Make _____ Ser.no _____ [X] VHS

WATER LEVEL: 64.25 ft rept meas APRIL 12 19 48 above below

TC

_____ which is 1.00 ft above below LS

PERMANENT RP is TOP OF 3'x3' CONC. BASE

which is 0.00 ft above below described MP and 1.00 ft above below LS

REMARKS 1-14-59 - RLB Disch. 30' N. To EARTH

AQUIFER(S): PSA 333059104313501

Well No. 1 on Photo RAC-2-181 DPN 05-5040

File No RA-3423 Loc. No. 9.24.20.32422

STATE ENGINEER
Technical Division

Description of well USGS annual
owner: Oscar White
MP: Ins FE-1
Elev: 3633

DATE	HOUR	DEPTH TO WATER		WATER LEVEL ELEV. ABOVE MSL
		Below MP	Below LSD	
4/12/48	Edm	64.25	-1.0 63.25	
2/1/79		110.12	-1.0 109.12	

Water Level Record from _____ 19 to _____ 19

Well No. 9.24.20.32422, County 5-5040

Remarks cont. RESERVOIR. 3-5-79 JA, FB
NOW UNEQUIPPED, COVERED WITH STEEL DISC. SHOWN ON TOPO Well is 8' south of concrete base and 14' east of power pole w/ cut notch.

SKETCH:

N

INITIAL WATER-LEVEL MEASUREMENT		DEPTH TO WATER			
		Below MP			Below LS
		1st	2nd	3rd	
Date APRil 12, 1948					64.25
Hour ____ AM PM	Obs EGm				1.00
Not POA (X)	POA ( )	64.25			63.25

W L meas after pump shut off ____ min. Pumping W L ( )

Remarks 9.24.20.32422

STATE ENGINEER
Technical Division

Owner OSCAR WHITE		DEPTH TO WATER			WATER LEVEL ELEV
Use IRR		Below MP		Below LSD	
		1st	2nd		
Date APRIL 12, 1948				64.25	3633
Hour ____ AM PM	Obs EGm			1.00	63
Not POA (X)	POA ( )	64.25		63.25	3570

W L meas after pump shut off ____ min. Pumping W L ( )
Remarks

Date MARCH 3, 1979		111.00	110.00	108.10	3633
Hour 4:30 AM (PM)	Obs JA FB	2.92	1.90	1.00	107
Not POA (X)	POA ( )	108.08	108.10	107.10	3526

W L meas after pump shut off ____ min. Pumping W L ( )
Remarks

Date JAN 17, 1984		110.00	109.00	107.51	3633
Hour 12:26 AM (PM)	Obs KOH JKC	2.49	1.46	1.00	107
Not POA (X)	POA ( )	107.51	107.54	106.51	3526

W L meas after pump shut off ____ min. Pumping W L ( )
Remarks Closest wooden pole now 5 ft high
Top of Concrete at land Surface [illegible]

Date 1 26, 1984		115.00	116.00	107.23	3633
Hour 9:15 (AM) PM	Obs Rogers & Chavez	7.77	8.76	1.00	106
Not POA (X)	POA ( )	107.23	107.24	106.23	3527

W L meas after pump shut off ____ min. Pumping W L ( )
Remarks Well csg. uneq. open hole.

Latitude ____ Longitude 5-5040
File No ____ Location No 9.24.20.32422

STATE ENGINEER
Technical Division

Owner Oscar White / Use Abd. Irr.	DEPTH TO WATER Below MP 1st	DEPTH TO WATER Below MP 2nd	DEPTH TO WATER Below LSD	WATER LEVEL ELEV
Date January 10, 19 89	95.00	96.00	92.06	3633
Hour 11:30 AM/PM Obs JC	2.94	3.93	1.00	91
Not POA (X) POA ( )	92.06	92.07	91.06	3542

W L meas after pump shut off _____ min. Pumping W L (
Remarks _____

Date Feb 01, 19 94	94.10	85.00	83.15	3633
Hour 9:45 AM/PM Obs DU & SNL	0.85	1.85	1.00	82
Not POA (X) POA ( )	83.15	83.15	82.15	3551

W L meas after pump shut off _____ min. Pumping W L (
Remarks _____

Date JAN. 11, 19 99	97.00	100.00	83.12	3633
Hour _____ AM/PM Obs _____	13.88	16.87	1.00	82
Not POA ( ) POA ( )	83.12	83.13	82.12	3551

W L meas after pump shut off _____ min. Pumping W L (
Remarks _____

Date Feb 18, ~~19~~ 2004	92.00	93.00	88.74	3633
Hour 0930 AM/~~PM~~ Obs MB/TW	3.27	4.26	1.00	88
Not POA (✓) POA ( )	88.73	88.74	87.74	3545

W L meas after pump shut off _____ min. Pumping W L (
Remarks MP = Same

W-104° 31' 41.3"

Latitude N-33° 31' 00.4" Longitude 5-5040

STATE ENGINEER
Technical Division

Owner / Use	DEPTH TO WATER Below MP 1st	Below MP 2nd	Below LSD	WATER LEVEL ELEV
Date 1 19, ~~19~~ 05	94.00	95.00	89.16	3633
Hour 9:10 (AM) PM Obs KF	4.84	5.84	1.00	88
Not POA (X) POA ( )	89.16	89.16	88.16	3545

W L meas after pump shut off _____ min. Pumping W L ( )
Remarks _____

Date 1 31, ~~19~~ 06	94.00	96.00	90.41	3633
Hour 7:45 (AM) PM Obs KF JW	3.58	5.59	1.00	89
Not POA ( ) POA ( )	90.42	90.41	89.41	3544

W L meas after pump shut off _____ min. Pumping W L (
Remarks _____

Date March 8, ~~19~~ 2007	92.00	93.00	89.11	3633
Hour 3:05 (AM) PM Obs JS, MB	2.89	3.89	1.00	88
Not POA (X) POA ( )	89.11	89.11	88.11	3545

W L meas after pump shut off _____ min. Pumping W L (
Remarks _____

Date 2 4, ~~19~~ 08	92.00	93.00	90.42	3633
Hour 1310 AM PM Obs CF	1.58	2.58	1.00	89
Not POA (X) POA ( )	90.42	90.42	89.42	3544

W L meas after pump shut off _____ min. Pumping W L (
Remarks _____

atitude _____ Longitude _____
le No Location No 9.24.20.3242

STATE ENGINEER
Technical Division

Owner / Use	DEPTH TO WATER Below MP 1st	Below MP 2nd	Below LSD	WATER LEVEL ELEV
Date 1/21/09 ~~19~~ 2009	115.00	117.00	92.48	3633
Hour 8:30 AM PM Obs VDA JS	22.52	24.52	1.00	91
Not POA (X) POA ( )	92.48	92.48	91.48	3542

W L meas after pump shut off_____min. Pumping W L ( )
Remarks_____

Date Jan 13 ~~19~~ 2010	100.00	101.00	93.68	3633
Hour 4:05 AM PM Obs JS	6.31	7.32	1.00	93
Not POA (X) POA ( )	93.69	93.68	92.68	3540

W L meas after pump shut off_____min. Pumping W L ( )
Remarks_____

Date Feb 14 ~~19~~ 2011	100.00	101.00	92.75	3633
Hour 3:10 AM PM Obs dta-JS	7.24	8.25	1.00	92
Not POA (X) POA ( )	92.76	92.75	91.75	3541

W L meas after pump shut off_____min. Pumping W L ( )
Remarks_____

Date Jan 9 ~~19~~ 2012	110.00	111.00	96.72	3633
Hour 9:35 AM PM Obs RG/DW	13.27	14.28	1.00	96
Not POA (X) POA ( )	96.73	96.72	95.72	3537

W L meas after pump shut off_____min. Pumping W L ( )
Remarks

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Betting Perkins or Jimmy Perkins Owner's Well No. 1
Street or Post Office Address 48 Star Rd
City and State Roswell N Mex 88201

Well was drilled under Permit No. RA-11052 and is located in the:

a. SW ¼ NE ¼ NE ¼ NW ¼ of Section 33 Township 9S Range 24E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in _____ Chaves County.

d. X= 104° 30m 43.3 Sec feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor Kennard Drilling License No. WD-1448

Address 2604 E Mescalero Roswell

Drilling Began 11-1-06 Completed 11-4-06 Type tools Rotary Size of hole 8 in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 157 ft.

Completed well is ☑ shallow ☐ artesian. Depth to water upon completion of well 40 - ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
105	140	35	sand - gravel	15 gpm

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5"	PVC	—	1	157	158	open	98	158

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

RECEIVED NOV 13 2006 STATE ENGINEER OFFICE ROSWELL, NEW MEXICO

Section 5. PLUGGING RECORD

Plugging Contractor _____
Address _____
Plugging Method _____
Date Well Plugged _____
Plugging approved by:
_____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

Date Received 11-20-06 FOR USE OF STATE ENGINEER ONLY 369763

Quad _____ FWL _____ FSL _____

File No. RA-11052 Use Dom Location No. 9S.24E.33.122

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	5	5	Surf soil
5	45	40	caliche
45	105	60	Tan clay
105	140	35	sand - gravel
140	150	10	Tan clay
150	157	7	Red clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Dale K
Driller

369763

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All se[illegible] except Section 5, shall be answered as completely and accurately [illegible]ossible when any well is drilled, repaired or deepened. [illegible]his form is used as a plugging record, only Section 1(a) and Section [illegible] be completed.

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFROMATION

(A) Owner of well: ANGELO SALAZAR — Owner's Well No. 1

Street or Post Office Address: 107 WEST PINE LODGE

City and State: ROSWELL NM 88201

Well was drilled under Permit No.: RA 10975 and is located in the:

a. NM 1/4 NW 1/4 NW 1/4 1/4of Section 33 Township 9-S Range 24-E N.M.P.M

b. Tract No. of Map No. of the

c. Lot No. of Block No. of the

Subdivision, recorded in CHAVES County.

d. X= feet, Y= feet, N.M. Coordinate System Zone in the Grant.

(B) Drilling Contractor KEY'S DRILLING & PUMP SERVICE INC. License No. WD-1058

Address 1012 EAST 2ND STREET, ROSWELL NM 88201

Drilling Began 6/14/06 Completed 7/7/06 Type tools ROTARY Size of hole 7-7/8" in.

Elevation of land surface or at well is ft. Total depth of well 487' ft.

Completed well is ☐ shallow ☒ artesian. Depth to water upon completion of well 68 FT ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
325	450	25	STRATAS OF POROUS LIMESTONE	50 GPM
475	480	5	CAVERNOUS LIMESTONE	200 GPM+

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
8-5/8"	24	8	-2	348	350	CEMENT GUIDE SHOE	NA	NA

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	348	12-1/4"	200		PUMP PLUG METHOD
		12-1/4"	100		PUMPED W/CEMENT PUMP PLUG & SQUEEZED.
					TWO DAYS LATER-DRILLED OUT W/GOOD SEAL

Section 5. PLUGGING RECORD

Plugging Contractor

Address

Plugging Method

Date Well Plugged

Plugging approved by:

State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY 358344

Date Received 7-26-06

Quad FWL FSL

File No. RA-10975 Use Multi Location No. 95.24E.33.111

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
			ANGELO SALAZAR N. 285 WELL
	3	3	BROWN TOP SOIL
3	10	7	RED CLAY
10	12	2	WHITE CALICHE
12	80	68	RED CLAY
80	90	10	GRAVEL
90	120	30	RED CLAY
120	135	15	GRAVEL
135	250	115	RED CLAY
250	260	10	GRAVEL
260	325	65	ANHYDRITE
325	450	125	GRAY LIMESTONE
450	480	30	BLACK DOLOMITE
480	487	7	GRAY LIMESTONE

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the fore going is a true and correct record of the above described hole.

Driller

358344

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, oly Section 1(a) and Section 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well David Stetter Owner's Well No. RA-8072
Street or Post Office Address P.O. Box 5902
City and State Roswell, N.M. 88201

Well was drilled under Permit No. RA-8072 and is located in the:

a. ____ ¼ ____ ¼ ____ ¼ NE ¼ of Section 33 Township 9½ S Range 24E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. 2 of Block No. ____ of the ____
Subdivision, recorded in Chaves County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Gary Reed Drilling License No. WD-II78
Address #64 Colbert Rd. Artesia, N.M. 88I02

Drilling Began 8/7/92 Completed 8/II/92 Type tools Cable Size of hole 8 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well I25 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 50 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
75	85	I0	Sand, Gravel	
II5	I25	I0	Sand, Gravel	8

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6 5/8		weld	0	I25	I25		75	I25

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 09-08-92

Quad 93.2.2 FWL 34,050 FSL 38,600

File No. RA-8072 Use Dom. & Stk. Location No. 9½S.24E.33.2

50/D
Dom. North

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	2	2	TOPSOIL BROWN
2	10	8	CLEACHI WHITE
10	25	15	CLAY RED
25	75	50	CLAY BROWN
75	85	10	SAND, GRAVEL, WATER
85	115	30	CLAY BLUE
115	125	10	SAND, GRAVEL, WATER

Section 7. REMARKS AND ADDITIONAL INFORMATION

STATE ENGINEER OFFICE
ROSWELL NEW MEXICO
'82 SEP 8 PM 1 00

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Gary Reed
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All ons, except Section 5, shall be answered as completely and accurat possible when any well is drilled, repaired or deepe en this form is used as a plugging record, only Section 1(a) and Sectio d be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Mark Waltmire Owner's Well No. _____
Street or Post Office Address 500 W Brasher #51
City and State Artesia, N.M. 88203

Well was drilled under Permit No. RA-10096 and is located in the:

a. ___ ¼ SW ¼ SW ¼ NW ¼ of Section 33 Township 9 S. Range 24 E. N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in _____ County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor martin water Well Drlg. Co. License No. WD 1064
Address 9775 Hope Hwy Artesia NM. 88210
Drilling Began Oct 10, 03 Completed Oct 13, 03 Type tools Rotary Size of hole 7 7/8 in.
Elevation of land surface or _____ at well is 0 ft. Total depth of well 210 ft.
Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 75 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
148	210	62	sand & Gravel	15+

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5½	PVC	Bell	0	210	210	———	130	210

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor _____
Address _____
Plugging Method _____
Date Well Plugged _____
Plugging approved by:
_____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY 218952

Date Received 10-20-03
Quad _____ FWL _____ FSL _____
File No. RA-10096 Use Dom. Location No. 9.24 33.133

From	To	Thickness in Feet	Color and Type of Material Encountered
0	5	5	Topsoil : Brown
5	15	10	calicha white
15	62	47	clay Tan
62	72	10	sand + clay Tan - various
72	116	42	clay Tan
116	148	32	clay Red
148	210	62	sand + gravel Tan - Various

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Delford Martin
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed

Log book

(This form is to be executed in triplicate)

WELL RECORD

Date of Receipt September 10, 1954 Permit No. RA-?

Name of permitee, MARTIN & MARTIN

Street or P. O. , City and State Roswell, New Mexico

1. Well location and description: The domestic shallow well is located in SW ¼, NE ¼, (shallow or artesian)

¼ of Section 32, Township 9 South, Range 24 East ; Elevation of top of casing above sea level, feet; diameter of hole, 7 inches; total depth, 116 feet; depth to water upon completion, 66 feet; drilling was commenced September 10, 19 54, and completed September 14, 19 54; name of drilling contractor O. B. Lewis

500 So. Missouri Address, Roswell, New Mexico; Driller's License No. WD 172

2. Principal Water-bearing Strata:

	Depth in Feet From	To	Thickness	Description of Water-bearing Formation
No. 1	68	74	6	Gravel
No. 2	74	98	24	Loose lime rock
No. 3	102	110	9	Gravel & lime
No. 4				
No. 5				

3. Casing Record:

Diameter in inches	Pounds per ft.	Threads per inch	Depth of Casing or Liner Top	Depth of Casing or Liner Bottom	Feet of Casing	Type of Shoe	Perforation From	Perforation To
7 OD	20	10	0	100	100	Shop made	77	100

4. If above construction replaces old well to be abandoned, give location: ¼, ¼, ¼ of Section , Township , Range ; name and address of plugging contractor,

date of plugging , 19 ; describe how well was plugged:

FILED
SEP 23 1954
OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

5. Log of Well:

Depth in Feet From	Depth in Feet To	Thickness in feet	Description of Formation
0	4	4	Soil
4	18	14	Caliche
18	30	12	Lime rock
30	35	5	Clay
35	51	16	Loose lime rock
51	56	5	Clay
56	68	12	Sandstone
68	74	6	Gravel
74	98	24	Loose lime rock
98	101	3	Lime
101	110	9	Gravel & Lime
110	115	5	Clay
115	116	1	Lime

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

O. E. Seeley

Licensed Well Driller

Instructions

This form shall be executed, preferably typewritten, in triplicate and filed with the State Engineer's Office at Roswell, New Mexico, within 10 days after drilling has been completed. Data on water-bearing strata and on all formations encountered should be as complete and accurate as possible.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well AL Semi~~NA~~tore Owner's Well No. 2

Street or Post Office Address 9250 N. Main

City and State Roswell NM

Well was drilled under Permit No. RA 9759 and is located in the:

a. NE ¼ NE ¼ SE ¼ ¼ of Section 32 Township 9-S Range 24 E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in _____ County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor Keys Drilling & Pump Inc License No. WD 1058

Address 1012 E 2nd

Drilling Began 12-20-00 Completed 1-4-01 Type tools rotary Size of hole 6 ¼ in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 300' ft.

Completed well is ☐ shallow ☒ artesian. Depth to water upon completion of well 100' ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
288	300'	20'	water bearing limestone	60+ gpm

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
7"	24	8	-2	280'	282'	—	—	

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0'	283'	15"	194 sacks of cement		pump plug
	Cement did circulate to surface				

Section 5. PLUGGING RECORD

Plugging Contractor _____

Address _____

Plugging Method _____

Date Well Plugged _____

Plugging approved by: _____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

Date Received 2/27/01

FOR USE OF STATE ENGINEER ONLY

File No. RA 9759 Use DOM Quad _____ FWL _____ FSL _____ Location No. 9S.24E.32.422

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0'	10'	10'	Brown Topsoil
10'	260'	250'	Red Bed Caay
260'	288'	20'	lime stone
288'	300	20'	water bearing lime stone

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Caleb Curry
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All ...tions, except Section 5, shall be answered as completely and accu... possible when any well is drilled, repaired or deepe... When this form is used as a plugging record, only Section 1(a) and Sec... need be completed.

Form WR-23 FIELD ENGR. LOG STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Joe P. McLean
Street and Number Clovis Star Route
City Roswell State N. Mex.
Well was drilled under Permit No. RA. 3957 and is located in the Center on East Line of Section 15 Twp. 9-S Rge. 24-E.
(B) Drilling Contractor J. D. Smith License No. W.D. 278
Street and Number 413 E. 2nd
City Roswell State N. Mex.
Drilling was commenced Feb. 20. 19 60
Drilling was completed May 20. 19 60

Elevation at top of casing in feet above sea level ____ Total depth of well 415'
State whether well is shallow or artesian Artesian Depth to water upon completion 47 ft.

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	410	415'	5'	Porous Lime
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
10"	15'	8	308	410	102	Acc.	None	

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
390	405'	6 1/2	3	15'	Dump Bailer & Pressure plug

Section 5 PLUGGING RECORD

Name of Plugging Contractor ____ License No. ____
Street and Number ____ City ____ State ____
Tons of Clay used ____ Tons of Roughage used ____ Type of roughage ____
Plugging method used ____ Date Plugged ____ 19 ____
Plugging approved by: ____ Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received JUL 19 AM 10:18

File No. RA-3957 Use Dom Location No. 9.24.15. 415

Section 6 **LOG OF WELL**

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
390	400	10	Gray	Lime Porous Lime High Salt & mineral Content unusable
400	410	10	Gray	Lime Sakip
410	415	5	Gray	Lime Porous With Salt content Less mineral

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

J. L. Smith
Well Driller

This well had very Bad water plenty in quantity but unusable & first tried plugging off Bad water but was unable to get sufficient seal.

& then deepened to 410 & cemented in solid 5½ in Liner Let same set 72 hr. I drilled out plug & deepened to 415 mineral content was lowered and the salt content was lowered from 2500 P.P.M. to 1500 P.P.M.

Form WR-[illegible] FIELD ENG[illegible] LOG STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well [illegible] Joe P. McLean

Street and Number

City Roswell, N. M. State

Well was drilled under Permit No. RA 3957 and is located in the ¼ ¼ ¼ of Section 15 Twp. 9 Rge. 23E

(B) Drilling Contractor Murray Drill. Co. License No. WD100

Street and Number Auto Route West

City Roswell, N. M. State

Drilling was commenced [illegible] 12/15/58 19

Drilling was completed 1/16/59 19

Elevation at top of casing in feet above sea level Total depth of well 375

State whether well is shallow or artesian Artesian Depth to water upon completion 55

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	40	55	15	sand and water
2	368	375	7	lime and water
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
7od	24		0	370	370	Cemented by Denton, Artesia, N. M.		
		45	sacks How Earley Cement Insp. by State Engineer					
		Samples picked up by Jim White on location.						

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received

FILED JUL 28 1959 OFFICE GROUND WATER SURVEY NEW MEX.

File No. RA-3957 Use Dom. Location No. 9.24.15.424

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	40	40	Red	Sandy Clay
40	55	15		Sand and water
55	360	305	Red	Sandy Clay
360	368	8	Gray	Shale
368	375	8		Lime and water

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

E H Murray
Well Driller

Form WR-23 STATE ENGINEER OFFICE

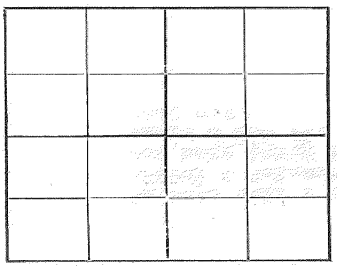
FIELD ENGR. LOG

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Well # 4

Section 1



(Plat of 640 acres)

(A) Owner of well J. P. Mc Lean

Street and Number Clovis Star Route

City Roswell State New Mexico

Well was drilled under Permit No. R A 3120 and is located in the 5 E. ¼ ¼ ¼ of Section 15 Twp. 9 S. Rge. 24 E.

(B) Drilling Contractor J. D. Smith License No. WD 278

Street and Number 413 East 23rd.

City Roswell State New Mexico

Drilling was commenced Feb. 14 19 59

Drilling was completed Mar 18 19 59

Elevation at top of casing in feet above sea level ..... Total depth of well .....

State whether well is shallow or artesian ..... Depth to water upon completion .....

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1				Not obtainable Due to nature of repair performed.
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
13 3/8	48	8	0	106	106	Reg.	None	
10 3/4	32.75	8	100	360	260	"	"	
8 5/8	32	8	245	365	120	"	"	
7	22	8	170	380	210	"	"	

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor ..... License No. .....

Street and Number ..... City ..... State .....

Tons of Clay used ..... Tons of Roughage used ..... Type of roughage .....

Plugging method used ..... Date Plugged ..... 19 .....

Plugging approved by:

..... Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received

FILED
MAY 26 1959
OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

File No. RA-3120 Use DW Location No. 9.24.15.424

Form WR-23 STATE ENGINEER OFFICE

LOG FILED

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well Myron Warboys
Street and Number Dunlap Star Rt.
City Roswell, State New Mexico
Well was drilled under Permit No. Ra-5705 and is located in the
SE-SW ¼ NW ¼ SW ¼ of Section 33 Twp. 9S Rge. 24E
(B) Drilling Contractor W. H. Brady License No. WD-359
Street and Number Rt. 2 Box 153,
City Roswell, State New Mexico
Drilling was commenced Dec. 27, 19 71
Drilling was completed Jan. 11, 19 72
Elevation at top of casing in feet above sea level Total depth of well 382'
State whether well is shallow or artesian Artesian Depth to water upon completion 84'

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	287	376	89	Limestone- water rock- tight formation
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
7	20	8	0	195	195	texas pattern		

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
0	195	9 5/8		60	Denton Cementing Co.

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.
Street and Number City State
Tons of Clay used Tons of Roughage used Type of roughage
Plugging method used Date Plugged 19
Plugging approved by:
Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received JAN 14 1972

File No. RA-5705 Use Dom Location No. 9.24.33.31343

156

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	3	3	brown-white	topsoil-caliche
3	12	9	mixed	cemented gravel
12	29	17	brown	clay
29	47	18	mixed	cemented gravel
47	129	80	red & brown	clay
129	133	4	red - gray	gravel & clay
133	150	17	red	clay
150	189	39	red- white	clay - Anhydrite
189	201	12	gray	limestone
201	233	32	white red -blue	clay, anhydrite, limestone
233	287	54	white-gray	limestone with clay &anhydrite streaks
287	376	89	gray	limestone water rock
376	382	6	gray	limestone

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

Well Driller

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well W.H. Nygren Owner's Well No. 1

Street or Post Office Address

City and State Roswell N.M.

Well was drilled under Permit No. and is located in the:

a. NW ¼ SW ¼ SW ¼ SW ¼ ¼ of Section 33 Township 9 S Range 24 E N.M.P.M.

b. Tract No. of Map No. of the

c. Lot No. of Block No. of the Subdivision, recorded in County.

d. X= feet, Y= feet, N.M. Coordinate System Zone in the Grant.

(B) Drilling Contractor Brumfield Drilling License No. W.D. 100

Address

Drilling Began Completed 10-7-82 Type tools Cable Size of hole 11 in.

Elevation of land surface or at well is ft. Total depth of well 385 ft.

Completed well is ☐ shallow ☑ artesian. Depth to water upon completion of well 100 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
362	370	12	Lime-Dolomite	42 - Pump, No pull down

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
7"	24	8	0	284	284	Texas		

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
80'	280'	11"		250 Sacks	B.J Hughes

Section 5. PLUGGING RECORD

Plugging Contractor

Address

Plugging Method

Date Well Plugged

Plugging approved by:

State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received September 7, 1984

Quad 93.2.2 FWL FSL

File No. RA-6900 Use Drinking/Sanitary Location No. 9.24.33.33314

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	3	3	Over burden
3	7	4	Caliche
7	10	3	Gravel
10	23	13	Gravel + Boulders
23	30	7	Boulders
30	50	20	Pink Clay
50	65	15	Boulders + Clay
65	80	15	White clay
80	84	4	Brown Clay
84	155	71	Red Bed - Some water at 90'
155	162	7	Clay + Gravel
162	169	7	Gravel
169	172	3	Clay + Gravel
172	180	8	Gravel
180	215	35	Brown Clay + Gravel
215	220	5	Red Clay + Gravel
220	248	28	Conglomerate
248	260	12	Brown Clay - Anahydrite
260	264	4	Brown clay + Gravel
264	274	8	Anahydrite + Clay
274	282	8	Clay + Gravel
282	301	19	" "
301	325	24	Lime
325	385	60	Lime

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Leon Brumfield
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All items, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE
WELL RECORD

TN 165285

Section 1. GENERAL INFORMATION

(A) Owner of well Pat Semingatore Owner's Well No. _____
Street or Post Office Address 2317 Gun Club Road SW
City and State ALBQ N.M. 87105

Well was drilled under Permit No. RA-9759 and is located in the:

a. _____ ¼ _____ ¼ N ½ ¼ S.E ¼ of Section 32 Township 9-S Range 24-E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in Chaves County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor Key's Drilling & Pump License No. WD-1058
Address 1012 East Second

Drilling Began 7-7-99 Completed 7-12-99 Type tools Rotary Size of hole 7 7/8 in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 300' ft.

Completed well is ☑ shallow ☐ artesian. Depth to water upon completion of well 40' ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
240'	255'		Shale & Lime	80 GPM +

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5"	PVC	—	0	300'	300'	—	220'	300'

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
		Cement	Pad & Surface Seal		Hand

Section 5. PLUGGING RECORD

Plugging Contractor _____
Address _____
Plugging Method _____
Date Well Plugged _____
Plugging approved by: _____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 07-19-99 T9s24e 32.42213

Quad _____ FWL _____ FSL _____

File No. RA-9759 Use Domestic Location No. T9s.R24e.sec.32.42213

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	15'	15'	(White) Caliche
15'	130'	115'	(Red) Clay
130'	140'	110'	(Gray) Clay
140'	240'	100'	(Red) Clay
240'	250'	10'	(Yellow) Shale
250'	255'	5'	(Gray) Lime
255'	270'	15'	(Yellow) Shale
270'	300'	30'	(Gray) Lime

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form sh[illegible] executed in triplicate, preferably typewritten, and submitted to [illegible] opriate district office of the State Engineer. All se[illegible] Section 5, shall be answered as completely and accurately [illegible] ible when any well is drilled, repaired or deepened. W[illegible]m is used as a plugging record, only Section 1(a) and Section 5 nee[illegible] completed.

Revised June 1972

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well MICHAEL D SMITH. Owner's Well No. RA-3121.
Street or Post Office Address #2 LUPITA LANE.
City and State ROSWELL, NM 88201.

Well was drilled under Permit No. RA-3121, and is located in the:

a. SE ¼ SE ¼ ¼ ¼ of Section 15, Township 9S, Range 24E, N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in _____ County.

d. X= _____ feet, Y= _____ feet, N. M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor ADDCO License No. 1608.
Address PO BOX 71 ROSWELL NM 88202.

Drilling Began 04-01-05, Completed 04-13-05, Type tools ROTARY, Size of hole 12.25 in

Elevation of land surface or _____ at well is _____ ft. Total depth of well 250 ft

Completed well is ☐ shallow ☐ artesian Depth to water upon completion of well 83 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness In Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
30	31	1	SANDY CLAY	?
128	133	5	SANDY CLAY	?
158	160	2	SANDY CLAY	?
209	250	41	CONGLOMERATE WITH FRACTURES	?

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads Per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
8 ID			+2	250	252		110	250

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

STATE ENGINEER OFFICE RECEIVED 2005 APR 18 A 8:30

Section 5. PLUGGING RECORD

Plugging Contractor _____.
Address _____.
Plugging Method _____.
Date Well Plugged _____.
Plugging approved by:
_____.
State Engineer Representative

No	Depth in feet Top	Depth in feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY 307089

Date Received 4-18-05

Quad _____ FWL _____ FSL _____

File No. RA, 3121 Use IRR Location No. 9s. 24E. 15. 42

Section 6. FORMATION LOG

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	3	3	TOP SOIL
3	30	27	SANDY BROWN CLAY
30	31	1	SAND AND GRAVEL
31	106	75	BROWN CLAY
106	108.5	2.5	SAND
108.5	128	19.5	BLUE CLAY
128	133	5	SAND/SANDY CLAY
133	158	25	BLUE CLAY
158	160	2	SANDY BROWN CLAY
160	182	22	SANDY BROWN CLAY/GRAVEL
182	209	27	BLUE CLAY
209	250	41	CONGLOMERATE WITH SAND INTERVALS

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that , to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer, All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepen[illegible]en this form is used as a plugging record, only Section 1(a) and Section [illegible]l be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well ELLA MC LEAN Owner's Well No. _____

Street or Post Office Address 204 CALLE DEL SOL

City and State ROSWELL N. MEX.

Well was drilled under Permit No. RA 6518 and is located in the:

a. N ½ ¼ NE ¼ ¼ ¼ of Section 34 Township 9S Range 24 E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in Chaves County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor C.G. (RED) YOUNG License No. WD 499

Address 1201 Baylor dr. Roswell N. Mex.

Drilling Began Nov 29 79 Completed Ded. 2179 Type tools Cable Size of hole 10.6 in to 302, 6¼ to 370 in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 370 ft.

Completed well is ☐ shallow ☒ artesian. Depth to water upon completion of well 46 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
48	57	9	Sand and gravel	
311 ~~317~~	317	6	BR. Clay	
346	370	24	Lime	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
7	20		0	305				
5½			288	370			345	370

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
		7		125 sacks	DENTON CEMENT TRUCK
			5yrds Grout		Roswell ready mix

Section 5. PLUGGING RECORD

Plugging Contractor _____

Address _____

Plugging Method _____

Date Well Plugged _____

Plugging approved by: _____ State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received January 8, 1980

Quad _____ FWL _____ FSL _____

File No. RA-6518 Use Dom. & Stk. Location No. 9.24.34.21221

on 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	4	4	top soil
4	28	24	clechi
28	48	20	clay
48	57	9	sand and gravel (water)
57	105	48	brown clay
105	273	168	blue clay
273	281	8	Anhy.
281	288	7	Red clay and Anhy.
288	302	14	Grey lime
302	311	9	Lime
311	317	6	Br. clay (water)
317	328	11	lime
328	342	14	Anhy.
342	346	4	clay
346	370	24	lime (water)

'80 JAN 8 PM 2 05
STATE ENGINEER OFFICE
ROSWELL, N.M.

Section 7. REMARKS AND ADDITIONAL INFORMATION RA-6518

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This fo ould be executed in triplicate, preferably typewritten, and submitted appropriate district office of the State Engineer ions, except Section 5, shall be answered as completely and accurat possible when any well is drilled, repaired or de When this form is used as a plugging record, only Section 1(a) and Section need be completed.

OSE FILE NUMBER _____
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD and DRILLING LOG

1. PERMIT HOLDER(S)

Name: George A Kennard
Address: 5010 Meadowlark Lane
City: Roswell
State: NM Zip: 88203
Phone: 575-622-6968
Contact: _____
Contact Phone: _____

Name: _____
Address: _____
City: _____
State: _____ Zip: _____
Phone: _____

2. STATE ENGINEER REFERENCE NUMBERS:
File # RA-11330, Well # _____

3. LOCATION OF WELL (The Datum Is Assumed To Be WGS 84 Unless Otherwise Specified)

Latitude: 33 Deg 29 Min 11.688 Sec
Longitude: 104 Deg 31 Min 13.368 Sec
(Enter Lat/Long To At Least 1/10th Of A Second)
Datum If Not WGS 84: _____

4. DRILLING CONTRACTOR
License Number: WD 1400
Name: Southeast Drilling Work Phone: 575-748-5963
Drill Rig Serial Number: 0-
List The Name Of Each Drill Rig Supervisor That Managed On-Site Operations During The Drilling Process:
Mark Hammond

STATE ENGINEER OFFICE
ROSWELL, NEW MEXICO
2008 JUN 12 A 11:52

5. DRILLING RECORD
Drilling Began: 12-5-08; Completed: 12-15-08; Drilling Method CABLE;
Diameter Of Bore Hole: 9 (in);
Total Depth Of Well: 193 (ft);
Completed Well Is (Circle One): (Shallow) / Artesian;
Depth To Water First Encountered: 136 (ft);
Depth To Water Upon Completion Of Well: 115 (ft).

Do Not Write Below This Line
TRN Number: 402803
Form: wr-20 May 07
File Number: RA-11330

Dom

95.24E.32.424

OSE FILE NUMBER _____
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD and DRILLING LOG

6. RECORD OF CASING

Diameter (inches)	Pounds (per ft.)	Threads (per inch)	Depth (feet)	Length Top to Bottom (feet)	Type of Shoe	Perforations (from to)
5 1/2	17	8	192	198.4	collar	136-142
						170-192

7. RECORD OF MUDDING AND CEMENTING

Depth (feet)	Hole (diameter)	Mud Used (# of sacks)	Cement (cubic feet)	Method of Placement
0-20	9"	2	8 sks	HAND

Do Not Write Below This Line

Trn Number: _____ File Number: _____
Form: wr-20 May 07

OSE FILE NUMBER _____
For OSE Use Only

NEW MEXICO OFFICE OF THE STATE ENGINEER
WELL RECORD

8. LOG OF HOLE. For Each Water Bearing Strata, Estimate The Yield Of The Formation In Gallons Per Minute.

Depth (feet) From	Depth (feet) To	Thickness (Feet)	For Water Bearing Strata Enter The Estimated Yield in GPM	Color and Type of Material Encountered
0	7	7		SOIL
7	30	23		GRAVEL
30	136	106		TAN SHALE
136	142	6	10	TAN SAND
142	171	28		TAN Shale Small gravels
171	192	21	10	TAN SAND
192	193	1		Shale
193	197	4		STICKY SHALE

STATE ENGINEER OFFICE
ROSWELL, NEW MEXICO
2011 JAN 12 A 11:52

Enter Method Used To Estimate Yield: _____

Do Not Write Below This Line

Trn Number: 402803
Form wr-20 May 07

File Number: RA-11330

Dom 9524E.32.424

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Johnny Sandoval Owner's Well No. RA-8080

Street or Post Office Address P.O. Box 293

City and State Roswell, N.M. 88201

Well was drilled under Permit No. I54294 and is located in the:

a. ____ ¼ S½ ¼ ____ ¼ ____ ¼ of Section 33 Township 9½ Range 24E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. 6 of Block No. ____ of the ____

Subdivision, recorded in Chaves County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor Gary Reed Drilling License No. WD 1178

Address #64 Colbert Rd. Artesia, N.M. 88102

Drilling Began 10/1/92 Completed 10/8/92 Type tools Cable Size of hole 8 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 125 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 45 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
75	125	50	FINE SAND RED	12

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6 5/8		weld	0	125	125		65	125

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

STATE ENGINEER OFFICE
ROSWELL NEW MEXICO
92 OCT 13 AM 10 35

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received 10-13-92

Quad 93.2.2 FWL 34,890 FSL 38,820

File No. RA-8080 Use Domestic Location No. 9.5S.24E.33.

190
92 2 7

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	2	2	TOPSOIL BROWN
2	I7	I5	CLEACHI WHITE
I7	47	30	CLAY BROWN
47	75	28	CLAY & GRAVEL BROWN
75	I25	50	FINE SAND,RED & WATER

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Gary Reed
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All ions, except Section 5, shall be answered as completely and accurate possible when any well is drilled, repaired or deepen en this form is used as a plugging record, only Section 1(a) and Sectio d be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well: Johnny Sandoval — Owner's Well No.: RA-8075
Street or Post Office Address: P.O. Box 293
City and State: Roswell, N.M. 88201

Well was drilled under Permit No.: I54242 and is located in the:

a. ____ ¼ S½ ¼ ____ ¼ ____ ¼ of Section 33 Township 9½ Range 24E N.M.P.M.

b. Tract No. ____ of Map No. ____ of the ____

c. Lot No. 3 of Block No. ____ of the ____
Subdivision, recorded in Chaves County.

d. X= ____ feet, Y= ____ feet, N.M. Coordinate System ____ Zone in the ____ Grant.

(B) Drilling Contractor: Gary Reed Drilling — License No.: WD II78

Address: #64 Colbert Rd. Artesia, N.M. 88102

Drilling Began: 9/1/92 Completed: 9/29/92 Type tools: cable Size of hole: 8 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well: 125 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well: 40 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
80	85	5	SAND & GRAVEL	9

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5		PVC	0	125	125		55	125

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

STATE ENGINEER OFFICE
ROSWELL NEW MEXICO
'92 OCT 13 AM 10 36

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:
____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received: 10-13-92

Quad 93.2.2 FWL 33,400 FSL 38,940

File No. RA-8075 Use Domestic Location No. 9½.24.33.S½

150

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	2	2	TOPSOIL BROWN
2	I2	I0	Cleachi WHITE
I2	40	28	CLAY BROWN
40	80	40	CLAY WHITE
80	85	5	SAND GRAVEL WATER
~~85~~	I25	40	SAND CLAY RED

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Gary Reed
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All ons, except Section 5, shall be answered as completely and accurate possible when any well is drilled, repaired or deepen en this form is used as a plugging record, only Section 1(a) and Sectio d be completed.

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFROMATION

(A) Owner of well: JIM CLARK Owner's Well No. 1

Street or Post Office Address: 2715 ONATE

City and State: ROSWELL NM 88201

Well was drilled under Permit No.: RA 10794 and is located in the:

a. SE 1/4 NW 1/4 SE 1/4 1/4of Section 32 Township 9-S Range 24-E N.M.P.M

b. Tract No. of Map No. of the

c. Lot No. of Block No. of the

Subdivision, recorded in CHAVES County.

d. X= feet, Y= feet, N.M. Coordinate System Zone in the Grant.

(B) Drilling Contractor KEYS DRILLING & PUMP SERVICE INC. License No. WD 1058

Address 1012 E SECOND STREET ROSWELL NM

Drilling Began 10/19/05 Completed 11/10/05 Type tools ROYARY Size of hole 7 7/8 in.

Elevation of land surface or at well is ft. Total depth of well 360 ft.

Completed well is ☐ shallow ☒ artesian. Depth to water upon completion of well 160 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
313	320	7	LIMESTONE	50
322	360	38	LIMESTONE	100

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
8 5/8	24.00	8	-1	277	278	CEMENT GUIDE SHOE		

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	277	12 1/4	200		HALLIBURTON PUMP PLUG

STATE ENGINEER OFFICE ROSWELL, NEW MEXICO 2006 MAR 16 PM 3:21

Section 5. PLUGGING RECORD

Plugging Contractor

Address

Plugging Method

Date Well Plugged

Plugging approved by:

State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY 334717

Date Received 3-16-06

Quad FWL FSL

File No. RA-10794 Use DOM Location No. 95.24E.32.414

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
	5	5	TOP SOIL
5	20	15	GRAY SHALE
20	30	10	RED CLAY
30	35	5	BROWN SANDSTONE
35	47	12	GRAY SHALE
47	78	31	RED CLAY
78	90	12	ANHYDRITE
90	95	5	PURPLE SHALE
95	145	50	ANHYDRITE
145	155	10	GRAY SHALE
155	170	15	ANHYDRITE
170	205	35	GRAY SHALE
205	215	10	ANHYDRITE
215	240	25	GRAY SHALE
240	257	17	ANHYDRITE
257	305	48	GRAY LIME
305	313	8	YELLOW LIME
313	320	7	GRAY LIME
320	322	2	YELLOW LIME
322	360	38	GRAY LIME

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the fore going is a true and correct record of the above described hole.

Driller

334717

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, oly Section 1(a) and Section 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well PAVELO VILLALOBOS Owner's Well No. _____

Street or Post Office Address 614 W. VANBUREN

City and State ROSWELL NEW MEXICO

Well was drilled under Permit No. ~~RA 8992~~ RA 8992 and is located in the:

a. NW ¼ SE ¼ SW ¼ ____ ¼ of Section 33 Township 9 S Range 24 E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in CHAVES County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor RAYMOND ANDERSON License No. WD 1344

Address 29 E. ANASAZI RD. DEXTER N.M. 88230

Drilling Began 5-25-95 Completed 5-30-95 Type tools CABLE Size of hole 7½ in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 125 ft.

Completed well is ☑ shallow ☐ artesian. Depth to water upon completion of well ~~75~~ 65 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
75	85	10	SAND + GRAVEL	20 GPM

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5"	PVC	WELL	CASING	125'			85	125

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
		TOP SEAL -	3	50 lbs	BAGS CONCRETE -

Section 5. PLUGGING RECORD

Plugging Contractor _____

Address _____

Plugging Method _____

Date Well Plugged _____

Plugging approved by:

_____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received July 12, 1995 Quad _____ FWL _____ FSL _____

File No. RA-8992 Use Dom/Stk Location No. 9½.24.33.34342

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encou
0	10	10	SUBSOIL
10	40	30	SAND clay & soft soil
40	75	35	SAND & clay
75	90	20	SAND & GRAVEL
90	125	35	SAND & little clay.

Section 7. REMARKS AND ADDITIONAL INFORMATION

'95 JUL 12 AM 11 19

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Ray Carlson
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

WELL RECORD & LOG

OFFICE OF THE STATE ENGINEER

www.ose.state.nm.us

1. GENERAL AND WELL LOCATION

POD NUMBER (WELL NUMBER)	OSE FILE NUMBER(S)
	RA-11361
WELL OWNER NAME(S)	PHONE (OPTIONAL)
Michael Smith	622.5969
WELL OWNER MAILING ADDRESS	CITY / STATE / ZIP
2 Lupita Lane	Roswell NM 88201

WELL LOCATION (FROM GPS)	DEGREES	MINUTES	SECONDS	
LATITUDE	33	31	51.0	N
LONGITUDE	104	29	11	W

* ACCURACY REQUIRED: ONE TENTH OF A SECOND
* DATUM REQUIRED: WGS 84

DESCRIPTION RELATING WELL LOCATION TO STREET ADDRESS AND COMMON LANDMARKS

2. OPTIONAL

(2.5 ACRE)	(10 ACRE)	(40 ACRE)	(160 ACRE)	SECTION	TOWNSHIP	RANGE
¼	SE ¼	NE ¼	SE ¼	15	9 ☐ NORTH ☒ SOUTH	24 ☒ EAST ☐ WEST

SUBDIVISION NAME	LOT NUMBER	BLOCK NUMBER	UNIT/TRACT

HYDROGRAPHIC SURVEY	MAP NUMBER	TRACT NUMBER

3. DRILLING INFORMATION

LICENSE NUMBER	NAME OF LICENSED DRILLER	NAME OF WELL DRILLING COMPANY
636	James Leatherman	Leatherman Drilling

DRILLING STARTED	DRILLING ENDED	DEPTH OF COMPLETED WELL (FT)	BORE HOLE DEPTH (FT)	DEPTH WATER FIRST ENCOUNTERED (FT)
5-20-09	5-25-09	280		

COMPLETED WELL IS: ☐ ARTESIAN ☐ DRY HOLE ☒ SHALLOW (UNCONFINED)

STATIC WATER LEVEL IN COMPLETED WELL (FT): 45-50

DRILLING FLUID: ☒ AIR ☐ MUD ☐ ADDITIVES – SPECIFY:

DRILLING METHOD: ☒ ROTARY ☐ HAMMER ☐ CABLE TOOL ☐ OTHER – SPECIFY:

DEPTH (FT) FROM	DEPTH (FT) TO	BORE HOLE DIA. (IN)	CASING MATERIAL	CONNECTION TYPE (CASING)	INSIDE DIA. CASING (IN)	CASING WALL THICKNESS (IN)	SLOT SIZE (IN)
Clean	Out		6 5/8 Steel				

2009 MAY 21 P 2:08 STATE ENGINEER OFFICE ROSWELL, NEW MEXICO

4. WATER BEARING STRATA

DEPTH (FT) FROM	DEPTH (FT) TO	THICKNESS (FT)	FORMATION DESCRIPTION OF PRINCIPAL WATER-BEARING STRATA (INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES)	YIELD (GPM)

METHOD USED TO ESTIMATE YIELD OF WATER-BEARING STRATA	TOTAL ESTIMATED WELL YIELD (GPM)

FOR OSE INTERNAL USE

WELL RECORD & LOG (Version 6/9/08)

FILE NUMBER	RA-11361	POD NUMBER	1	TRN NUMBER	429465
LOCATION	Dom/StK	9S.24E.15.424			PAGE 1 OF 2

5. SEAL AND PUMP

TYPE OF PUMP: ☒ SUBMERSIBLE ☐ TURBINE ☐ JET ☐ CYLINDER ☐ NO PUMP – WELL NOT EQUIPPED ☐ OTHER – SPECIFY:

ANNULAR SEAL AND GRAVEL PACK	DEPTH (FT) FROM	DEPTH (FT) TO	BORE HOLE DIA. (IN)	MATERIAL TYPE AND SIZE	AMOUNT (CUBIC FT)	METHOD OF PLACEMENT

6. GEOLOGIC LOG OF WELL

DEPTH (FT) FROM	DEPTH (FT) TO	THICKNESS (FT)	COLOR AND TYPE OF MATERIAL ENCOUNTERED (INCLUDE WATER-BEARING CAVITIES OR FRACTURE ZONES)	WATER BEARING?
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO
				☐ YES ☐ NO

ATTACH ADDITIONAL PAGES AS NEEDED TO FULLY DESCRIBE THE GEOLOGIC LOG OF THE WELL

7. TEST & ADDITIONAL INFO

WELL TEST — METHOD: ☐ BAILER ☐ PUMP ☒ AIR LIFT ☐ OTHER – SPECIFY:

TEST RESULTS - ATTACH A COPY OF DATA COLLECTED DURING WELL TESTING, INCLUDING START TIME, END TIME, AND A TABLE SHOWING DISCHARGE AND DRAWDOWN OVER THE TESTING PERIOD.

ADDITIONAL STATEMENTS OR EXPLANATIONS:

old well with steel casing - Rusting bridge at 100 Ft. — Set 12 GPM pump 180 Ft.

8. SIGNATURE

THE UNDERSIGNED HEREBY CERTIFIES THAT, TO THE BEST OF HIS OR HER KNOWLEDGE AND BELIEF, THE FOREGOING IS A TRUE AND CORRECT RECORD OF THE ABOVE DESCRIBED HOLE AND THAT HE OR SHE WILL FILE THIS WELL RECORD WITH THE STATE ENGINEER AND THE PERMIT HOLDER WITHIN 20 DAYS AFTER COMPLETION OF WELL DRILLING:

James Leatherman — SIGNATURE OF DRILLER

5 26 09 — DATE

FOR OSE INTERNAL USE — WELL RECORD & LOG (Version 6/9/08)

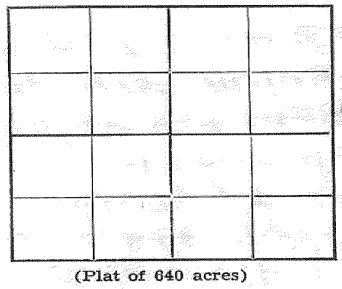
FILE NUMBER	POD NUMBER	TRN NUMBER
LOCATION		PAGE 2 OF 2

Form WR-23 FIELD ENGR. LOG STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1



(Plat of 640 acres)

(A) Owner of well Joe P. McLean
Street and Number Clovis Star Route
City Roswell State N. Mex.
Well was drilled under Permit No. RA. 3957 and is located in the Center ¼ on East Line ¼ of Section 15 Twp. 9-S Rge. 24-E.
(B) Drilling Contractor J. D. Smith License No. RW.D. 278
Street and Number 413 E. 23rd
City Roswell State N. Mex.
Drilling was commenced Feb. 20. 19 60
Drilling was completed May 20. 19 60

Elevation at top of casing in feet above sea level ____ Total depth of well 415'
State whether well is shallow or artesian Artesian Depth to water upon completion 47 ft

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	410	415'	5'	Porous Lime
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
10"	15'	8	308	410	10"	Reg.	None	

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used
350	405'	6¼	3	15'	Dump Bailer & Pressure Plug

Section 5 PLUGGING RECORD

Name of Plugging Contractor ____ License No. ____
Street and Number ____ City ____ State ____
Tons of Clay used ____ Tons of Roughage used ____ Type of roughage ____
Plugging method used ____ Date Plugged ____ 19____
Plugging approved by:

____ Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

Date Received JUL 19 AM 10:18 (STATE ENGINEER OFFICE)

File No. RA-3957 Use Dam Location No. 9.24.15

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
				"
390	400	10	Gray	Lime porous Lime Hiss Salt & mineral Content Unusable
400	410	10	Gray	Lim. - Solid
410	415	5	Gray	Lim. - Porous with Salt Content less mineral

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

J. L. Smith
Well Driller

This well had very Bad water rights in quantity but unusable of first kind plugging off Bad water but was unable to get sufficient seal.
Then Lowered to 410 & cemented in solid 5½ in Liner Entrance at 72 hr 2 Bailers Type 2 Reported to 415 Mineral Content was Lowered and chemical Content was Lowered from 2500 PPM to 1500 P.P.M.

Revised June 197

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well RICHARD Smith Owner's Well No. RA 11341
Street or Post Office Address 2 Juanita Lane
City and State Roswell N.M. 88201

Well was ~~drilled~~ under Permit No. RA 11341 and is located in the:

a. WASH ¼ NE ¼ SE ¼ SE ¼ of Section 15 Township 9S Range 24E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in CHAVES County. X= 547,813 Y= 3,710,097

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone i
the _____ Gran

(B) Drilling Contractor heatherman Drilling License No. 636
Address PO Box 2065 Roswell
~~Drilling~~ Began WASH 5-25-08 Completed 6-10-08 Type tools Rotary A.R Size of hole 8 i
Elevation of land surface or _____ at well is 250 ft. Total depth of well 250 f
Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 50

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
			must be Sand	pump 20

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
8	plastic		0	250		as said	150	25?

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	0		0	0	0

STATE ENGINEER OFFICE ROSWELL, NEW MEXICO 2008 JUN 16 A 8:12

Section 5. PLUGGING RECORD

Plugging Contractor _____
Address _____
Plugging Method _____
Date Well Plugged _____
Plugging approved by: _____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY 404925

Date Received 6-16-08
RA-11341
Quad Dunlap FWL _____ FSL ac 705 ic 1107

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
			only clean old drilling mud was air blown out of well

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

James Leatherman

Drill

Indiana

INSTRUCTIONS: This fo[illegible] should be executed in triplicate [illegible]

Revised June 1972

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Michael Smith Owner's Well No. _____
Street or Post Office Address 2 Lupita Lane
City and State Roswell NM 88201

Well was drilled under Permit No. RA 11339 and is located in the:

a. ____ ¼ ____ ¼ ____ ¼ SW ¼ of Section 11 Township 9 S Range 24 E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in Chaves County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System Lat 33 32 3208 Lon 104 29 172 Zone in the _____ Grant.

(B) Drilling Contractor Leatherman Drilling License No. 636
Address PO Box 2065 Roswell NM 88202
Drilling Began 4 14 08 Completed 5 8 08 Type tools Rotary Size of hole 7 7/8 in.
Elevation of land surface or _____ at well is _____ ft. Total depth of well 130 ft.
Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 70 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
58	68	10	Fine Sand	pump 9 min

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
0	120	plastic					60	120

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
0	20			2	mix

STATE ENGINEER OFFICE RECEIVED 2008 MAY 8 A 8:

Section 5. PLUGGING RECORD

Plugging Contractor _____
Address _____
Plugging Method _____
Date Well Plugged _____
Plugging approved by: _____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

Date Received 5-9-08 FOR USE OF STATE ENGINEER ONLY 404342

Quad _____ FWL _____ FSL _____

RA-11229 Dawn 9C.245.11.33

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	4	4	overburden
4	60	56	white brown Clays
60	70	10	Sands
70	120	50	Sandy Clays

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

James Leatherwood
Driller

4342

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Chad Chappell Owner's Well No.
Street or Post Office Address P.O. Box 96
City and State Hobbs, N.M. 88241

Well was drilled under Permit No. RA-10488 and is located in the:

a. ¼ SE ¼ SW ¼ SW¼ of Section 33 Township 9 S. Range 34 E. N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in _____ County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor Martin Waterwell Drlg. Co. License No. WD-1064
Address 9775 Hope Hwy Artesia, N.M. 88210
Drilling Began 1-20-04 Completed 2-1-04 Type tools Rotary Size of hole 7 7/8 in.
Elevation of land surface or _____ at well is 0 ft. Total depth of well 220 ft.
Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 70 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
125	160	35	sand & gravel	10
170	220	50	sand & gravel	20

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5 ½	PVC	Bell	0	220	220	—	140	220

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor _____
Address _____
Plugging Method _____
Date Well Plugged _____
Plugging approved by: _____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

Date Received 2-10-04 FOR USE OF STATE ENGINEER ONLY 290475

Quad _____ FWL _____ FSL _____

File No. RA-10488 Use Dom/Stk Location No. 9.24.33.334

From	To	Thickness in Feet	Color and Type of Material Encountered
0	6	6	Topsoil : Brown
6	17	11	caliche Tan
17	27	10	Rock (Hard) Blue: Various
27	90	63	clay Tan
90	97	7	sand + gravel Tan - Various
97	125	28	clay Red
125	160	35	Sand - Gravel Tan - Various
160	170	10	sand - clay Red
170	220	50	sand - gravel Tan - Various

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Delford Martin
Driller

INSTRUCTIONS: This ... should be executed in triplicate, preferably typewritten, and submitted ... appropriate district office of the State Engineer. ... ctions, except Section 5, shall be answered as completely and accurate ... possible when any well is drilled, repaired or deepen ... When this form is used as a plugg...

STATE ENGINEER OFFICE
WELL RECORD

Section 1. GENERAL INFROMATION

(A) Owner of well: CLINTON KEY — Owner's Well No. 1

Street or Post Office Address: 207 W. PINELODGE

City and State: ROSWELL NM 88201

Well was drilled under Permit No.: RA 10745 and is located in the:

a. SW 1/4 SE 1/4 SW 1/4 1/4of Section 8 Township 9-S Range 24-E N.M.P.M

b. Tract No. of Map No. of the

c. Lot No. of Block No. of the

Subdivision, recorded in CHAVES County.

d. X= feet, Y= feet, N.M. Coordinate System Zone in the Grant.

(B) Drilling Contractor KEYS DRILLING AND PUMP SERVICE INC. License No. WD 1058

Address 1012 E. SECOND STREET ROSWELL NM

Drilling Began 4/11/06 Completed 4/14/06 Type tools ROTARY Size of hole 7 7/8 in.

Elevation of land surface or at well is ft. Total depth of well 118 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 91 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
90	95	5	GRAVEL	10
105	110	5	GRAVEL	15

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5" OD	PVC	NA	-1	118	119	NA	98	118

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
-1	20	8 5/8			SURFACE CASING CEMENTED

Section 5. PLUGGING RECORD

Plugging Contractor

Address

Plugging Method

Date Well Plugged

Plugging approved by:

State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY 332016

Date Received 4-26-06

Quad FWL FSL

File No. RA-10745 Use Dom Location No. 95.24E.8.343

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
			CLINTON WELL
	10	10	BROWN TOPSOIL
10	30	20	RED CLAY AND GRAVEL
30	90	60	RED CLAY
90	118	28	GRAVEL

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the fore going is a true and correct record of the above described hole.

Driller 332016

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, oly Section 1(a) and Section 5 r[illegible] be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well KURT PFEIFFER Owner's Well No. _____
Street or Post Office Address 2003 GALLINA RD.
City and State Roswell, N. M. 88201

Well was drilled under Permit No. RA-7723 and is located in the:

a. _____ ¼ _____ ¼ _____ ¼ NE ¼ of Section 34 Township 9½ S Range 24 E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in CHAVES County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor HONDO PIPE & SUPPLY CO. INC. License No. WD-1198

Address P.O. BOX 787 Roswell, N.M. 88202

Drilling Began 5-12-89 Completed 7-1-89 Type tools CABLE Size of hole 8 1/4 in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 176 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 60 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
112	128	16	gravel	5
138	146	8	sand & gravel	10
172	176	4	sand & gravel	5

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
6 5/8 OD	FINE PIPE	..	0	176	176	none	100	176

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement

Section 5. PLUGGING RECORD

Plugging Contractor _____
Address _____
Plugging Method _____
Date Well Plugged _____
Plugging approved by: _____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received July 26, 1989 Quad _____ FWL _____ FSL _____

File No. RA-7723 Use Domestic Location No. 9½.24.34.21231

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	60	60	Tan clay
60	76	16	Gravel sand
76	112	36	Tan clay
112	128	16	Sand & gravel
128	172	44	Tan clay
172	176	4	Sand & gravel

Section 7. REMARKS AND ADDITIONAL INFORMATION

'89 JUL 26 AM 8 28
STATE ENGINEER OFFICE
ROSWELL, NEW MEXICO

'89 JUL 21 AM 8 22
STATE ENGINEER OFFICE
ROSWELL, NEW MEXICO

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Driller

INSTRUCTIONS: This form shall be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All items, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record only Section 1(a) and Section 5 shall be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well PANFILO VILLALOBOS Owner's Well No. _____

Street or Post Office Address 614 W. VAN BUREN

City and State ROSWELL, N. M. 88201

Well was drilled under Permit No. RA-8992 and is located in the: 9½

a. SW ¼ ~~SE~~ SW ¼ ~~NW~~ ¼ ¼ of Section ~~34~~ 33 Township ~~10~~ 8 Range ~~24~~ 24 E N.M.P.M.

b. Tract No. _____ of Map No. _____ of the _____

c. Lot No. _____ of Block No. _____ of the _____
Subdivision, recorded in CHAVES County.

d. X= _____ feet, Y= _____ feet, N.M. Coordinate System _____ Zone in the _____ Grant.

(B) Drilling Contractor RAYMOND ANDERSON License No. WD 1364

Address H 29 E. ANASAZI RD. DEXTER N. M. 88230

Drilling Began 9-25-95 Completed 12-15-95 Type tools CABLE Size of hole 7½ in.

Elevation of land surface or _____ at well is _____ ft. Total depth of well 190' ft.

Completed well is ☑ shallow ☐ artesian. Depth to water upon completion of well 60' ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
110	120	10	SAND + GRAVEL	2
140	145	5	SAND + GRAVEL	10 +

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet Top	Depth in Feet Bottom	Length (feet)	Type of Shoe	Perforations From	Perforations To
5" P.V.C. WELL CASING			0	190	190	NONE	60	190

Section 4. RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Hole Diameter	Sacks of Mud	Cubic Feet of Cement	Method of Placement
TOP	SEAL	3-	50# CONCRETE MIX		POUR

1 SD

Section 5. PLUGGING RECORD

Plugging Contractor _____

Address _____

Plugging Method _____

Date Well Plugged _____

Plugging approved by: _____
State Engineer Representative

No.	Depth in Feet Top	Depth in Feet Bottom	Cubic Feet of Cement
1			
2			
3			
4			

FOR USE OF STATE ENGINEER ONLY

Date Received December 21, 1995

Quad _____ FWL _____ FSL _____

File No. RA-8992 Use Domestic/Stock Location No. 9S.24E.33.34342
(Change Location)

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	8	8	top soil
8	50	42	SANDY clay & soft soil REDDISH
50	110	60	SAND & little clay GRAY
110	120	10	SAND & GRAVEL (little WATER)
120	140	20	SAND & clay REDISH
140	145	5	SAND & GRAVEL (WATER)
145	190	45	SAND & clay. REDDISH
		~~44~~	FIRST WELL 120' WENT DRY AFTER
			4 MONTHS ~~Bet~~ PLUGGED IT &
			DRILLED NEW WELL - 190'

Section 7. REMARKS AND ADDITIONAL INFORMATION

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described hole.

Roy Allen
Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1(a) and Section 7 need be completed.

Form WR-23 STATE ENGINEER OFFICE

WELL RECORD

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the nearest district office of the State Engineer. All sections, except Section 5, shall be answered as completely and accurately as possible when any well is drilled, repaired or deepened. When this form is used as a plugging record, only Section 1A and Section 5 need be completed.

Section 1

(Plat of 640 acres)

(A) Owner of well J. M. Sartin

~~Street and Number~~

City Roswell State New Mexico

Well was drilled under Permit No. R.A. 3497 and is located in the S.E. ¼ S.E. ¼ S.E. ¼ of Section 32 Twp. 9-S Rge. 24 East

(B) Drilling Contractor Paul Woody License No. W.D. 19

~~Street and Number~~ Rte. 1

City Dexter State New Mexico

Drilling was commenced Nov. 14 19 55

Drilling was completed Nov. 18 19 55

Elevation at top of casing in feet above sea level Total depth of well 150 ft.

State whether well is shallow or artesian Shallow Depth to water upon completion 103 ft

Section 2 PRINCIPAL WATER-BEARING STRATA

No.	Depth in Feet From	Depth in Feet To	Thickness in Feet	Description of Water-Bearing Formation
1	138	140	2	Blue Sand and gravel
2				
3				
4				
5				

Section 3 RECORD OF CASING

Dia in.	Pounds ft.	Threads in	Depth Top	Depth Bottom	Feet	Type Shoe	Perforations From	Perforations To
			None					

Section 4 RECORD OF MUDDING AND CEMENTING

Depth in Feet From	Depth in Feet To	Diameter Hole in in.	Tons Clay	No. Sacks of Cement	Methods Used

Section 5 PLUGGING RECORD

Name of Plugging Contractor License No.

Street and Number City State

Tons of Clay used Tons of Roughage used Type of roughage

Plugging method used Date Plugged 19

Plugging approved by:

Basin Supervisor

Cement Plugs were placed as follows:

No.	Depth of Plug From	Depth of Plug To	No. of Sacks Used

FOR USE OF STATE ENGINEER ONLY

FILED
DEC 7 1955
OFFICE
GROUND WATER SUPERVISOR
ROSWELL, NEW MEXICO

Date Received

File No. RA-3497 Use Irrig. Location No. 9.24.32.444

Section 6

LOG OF WELL

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color	Type of Material Encountered
0	3	3	Brown	Soil
3	21	18	White	Lime Rock
21	23	2	Brown	Sand
23	38	15	Pink	Clay
38	45	7	Cream	Clay and Lip
45	48	3	White	Hard Lip Rock "Sloping"
48	50	2	Brown	Sand
50	56	6	White	Rock "Sloping"
56	90	34	Red	Red clay
90	108	18	Blue	Blue Sticky Clay
108	110	2	Blue	Muddy Sand "Seeping Water"
110	137	27	Blue	Clay
137	140	3	Blue	Sand, Gravel, Water "25 gal hr"
140	145	5	Blue	Clay
145	150	5	Red	Clay

Woody says well is dry or very little water – No casing was used. Owner undecided what to do with well

E. S. Mintonye
11-7-56

Woody says water has raised to 74 feet. 8 Set 135 feet of 7 O.D casing. Perforated at 90 to 110 and 130 – 135.

Drilled 4-18-56

The undersigned hereby certifies that, to the best of his knowledge and belief, the foregoing is a true and correct record of the above described well.

Paul Woody
Well Driller

Water Well Report™

DISCLAIMER/DETAILS

Banks Environmental Data Water Well Report™ is prepared from existing state water well databases and/or additional file data/records research conducted at the State Engineers Office located in Santa Fe, New Mexico.

Banks Environmental Data has performed a thorough and diligent search of all groundwater well information provided and recorded with the New Mexico State Engineers Office. All mapped locations are based on information obtained from the NMSEO. Although Banks performs quality assurance and quality control on all research projects, we recognize that any inaccuracies of the records and mapped well locations could possibly be traced to the appropriate regulatory authority or the actual driller. It may be possible that some water well schedules and logs have never been submitted to the regulatory authority by the water driller and, thus, may explain the possible unaccountability of privately drilled wells. It is uncertain if the above listing provides 100% of the existing wells within the area of review. Therefore, Banks Environmental Data cannot fully guarantee the accuracy of the data or well location(s) of those maps and records maintained by the New Mexico State Engineer regulatory authorities.

1601 Rio Grande Suite 500 Austin, Texas 78701
PH 512.478.0059 FAX 512.478.1433 E-mail banks@banksinfo.com

Appendix C

Quality Assurance Project Plans

Work Plan QAPP

March 2013

QUALITY ASSURANCE PROJECT PLAN

FOR THE

AMENDED INVESTIGATION WORK PLAN

& GROUNDWATER MONITORING PLAN

ROSWELL COMPRESSOR STATION NO. 9
6381 NORTH MAIN STREET
ROSWELL, CHAVES COUNTY, NEW MEXICO
EPA ID NO. NMD986676955

PREPARED FOR:

TRANSWESTERN PIPELINE COMPANY, LLC
711 LOUISIANA, SUITE 900
HOUSTON, TX 77002

March 29, 2013

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1 Analytical Parameters, Methods, and Data Quality Objectives

2 Sample Collection Protocol

LIST OF ATTACHMENTS

Attachment

A *Quality Assurance Plan* by Hall Environmental Analysis Laboratory

B *Quality Assurance Manual* by TestAmerica Houston

QUALITY ASSURANCE PROJECT PLAN

This document describes the procedures that will be followed to ensure that the data obtained during investigation activities will be adequate for the project objectives. The Quality Assurance Project Plan (QAPP) presented herein describes the laboratory analyses to be performed, data quality objectives, and quality assurance/quality control (QA/QC) procedures to be used to ensure that project objectives are met. Sections 1 through 12 have been prepared in accordance with the *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (U.S. EPA, 1983), and are those elements required for consideration in any QAPP, according to EPA.

1. Analytical Parameters and Methods

Based on previous investigations, petroleum hydrocarbons, SVOCs, benzene, and the chlorinated solvents 1,1,1-TCA and 1,1-DCE are recognized as the principal constituents of concern in soil and ground water at the site. In order to ensure that other constituents are not present, initial characterization included nearly all of the Appendix IX constituents. Accordingly, soil and ground water samples will be collected and analyzed as described in the *Amended Investigation Work Plan and Groundwater Monitoring Plan* (Amended IWP).

In addition, ground water samples may be analyzed for major cations and anions and total dissolved solids in order to characterize the overall water quality. Total petroleum hydrocarbons (TPH) may also be determined for soil samples. Analytical methods for all parameters will follow standard RCRA procedures specified in *Test Methods for Evaluating Solid Waste* (SW-846) (EPA, Third Edition, Update IV).

2. Data Quality Objectives

Data quality objectives (DQOs) are the qualitative and quantitative objectives established to ensure that the data generated meet the needs of the project. Therefore DQOs are project-specific and depend largely on the ultimate use for which the data are intended. DQOs have been

established for this project in accordance with EPA guidance documents, particularly *Data Quality Objectives for Remedial Response Activities* (U.S. EPA, 1987a), and *RCRA Ground Water Monitoring: Draft Technical Guidance* (U.S. EPA, 1992). The parameters used to quantify data quality include precision, accuracy, representativeness, completeness, and comparability (PARCC).

Objectives or goals for the so-called PARCC parameters (U.S. EPA, 1987a) constitute the project-specific DQOs for a particular investigation. Each PARCC parameter is described below, along with the proposed DQO for this closure plan, where applicable. The proposed DQOs for this investigation are summarized in Table 1.

- **Precision** is a quantitative measure of the reproducibility (or variability) of the analytical results. Precision will be calculated by determining the relative percent difference (RPD) between the concentrations reported for field duplicate samples collected from the same location. Methods for collecting duplicate field samples are discussed in the Amended IWP. The proposed RPD precision objective is 20 or less.

- **Accuracy** is defined as the degree to which the reported analytical result approaches the "true" value. Accuracy will be estimated through the analysis of matrix spikes (MS). The percent recovery (%R) of the "true" spike concentration will be calculated for each MS. The accuracy objective is within the range of 80 to 120 percent recovery of the matrix spike.

- **Representativeness** refers to how well the analytical data reflect subsurface contaminant concentrations. Due to numerous site-specific factors, such as the degree of heterogeneity in the subsurface, representativeness is difficult to define and even more difficult to quantify. For this project, representative data will be attained through the use of consistent and approved sampling and analytical procedures and through a well defined sampling plan that specifies adequate investigation of all areas of concern.

- **Completeness** is the percentage of samples collected that meet or exceed the DQOs for precision, accuracy, and representativeness, as estimated from the analysis of QA/QC samples described above. The completeness objective for this project is 90%.

- **Comparability** is an assessment of the relative consistency of the data. No quantitative method exists for evaluating comparability; hence, professional judgment must be relied upon. Internal comparability of the soil and ground water data set will be achieved by the use of consistent sampling and analysis procedures throughout the project. Likewise, by using identical analytical methods to those employed during previous investigations, the data generated during this investigation will be comparable with existing data.

3. Quality Assurance/Quality Control Samples

QA/QC samples include matrix spikes/matrix spike duplicates (MS/MSD), field duplicates, trip blanks, field blanks, and equipment blanks. EPA guidance recommends that QA/QC samples be collected at a minimum 10-percent frequency (U.S. EPA, 1987). For this project, both soil and ground water QA/QC samples will be analyzed at this frequency.

Equipment blank samples are collected in order to determine if any of the analytes detected in environmental samples may be attributable to improper and/or incomplete decontamination of field sampling equipment. Equipment blanks will be collected in the following manner. After the sampling device has been decontaminated, it will be rinsed with deionized water. The rinsate will be collected and sent to the laboratory as an equipment blank.

Field duplicate samples will be collected to provide a measure of precision for the analytical results. VOC soil duplicates will be collected by submitting two adjacent brass liner rings from the same split-barrel sample. The ground water duplicate samples will be collected by filling sample containers in an alternating manner following the sampling protocol described in the Amended IWP.

Field blanks shall be obtained at a minimum frequency of one per day per site or unit. Field blanks shall be generated by filling sample containers in the field with deionized water and submitting the samples, along with the groundwater or surface water samples, to the analytical laboratory for the appropriate analyses.

One VOC trip blank will accompany each shipment to the laboratory. VOC trip blanks are prepared as a check on possible contamination originating from container preparation methods, shipment, handling, storage, or other site-specific conditions. VOC trip blanks will consist of deionized, organic-free water added to a clean 40-mL glass septum vial.

In addition to the above QA/QC samples, MS/MSD analyses will be performed in the laboratory by spiking the soil or water samples with a known quantity of the analyte of interest. MS/MSD analyses are performed to determine laboratory accuracy and precision and to determine if any matrix interferences exist. MS/MSD analysis will be specified on the chain-of custody form for at least 5 percent of the samples collected.

4. Sampling Procedures

The soil and ground water sampling procedures are described in the Amended IWP. A summary of the analytical methods, required sample volumes, containers, and sample preservation is provided in Table 2. All sample containers will be acquired from the laboratory and will be certified clean.

Adhesive labels will be applied to the sample containers, and a waterproof marking pen will be used to complete the labels. Information will include the date and time of sample collection, type of analysis to be performed, preservative used (if any), depth of sample (for soils), and the initials of sampling personnel. The containers will be sealed and placed in clear plastic bags. The sealed containers will be put in coolers on bags of ice or frozen ice packs. Plastic bubble pack or other suitable packing material will be used to prevent breakage.

The field personnel will ship the sample coolers to the laboratory using an overnight courier

service. The fastest possible shipping method will be used, and all sample shipments will be carefully tracked to ensure that samples arrive intact and that all holding times are met.

5. Chain of Custody Procedures

For analytical data to be valid, samples must be traceable from the time of collection through chemical analysis and final disposition. Chain-of-custody forms have been developed for this purpose. The necessary blank documents will be obtained from the laboratory, including chain-of-custody forms and seals.

Chain-of-custody forms will be completed in triplicate. The original form and one copy will be placed inside each cooler, and one copy will be retained by field personnel. The chain-of-custody forms accompanying each cooler will be sealed in a plastic bag and taped to the inside of the cooler lid. Each cooler will have a clearly visible return address. The cooler lids will be secured with shipping tape that encircles the cooler ends. A chain-of-custody seal will be placed at the front left and rear right sides of the cooler so that opening the lid will break the chain-of-custody seals.

Field activities and sample collection will be documented in a bound logbook dedicated to the project. For each sample, the location, time, monitor well/boring number, sample depth, sample volumes and preservation, and other pertinent field observations will be recorded. Each page of the logbook will be dated, numbered, and signed by those individuals making entries.

6. Equipment Calibration Procedures and Frequency

Numerous instruments will be used in the field and the laboratory during investigation. In order for reliable data to be generated, it is important that these instruments be routinely calibrated. Calibration of analytical instruments within the laboratory will be the responsibility of the contracted laboratory. Although the details of the laboratory calibration procedures are beyond the scope of this QAPP, the frequency of initial and continuing calibrations will adhere to established EPA protocols, as described in the analytical method (U.S. EPA, 1986). In addition,

the laboratory's QA manual for both **Hall Environmental Analysis Laboratory** and **TestAmerica Houston** have been included as an attachment to this document.

During field investigation, use of the following field equipment is anticipated:

- PID (Thermo Environmental 580B or equivalent)
- FID type OVA (Foxboro 108 or equivalent)
- Salinity-conductivity-temperature (SCT) meter (YSI Model 33 or equivalent)
- pH meter (Orion Model 250A or equivalent)
- Dissolved oxygen (DO) meter (YSI Model 57 or equivalent)
- Water level indicator (Solinst or equivalent)
- PSH interface meter (Solinst or equivalent)

Calibration and maintenance procedures for each of these instruments are described in the following paragraphs. Documentation of daily calibration for each of these instruments will be recorded in the field logbook, along with any required maintenance procedures performed.

A PID and/or FID will be used to screen soil samples for volatile organic compounds using the headspace method. The PID or FID will also serve for health and safety monitoring of the work area for organic vapors. Background VOC concentrations will be recorded daily in the logbook. The PID and/or FID will be calibrated daily with standard isobutylene (PID) or standard methane (FID). Recalibration of the PID and/or FID can occur during the work day at the discretion of the site health and safety officer in the event of suspect readings. Care will be taken to ensure that the PID and/or FID remains free of sand and dirt. The battery will be charged on a daily basis.

The SCT meter calibration will be checked initially with a standard potassium chloride solution, and a battery check will be performed daily prior to beginning field work. In the event of erratic measurements, the instrument calibration will be checked in the field. When not in use, the electrode will be kept immersed in deionized water to keep the platinum black surfaces fully hydrated, in accordance with manufacturers' instructions.

Prior to use each day, the pH meter will be calibrated using two pH buffers. The buffer solutions will be chosen to bracket the expected ground water pH range. Calibration of the instrument will be periodically checked throughout the day using the pH buffers to ensure accurate readings. In the event of instrument drift, the pH meter will be recalibrated. The electrode will be rinsed with water following each measurement and placed in the appropriate potassium chloride storage solution.

The DO meter will be calibrated in air by adjusting the calibration control until the oxygen concentration reads the correct value for the elevation and temperature at the site. The DO meter calibration will be checked periodically during the day and recalibrated if necessary.

The water level indicator will be initially calibrated against a steel tape. The battery and electrical connections will be periodically checked to ensure proper functioning of the instrument. The indicator probe and tape will be rinsed clean following each measurement. The PSH interface meter will be calibrated in a similar manner following manufacturer's instructions.

7. Data Reduction and Reporting

Data reduction will be performed by the laboratory in accordance with EPA protocols for the respective analytical method. Data from the analytical laboratory will be reviewed following the laboratory's internal QA/QC plan. All EPA required elements will be provided with the data package. If the analytical data do not meet the minimum data quality objectives, the laboratory will implement the corrective actions described in Section 10. All data falling outside the quality control limits defined in this QAPP will be flagged by the laboratory, as required by EPA protocol. Any discrepancies noted in the laboratory QA review will be noted in the case summaries included with the data packages.

Following each investigation phase of the project, the degree to which the data quality objectives have been met will be examined by comparing the actual results for the QA/QC samples with the objectives listed in Table 1. The results of this comparison will be tabulated in the Data Verification Report, along with detailed descriptions of any deviations from the protocols.

8. Internal Quality Control Checks

The specific quality control checks to be used are included with the individual analytical methods specified for each parameter. The quality control criteria for VOCs and TPH are described in *Test Methods for Evaluating Solid Wastes - SW-846*, (U.S. EPA, 1986).

9. Performance and System Audits

Performance and system audits are the practices followed by analytical laboratories to evaluate quality control procedures and laboratory performance (U.S. EPA, 1983). System audits are performed in order to assess whether a new analytical system is functioning properly. Performance audits rate the ongoing performance of the laboratory in terms of the accuracy and precision of the analytical data generated. Examples of performance audits include the analysis of performance evaluation samples, such as standard reference materials obtained from the National Institute of Standards and Technology or EPA, or participation in interlaboratory performance evaluation studies using "round-robin" samples. Each participating laboratory is graded and ranked based on the results. The performance and system audits of the laboratory contracted for this Amended IWP will be provided upon request and available for review.

10. Corrective Actions

If QA activities reveal apparent problems or deficiencies with the analytical data, corrective actions must be applied. The type of corrective action depends on the specific problem that occurs, but a general sequence of corrective actions will be followed. If the data do not fall within the prescribed data quality objectives, the affected samples will be re-analyzed by the laboratory until the objectives are met. Any data falling outside QC limits will be flagged and qualified to explain the nature of the data quality problem.

11. Routine Data Assessment Procedures

Routine procedures to assess the precision, accuracy, and completeness of the analyses include RPD for field duplicates and MS/MSD samples, as well as percent recovery (%R) for MS samples. The specific statistical techniques to be used are described with the appropriate analytical method (U.S. EPA, 1986). Any problems or deficiencies will be reported to the agency in the progress reports, or by telephone, if warranted by the nature and urgency of the problem.

12. Quality Assurance Reports to Management

Periodic assessment of data accuracy, precision, and completeness will be performed by the QA manager of the contracted laboratory. The results of these assessments, as well as the results of laboratory performance and system audits, will be available upon request. The laboratory QA manager will also review the case narratives and accompanying analytical data package to ensure that all data quality objectives are met. In the event that objectives are not met, the QA manager will consult with the laboratory manager to correct the problem.

13. REFERENCES

U.S. Environmental Protection Agency (U.S. EPA). 1983. Interim guidelines and specifications for preparing quality assurance project plans. QAMS-005/80, December 1983.

U.S. EPA. 1986. Test methods for evaluating solid waste, physical and chemical properties, 3rd ed. EPA-SW-846, November 1986.

U.S. EPA. 1987a. Data quality objectives for remedial response activities. EPA/540/G-87/003 (OSWER Directive 9355.0-7B), March 1987.

U.S. EPA. 1987b. Alternate concentrations limit guidance, Part 1, ACL Policy and Info Requirements. Interim Final, July 1987. EPA/530-SW-87-017, OSWER Directive 9481.

U.S. EPA. 1988. Contract laboratory program statement of work for organics analysis. February 1988 SOW.

U.S. EPA. 1992. RCRA ground water monitoring: Draft technical guidance. EPA/530-R-93-001, November 1992.

U.S. EPA. 1991. National functional guidelines for organic data review (draft), Contract Laboratory Program, December 1990, revised June 1991.

Table 1. Analytical Parameters, Methods, and Data Quality Objectives

Analyte Class	EPA Method [a]	Precision Objective (RPD) [b]	Accuracy Objective (%R) [c]	Completeness Objective (%)
VOCs	8010/8020/8240	20	80–120	90
SVOCs	8100/8270	30	60–140	90
PCBs	8080	30	60–140	90
Appendix IX total metals [d]	6010/7000	20	80–120	90
Total cyanide	9012	20	80–120	90
Total sulfide	9030	20	80–120	90
Total petroleum hydrocarbons	418.1	20	NA	90
Major cations [e]	6010	20	NA	90
Total alkalinity	310.1	20	NA	90
Chloride	9250	20	NA	90
Sulfate	9038	20	NA	90
Nitrate and nitrite	9200	20	NA	90
TDS	160.1	20	NA	90

[a] U.S. EPA, 1986
[b] Relative percent difference between duplicate
[c] Percent recovery of matrix spike
[d] Includes Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V, Zn
[e] Includes Ca, K, Mg, Na, Fe, Mn

Note: The proposed analysis for each sample is described in the Phase II work plan.

Table 2. Sample Collection Protocol

Analyte	EPA Method [a]	Sample Volume/Container	Sample Preservation	Holding Time
Soil Matrix				
VOCs	8010/8020/ 8240	6" brass ring/250 mL glass jars	Chill to 4°C	14 days
SVOCs	8100/8270	6" brass ring/250 mL glass jars	Chill to 4°C	14/40 days
PCBs	8080	6" brass ring/250 mL glass jars	Chill to 4°C	14/40 days
Appendix IX metals [b]	6010/7000	6" brass ring/250 mL glass jars	Chill to 4°C	6 months
Total cyanide	9010	6" brass ring/250 mL glass jars	Chill to 4°C	14 days
Total sulfide	9030	6" brass ring/250 mL glass jars	Chill to 4°C	7 days
TPH (gasoline)	418.1	6" brass ring/250 mL glass jars	Chill to 4°C	28 days
Ground-Water Matrix				
VOCs	8010/8020 8240	Two 40-mL septum vials	HCl to pH<2; chill to 4°C	14 days
SVOCs	8100/8270	1 L glass	Chill to 4°C	7/40 days
PCBs	8080	1 L glass	Chill to 4°C	7/40 days
Appendix IX metals [b]	6010/7000	1 L glass	Chill to 4°C	6 months
Total cyanide	9010	1 L glass	NaOH to pH>12	14 days
Total sulfide	9030	1 L glass	ZnAc + NaOH to pH>12	7 days
TPH (gasoline)	418.1	Two 40-mL septum vials	HCl to pH<2; chill to 4°C	28 days
Major cations [c]	3010/6010	500-mL plastic	HNO_3 to pH<2	6 months
Bicarbonate (total)	310.1	500-mL plastic	Chill to 4°C	14 days
Chloride (total)	9250	500-mL plastic	Chill to 4°C	28 days
Nitrate (total)	9200	500-mL plastic	H_2SO_4 to pH<2; chill to 4°C	28 days
Sulfate (total)	9038	500-mL plastic	Chill to 4°C	28 days
TDS	160.1	500-mL plastic	Chill to 4°C	7 days

Note: All laboratory analyses to be performed on unfiltered ground-water samples except for samples with a measured turbidity of 5 NTU or greater, in which case the laboratory will be instructed to filter the sample prior to analysis.

[a] U.S. EPA, 1986
[b] Includes Ag, As, Ba, Be, Cd, Co, Cr, Cu, Hg, Ni, Pb, Sb, Se, Sn, Tl, V, Zn
[c] Includes Ca, K, Mg, Na, Fe, Mn

VOCs = Volatile organic compounds
SVOCs = Semivolatile organic compounds
PCBs = Polychlorinated biphenyls
TPH = Total petroleum hydrocarbons
TDS = Total dissolved solids

Lab QAPP

(Hall Environmental)

July 2012

HALL ENVIRONMENTAL ANALYSIS LABORATORY

Hall Environmental Analysis Laboratory

QUALITY ASSURANCE PLAN

Effective Date: July 2nd, 2012

Revision 9.5

www.hallenvironmental.com

Control Number: 00000128

Approved By:

Andy Freeman — 6/29/12
Laboratory Manager — Date

Approved By:

Carolyn Swanson — 6/29/2012
Quality Assurance/Quality Control Officer — Date

4901 Hawkins NE ■ Suite D ■ Albuquerque, NM 87109
505.345.3975 ■ Fax 505.345.4107
www.hallenvironmental.com

Approved By:

6/29/12

Andy Freeman Date
Organics Technical Director

Approved By:

7/2/12

Ian Cameron Date
Inorganics Technical Director

Approved By:

7/2/12

Leva Jensen Date
Microbiology Technical Director

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3.0 Introduction

Purpose of Document

The purpose of this Quality Assurance Plan is to formally document the quality assurance policies and procedures of Hall Environmental Analysis Laboratory, Inc. (HEAL), for the benefit of its employees, clients, and accrediting organizations. HEAL continually implements all aspects of this plan as an essential and integral part of laboratory operations in order to ensure that high quality data is produced in an efficient and effective manner.

Objectives

The objective of HEAL is to achieve and maintain excellence in environmental testing. This is accomplished by developing, incorporating and documenting the procedures and policies specified by each of our accrediting authorities and outlined in this plan. These activities are carried out by a laboratory staff that is analytically competent, well-qualified, and highly trained. An experienced management team, knowledgeable in their area of expertise, monitors them. Finally, a comprehensive quality assurance program governs laboratory practices and ensures that the analytical results are valid, defensible, reproducible, reconstructable and of the highest quality.

HEAL establishes and thoroughly documents its activities to ensure that all data generated and processed will be scientifically valid and of known and documented quality. Routine laboratory activities are detailed in method specific standard operating procedures (SOP). All data reported meets the applicable requirements for the specific method that is referenced, ORELAP, TCEQ, EPA, client specific requirements and/or State Bureaus. In the event that these requirements are ever in contention with each other, it is HEAL's policy to always follow the most prudent requirement available. For specific method requirements refer to HEAL's Standard Operating Procedures (SOP's), EPA methods, Standard Methods 20th edition, ASTM methods or state specific methods.

HEAL management ensures that this document is correct in terms of required accuracy and data reproducibility, and that the procedures contain proper quality control measures. HEAL management additionally ensures that all equipment is reliable, well-maintained and appropriately calibrated. The procedures and practices of the laboratory are geared towards not only strictly following our regulatory requirements but also allowing the flexibility to conform to client specific specifications. Meticulous records are maintained for all samples and their respective analyses so that results are well-documented and defensible in a court of law.

The HEAL Quality Assurance/Quality Control Officer (QA/QCO) and upper management are responsible for supervising and administering this quality assurance program, and ensuring each individual is responsible for its proper implementation. All HEAL

management remains committed to the encouragement of excellence in analytical testing and will continue to provide the necessary resources and environment conducive to its achievement.

Policies

Understanding that quality cannot be mandated, it is the policy of this laboratory to provide an environment that encourages all staff members to take pride in the quality of their work. In addition to furnishing proper equipment and supplies, HEAL stresses the importance of continued training and professional development. Further, HEAL recognizes the time required for data interpretation. Therefore, no analyst should feel pressure to sacrifice data quality for data quantity. Each staff member must perform with the highest level of integrity and professional competence, always being alert to problems that could compromise the quality of their technical work.

Management and senior personnel supervise analysts closely in all operations. Under no circumstance is the willful act or fraudulent manipulation of analytical data condoned. Such acts must be reported immediately to HEAL management. Reported acts will be assessed on an individual basis and resulting actions could result in dismissal. The laboratory staff is encouraged to speak with lab managers or senior management if they feel that there are any undo commercial, financial, or other pressures, which might adversely affect the quality of their work; or in the event that they suspect that data quality has been compromised in any way. HEAL's Quality Assurance/Quality Control Officer is available if any analyst and/or manager wishes to anonymously report any suspected or known breaches in data integrity.

Understanding the importance of meeting customer requirements in addition to the requirements set forth in statutory and regulatory requirements, HEAL shall periodically seek feedback from customers and evaluate the feedback in order to initiate improvements.

All proprietary rights and client information at HEAL (including national security concerns) are considered confidential. No information will be given out without the express verbal or written permission of the client. All reports generated will be held in the strictest of confidence.

HEAL shall continually improve the effectiveness of its management system through the use of the policies and procedures outlined in this Quality Assurance Plan. Quality control results, internal and external audit findings, management reviews, new and continual training and corrective and preventive actions are continually evaluated to identify possible improvements and to ensure that appropriate communication processes are taking place regarding the effectiveness of the management system. HEAL shall ensure that the integrity of the quality system is maintained when changes to the system are planned and implemented.

This is a controlled document. Each copy is assigned a unique tracking number and when released to a client or accrediting agency the QA/QCO keeps the tracking number on file. This document is reviewed on an annual basis to ensure that it is valid and representative of current practices at HEAL.

4.0 Organization and Responsibility

Company

HEAL is accredited in accordance with the 2009 TNI standard (see NELAC accredited analysis list in the Document Control Logbook), through ORELAP and TCEQ and by the Arizona Department of Health Services. Additionally, HEAL is qualified as defined under the State of New Mexico Water Quality Control Commission regulations and the New Mexico State Drinking Water Bureau. HEAL is a locally owned small business that was established in 1991. HEAL is a full service environmental analysis laboratory with analytical capabilities that include both organic and inorganic methodologies and has performed analyses of soil, water, and air as well as various other matrices for many sites in the region. HEAL's client base includes local, state and federal agencies, private consultants, commercial industries as well as individual homeowners. HEAL has performed as a subcontractor to the state of New Mexico and to the New Mexico Department of Transportation. HEAL has been acclaimed by its customers as producing quality results and as being adaptive to client-specific needs.

The laboratory is divided into an organic section and an inorganic section. Each section has a designated manager/technical director. The technical directors report directly to the laboratory manager, who oversees all operations.

Certifications

ORELAP – NELAC Oregon Primary accrediting authority.

TCEQ – NELAC Texas Secondary accrediting authority.

The Arizona Department of Health Services

The New Mexico Drinking Water Bureau

The New Mexico Department of Health

See the current Document Control Logbook for copies of current licenses and licensed parameters, or refer to our current list of certifications online at www.hallenvironmental.com.

In the event of a certification being revoked or suspended, HEAL will notify, in writing, those clients that require the affected certification.

Personnel

HEAL management ensures the competence of all who operate equipment, perform environmental tests, evaluate results, and sign test reports. Personnel performing specific tasks shall be qualified on the basis of appropriate education, training, experience and /or demonstrated skills.

HEAL ensures that all personnel are aware of the relevance and importance of their activities and how each employee contributes to the achievement of the objectives defined throughout this document.

All personnel shall be responsible for complying with HEAL's quality assurance/quality control requirements that pertain to their technical function. Each technical staff member must have a combination of experience and education to adequately demonstrate specific knowledge of their particular function and a general knowledge of laboratory operations, test methods, quality assurance/quality control procedures, and records management.

All employees' training certificates and diplomas are kept on file with demonstrations of capability for each method they perform. An Organizational Chart can be found at the end of this section and a personnel list is available in the current Document Control Logbook.

Laboratory Director

The Laboratory Director is responsible for overall technical direction and business leadership of HEAL. The Laboratory Manager, the Project Manager and Quality Assurance/Quality Control Officer report directly to the Laboratory Director. Someone with a minimum of 7 years of directly related experience and a bachelor's degree in a scientific or engineering discipline should fill this position.

Laboratory Manager/Lead Technical Director

The Laboratory Manager shall exercise day–to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results. The Laboratory Manager shall be experienced in the fields of accreditation for which the laboratory is approved or seeking accreditation. The Laboratory Manager shall certify that personnel with appropriate educational and/or technical background perform all tests for which HEAL is accredited. Such certification shall be documented.

The Laboratory Manager shall monitor standards of performance in quality control and quality assurance and monitor the validity of the analyses performed and data generated at HEAL to assure reliable data.

The Laboratory Manager is responsible for the daily operations of the laboratory. The Laboratory Manager is the lead technical director of the laboratory and, in conjunction

with the section technical directors, is responsible for coordinating activities within the laboratory with the overall goal of efficiently producing high quality data within a reasonable time frame.

In events where employee scheduling or current workload is such that new work cannot be incorporated, without missing hold times, the Laboratory Manager has authority to modify employee scheduling, re-schedule projects or, when appropriate, allocate the work to approved subcontracting laboratories.

Additionally, the laboratory manager reviews and approves new analytical procedures and methods, and performs a final review of most analytical results. The Laboratory Manager provides technical support to both customers and HEAL staff.

The Laboratory Manager also observes the performance of supervisors to ensure that good laboratory practices and proper techniques are being taught and utilized, and to assist in overall quality control implementation and strategic planning for the future of the company. Other duties include assisting in establishing laboratory policies that lead to the fulfillment of requirements for various certification programs, assuring that all Quality Assurance and Quality Control documents are reviewed and approved, and assisting in conducting Quality Assurance Audits.

The laboratory manager addresses questions or complaints that cannot be answered by the section managers.

The Laboratory Manager shall have a bachelor's degree in a chemical, environmental, biological sciences, physical sciences or engineering field, and at least five years of experience in the environmental analysis of representative inorganic and organic analytes for which the laboratory seeks or maintains accreditation.

Quality Assurance Quality Control Officer

The Quality Assurance/Quality Control Officer (QA/QCO) serves as the focal point for QA/QC and shall be responsible for the oversight and/or review of quality control data. The QA/QCO functions independently from laboratory operations and shall be empowered to halt unsatisfactory work and/or prevent the reporting of results generated from an out-of-control measurement system. The QA/QCO shall objectively evaluate data and perform assessments without any outside/managerial influence. The QA/QCO shall have direct access to the highest level of management at which decisions are made on laboratory policy and/or resources. The QA/QCO shall notify laboratory management of deficiencies in the quality system in periodic, independent reports.

The QA/QCO shall have general knowledge of the analytical test methods for which data review is performed and have documented training and/or experience in QA/QC procedures and in the laboratory's quality system. The QA/QCO will have a

minimum of a BS in a scientific or related field and a minimum of three years of related experience.

The QA/QCO shall schedule and conduct internal audits as per the Internal Audit SOP at least annually, monitor and trend Corrective Action Reports as per the Data Validation SOP, periodically review control charts for out of control conditions, and initiate any appropriate corrective actions.

The QA/QCO shall oversee the analysis of proficiency testing in accordance with our standards and monitor any corrective actions issued as a result of this testing.

The QA/QCO reviews all standard operating procedures and statements of work in order to assure their accuracy and compliance to method and regulatory requirements.

The QA/QCO shall be responsible for maintaining and updating this quality manual.

Project Manager

The role of the project manager is to act as a liaison between HEAL and our clients. The Project Manager updates clients on the status of projects in-house, prepares quotations for new work, and is responsible for HEAL's marketing effort.

All new work is assessed by the Project Manager and reviewed with the other managers so as to not exceed the laboratory's capacity. In events where employee scheduling or current workload is such that new work cannot be incorporated without missing hold times, the Project Manager has authority to re-schedule projects.

It is also the duty of the project manager to work with the Laboratory Manager and QA/QCO to insure that before new work is undertaken, the resources required and accreditations requested are available to meet the client's specific needs.

Additionally, the Project Manager can initiate the review of the need for new analytical procedures and methods, and perform a final review of some analytical results. The Project Manager provides technical support to customers. Someone with a minimum of 2 years of directly related experience and a bachelor's degree in a scientific or engineering discipline should fill this position.

Technical Directors

Technical Directors are full-time members of the staff at HEAL who exercise day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results for their department within HEAL. A Technical Director's duties shall include, but not be limited to, monitoring standards of performance in quality

control and quality assurance, monitoring the validity of the analyses performed and the data generated in their sections to ensure reliable data, overseeing training and supervising departmental staff, scheduling incoming work for their sections, and monitoring laboratory personnel to ensure that proper procedures and techniques are being utilized. They supervise and implement new Quality Control procedures as directed by the QA/QCO, update and maintain quality control records including, but not limited to, training forms, IDOCs, ADOCPs, and MDLs, and evaluate laboratory personnel in their Quality Control activities. In addition, technical directors are responsible for upholding the spirit and intent of HEAL's data integrity procedures.

As Technical Directors of their associated section, they review analytical data to acknowledge that data meets all criteria set forth for good Quality Assurance practices. Someone with a minimum of 2 years of experience in the environmental analysis of representative analytes for which HEAL seeks or maintains accreditation and a bachelor's degree in a scientific or related discipline should fill this position.

Section Supervisors

Section Supervisors are full time members of staff at HEAL who exercise day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results for their department within HEAL. Section Supervisors report directly to their technical director. A Section Supervisor's duties shall include, but not be limited to, monitoring standards of performance in quality control and quality assurance, monitoring the validity of the analyses performed and the data generated in their sections to ensure reliable data, overseeing training and supervising departmental staff, scheduling incoming work for their sections, and monitoring laboratory personnel to ensure that proper procedures and techniques are being utilized. They supervise and implement new Quality Control procedures as directed by the QA/QCO, update and maintain quality control records including, but not limited to, training forms, IDOCs, ADOCPs, and MDLs, and evaluate laboratory personnel in their Quality Control activities. In addition, Section Supervisors are responsible for upholding the spirit and intent of HEAL's data integrity procedures. Section Supervisors update their Technical Director on the status and needs of their departments and submit all Quality Control documents to their technical director for their review, approval and signature.

As section supervisors, they review analytical data to acknowledge that data meets all criteria set forth for good Quality Assurance practices. Someone with a minimum of 2 years of experience in the environmental analysis of representative analytes for which HEAL seeks or maintains accreditation and a bachelor's degree, or equivalent experience in a scientific or related discipline should fill this position.

Health and Safety / Chemical Hygiene Officer

Refer to the most recent version of the Health and Safety and Chemical Hygiene Plans for the roles, responsibilities, and basic requirements of the Health and Safety Officer (H&SO) and the Chemical Hygiene Officer (CHO). These jobs can be executed by the same employee.

Analyst I, II and III

Analysts are responsible for the analysis of various sample matrices including, but not limited to, solid, aqueous, and air, as well as the generation of high quality data in accordance with the HEAL SOPs and QA/QC guidelines in a reasonable time as prescribed by standard turnaround schedules or as directed by the Section Manager or Laboratory Manager.

Analysts are responsible for making sure all data generated is entered in the database in the correct manner and the raw data is reviewed, signed and delivered to the appropriate peer for review. An analyst reports daily to the section manager and will inform them as to material needs of the section specifically pertaining to the analyses performed by the analyst. Additional duties may include preparation of samples for analysis, maintenance of lab instruments or equipment, and cleaning and providing technical assistance to lower level laboratory staff.

The senior analyst in the section may be asked to perform supervisory duties as related to operational aspects of the section. The analyst may perform all duties of a lab technician.

The position of Analyst is a full or part time hourly position and is divided into three levels, Analyst I, II, and III. All employees hired into an Analyst position at HEAL must begin as an Analyst I and remain there at a minimum of three months regardless of their education and experience. Analyst I must have a minimum of an AA in a related field or equivalent experience (equivalent experience means years of related experience can be substituted for the education requirement). An Analyst I is responsible for analysis, instrument operation, including calibration and data reduction. Analyst II must have a minimum of an AA in a related field or equivalent experience and must have documented and demonstrated aptitude to perform all functions of an Analyst II. An Analyst II is responsible for the full analysis of their test methods, routine instrument maintenance, purchase of consumables as dictated by their Technical Director, advanced data reduction, and basic data review. Analyst II may also assist Analyst III in method development and, as dictated by their Technical Director, may be responsible for the review and/or revision of their method specific SOPs. Analyst III must have Bachelors degree or equivalent experience and must have documented and demonstrated aptitude to perform all functions of an Analyst III. An Analyst III is responsible for all tasks completed by an Analyst I and II as well as advanced data review, non-routine instrument maintenance, assisting their technical director in basic supervisory duties and method development.

Laboratory Technician

A laboratory technician is responsible for providing support to analysts in the organics, inorganics and disposal departments. Laboratory Technicians can assist analysts in basic sample preparation, general laboratory maintenance, glassware washing, chemical inventories, sample disposal and sample kit preparation. This position can be filled by someone without the education and experience necessary to obtain a position as an analyst.

Sample Control Manager

The sample control manager is responsible for receiving samples and reviewing the sample login information after it has been entered into the computer. The sample control manager also checks the samples against the chain-of-custody for any sample and/or labeling discrepancies prior to distribution.

The sample control manager is responsible for sending out samples to the sub-contractors along with the review and shipping of field sampling bottle kits. The sample control manager acts as a liaison between the laboratory and field sampling crew to ensure that the appropriate analytical test is assigned. If a discrepancy is noted, the sample control manager or sample custodian will contact the customer to resolve any questions or problems. The sample control manager is an integral part of the customer service team.

This position should be filled by someone with a high school diploma and a minimum of 2 years of related experience and can also be filled by a senior manager.

Sample Custodians

Sample Custodians work directly under the Sample Control Manager. They are responsible for sample intake into the laboratory and into the LIMS. Sample Custodians take orders from our clients and prepare appropriate bottle kits to meet the clients' needs. Sample Custodians work directly with the clients in properly labeling and identifying samples as well as properly filling out legal COCs. When necessary, Sample Custodians contact clients to resolve any questions or problems associated with their samples. Sample Custodians are responsible for distributing samples throughout the laboratory and are responsible for notifying analysts of special circumstances such as short holding times or improper sample preservation upon receipt.

Sample Disposal Custodian

The sample disposal custodian is responsible for characterizing and disposing of samples in accordance to the most recent version of the sample disposal SOP. The sample disposal custodian collects waste from the laboratory and transports it to the disposal warehouse for storage and eventual disposal. The sample disposal custodian is responsible for maintaining the disposal warehouse and following the requirements for documentation, integrity, chemical hygiene and health and safety as set forth in the various HEAL administrative SOPs. The sample disposal custodian is responsible for overseeing any laboratory technicians employed at the disposal warehouse.

This position should be filled by someone with a high school diploma and a minimum of 1 year of related experience.

Bookkeeper

The Bookkeeper is responsible for the preparation of quarterly financials and quarterly payroll reports. The bookkeeper monitors payables, receivables, deposits, pays all bills and maintains an inventory of administrative supplies. The Bookkeeper completes final data package assembly and oversees the consignment of final reports. The Bookkeeper assists in the project management of drinking water compliance samples for NMED and NMEFC and any other tasks as assigned by the Laboratory Manager. This position should be filled by someone with a degree in accounting or a minimum of a high school diploma and at least 4 years of directly related experience.

Administrative Assistant

The Administrative Assistant is responsible for aiding administrative staff in tasks that include but are not limited to: the processing and consignment of final reports, and the generation of client specific spreadsheets. This position should be filled by someone with a minimum of a high school diploma.

IT Specialist

The IT Specialist is responsible for the induction and maintenance of all hard and software technology not maintained through a service agreement. The IT Specialist follows the requirements of this document, all regulatory documents and the EPAs Good Automated Laboratory Practices. This position should be filled by someone with a degree in a computer related field, or at least two years of directly related experience.

Delegations in the Absence of Key Personnel

Planned absences shall be preceded by notification to the Laboratory Manager. The appropriate staff members shall be informed of the absence. In the case of unplanned absences, the superior shall either assume the responsibilities and duties or delegate the responsibilities and duties to another appropriately qualified employee.

In the event that the Laboratory Manager is absent for a period of time exceeding fifteen consecutive calendar days, another full-time staff member meeting the basic qualifications and competent to temporarily perform this function will be designated. If this absence exceeds thirty-five consecutive calendar days, HEAL will notify ORELAP in writing of the absence and the pertinent qualifications of the temporary laboratory manager.

Laboratory Personnel Qualification and Training

All personnel joining HEAL shall undergo orientation and training. During this period the new personnel shall be introduced to the organization and their responsibilities, as well as the policies and procedures of the company. They shall also undergo on-the-job training and shall work with trained staff. They will be shown required tasks and be observed while performing them.

When utilizing staff undergoing training, appropriate supervision shall be dictated and overseen by the appropriate section technical director. Prior to analyzing client samples, a new employee, or an employee new to a procedure, must meet the following basic requirements. The SOP and Method for the analysis must be read and signed by the employee indicating that they read, understand, and intend to comply with the requirements of the documents. The employee must undergo documented training. Training is conducted by a senior analyst familiar with the procedure and overseen by the section Technical Director. This training is documented by any means deemed appropriate by the trainer and section Technical Director, and kept on file in the employees file located in the QA/QCO's office. The employee must perform a successful Initial Demonstration of Proficiency (IDOC). See the current Document Control Logbook for the training documents and checklists utilized at HEAL to ensure that all of these requirements are met. Once all of the above requirements are met it is incumbent upon the section Technical Director to determine at which point the employee can begin to perform the test unsupervised. A Certification to Complete Work Unsupervised (see the current Document Control Logbook) is then filled out by the employee and technical director.

IDOCs are required for all new analysts and methods prior to sample analysis. IDOCs are also required any time there is a change in the instrument, analyte list or method. If more than twelve months have passed since an analyst performed an IDOC and they have not performed the method and/or have not met the continuing DOC requirements, the analyst must perform an IDOC prior to resuming the test.

All IDOCs shall be documented through the use of the certification form which can be found in the current Document Control Logbook. IDOCs are performed by analyzing four Laboratory Control Spikes (LCSs). Using the results of the LCSs the mean recovery is calculated in the appropriate reporting units and the standard deviations of the population sample (n-1) (in the same units) as well as the relative percent difference for each parameter of interest. When it is not possible or pertinent to determine mean and standard deviations HEAL assesses performance against establish and documented criteria dictated in the method SOP. The mean and standard deviation are compared to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory-generated acceptance criteria. In the event that the HEAL SOP or test method fail to establish the pass/fail criteria the default limits of +/- 20% for calculated recovery and <20% relative percent difference based on the standard deviation will be utilized. If all parameters meet the acceptance criteria, the IDOC is successfully completed. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter and the analyst must either locate and correct the source of the problem and repeat the test for all parameters of interest or repeat the test for all parameters that failed to meet criteria. Repeat failure, however, confirms a general problem with the measurement system. If this occurs the source of the problem must be identified and the test repeated for all parameters of interest.

New employees that do not have prior analysis experience will not be allowed to perform analysis until they have demonstrated attention to detail with minimal errors in the assigned tasks. To ensure a sustained level of quality performance among staff members, continuing demonstration of capability shall be performed at least once a year. These are as an Annual Documentation of Continued Proficiency (ADOCP).

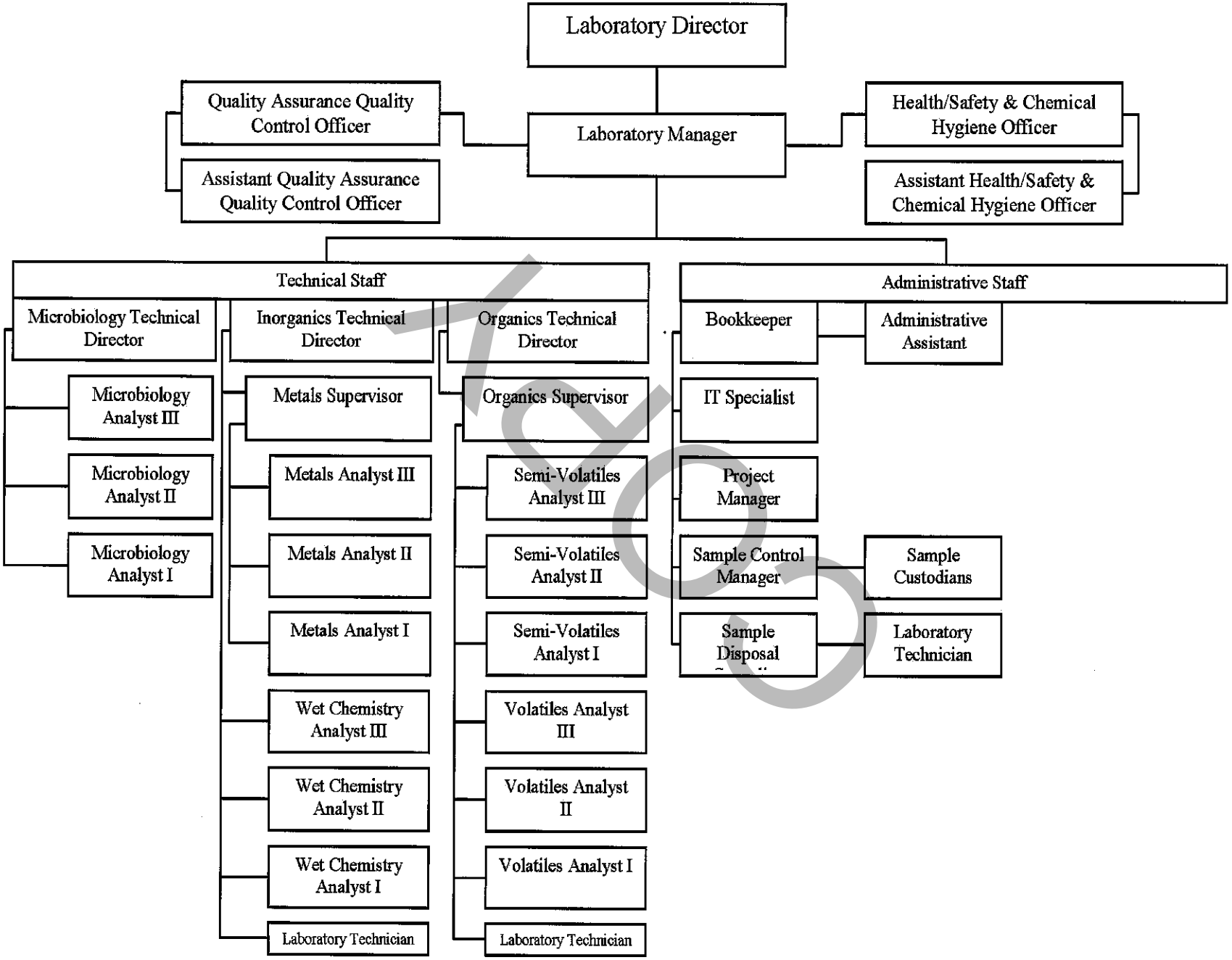
At least once per year an ADOCP must be completed. This is achieved by the acceptable performance of a blind sample (typically by using a PT sample, but can be a single blind (to the analyst) sample), by performing another IDOC, or by summarizing the data of four consecutive laboratory control samples with acceptable levels of precision and accuracy (these limits are those currently listed in the LIMS for an LCS using the indicated test method.) ADOCPs are documented using a standard form and are kept on file in each analyst's employee folder.

Each new employee shall be provided with data integrity training as a formal part of their new employee orientation. Each new employee will sign an ethics and data integrity agreement to ensure that they understand that data quality is our main objective. Every HEAL employee recognizes that although turn around time is important, quality is put above any pressure to complete the task expediently. Analysts are not compensated for passing QC parameters nor are incentives given for the quantity of work produced. Data Integrity and Ethics training are performed on an annual basis in order to remind all employees of HEAL's policy on data quality. Employees are required to understand that any infractions of the laboratory data integrity procedures will result in a detailed investigation that could lead to very serious

consequences including immediate termination, debarment, or civil/criminal prosecution.

Training for each member of HEAL's technical staff is further established and maintained through documentation that each employee has read, understood, and is using the latest version of this Quality Assurance Manual. Training courses or workshops on specific equipment, analytical techniques, or laboratory procedures are documented through attendance sheets, certificates of attendance, training forms, or quizzes. This training documentation is located in analyst specific employee folders in the QA/QCO Office. On the front of all methods, SOPs, and procedures for HEAL, there is a signoff sheet that is signed by all pertinent employees, indicating that they have read, understand, and agree to perform the most recent version of the document.

The effectiveness of training will be evaluated during routine data review, annual employee reviews, and internal and external audits. Repetitive errors, complaints and audit findings serve as indicators that training has been ineffective. When training is deemed to have been ineffective a brief review of the training process will be completed and a re-training conducted as soon as possible.


Laboratory Director
Quality Assurance Quality Control Officer
Assistant Quality Assurance Quality Control Officer
Laboratory Manager
Health/Safety & Chemical Hygiene Officer
Assistant Health/Safety & Chemical Hygiene Officer
Technical Staff
Administrative Staff
Microbiology Technical Director
Inorganics Technical Director
Organics Technical Director
Bookkeeper
Administrative Assistant
Microbiology Analyst III
Microbiology Analyst II
Microbiology Analyst I
Metals Supervisor
Metals Analyst III
Metals Analyst II
Metals Analyst I
Wet Chemistry Analyst III
Wet Chemistry Analyst II
Wet Chemistry Analyst I
Laboratory Technician
Organics Supervisor
Semi-Volatiles Analyst III
Semi-Volatiles Analyst II
Semi-Volatiles Analyst I
Volatiles Analyst III
Volatiles Analyst II
Volatiles Analyst I
Laboratory Technician
IT Specialist
Project Manager
Sample Control Manager
Sample Custodians
Sample Disposal
Laboratory Technician

5.0 Receipt and Handling of Samples

Sampling

Procedures

HEAL does not provide field sampling for any projects. Sample kits are prepared and provided for clients upon request. The sample kits contain the appropriate sampling containers (with a preservative when necessary), labels, blue ice (The use of "blue ice" by anyone except HEAL personnel is discouraged because it generally does not maintain the appropriate temperature of the sample. If blue ice is used, it should be completely frozen at the time of use, the sample should be chilled before packing, and special notice taken at sample receipt to be certain the required temperature has been maintained.), a cooler, chain-of-custody forms, plastic bags, bubble wrap, and any special sampling instructions. Sample kits are reviewed prior to shipment for accuracy and completeness.

Containers

Containers which are sent out for sampling are purchased by HEAL from a commercial source. Glass containers are certified "EPA Cleaned" QA level 1. Plastic containers are certified clean when required. These containers are received with a Certificate of Analysis verifying that the containers have been cleaned according to the EPA wash procedure. Containers are used once and discarded. If the samples are collected and stored in inappropriate containers the laboratory may not be able to accurately quantify the amount of the desired components. In this case, re-sampling may be required.

Preservation

If sampling for analyte(s) requires preservation, the sample custodians fortify the containers prior to shipment to the field, or provide the preservative for the sampler to add in the field. The required preservative is introduced into the vials in uniform amounts and done so rapidly to minimize the risk of contamination. Vials that contain a preservative are labeled appropriately. If the samples are stored with inappropriate preservatives, the laboratory may not be able to accurately quantify the amount of the desired components. In this case re-sampling may be required.

Refer to the current Login SOP and/or the current price book for detailed sample receipt and handling procedures, appropriate preservation and holding time requirements.

Sample Custody

Chain-of-Custody Form

A Chain-of-Custody (COC) form is used to provide a record of sample chronology from the field to receipt at the laboratory. HEAL's COC contains the client's name, address, phone and fax numbers, the project name and number, the project manager's name, and the field sampler's name. It also identifies the date and time of sample collection, sample matrix, field sample ID number, number/volume of sample containers, sample temperature upon receipt, and any sample preservative information.

There is also a space to record the HEAL ID number assigned to samples after they are received. Next to the sample information is a space for the client to indicate the desired analyses to be performed. There is a section for the client to indicate the data package level as well as any accreditation requirements. Finally, there is a section to track the actual custody of the samples. The custody section contains lines for signatures, dates and times when samples are relinquished and received. The COC form also includes a space to record special sample related instructions, sampling anomalies, time constraints, and any sample disposal considerations.

It is paramount that all COCs arrive at HEAL complete and accurate so that the samples can be processed and allocated for testing in a timely and efficient manner. A sample chain-of-custody form can be found in the current Document Control Logbook or on line at www.hallenvironmental.com.

Receiving Samples

Samples are received by authorized HEAL personnel. Upon arrival, the COC is compared to the respective samples. After the samples and COC have been determined to be complete and accurate, the sampler signs over the COC. The HEAL staff member in turn signs the chain-of-custody, also noting the current date, time, and sample temperature. This relinquishes custody of the samples from the sampler and delegates sample custody to HEAL. The first (white) copy of the COC form is filed in the appropriate sample folder. The second (yellow) copy of the COC form is filed in the COC file in the sample control manger's office. The third (pink) copy of the COC form is given to the person who has relinquished custody of the samples.

Logging in Samples and Storage

Standard Operating Procedures have been established for the receiving and tracking of all samples (refer to the current HEAL Login SOP). These procedures ensure that samples are received and properly logged into the laboratory and that all associated documentation, including chain of custody forms, is complete and consistent with the samples received. Each sample set is given a unique HEAL tracking ID number.

Individual sample locations within a defined sample set are given a unique sample ID suffix-number. Labels with the HEAL numbers, and tests requested, are generated and placed on their respective containers. The pH of preserved, non-volatile samples is checked and noted if out of compliance. Due to the nature of the samples, the pHs of volatiles samples are checked after analysis. Samples are reviewed prior to being distributed for analysis.

Samples are distributed for analysis based upon the requested tests. In the event that sample volume is limited and different departments at HEAL are required to share the sample, volatile work takes precedence and will always be analyzed first before the sample is sent to any other department for analysis.

All samples that require thermal preservation shall be acceptably stored at a temperature range just above freezing to 6 °C.

Each project (sample set) is entered into the Laboratory Information Management System (LIMS) with a unique ID that will be identified on every container. The ID tag includes the Lab ID, Client ID, date and time of collection, and the analysis/analyses to be performed. The LIMS continually updates throughout the lab. Therefore, at any time, an analyst or manager may inquire about a project and/or samples status. For more information about the login procedures, refer to the Sample Login SOP.

Disposal of Samples

Samples are held at HEAL for a minimum of thirty days and then transferred to the HEAL warehouse for disposal. Analytical results are used to characterize their respective sample contamination level(s) so that the proper disposal can be performed. These wastes will be disposed of according to their hazard as well as their type and level of contamination. Refer to the Hall Environmental Analysis Laboratory Chemical Hygiene Plan and current Sample Disposal SOP for details regarding waste disposal.

Waste drums are provided by an outside agency. These drums are removed by the outside agency and disposed of in a proper manner.

The wastes that are determined to be non-hazardous are disposed of as non-hazardous waste in accordance with the Chemical Hygiene Plan and Sample Disposal SOP.

6.0 Analytical Procedures

All analytical methods used at HEAL incorporate necessary and sufficient Quality Assurance and Quality Control practices. A Standard Operating Procedure (SOP) is used for each method to provide the necessary criteria to yield acceptable results. These procedures are reviewed at least annually and revised as necessary and are attached as a pdf file in the Laboratory Information Management System (LIMS) for easy access by each analyst. The sample is often consumed or altered during the analytical process. Therefore, it is important that each step in the analytical process be correctly followed in order to yield valid data.

When unforeseen problems arise, the analyst, technical director, and, when necessary, laboratory manager meet to discuss the factors involved. The analytical requirements are evaluated and a suitable corrective action or resolution is established. The client is notified in the case narrative with the final report or before, if the validity of their result is in question.

List of Procedures Used

Typically, the procedures used by HEAL are EPA approved methodologies or 20th edition Standard Methods. However, proprietary methods for client specific samples are sometimes used. The following tables list EPA and Standard Methods Method numbers with their corresponding analytes and/or instrument classification.

Methods Utilized at HEAL

Drinking Water(DW) Non-Potable Water (NPW) Solids (S)

Methodology	Matrix	Title of Method
120.1	DW NPW	"Conductance(Specific Conductance, *u*ohms at 25 ° C)"
180.1	DW NPW	"Turbidity (Nephelometric)"
200.2	DW NPW	"Sample Preparation Procedure For Spectrochemical Determination of Total Recoverable Elements"
200.7	DW NPW	"Determination of Metals and Trace Elements in Water and Wastes by Inductively Coupled Plasma-Atomic Emission Spectrometry"
200.8	DW NPW	"Determination of Trace Elements in Waters and Wastes by Inductively Coupled Plasma-Mass Spectrometry."
245.1	DW NPW	"Mercury (Manual Cold Vapor Technique)"
300	DW NPW S	"Determination of Inorganic Anions by Ion Chromatography"

413.2	NPW S	"Oil and Grease"
418.1	NPW S	"Petroleum Hydrocarbons (Spectrophotometric, Infrared)"
504.1	DW	"EDB, DBCP and 123TCP in Water by Microextraction and Gas Chromatography"
505	DW	"Analysis of Organohalide Pesticides and Commercial Polychlorinated Biphenyl (PCB) Products in Water by Microextraction and Gas Chromatography"
515.1	DW	"Determination of Chlorinated Acids in Water by Gas Chromatography with an Electron Capture Detector"
524.2	DW	"Measurement of Purgeable Organic Compounds in Water by Capillary Column Gas Chromatography/Mass Spectrometry"
531.1	DW	"Measurement of N-Methylcarbomoyloximes and N-Methylcarbamates in Water by Direct Aqueous Injection HPLC with Post Column Derivatization"
547	DW	"Determination of Glyphosate in Drinking Water by Direct-Aqueous Injection HPLC, Post-Column Derivatization, and Fluorescence Detection"
552.1	DW	"Determination of Haloacetic Acids and Dalapon in Drinking Water by Ion-Exchange Liquid-Solid Extraction and Gas Chromatography with an Electron Capture Detector"
624	DW	Appendix A to Part 136 Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater Method 624-Purgeables"
625	DW	Appendix A to Part 136 Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater Method 625-Base/Neutrals and Acids"
1311	S	"Toxicity Characteristic Leaching Procedure"
1311ZHE	S	"Toxicity Characteristic Leaching Procedure"
1164A	NPW	"N-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated N-Hexane Extractable Material) by Extraction and Gravimetry"
3005A	NPW	"Acid Digestion of Waters for Total Recoverable or Dissolved Metals for Analysis by FLAA or ICP Spectroscopy"
3010A	S	"Acid Digestion of Aqueous Samples and Extracts for Total Metals for Analysis by FLAA or ICP Spectroscopy"
3050B	S	"Acid Digestion of Sediment, Sludge, and Soils"
3510C	DW NPW	"Separatory Funnel Liquid-Liquid Extraction"

3540	S	"Soxhlet Extraction"
3545	S	"Pressurized Fluid Extraction(PFE)"
3665	NPW S	"Sulfuric Acid/Permanganate Cleanup"
5030B	NPW	"Purge-and-Trap for Aqueous Samples"
5035	S	"Closed-System Purge-and-Trap and Extraction for Volatile Organics in Soil and Waste Samples"
6010B	NPW S	"Inductively Coupled Plasma-Atomic Emission Spectrometry"
6020	NPW S	"Inductively Coupled Plasma-Mass Spectrometry"
7470A	NPW	"Mercury in Liquid Waste (Manual Cold-Vapor Technique)"
7471A	S	"Mercury in Solid or Semisolid Waste (Manual Cold Vapor Technique)"
8021B	NPW S	"Aromatic and Halogenated Volatiles By Gas Chromatography Using Photoionization and/or Electrolytic Conductivity Detectors"
8015B	NPW S	"Nonhalogenated Volatile Organics by Gas Chromatography" (Gasoline Range and Diesel Range Organics)
8015AZ	S	"C10-C32 Hydrocarbons in Soil-8015AZ"
8081A	NPW S	"Organochlorine Pesticides by Gas Chromatography"
8082	NPW S	"Polychlorinated Biphenyls (PCBs) by Gas Chromatography"
8260B	NPW S	"Volatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS)"
8270C	NPW S	"Semivolatile Organic Compounds by Gas Chromatography/ Mass Spectrometry (GC/MS)"
8310	NPW S	"Polynuclear Aromatic Hydrocarbons"
9045C	S	"Soil and Waste pH"
9060	NPW	"Total Organic Carbon"
9067	NPW S	"Phenolics (Spectrophotometric, MBTH With Distillation)"
9095	S	Paint Filter
Walkley/Black	S	FOC/TOC WB
SM2320 B	DW NPW	"Alkalinity"
SM2540 B	NPW	"Total Solids Dried at 103-105° C"

SM2540 C	DW NPW	"Total Dissolved Solids Dried at 180° C"
SM2540 D	NPW	"Total Suspended Solids Dried at 103-105° C"
SM4500-CL G	DW	"Chlorine (Residual) 4500-CL G. DPD Colorimetric Method"
SM4500-H+B	DW NPW	"pH Value"
SM4500-NH3 C	NPW S	"4500-NH3" Ammonia
SM4500-Norg C	NPW S	"4500-Norg" Total Kjeldahl Nitrogen (TKN)
SM5210 B	NPW	"5210 B. 5-day BOD Test"
SM5310 B	DW	"5310" Total Organic Carbon (TOC)
8000B	NPW S	"Determinative Chromatographic Separations"
8000C	NPW S	"Determinative Chromatographic Separations"

Criteria for Standard Operating Procedures

HEAL has Standard Operating Procedures (SOPs) for each of the test methods listed above. These SOPs are based upon the listed methods and detail the specific procedure and equipment utilized as well as the quality requirements necessary to prove the integrity of the data. SOPs are reviewed or revised every twelve months or sooner if necessary. The review/revision is documented in the Master SOP Logbook filed in the QA/QC Office. All SOPs are available in the LIMS linked under the specific test method. Administrative SOPs, which are not linked in the LIMS, are available on desktops throughout the laboratory in the link to administrative SOPs folder.

Hand written corrections or alterations to SOPs are not permitted. In the event that a correction is needed and a revision is not immediately possible, a corrective action report will be generated documenting the correction or alteration, signed by the section Technical Director and the QA/QC Officer and will be scanned into the current SOP and will document the change until a new revision is possible.

Each HEAL test method SOP shall include or reference the following topics where applicable:

Identification of the test method;
Applicable matrix or matrices;
Limits of detection and quantitation;
Scope and application, including parameters to be analyzed;
Summary of the test method;
Definitions;
Interferences;
Safety;
Equipment and supplies;
Reagents and standards;
Sample collection, preservation, shipment and storage;
Quality control parameters;
Calibration and standardization;
Procedure;
Data analysis and calculations;
Method performance;
Pollution prevention;
Data assessment and acceptance criteria for quality control measures;
Corrective actions for out-of-control data;
Contingencies for handling out-of-control or unacceptable data;
Waste management;
References; and
Any tables, diagrams, flowcharts and validation data.

7.0 Calibration

All equipment and instrumentation used at HEAL are operated, maintained and calibrated according to manufacturers' guidelines, as well as criteria set forth in applicable analytical methodology. Personnel who have been properly trained in their procedures perform the operation and calibration. Brief descriptions of the calibration processes for our major laboratory equipment and instruments are found below.

Thermometers

The thermometers in the laboratory are used to measure the temperatures of the refrigerators, freezers, ovens, water baths, incubators, hot blocks, ambient laboratory conditions, TCLP Extractions, digestion blocks, and samples at the time of log-in. All NIST traceable thermometers are either removed from use upon their documented expiration date or they are checked annually with a NIST-certified thermometer and a correction factor is noted on each thermometer log. See the most current Login SOP for detailed procedures on this calibration procedure.

Data Loggers are used to record refrigerator temperatures. These data loggers are calibrated quarterly with NIST-certified thermometers.

Refrigerators/Freezers

Each laboratory refrigerator or freezer contains a thermometer capable of measuring to a minimum precision of 0.1°C. The thermometers are kept with the bulb immersed in liquid. Each day of use, the temperatures of the refrigerators are recorded to insure that the refrigerators are within the required designated range. Samples are stored separately from the standards to reduce the risk of contamination.

See the current Catastrophic Failure SOP for the procedure regarding how to handle failed refrigerators or freezers.

Ovens

The ovens contain thermometers graduated by 1° C. The ovens are calibrated quarterly against NIST thermometers and checked each day of use as required and in whatever way is dictated by or appropriate for the method in use.

Analytical and Table Top Balances

The table top balances are capable of weighing to a minimum precision of 0.01 grams. The analytical balances are capable of weighing to a minimum precision of 0.0001 grams. Records are kept of daily calibration checks for the balances in use. Working weights are used in these checks. The balances are annually certified by an outside source and the certifications are on file with the QA/QCO.

Balances, unless otherwise indicated by method specific SOPs, will be checked each day of use with at least two weights that will bracket the working range of the balance for the day. Daily balance checks will be done using working weights that are calibrated annually against Class S weights. Class S weights are calibrated by an external provider as required. The Class S weights are used once a year, or more frequently if required, to assign values to the Working Weights. During the daily balance checks, the working weights are compared to their assigned values and must pass in order to validate the calibration of the balance. The assigned values, as well as the daily checks, for the working weights are recorded in the balance logbook for each balance.

Instrument Calibration

An instrument calibration is the relationship between the known concentrations of a set of calibration standards introduced into an analytical instrument and the measured response they produce. Calibration curve standards are a prepared series of aliquots at various known concentration levels from a primary source reference standard. Specific mathematical types of calibration techniques are outlined in SW-846 8000B and/or 8000C. The entire initial calibration must be performed prior to sample analyses.

The lowest standard in the calibration curve must be at or below the required reporting limit.

Refer to the current SOP to determine the minimum requirement for calibration points.

Most compounds tend to be linear and a linear approach should be favored when linearity is suggested by the calibration data. Non-linear calibration should be considered only when a linear approach cannot be applied. It is not acceptable to use an alternate calibration procedure when a compound fails to perform in the usual manner. When this occurs, it is indicative of instrument issues or operator error.

If a non-linear calibration curve fit is employed, a minimum of six calibration levels must be used for second-order (quadratic) curves.

When more than 5 levels of standards are analyzed in anticipation of using second-order calibration curves, all calibration points MUST be used regardless of the calibration option employed. The highest or lowest calibration point may be excluded for the purpose of narrowing the calibration range and meeting the requirements for a specific calibration option. Otherwise, unjustified exclusion of calibration data is expressly forbidden.

Analytical methods vary in QC acceptance criteria. HEAL follows the method specific guidelines for QC acceptance. The specific acceptance criteria are outlined in the analytical methods and their corresponding SOPs.

pH Meter

The pH meter measures to a precision of 0.01 pH units. The pH calibration logbook contains the calibration before each use, or each day of use, if used more than once per day. It is calibrated using a minimum of 3 certified buffers. Also available with the pH meter is a magnetic stirrer with a temperature sensor. See the current pH SOP (SM4500 H+ B) for specific details regarding calibration of the pH probe.

Other Analytical Instrumentation and Equipment

The conductivity probe is calibrated as needed and checked daily when in use.

Eppendorf (or equivalent brands) pipettes are checked gravimetrically prior to use.

Standards

All of the source reference standards used are ordered from a reliable commercial vendor. A Certificate of Analysis (CoA), which verifies the quality of the standard, accompanies the standards from the vendor. The Certificates of Analysis are dated and stored on file by the Technical Directors or their designee. These standards are traceable to the National Institute of Standards (NIST). When salts are purchased and used as standards the certificate of purity must be obtained from the vendor and filed with the CoAs.

All standard solutions, calibration curve preparations, and all other quality control solutions are labeled in a manner that can be traced back to the original source reference standard. All source reference standards are entered into the LIMS with an appropriate description of the standard. Dilutions of the source reference standard (or any mixes of the source standards) are fully tracked in the LIMS. Standards are labeled with the date opened for use and with an expiration date.

As part of the quality assurance procedures at HEAL, analysts strictly adhere to manufacturer recommendations for storage times/expiration dates and policies of analytical standards and quality control solutions.

Reagents

HEAL ensures that the reagents used are of acceptable quality for their intended purpose. This is accomplished by ordering high quality reagents and adhering to good laboratory practices so as to minimize contamination or chemical degradation. All reagents must meet any specifications noted in the analytical method. Refer to the current Purchase of Consumables SOP for details on how this is accomplished and documented.

Upon receipt, all reagents are assigned a separate ID number, and logged into the LIMS. All reagents shall be labeled with the date received into the laboratory and again with the date opened for use. Recommended shelf life, as defined by the manufacturer, shall be documented and controlled. Dilutions or solutions prepared shall be clearly labeled, dated, and initialed. These solutions are traceable back to their primary reagents and do not extend beyond the expiration date listed for the primary reagent.

All gases used with an instrument shall meet specifications of the manufacturer. All safety requirements that relate to maximum and/or minimum allowed pressure, fitting types, and leak test frequency, shall be followed. When a new tank of gas is placed in use, it shall be checked for leaks and the date put in use will be written in the instrument maintenance logbook.

HEAL continuously monitors the quality of the reagent water and provides the necessary indicators for maintenance of the purification systems in order to assure that the quality of laboratory reagent water meets established criteria for all analytical methods.

Reagent blank samples are also analyzed to ensure that no contamination is present at detectable levels. The frequency of reagent blank analysis is typically the same as calibration verification samples. Refrigerator storage blanks are stored in the volatiles refrigerator for a period of one week and analyzed and replaced once a week.

8.0 Maintenance

Maintenance logbooks are kept for each major instrument and all support equipment in order to document all repair and maintenance. In the front of the logbook, the following information is included:

Unique Name of the Item or Equipment
Manufacturer
Type of Instrument
Model Number
Serial Number
Date Received and Date Placed into Service
Location of Instrument
Condition of Instrument Upon Receipt

For routine maintenance, the following information shall be included in the log:

Maintenance Date
Maintenance Description
Maintenance Performed by Initials

A manufacturer service agreement (or equivalent) covers most major instrumentation to assure prompt and reliable response to maintenance needs beyond HEAL instrument operator capabilities.

Refer to the current Maintenance and Troubleshooting SOP for each section in the laboratory for further information.

9.0 Data Integrity

For HEAL's policy on ethics and data integrity, see section 3.0 of this document. Upon being hired, and annually there after, all employees at HEAL undergo documented data integrity training. All new employees sign an Ethics and Data Integrity Agreement, documenting their understanding of the high standards of integrity required at HEAL and outlining their responsibilities in regards to ethics and data integrity. See the current Document Control Logbook for a copy of this agreement.

In instances of ethical concern, analysts are required to report the known or suspected concern to their Technical Director, the Laboratory Manager, or the QA/QCO. This will be done in a confidential and receptive environment, allowing all employees to privately discuss ethical issues or report items of ethical concern.

Once reported and documented, the ethical concern will be immediately elevated to the Laboratory Manager and the need for an investigation, analyst remediation, or termination will be determined on a case-by-case basis.

All reported instances of ethical concern will be thoroughly documented and handled in a manner sufficient to rectify any breaches in data integrity with an emphasis on preventing similar incidences from happening in the future.

10.0 Quality Control

Internal Quality Control Checks

HEAL utilizes various internal quality control checks, including duplicates, matrix spikes, matrix spike duplicates, method blanks, laboratory control spikes, laboratory control spike duplicates, surrogates, internal standards, calibration standards, quality control charts, proficiency tests and calculated measurement uncertainty.

Refer to the current method SOP to determine the frequency and requirements of all quality controls. In the event that the frequency of analysis is not indicated in the method specific SOP, duplicate samples, laboratory control spikes (LCS), Method Blanks (MB), and matrix spikes and matrix spike duplicates (MS/MSD) are analyzed for every batch of twenty samples.

When sample volume is limited on a test that requires an MS/MSD an LCSD shall be analyzed to demonstrate precision and accuracy and when possible a sample duplicate will be analyzed.

Duplicates are identical tests repeated for the same sample or matrix spike in order to determine the precision of the test method. A Relative Percent Difference (RPD) is calculated as a measure of this precision. Unless indicated in the SOP, the default acceptance limit is </= 20%.

Matrix Spikes and Matrix Spike Duplicates are spiked samples (MS/MSD) that are evaluated with a known added quantity of a target compound. This is to help determine the accuracy of the analyses and to determine the matrix affects on analyte recovery. A percent recovery is calculated to assess the quality of the accuracy. In the event that the acceptance criteria is not outlined in the SOP, a default limits of 70-130% will be utilized. When an MSD is employed an RPD is calculated and when not indicated in the SOP shall be acceptable at </= 20%.

When appropriate for the method, a Method Blank should be analyzed with each batch of samples processed to assess contamination levels in the laboratory. MBs consist of all the reagents measured and treated as they are with samples, except without the samples. This enables the laboratory to ensure clean reagents and procedures. Guidelines should be in place for accepting or rejecting data based on the level of contamination in the blank. In the event that these guidelines are not dictated by the SOP or in client specific work plans, the MB should be less than the MDL reported for the analyte being reported.
A Laboratory Control Spike and Laboratory Control Spike Duplicate (LCS/LCSD) are reagent blanks, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst-specific precision and bias or to assess the performance of all or a portion of the measurement system. Guidelines are outlined in each

SOP for the frequency and pass fail requirements for LCS and LCSDs. These limits can be set utilizing control charts as discussed below.

Surrogates are utilized when dictated by method and are substances with properties that mimic the analytes of interest. The surrogate is an analyte that is unlikely to be found in environmental samples. Refer to the appropriate Method and SOP for guidelines on pass/fail requirements for surrogates.

Internal Standards are utilized when dictated by the method and are known amounts of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical method. Refer to the appropriate Method and SOP for guidelines on pass/fail requirements for Internal Standards.

Proficiency Test (PT) Samples are samples provided by an unbiased third party. They are typically analyzed twice a year, between five and seven months apart, or at any other interval as defined in the method SOP. They contain a pre-determined concentration of the target compound, which is unknown to HEAL. HEAL's management and all analysts shall ensure that all PT samples are handled in the same manner as real environmental samples utilizing the same staff, methods, procedures, equipment, facilities and frequency of analysis as used for routine analysis of that analyte. When analyzing a PT, HEAL shall employ the same calibration, laboratory quality control and acceptance criteria, sequence of analytical steps, number of replicates and other procedures as used when analyzing routine samples. PT results are reported as normal samples, within the working range of the associated calibration curve. In the event an analyte concentration is less than the PQL, the result shall be reported as less than the PQL.

With regards to analyzing PT Samples HEAL shall not send any PT sample, or portion of a PT sample, to another laboratory for any analysis for which we seek accreditation, or are accredited. HEAL shall not knowingly receive any PT sample or portion of a PT sample from another laboratory for any analysis for which the sending laboratory seeks accreditation, or is accredited. Laboratory management or staff will not communicate with any individual at another laboratory concerning the PT sample. Laboratory management or staff shall not attempt to obtain the assigned value of any PT sample from the PT Provider.

Upon receiving a Not Acceptable PT result for any analyte, a root cause analysis is conducted and the cause of the failure determined and corrected. As defined by TNI, two out of the past three PTs must be acceptable to maintain accreditation for any given analyte. If this requirement is not met a successful history will be reestablished by the analysis of an additional PT sample. For accredited tests, the PT provider will be notified, when the PT is for corrective action purposes. The analysis dates of successive PT samples for the same accredited analyte shall be at least fifteen days apart.

Calibration standards are standards run to calibrate. Once the calibration is established the same standards can be analyzed as Continuing Calibration Verifications (CCV), used to confirm the consistency of the instrumentation. Calibration standards can be utilized at the beginning and end of each batch, or more frequently as required. Typically Continuing

Calibration Blanks (CCB) are run in conjunction with CCVs. Refer to the current method SOP for frequency and pass/fail requirements of CCVs and CCBs.

Control Limits are limits of acceptable ranges of the values of quality control checks. The control limits approximate a 99% confidence interval around the mean recovery. Any matrix spike, surrogate, or LCS results outside of the control limits require further evaluation and assessment. This should begin with the comparison of the results from the samples or matrix spike with the LCS results. If the recoveries of the analytes in the LCS are outside of the control limits, then the problem may lie with the application of the extraction, with cleanup procedures, or with the chromatographic procedure. Once the problem has been identified and addressed, corrective action may include reanalysis of samples or re-extraction followed by reanalysis. When the LCS results are within the control limits, the issue may be related to the sample matrix or to the use of an inappropriate extraction, cleanup, and/or determinative method for the matrix. If the results are to be used for regulatory compliance monitoring, then steps must be taken to demonstrate that the analytes of concern can be determined in the sample matrix at the levels of interest. Data generated with laboratory control samples that fall outside of the established control limits are judged to be generated during an "out-of-control" situation. These data are considered suspect and shall be repeated or reported with qualifiers.

Control limits are to be updated only by Technical Directors, Section Supervisors or the Quality Assurance Officer. Control limits should be established and updated according to the requirements of the method being utilized. When the method does not specify, and control limits are to be generated or updated for a test, the following guidelines shall be utilized.

Limits should typically be generated utilizing the most recent 20-40 data values. In order to obtain an even distribution across multiple instruments and to include more than a single day's worth of data, surrogate limits should be generated using around 100 data values. The data values used shall not reuse values that were included in the previous Control Limit update. The data values shall also be reviewed by the LIMS for any Grubbs Outliers, and if identified, the outliers must be removed prior to generating new limits. The results used to update control limits should meet all other QC criteria associated with the determinative method. For example, MS/MSD recoveries from a GC/MS procedure should be generated from samples analyzed after a valid tune and a valid initial calibration that includes all analytes of interest. Additionally, no analyte should be reported when it is beyond the working range of the calibration currently in use. MS/MSD and surrogate limits should be generated using the same set of extraction, cleanup, and analysis procedures.

All generated limits should be evaluated for appropriateness. Where limits have been established for MS/MSD samples, the LCS/LCSD limits should fall within those limits, as the LCS/LCSD are prepared in a clean matrix. Surrogate limits should be updated using all sample types and should be evaluated to ensure that all instruments as well as a reasonable dispersion across days are represented by the data. LCS/LCSD recovery limits should be evaluated to verify that they are neither inappropriately wide nor unreasonably tight. The default LCS/LCSD acceptance limits of 70-130% and RPD of 20% (or those limits

specified by the method for LCS/LCSD and/or CCV acceptability), should be used to help make this evaluation. Technical directors may choose to use warning limits when they feel their generated limits are too wide, or default LCS limits when they feel their limits have become arbitrarily tight.

Once new Control Limits have been established and updated in the LIMS, the Control Charts shall be printed and reviewed by the appropriate section supervisor and primary analyst performing the analysis for possible trends and compared to the previous Control Charts. The technical director initials the control charts, indicating that they have been reviewed and that the updated Limits have been determined to be accurate and appropriate. Any manual alterations to the limits will be documented and justified on the printed control chart. These initialed charts are then filed in the QA/QCO office.

Once established, control limits should be reviewed after every 20-30 data values and updated at least every six months, provided that there are sufficient points to do so. The limits used to evaluate results shall be those in place at the time that the sample was analyzed. Once limits are updated, those limits apply to all subsequent analyses.

When updating surrogate control limits, all data, regardless of sample/QC type, shall be updated together and assigned one set of limits for the same method/matrix.

In the event that there are insufficient data points to update limits that are over a year old, the default limits, as established in the method or SOP, shall be re-instated. Refer to the requirements in SW-846 method 8000B and 8000C for further guidance on generating control limits.

Calculated Measurement Uncertainty is calculated annually using LCSs in order to determine the laboratory specific uncertainty associated with each test method. These uncertainty values are available to our clients upon request and are utilized as a trending tool internally to determine the effectiveness of new variables introduced into the procedure over time.

Precision, Accuracy, Detection Levels

Precision

The laboratory uses sample duplicates, laboratory control spike duplicates, and matrix spike duplicates to assess precision in terms of relative percent difference (RPD). HEAL requires the RPD to fall within the 99% confidence interval of established control charts or an RPD of less than 20% if control charts are not available. RPD's greater than these limits are considered out-of-control and require an appropriate response.

$$RPD = \frac{2 \times (\text{Sample Result} - \text{Duplicate Result})}{(\text{Sample Result} + \text{Duplicate Result})} \times 100$$

Accuracy

The accuracy of an analysis refers to the difference between the calculated value and the actual value of a measurement. The accuracy of a laboratory result is evaluated by comparing the measured amount of QC reference material recovered from a sample and the known amount added. Control limits can be established for each analytical method and sample matrix. Recoveries are assessed to determine the method efficiency and/or the matrix effect.

Analytical accuracy is expressed as the Percent Recovery (%R) of an analyte or parameter. A known amount of analyte is added to an environmental sample before the sample is prepared and subsequently analyzed. The equation used to calculate percent recovery is:

%Recovery = {(concentration* recovered)/(concentration* added)} X 100

*or amount

HEAL requires that the Percent Recovery to fall within the 99 % confidence interval of established control limits. A value that falls outside of the confidence interval requires a warning and process evaluation. The confidence intervals are calculated by determining the mean and sample standard deviation. If control limits are not available, the range of 80 to 120% is used unless the specific method dictates otherwise. Percent Recoveries outside of this range mandate additional action such as analyses by Method of Standard Additions, additional sample preparation(s) where applicable, method changes, and out-of-control action or data qualification.

Detection Limit

Current practices at HEAL define the Detection Limit (DL) as the smallest amount that can be detected above the baseline noise in a procedure within a stated confidence level.

HEAL presently utilizes an Instrument Detection Limit (IDL), a Method Detection Limit (MDL), and a Practical Quantitation Limit (PQL). The relationship between these levels is approximately
IDL: MDL: PQL = 1:5:5.

The IDL is a measure of the sensitivity of an analytical instrument. The IDL is the amount which, when injected, produces a detectable signal in 99% of the analyses at that concentration. An IDL can be considered the minimum level of analyte concentration that is detectable above random baseline noise.

The MDL is a measure of the sensitivity of an analytical method. MDL studies are required annually for each quality system matrix, technology and analyte, unless indicated otherwise in the referenced method. An MDL determination (as required in 40CFR part 136 Appendix B) consists of replicate spiked samples carried through all necessary preparation steps. The spike concentration is three times the standard deviation of three replicates of spikes. At least seven replicates are spiked and analyzed and their standard deviation(s) calculated. Routine variability is critical in passing the 10 times rule and is best achieved by running the MDLs over different days and when possible over several calibration events. Standard Methods and those methods used for drinking water analysis must have MDL studies that are performed over a period of at least three days in order to include day to day variations. The method detection limit (MDL) can be calculated using the standard deviation according to the formula:

$$MDL = s * t\ (99\%),$$

where t (99%) is the Student's t-value for the 99% confidence interval. The t-value depends on the number of trials used in calculating the sample standard deviation, so choose the appropriate value according to the number of trials.

Number of Trials	t(99%)
6	3.36
7	3.14
8	3.00
9	2.90

The calculated MDL must not be less than 10 times the spiked amount or the study must be performed again with a lower concentration.

Where there are multiple MDL values for the same test method in the LIMS the highest MDL value is utilized.

The PQL is significant because different laboratories can produce different MDLs although they may employ the same analytical procedures, instruments and sample matrices. The PQL is about two to five times the MDL and represents a practical, and routinely achievable, reporting level with a good certainty that the reported value is reliable. It is often determined by regulatory limits. The reported PQL for a sample is dependent on the dilution factor utilized during sample analysis.

In the event that an analyte will not be reported less than the PQL, an MDL study is not required and a PQL check shall be done, at least annually, in place of the MDL study. The PQL check shall consist of a QC sample spiked at or below the PQL. All sample-processing and analysis steps of the analytical method shall be included in the PQL check and shall be done for each quality system matrix, technology, and analyte. A successful check is one where the recovery of each analyte is within the

established method acceptance criteria. When this criterion is not defined by the method or SOP, a default limit of +/-50% shall be utilized.

Quality Control Parameter Calculations

Mean

The sample mean is also known as the arithmetic average. It can be calculated by adding all of the appropriate values together, and dividing this sum by the number of values.

$$\text{Average} = (\Sigma x_l) / n$$

x_l = the value x in the l^{th} trial
n = the number of trials

Standard Deviation

The sample standard deviation, represented by s, is a measure of dispersion. The dispersion is considered to be the difference between the average and each of the values x_i. The variance, s^2, can be calculated by summing the squares of the differences and dividing by the number of differences. The sample standard deviation, s, can be found by taking the square root of the variance.

$$\text{Standard deviation} = s = [\Sigma (x_l - \text{average})^2 / (n - 1)]^{1/2}$$

Percent Recovery (LCS and LCSD)

$$\text{Percent Recovery} = \frac{(\text{Spike Sample Result})}{(\text{Spike Added})} \text{X100}$$

Percent Recovery (MS, MSD)

$$\text{Percent Recovery} = \frac{(\text{Spike Sample Result} - \text{Sample Result})}{(\text{Spike Added})} \text{X100}$$

Control Limits

Control Limits are calculated by the LIMS using the average percent recovery (x), and the standard deviation (s).

$$\text{Upper Control Limit} = x + 3s$$
$$\text{Lower Control Limit} = x - 3s$$

These control limits approximate a 99% confidence interval around the mean recovery.

RPD (Relative Percent Difference)

Analytical precision is expressed as a percentage of the difference between the results of duplicate samples for a given analyst. Relative percent difference (RPD) is calculated as follows:

$$RPD = \frac{2 \times (\text{Sample Result} - \text{Duplicate Result})}{(\text{Sample Result} + \text{Duplicate Result})} \times 100$$

Uncertainty Measurements

Uncertainty, as defined by ISO, is the parameter associated with the result of a measurement that characterizes the dispersion of the values that could reasonably be attributed to the measurement. Ultimately, uncertainty measurements are used to state how good a test result is and to allow the end user of the data to properly interpret their reported data. All procedures allow for some uncertainty. For most analyses, the components and estimates of uncertainty are reduced by following well-established test methods. To further reduce uncertainty, results generally are not reported below the lowest calibration point (PQL) or above the highest calibration point (UQL). Understanding that there are many influential quantities affecting a measurement result, so many in fact that it is impossible to identify all of them, HEAL calculates measurement uncertainty at least annually using LCSs. These estimations of measurement uncertainty are kept on file in the method folders in the QA/QC office.

Measurement Uncertainty contributors are those that may be determined statistically. These shall be generated by estimating the overall uncertainty in the entire analytical process by measuring the dispersion of values obtained from laboratory control samples over time. At least 20 of the most recent LCS data points are gathered. The standard deviation(s) is calculated using these LCS data points. Since it can be assumed that the possible estimated values of the spikes are approximately normally distributed with approximate standard deviation(s), the unknown value of the spike is

believed to lie in 95% confidence interval, corresponding to an uncertainty range of +/- 2(s).

Calculate standard deviation (s) and 95% confidence interval according to the following formulae:

$$s = \sqrt{\frac{\sum (x - \bar{x})^2}{(n-1)}}$$

Where: s = standard deviation
x = number in series
$\bar{x}$ = calculated mean of series
n = number of samples taken

$$95\%\ confidence = 2 \times s$$

Example: Assuming that after gathering 20 of the most recent LCS results for Bromide, we have calculated the standard deviations of the values and achieved a result of 0.0326, our measurement of uncertainty for Bromide (at 95% confidence = 2 x s) is 0.0652.

Total Nitrogen

Total nitrogen is calculated as follows:

Total Nitrogen = TKN + NO_2 + NO_3

Calibration Calculations

1. Response Factor or Calibration Factor:

$RF = ((A_x)(C_{is}))/((A_{is})(C_x))$ $\qquad$ $CF = (A_x)/(C_x)$

a. Average RF or CF

$RF_{AVE} = \Sigma\ RF_i / n$

b. Standard Deviation

$s = SQRT\ \{ [\ \Sigma\ (RF_i - RF_{AVE})^2\ ] / (n-1)\ \}$

c. Relative Standard Deviation

$RSD = s / RF_{AVE}$

Where:
A_x = Area of the compound
C_x = Concentration of the compound
A_{is} = Area of the internal standard
C_{is} = Concentration of the internal standard
n = number of pairs of data
RF_i = Response Factor (or other determined value)
RF_{AVE} = Average of all the response factors
Σ = the sum of all the individual values

2. Linear Regression

$y=mx+b$

a. Slope (m)

$$m =(n\Sigma x_i y_i - (n\Sigma x_i)*(n\Sigma y_i)) / (n\Sigma x_i^2 - (\Sigma x_i)^2)$$

b. Intercept (b)

$$b = y_{AVE} - m*(x_{AVE})$$

c. Correlation Coefficient (cc)

$$CC\ (r) = \{ \Sigma((x_i-x_{ave})*(y_i-y_{ave})) \} / \{ SQRT((\Sigma(x_i-x_{ave})^2)*(\Sigma(y_i-y_{ave})^2)) \}$$

Or

$$CC\ (r) = [(\Sigma w * \Sigma wxy) - (\Sigma wx * \Sigma wy)] / (sqrt(([(\Sigma w * \Sigma wx^2) - (\Sigma wx * \Sigma wx)] * [(\Sigma w * \Sigma wy^2) - (\Sigma wy * \Sigma wy)])))]$$

d. Coefficient of Determination

$$COD\ (r^2) = CC*CC$$

Where:
y = Response (Area) Ratio A_x/A_{is}
x = Concentration Ratio C_x/C_{is}
m = slope
b = intercept
n = number of replicate x,y pairs
x_i = individual values for independent variable
y_i = individual values for dependent variable

Σ = the sum of all the individual values
x_{ave} = average of the x values
y_{ave} = average of the y values
w = weighting factor, for equal weighting w=1

3. Quadratic Regression

$y = ax^2 + bx + c$

a. Coefficient of Determination

$$COD\ (r^2) = (\Sigma(y_i-y_{ave})^2 - \{[(n-1)/(n-p)] * [\Sigma(y_i-Y_i)^2]\}) / \Sigma(y_i-y_{ave})^2$$

Where:
y = Response (Area) Ratio A_x/A_{is}
x = Concentration Ratio C_x/C_{is}
a = x^2 coefficient
b = x coefficient
c = intercept
y_i = individual values for each dependent variable
x_i = individual values for each independent variable
y_{ave} = average of the y values
n = number of pairs of data
p = number of parameters in the polynomial equation (I.e., 3 for third order, 2 for second order)
Yi = ((2*a*(Cx/Cis)^2)-b^2+b+(4*a*c))/(4a)

b. Coefficients (a,b,c) of a Quadratic Regression

$$a = S_{(x2y)}S_{(xx)}-S_{(xy)}S_{(xx2)} / S_{(xx)}S_{(x2x2)}-[S_{(xx2)}]^2$$

$$b = S_{(xy)}S_{(x2x2)}-S_{(x2y)}S_{(xx2)} / S_{(xx)}S_{(x2x2)}-[S_{(xx2)}]^2$$

$$c = [(\Sigma yw)/n] - b*[(\Sigma xw)/n] - a*[\Sigma(x^2w)/n]$$

Where:
n = number of replicate x,y pairs
x = x values
y = y values
$w = S^{-2} / (\Sigma S^{-2}/n)$
$S_{(xx)} = (\Sigma x^2w) - [(\Sigma xw)^2 / n]$
$S_{(xy)} = (\Sigma xyw) - [(\Sigma xw)*(\Sigma yw) / n]$
$S_{(xx2)} = (\Sigma x^3w) - [(\Sigma xw)*(\Sigma x^2w) / n]$
$S_{(x2y)} = (\Sigma x^2yw) - [(\Sigma x^2w)*(\Sigma yw) / n]$

$S_{(x2x2)} = (\Sigma x^4 w) - [(\Sigma x^2 w)^2 / n]$
Or If unweighted calibration, w=1
S(xx) = (Sx2) - [(Sx)2 / n]
S(xy) = (Sxy) - [(Sx)*(Sy) / n]
S(xx2) = (Sx3) - [(Sx)*(Sx2) / n]
S(x2y) = (Sx2y) - [(Sx2)*(Sy) / n]
S(x2x2) = (Sx4) - [(Sx2)2 / n]

Concentration Calculations

On-Column Concentration for Average RRF Calibration using Internal Standard

On-Column Concentration $C_x = ((A_x)(C_{is}))/((A_{is})(RF_{AVE}))$

On-Column Concentration for Average CF Calibration using External Standard

On-Column Concentration $C_x = (A_x)/(CF_{AVE})$

On-Column Concentration for Linear Calibration

If determining an external standard, then exclude the A_{is} and C_{is} for internal standards
On-Column Concentration C_x = ((Absolute{[$(A_x)/(A_{is})$] - b})/m) * C_{is}

Where: m = slope
b = intercept
A_x = Area of the Sample
C_{is} = Concentration of the Internal Standard
A_{is} = Area of the Internal Standard

On-Column Concentration for Quadratic Calibration

If determining an external standard, then exclude the A_{is} and C_{is} for internal standards
On-Column Concentration =[(+SQRT(b^2-(4*a*(c-y)))-b)/(2*a)] * C_{is}
Where: a = x^2 coefficient
b = x coefficient
c = intercept
y = Area Ratio = A_x/A_{is}
C_{is} = Concentration of the Internal Standard

Final Concentration (Wet Weight)

$$\text{Concentration for Extracted Samples} = \frac{\text{(On-Column Conc)(Dilution)(Final Volume)}}{\text{(Initial Amount)(Injection Volume)}}$$

$$\text{Concentration for Purged Samples} = \frac{\text{(On-Column Conc)(Purged Amount)(Dilution)}}{\text{(Purged Amount)}}$$

Dry Weight Concentration

$$\text{Dry Weight Concentration} = \frac{\text{Final Concentration Wet Weight}}{\text{Total Solids}}$$

Percent Difference

$$\%\ \text{Difference} = \frac{\text{Absolute(Continuing Calibration RRF - Average RRF)}}{} * 100$$

Average RRF

Percent Drift

$$\% \text{ Drift} = \frac{\text{Absolute(Calculated Concentration - Theoretical Concentration)}}{\text{Theoretical Concentration}} * 100$$

Dilution Factor

Dilution Factor =(Volume of Solvent + Solute) / Volume of Solute

Relative Retention Time

RRT =RT of Compound / RT of ISTD

Breakdown Percent

$$\text{Breakdown} = \frac{\text{Area of DDD + Area of DDE}}{\text{Average (DDT, DDE and DDD)}}$$

-or-

$$\frac{\text{Area of Endrin Ketone + Area of Endrin Aldehyde}}{\text{Average (Endrin, Endrin Ketone, Endrin Aldehyde)}}$$

11.0 Data Reduction, Validation, Reporting, and Record Keeping

All data reported must be of the highest possible accuracy and quality. During the processes of data reduction, validation, and report generation, all work is thoroughly checked to insure that error is minimized.

Data Reduction

The analyst who generated the data usually performs the data reduction. The calculations include evaluation of surrogate recoveries (where applicable), and other miscellaneous calculations related to the sample quantitation.

If the results are computer generated, then the formulas must be confirmed by hand calculations, at minimum, one per batch.

See the current Data Validation SOP for details regarding data reduction.

Validation

A senior analyst, most often the section supervisor, validates the data. All data undergoes peer review. If an error is detected, it is brought to the analyst's attention so that he or she can rectify the error, and perform further checks to ensure that all data for that batch is sound. Previous and/or common mistakes are stringently monitored throughout the validation process. Data is reported using appropriate significant figure criteria. In most cases, two significant digits are utilized, but three significant digits can be used in QC calculations. Significant digits are not rounded until after the last step of a sample calculation. All final reports undergo a review by the laboratory manager, the project manager, or their designee, to provide a logical review of all results before they are released to the client.

If data is to be manually transferred between media, the transcribed data is checked by a peer. This includes data typing, computer data entry, chromatographic data transfer, data table inclusion to a cover letter, or when data results are combined with other data fields.

All hand-written data from run logs, analytical standard logbooks, hand-entered data logbooks, or on instrument-generated chromatograms, are systematically archived should the need for future retrieval arise.

See the current Data Validation SOP for details regarding data validation.

Reports and Records

All records at HEAL are retained and maintained through the procedures outlined in the most recent version of the Records Control SOP.

Sample reports are compiled by the Laboratory Information Management System (LIMS). Most data is transferred directly from the instruments to the LIMS. After being processed by the analyst and reviewed by a data reviewer, final reports are approved and signed by the senior laboratory management. A comparative analysis of the data is performed at this point. For example, if TKN and NH3 are analyzed on the same sample, the NH3 result should never be greater than the TKN result. Lab results and reports are released only to appropriately designated individuals. Release of the data can be by fax, email, electronic deliverables, or mailed hard copy.

When a project is completed, the final report, chain of custody, any relevant supporting data, and the quality assurance/control worksheets are scanned as a .pdf file onto the main server. Original client folders are kept on file and are arranged by project number. Additionally, all electronic data is backed up routinely on the HEAL main server. The backup includes raw data, chromatograms, and report documents. Hard copies of chromatograms are stored separately according to the instrument and the analysis date. All records and analytical data reports are retained in a secure location as permanent records for a minimum period of five years (unless specified otherwise in a client contract). Access to archived information shall be documented with an access log. Access to archived electronic reports and data will be password protected. In the event that HEAL transfers ownership or terminates business practices, complete records will be maintained or transferred according to the client's instructions.

After issuance, the original report shall remain unchanged. If a correction to the report is necessary, then an additional document shall be issued. This document shall have a title of "Addendum to Test Report or Correction to Original Report", or equivalent. Demonstration of original report integrity comes in two forms. First, the report date is included on each page of the final report. Second, each page is numbered in sequential order, making the addition or omission of any data page(s) readily detectable.

12.0 Corrective Action

Refer to the most recent version of the Data Validation SOP for the procedure utilized in filling out a Corrective Action Report. A blank copy of the corrective action report is available in the current Document Control Logbook.

The limits that have been defined for data acceptability also form the basis for corrective action initiation. Initiation of corrective action occurs when the data generated from continuing calibration standard, sample surrogate recovery, laboratory control spike, matrix spike, or sample duplicates exceed acceptance criteria. If corrective action is necessary, the analyst or the section supervisor will coordinate to take the following guidelines into consideration in order to determine and correct the measurement system deficiency:

Check all calculations and data measurements systems (Calibrations, reagents, instrument performance checks, etc.).

Assure that proper procedures were followed.

Unforeseen problems that arise during sample preparation and/or sample analysis that lead to treating a sample differently from documented procedures shall be documented with a corrective action report. The section supervisor and laboratory manager shall be made aware of the problem at the time of the occurrence. See the appropriate SOP regarding departures from documented procedures.

Continuing calibration standards below acceptance criteria can not be used for reporting analytical data unless method specific criteria states otherwise.

Continuing calibration standards above acceptance criteria can be used to report data as long as the failure is isolated to a single standard and the corresponding samples are non-detect for the failing analyte.

Samples with non-compliant surrogate recoveries should be reanalyzed, unless deemed un-necessary by the supervisor for matrix, historical data, or other analysis-related anomalies.

Laboratory and Matrix Spike acceptance criteria vary significantly depending on method and matrix. Analysts and supervisors meet and discuss appropriate corrective action measures as spike failures occur.

Sample duplicates with RPD values outside control limits require supervisor evaluation and possible reanalysis.

A second mechanism for initiation of corrective action is that resulting from Quality Assurance performance audits, system audits, inter- and intra-laboratory comparison studies. Corrective Actions initiated through this mechanism will be monitored and coordinated by the laboratory QA/QCO.

All corrective action forms are entered in the LIMS and included with the raw data for peer review, signed by the technical director of the section and included in the case narrative to the client whose samples were affected. All Corrective action forms in the LIMS are reviewed by the QA/QCO.

13.0 Quality Assurance Audits, Reports and Complaints

Internal/External Systems' Audits, Performance Evaluations, and Complaints

Several procedures are used to assess the effectiveness of the quality control system. One of these methods includes internal performance evaluations, which are conducted by the use of control samples, replicate measurements, and control charts. External performance audits, which are conducted by the use of inter-laboratory checks, such as participation in laboratory evaluation programs and performance evaluation samples available from a NELAC-accredited Proficiency Standard Vendor, are another method.

Proficiency samples will be obtained twice per year from an appropriate vendor for all tests and matrices for which we are accredited and for which PTs are available. HEAL participates in soil, waste water, drinking water, and underground storage tank PT studies. Copies of results are available upon request. HEAL's management and all analysts shall ensure that all PT samples are handled in the same manner as real environmental samples utilizing the same staff, methods, procedures, equipment, facilities, and frequency of analysis as used for routine analysis of that analyte. When analyzing a PT, HEAL shall employ the same calibration, laboratory quality control and acceptance criteria, sequence of analytical steps, number of replicates, and other procedures as used when analyzing routine samples.

With regards to analyzing PT Samples, HEAL shall not send any PT sample, or portion of a PT sample, to another laboratory for any analysis for which we seek accreditation, or are accredited. HEAL shall not knowingly receive any PT sample or portion of a PT sample from another laboratory for any analysis for which the sending laboratory seeks accreditation, or is accredited. Laboratory management or staff will not communicate with any individual at another laboratory concerning the PT sample. Laboratory management or staff shall not attempt to obtain the assigned value of any PT sample from the PT Provider.

Internal Audits are performed annually by the QA/QCO in accordance with the current Internal Audit SOP. The system audit consists of a qualitative inspection of the QA system in the laboratory and an assessment of the adequacy of the physical facilities for sampling, calibration, and measurement. This audit includes a careful evaluation and review of laboratory quality control procedures. Internal audits are performed using the guidelines outlined below, which include, but are not limited to:

1. Review of staff qualifications, demonstration of capability, and personnel training programs
2. Storage and handling of reagents, standards, and samples
3. Standard preparation logbook and LIMS procedures
4. Extraction logbooks
5. Raw data logbooks
6. Analytical logbooks or batch printouts and instrument maintenance logbooks
7. Data review procedures

8. Corrective action procedures
9. Review of data packages, which is performed regularly by the lab manager/QA Officer.

The QA/QCO will conduct these audits on an annual basis.

Management Reviews

HEAL management shall periodically, and at least annually, conduct a review of the laboratory's quality system and environmental testing activities to ensure their continuing suitability and effectiveness, and to introduce necessary changes or improvements. The review shall take account of:

1. the suitability and implementation of policies and procedures
2. reports from managerial and supervisory personnel
3. the outcome of recent internal audits
4. corrective and preventive actions
5. assessments by external bodies
6. the results of inter-laboratory comparisons or proficiency tests
7. changes in volume and type of work
8. client feed back
9. complaints
10. other relevant factors, such as laboratory health and safety, QC activities, resources, and staff training.

Findings from management reviews and the actions that arise from them shall be recorded and any corrective actions that arise shall be completed in an appropriate and agreed upon timescale.

Complaints

Complaints from clients are documented and given to the laboratory manager. The lab manager shall review the information and contact the client. If doubt is raised concerning the laboratory's policies or procedures, then an audit of the section or sections may be performed. All records of complaints and subsequent actions shall be maintained in the client compliant logbook for five years unless otherwise stated.

Internal and External Reports

The QA/QCO is responsible for preparation and submission of quality assurance reports to the appropriate management personnel as problems and issues arise. These reports include the assessment of measurement systems, data precision and accuracy, and the results of performance and system audits. Additionally, they include significant QA

problems, corrective actions, and recommended resolution measures. Reports of these Quality Assurance Audits describe the particular activities audited, procedures utilized in the examination and evaluation of laboratory records, and data validation procedures. Finally, there are procedures for evaluating the performance of Quality Control and Quality Assurance activities, and laboratory deficiencies and the implementation of corrective actions with the review requirements.

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Lab QAPP

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REFERENCED CORPORATE SOPs AND POLICIES

SOP / Policy Reference	Title
CA-Q-S-001	Solvent and Acid Lot Testing and Approval
CA-Q-S-002	Acceptable Manual Integration Practices
CA-Q-S-004	Method Compliance & Data Authenticity Audits
CA-Q-S-006	Detection Limits
CA-Q-S-008	Management Systems Review
CW-Q-S-001	Corporate Document Control and Archiving
CW-Q-S-002	Writing a Standard Operating Procedure (SOPs)
CW-L-S-002	Internal Investigation of Potential Data Discrepancies and Determination for Data Recall
CA-L-S-002	Subcontracting Procedures
CW-L-P-004	Ethics Policy
CA-L-P-002	Contract Compliance Policy
CW-F-P-002	Authorization Matrix
CW-F-P-004	Procurement and Contracts Policy
CA-C-S-001	Work Sharing Process
CA-T-P-001	Qualified Products List
CW-F-S-007	Controlled Purchases Policy
CW-F-S-018	Vendor Selection
CA-Q-M-002	Corporate Quality Management Plan
CW-E-M-001	Corporate Environmental Health & Safety Manual

REFERENCED LABORATORY SOPs

SOP Reference	Title
HS-QA-WI-002	Document Control
HS-QA-032	Handling Client Technical Complaints
HS-QA-023	MOC
HS-QA-WI-014	Data Scanning
HS-QA-001	Lab Training
HS-QA-004	Writing SOPs
HS-QA-WI-009	DOCs
HS-QA-WI-012	MDLs
HS-QA-WI-013	MI
HS-SA-017	Determining Matrices, Phases, Compositing, & Subsampling
HS-SA-001	Sample Receipt

SECTION 3. INTRODUCTION, SCOPE AND APPLICABILITY

3.1 Introduction and Compliance References

TestAmerica Houston's Quality Assurance Manual (QAM) is a document prepared to define the overall policies, organization objectives and functional responsibilities for achieving TestAmerica's data quality goals. The laboratory maintains a local perspective in its scope of services and client relations and maintains a national perspective in terms of quality.

The QAM has been prepared to assure compliance with The NELAC Institute (TNI) Standard, dated 2009, Volume 1 Modules 2 and 4, and ISO/IEC Guide 17025:2005(E). In addition, the policies and procedures outlined in this manual are compliant with TestAmerica's Corporate Quality Management Plan (CQMP) and the various accreditation and certification programs listed in Appendix 3. The CQMP provides a summary of TestAmerica's quality and data integrity system. It contains requirements and general guidelines under which all TestAmerica facilities shall conduct their operations. ***[Please note that the 2009 TNI Standard is based on the 2005 version of 17025.]***

The QAM has been prepared to be consistent with the requirements of the following documents:

- EPA 600/4-79-019, *Handbook for Analytical Quality Control in Water and Wastewater Laboratories,* EPA, March 1979.
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- Federal Register, 40 CFR Parts 136, 141, 172, 173, 178, 179 and 261.
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- APHA, *Standard Methods for the Examination of Water and Wastewater,* 18th Edition, 19th, 20th, 21st, and on-line Editions.
- *U.S. Department of Energy* Order 414.1B, *Quality Assurance*, Approved April 29, 2004.
- *U.S. Department of Energy* Order 414.1C, *Quality Assurance*, June 17, 2005.
- *U.S. Department of Energy, Quality Systems for Analytical Services*, Revision **3.6, November 2010.**
- U.S. Department of Defense, *Air Force Center for Environmental Excellence Quality Assurance Project Plan (QAPP),* Version 4.0.02, May 2006.
- Nuclear Regulatory Commission (NRC) Quality Assurance Requirements.
- Marine Protection, Research, and Sanctuaries Act (MPRSA).
- Toxic Substances Control Act (TSCA).

3.2 Terms and Definitions

A Quality Assurance Program is a company-wide system designed to ensure that data produced by the laboratory conforms to the standards set by state and/or federal regulations.

The program functions at the management level through company goals and management policies, and at the analytical level through Standard Operating Procedures (SOPs) and quality control. The TestAmerica program is designed to minimize systematic error, encourage constructive, documented problem solving, and provide a framework for continuous improvement within the organization.

Refer to Appendix 2 for the Glossary/Acronyms.

3.3 Scope / Fields of Testing

The laboratory analyzes a broad range of environmental and industrial samples every month. Sample matrices vary among air, effluent water, groundwater, hazardous waste, sludge and soils. The Quality Assurance Program contains specific procedures and methods to test samples of differing matrices for chemical, physical and biological parameters. The Program also contains guidelines on maintaining documentation of analytical processes, reviewing results, servicing clients and tracking samples through the laboratory. The technical and service requirements of all analytical requests are thoroughly evaluated before commitments are made to accept the work. Measurements are made using published reference methods or methods developed and validated by the laboratory.

The methods covered by this manual include the most frequently requested methodologies needed to provide analytical services in the United States and its territories. The specific list of test methods used by the laboratory can be found in the Statement of Qualifications and the Laboratory's Information Management System (TALS). The approach of this manual is to define the minimum level of quality assurance and quality control necessary to meet these requirements. All methods performed by the laboratory shall meet these criteria as appropriate. In some instances, quality assurance project plans (QAPPs), project specific data quality objectives (DQOs) or local regulations may require criteria other than those contained in this manual. In these cases, the laboratory will abide by the requested criteria following review and acceptance of the requirements by the Laboratory Director and the Quality Assurance (QA) Manager. In some cases, QAPPs and DQOs may specify less stringent requirements. The Laboratory Director and the QA Manager must determine if it is in the lab's best interest to follow the less stringent requirements.

3.4 Management of the Manual

3.4.1 Review Process

The template on which this manual is based is reviewed annually by Corporate Quality Management Personnel to assure that it remains in compliance with Section 3.1. This manual itself is reviewed every two years by senior laboratory management to assure that it reflects current practices and meets the requirements of the laboratory's clients and regulators as well as the CQMP. Occasionally, the manual may need changes in order to meet new or changing regulations and operations. The QA Manager will review the changes in the normal course of business and incorporate changes into revised sections of the document. All updates will be reviewed by the senior laboratory management staff. The laboratory updates and approves such changes according to our Document Control & Updating procedures (refer to SOP No. HS-QA-WI-002).

SECTION 4. MANAGEMENT REQUIREMENTS

4.1 Overview

TestAmerica Houston is a local operating unit of TestAmerica Laboratories, Inc.. The organizational structure, responsibilities and authorities of the corporate staff of TestAmerica Laboratories, Inc. are presented in the CQMP. The laboratory has day-to-day independent operational authority overseen by corporate officers (e.g., President, Chief Operating Officer, Corporate Quality, etc.). The laboratory operational and support staff work under the direction of the Laboratory Director. The organizational structure for both Corporate & TestAmerica Houston is presented in Figure 4-1.

4.2 Roles and Responsibilities

In order for the Quality Assurance Program to function properly, all members of the staff must clearly understand and meet their individual responsibilities as they relate to the quality program. The following descriptions briefly define each role in its relationship to the Quality Assurance Program.

4.2.1 Additional Requirements for Laboratories

The responsibility for quality resides with every employee of the laboratory. All employees have access to the QAM, are trained to this manual, and are responsible for upholding the standards therein. Each person carries out his/her daily tasks in a manner consistent with the goals and in accordance with the procedures in this manual and the laboratory's SOPs. Role descriptions for Corporate personnel are defined in the CQMP. This manual is specific to the operations of TestAmerica's Houston laboratory.

4.2.2 Quality Assurance (QA) Manager or Designee

The QA Manager has responsibility and authority to ensure the continuous implementation of the quality system.

The QA Manager reports directly to the Laboratory Director and has access to Corporate QA for advice and resources. This position is able to evaluate data objectively and perform assessments without outside (e.g., managerial) influence. Corporate QA may be used as a resource in dealing with regulatory requirements, certifications and other quality assurance related items. The QA Manager directs the activities of the QA officers to accomplish specific responsibilities, which include, but are not limited to:

- Serves as the focal point for QA/QC in the laboratory.
- Having functions independent from laboratory operations for which he/she has quality assurance oversight.
- Maintaining and updating the QAM.
- Monitoring and evaluating laboratory certifications; scheduling proficiency testing samples.
- Monitoring and communicating regulatory changes that may affect the laboratory to management.
- Training and advising the laboratory staff on quality assurance/quality control procedures that are pertinent to their daily activities.
- Have documented training and/or experience in QA/QC procedures and the laboratory's Quality System.
- Having a general knowledge of the analytical test methods for which data audit/review is performed (and/or having the means of getting this information when needed).
- Arranging for or conducting internal audits on quality systems and the technical operation.
- The laboratory QA Manager will maintain records of all ethics-related training, including the type and proof of attendance.
- Maintain, improve, and evaluate the corrective action database and the corrective and preventive action systems.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs shall be investigated following procedures outlined in Section 12 and if deemed necessary may be temporarily suspended during the investigation.
- Objectively monitor standards of performance in quality control and quality assurance without outside (e.g., managerial) influence.
- Coordinating of document control of SOPs, MDLs, control limits, and miscellaneous forms and information.
- Review a percentage of all final data reports for internal consistency. Review of Chain of Custody (COC), correspondence with the analytical request, batch QC status, completeness of any corrective action statements, 5% of calculations, format, holding time, sensibility and completeness of the project file contents.
- Review of external audit reports and data validation requests.
- Follow-up with audits to ensure client QAPP requirements are met.
- Establishment of reporting schedule and preparation of various quality reports for the Laboratory Director, clients and/or Corporate QA.

- Development of suggestions and recommendations to improve quality systems.
- Research of current state and federal requirements and guidelines.
- Captains the QA team to enable communication and to distribute duties and responsibilities.
- Ensuring Communication & monitoring standards of performance to ensure that systems are in place to produce the level of quality as defined in this document.
- Notifying laboratory management of deficiencies in the quality system and ensuring corrective action is taken. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs are temporarily suspended following the procedures outlined in Section 12.
- Evaluation of the thoroughness and effectiveness of training.
- **Compliance with ISO 17025.** (where applicable)

4.2.3 Technical Manager or Designee

The Technical Manager(s) report(s) directly to the Laboratory Director. He/she is accountable for all analyses and analysts under their experienced supervision and for compliance with the ISO 17025 Standard (where applicable). The scope of responsibility ranges from the new-hire process and existing technology through the ongoing training and development programs for existing analysts and new instrumentation. Specific responsibilities include, but are not limited to:

- Exercises day-to-day supervision of laboratory operations for the appropriate field of accreditation and reporting of results. Coordinating, writing, and reviewing preparation of all test methods, i. e., SOPs, with regard to quality, integrity, regulatory and optimum and efficient production techniques, and subsequent analyst training and interpretation of the SOPs for implementation and unusual project samples. He/she insures that the SOPs are properly managed and adhered to at the bench. He/she develops standard costing of SOPs to include supplies, labor, overhead, and capacity (design vs. demonstrated versus first-run yield) utilization.
- Reviewing and approving, with input from the QA Manager, proposals from marketing, in accordance with an established procedure for the review of requests and contracts. This procedure addresses the adequate definition of methods to be used for analysis and any limitations, the laboratory's capability and resources, the client's expectations. Differences are resolved before the contract is signed and work begins. A system documenting any significant changes is maintained, as well as pertinent discussions with the client regarding their requirements or the results of the analyses during the performance of the contract. All work subcontracted by the laboratory must be approved by the client. Any deviations from the contract must be disclosed to the client. Once the work has begun, any amendments to the contract must be discussed with the client and so documented.
- Monitoring the validity of the analyses performed and data generated in the laboratory. This activity begins with reviewing and supporting all new business contracts, insuring data quality, analyzing internal and external non-conformances to identify root cause issues and implementing the resulting corrective and preventive actions, facilitating the data review process (training, development, and accountability at the bench), and providing technical and troubleshooting expertise on routine and unusual or complex problems.

- Providing training and development programs to applicable laboratory staff as new hires and, subsequently, on a scheduled basis. Training includes instruction on calculations, instrumentation management to include troubleshooting and preventive maintenance.
- Enhancing efficiency and improving quality through technical advances and improved LIMS utilization. Capital forecasting and instrument life cycle planning for second generation methods and instruments as well as asset inventory management.
- Coordinating sample management from "cradle to grave," insuring that no time is lost in locating samples.
- Scheduling all QA/QC-related requirements for compliance, e.g., MDLs, etc..
- Captains department personnel to communicate quality, technical, personnel, and instrumental issues for a consistent team approach.
- Coordinates audit responses with the QA Manager.

4.2.4 Laboratory Director

The Laboratory Director is responsible for the overall quality, safety, financial, technical, human resource, and service performance of the laboratory. He/she provides the resources necessary to implement and maintain an effective and comprehensive quality and data integrity program. Specific responsibilities include but are not limited to:

- Provides one or more technical directors for the appropriate fields of testing. If the Technical Director is absent for a period of time exceeding 15 calendar days, the Laboratory Director must designate another full time staff member meeting the qualifications of the Technical Director to temporarily perform this function. If the absence exceeds 65 consecutive days, the primary accrediting authority must be notified in writing.

- Ensures that all analysts and supervisors have the appropriate education and training to properly carry out the duties assigned to them and ensures that the training is documented.

- Ensures that personnel are free from any commercial, financial, or other undue pressure that may adversely affect the quality of their work. Ensures that TestAmerica's human resource policies are adhered to and maintained.

- Ensures that sufficient numbers of qualified personnel are employed to perform the work of the laboratory.

- Ensures appropriate corrective actions are taken to address issues identified as requiring such actions by internal and external procedural or performance audits. Procedures that do not meet the standards set forth in the QAM or laboratory SOPs may be temporarily suspended by the Laboratory Director.

- Reviews and approves all SOPs prior to their implementation and ensures all approved SOPs are implemented and adhered to.

- Pursues and maintains appropriate laboratory certifications and contract approvals, ensuring client specific reporting and quality control requirements are met.

- Heads the management team, consisting of the Quality Manager and the Technical Directors.

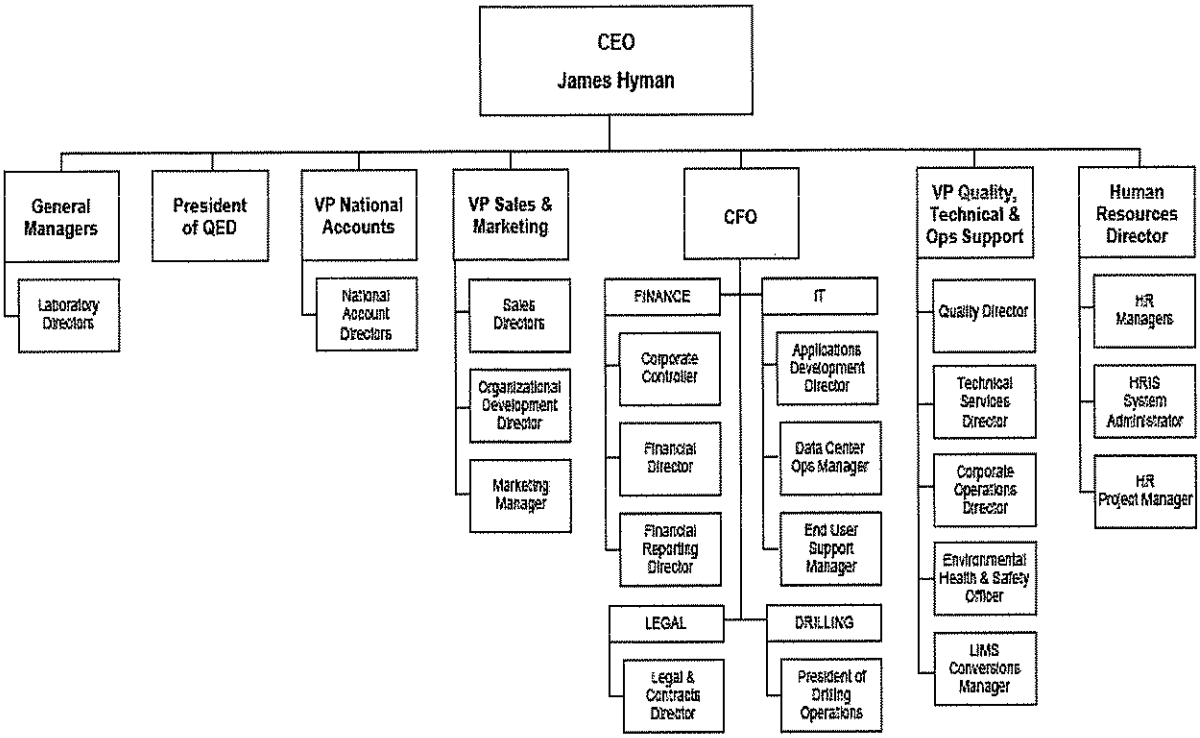
4.3 Deputies

The following table defines who assumes the responsibilities of key personnel in their absence:

Key Personnel	Deputy
Chris Schepcoff Laboratory Director	Jodi Allen Client Services Manager
Jane Baxter Quality Manager	Chris Schepcoff Laboratory Director
Kamrul Alam Organic Technical Manager	Jane Baxter Quality Manager
Travis Richter Metals Technical Manager	Brandon Grimm Wet Chemistry Technical Manager
Brandon Grimm Wet Chemistry Technical Manager	Jane Baxter Quality Manager
Brandi Meeler EHS Coordinator	Chris Schepcoff Laboratory Director
Jodi Allen Client Services Manager	Chris Schepcoff Laboratory Director

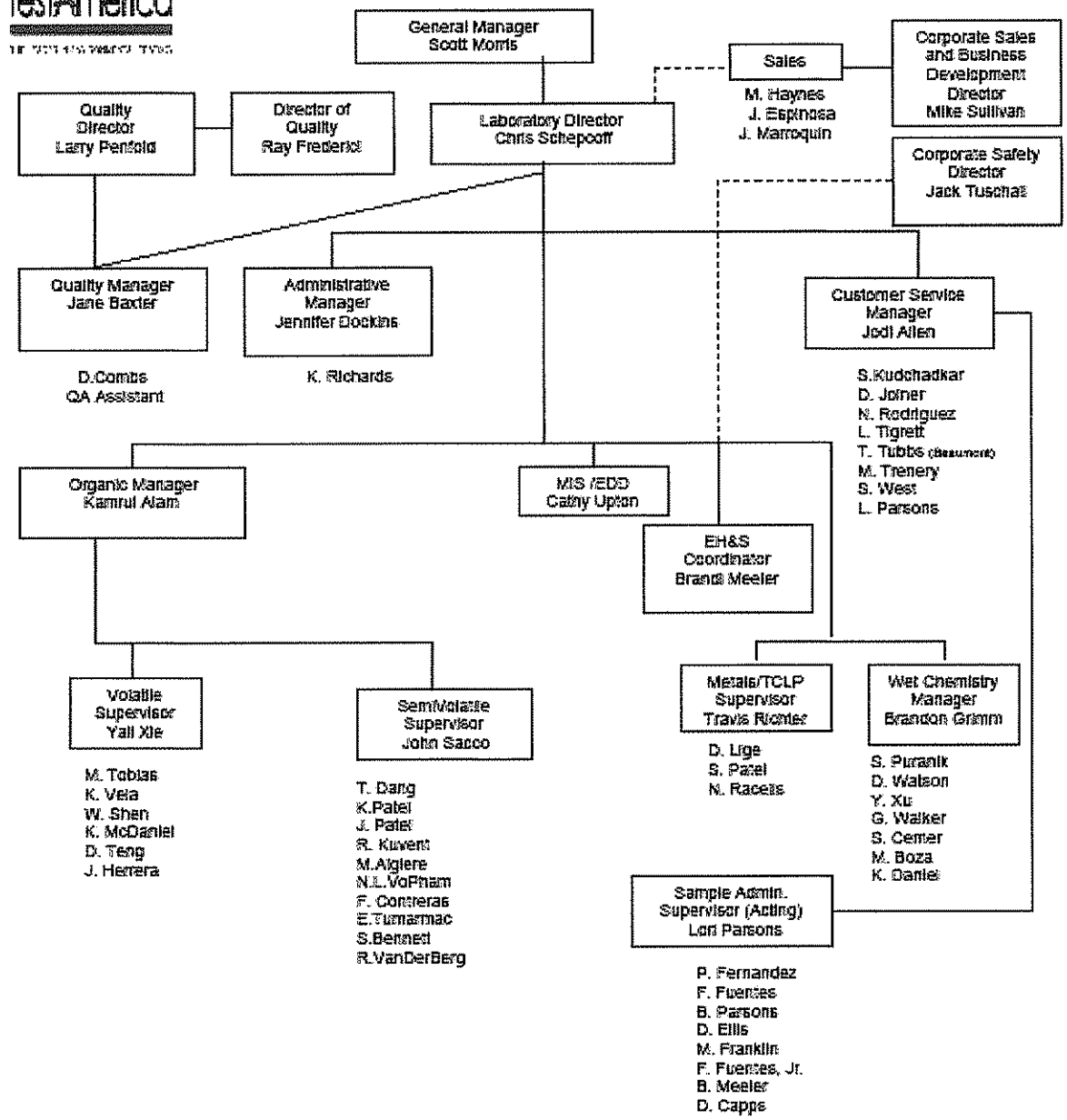
Figure 4-1. Corporate and Laboratory Organization Charts

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING



Aug 2011

Houston Laboratory Organization



Jan. 2012

SECTION 5. QUALITY SYSTEM

5.1 Quality Policy Statement

It is TestAmerica's Policy to:

- Provide data of known quality to its clients by adhering to approved methodologies, regulatory requirements and the QA/QC protocols.
- Effectively manage all aspects of the laboratory and business operations by the highest ethical standards.
- Continually improve systems and provide support to quality improvement efforts in laboratory, administrative and managerial activities. TestAmerica recognizes that the implementation of a quality assurance program requires management's commitment and support as well as the involvement of the entire staff.
- Provide clients with the highest level of professionalism and the best service practices in the industry.
- To comply with the ISO/IEC 17025:2005(E) International Standard, the 2009 TNI Standard and to continually improve the effectiveness of the management system.

Every staff member at the laboratory plays an integral part in quality assurance and is held responsible and accountable for the quality of their work. It is, therefore, required that all laboratory personnel are trained and agree to comply with applicable procedures and requirements established by this document.

5.2 Ethics and Data Integrity

TestAmerica is committed to ensuring the integrity of its data and meeting the quality needs of its clients. The elements of TestAmerica's Ethics and Data Integrity Program include:

- An Ethics Policy (Corporate Policy No. CW-L-P-004) and Employee Ethics Statements.
- Ethics and Compliance Officers (ECOs).
- A Training Program.
- Self-governance through disciplinary action for violations.
- A confidential mechanism for anonymously reporting alleged misconduct and a means for conducting internal investigations of all alleged misconduct. (Corporate SOP No. CW-L-S-002)
- Procedures and guidance for recalling data if necessary (Corporate SOP No. CW-L-S-002).
- Effective external and internal monitoring system that includes procedures for internal audits (Section 15).
- Produce results, which are accurate and include QA/QC information that meets client pre-defined Data Quality Objectives (DQOs).
- Present services in a confidential, honest and forthright manner.

- Provide employees with guidelines and an understanding of the Ethical and Quality Standards of our Industry.
- Operate our facilities in a manner that protects the environment and the health and safety of employees and the public.
- Obey all pertinent federal, state and local laws and regulations and encourage other members of our industry to do the same.
- Educate clients as to the extent and kinds of services available.
- Assert competency only for work for which adequate personnel and equipment are available and for which adequate preparation has been made.
- Promote the status of environmental laboratories, their employees, and the value of services rendered by them.

5.3 Quality System Documentation

The laboratory's Quality System is communicated through a variety of documents.

- Quality Assurance Manual – Each laboratory has a lab-specific quality assurance manual.
- Corporate SOPs and Policies – Corporate SOPs and Policies are developed for use by all relevant laboratories. They are incorporated into the laboratory's normal SOP distribution, training and tracking system. Corporate SOPs may be general or technical.
- Work Instructions – A subset of procedural steps, tasks or forms associated with an operation of a management system (e.g., checklists, preformatted bench sheets, forms).
- Laboratory SOPs – General and Technical
- Laboratory QA/QC Policy Memorandums

5.3.1 Order of Precedence

In the event of a conflict or discrepancy between policies, the order of precedence is as follows:

- Corporate Quality Management Plan (CQMP)
- Corporate SOPs and Policies
- Laboratory QA/QC Policy Memorandum
- Laboratory Quality Assurance Manual (QAM)
- Laboratory SOPs and Policies
- Other (Work Instructions (WI), memos, flow charts, etc.)

Note: The laboratory has the responsibility and authority to operate in compliance with regulatory requirements of the jurisdiction in which the work is performed. Where the CQMP conflicts with those regulatory requirements, the regulatory requirements of the jurisdiction shall hold primacy. The laboratory's QAM shall take precedence over the CQMP in those cases.

5.4 QA/QC Objectives for the Measurement of Data

Quality Assurance (QA) and Quality Control (QC) are activities undertaken to achieve the goal of producing data that accurately characterize the sites or materials that have been sampled. Quality Assurance is generally understood to be more comprehensive than Quality Control. Quality Assurance can be defined as the integrated system of activities that ensures that a product or service meets defined standards.

Quality Control is generally understood to be limited to the analyses of samples and to be synonymous with the term *"analytical quality control"*. QC refers to the routine application of statistically based procedures to evaluate and control the accuracy of results from analytical measurements. The QC program includes procedures for estimating and controlling precision and bias and for determining reporting limits.

Request for Proposals (RFPs) and Quality Assurance Project Plans (QAPP) provide a mechanism for the client and the laboratory to discuss the data quality objectives in order to ensure that analytical services closely correspond to client needs. The client is responsible for developing the QAPP. In order to ensure the ability of the laboratory to meet the Data Quality Objectives (DQOs) specified in the QAPP, clients are advised to allow time for the laboratory to review the QAPP before being finalized. Additionally, the laboratory will provide support to the client for developing the sections of the QAPP that concern laboratory activities.

Historically, laboratories have described their QC objectives in terms of precision, accuracy, representativeness, comparability, completeness, selectivity and sensitivity (PARCCSS).

5.4.1 Precision

The laboratory objective for precision is to meet the performance for precision demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Precision is defined as the degree of reproducibility of measurements under a given set of analytical conditions (exclusive of field sampling variability). Precision is documented on the basis of replicate analysis, usually duplicate or matrix spike (MS) duplicate samples.

5.4.2 Accuracy

The laboratory objective for accuracy is to meet the performance for accuracy demonstrated for the methods on similar samples and to meet data quality objectives of the EPA and/or other regulatory programs. Accuracy is defined as the degree of bias in a measurement system. Accuracy may be documented through the use of laboratory control samples (LCS) and/or MS. A statement of accuracy is expressed as an interval of acceptance recovery about the mean recovery.

5.4.3 Representativeness

The laboratory objective for representativeness is to provide data which is representative of the sampled medium. Representativeness is defined as the degree to which data represent a characteristic of a population or set of samples and is a measurement of both analytical and field sampling precision. The representativeness of the analytical data is a function of the procedures used in procuring and processing the samples. The representativeness can be documented by the relative percent difference between separately procured, but otherwise identical samples or sample aliquots.

The representativeness of the data from the sampling sites depends on both the sampling procedures and the analytical procedures. The laboratory may provide guidance to the client regarding proper sampling and handling methods in order to assure the integrity of the samples.

5.4.4 Comparability

The comparability objective is to provide analytical data for which the accuracy, precision, representativeness and reporting limit statistics are similar to these quality indicators generated by other laboratories for similar samples, and data generated by the laboratory over time.

The comparability objective is documented by inter-laboratory studies carried out by regulatory agencies or carried out for specific projects or contracts, by comparison of periodically generated statements of accuracy, precision and reporting limits with those of other laboratories.

5.4.5 Completeness

The completeness objective for data is 90% (or as specified by a particular project), expressed as the ratio of the valid data to the total data over the course of the project. Data will be considered valid if they are adequate for their intended use. Data usability will be defined in a QAPP, project scope or regulatory requirement. Data validation is the process for reviewing data to determine its usability and completeness. If the completeness objective is not met, actions will be taken internally and with the data user to improve performance. This may take the form of an audit to evaluate the methodology and procedures as possible sources for the difficulty or may result in a recommendation to use a different method.

5.4.6 Selectivity

Selectivity is defined as: The capability of a test method or instrument to respond to a target substance or constituent in the presence of non-target substances. Target analytes are separated from non-target constituents and subsequently identified/detected through one or more of the following, depending on the analytical method: extractions (separation), digestions (separation), interelement corrections (separation), use of matrix modifiers (separation), specific retention times (separation and identification), confirmations with different columns or detectors (separation and identification), specific wavelengths (identification), specific mass spectra (identification), specific electrodes (separation and identification), etc..

5.4.7 Sensitivity

Sensitivity refers to the amount of analyte necessary to produce a detector response that can be reliably detected (Method Detection Limit) or quantified (Reporting Limit).

5.5 Criteria for Quality Indicators

The laboratory maintains a *Quality Control Limit Summary that contains tables* that summarize the precision and accuracy acceptability limits for performed analyses. This summary includes an effective date, is updated each time new limits are generated and are managed by the laboratory's QA department and are tracked in the LIMS. Unless otherwise noted, limits within these tables are laboratory generated. Some acceptability limits are derived from US EPA methods when they are required. Where US EPA method limits are not required, the laboratory has developed limits from evaluation of data from similar matrices. Criteria for development of control limits is contained in SOP number HS-QA-WI-006 and in Section 24.

5.6 Statistical Quality Control

Statistically-derived precision and accuracy limits are required by selected methods (such as SW-846) and programs. The laboratory routinely utilizes statistically-derived limits to evaluate method performance and determine when corrective action is appropriate. The analysts are instructed to use the current limits in the laboratory (dated and approved by the Technical Manager and QA Manager) and entered into the Laboratory Information Management System (LIMS). The Quality Assurance department maintains an archive of all limits used within the laboratory, located in the LIMS. Details may be found in SOP number HS-QA-WI-006. If a method defines the QC limits, the method limits are used.

If a method requires the generation of historical limits, the lab develops such limits from recent data in the QC database of the LIMS following the guidelines described in Section 24. All calculations and limits are documented and dated when approved and effective. On occasion, a client requests contract-specified limits for a specific project.

Current QC limits are entered and maintained in the LIMS analyte database. As sample results and the related QC are entered into LIMS, the sample QC values are compared with the limits in LIMS to determine if they are within the acceptable range. The analyst then evaluates if the sample needs to be rerun or re-extracted/rerun or if a comment should be added to the report explaining the reason for the QC outlier.

5.6.1 QC Charts

The QA Manager evaluates these to determine if adjustments need to be made or for corrective actions to methods. All findings are documented and kept on file.

5.7 Quality System Metrics

In addition to the QC parameters discussed above, the entire Quality System is evaluated on a monthly basis through the use of specific metrics (refer to Section 16). These metrics are used to drive continuous improvement in the laboratory's Quality System.

SECTION 6. DOCUMENT CONTROL

6.1 Overview

The QA Department is responsible for the control of documents used in the laboratory to ensure that approved, up-to-date documents are in circulation and out-of-date (obsolete) documents are archived or destroyed. The following documents, at a minimum, must be controlled:

- Laboratory Quality Assurance Manual
- Laboratory Standard Operating Procedures (SOP)
- Laboratory Policies
- Work Instructions and Forms
- Corporate Policies and Procedures distributed outside the intranet

Corporate Quality posts Corporate Manuals, SOPs, Policies, Work Instructions, White Papers and Training Materials on the company intranet site. These Corporate documents are only considered controlled when they are read on the intranet site. Printed copies are considered uncontrolled unless the laboratory physically distributes them as controlled documents. A detailed description of the procedure for issuing, authorizing, controlling, distributing, and archiving Corporate documents is found in Corporate SOP No. CW-Q-S-001, Corporate Document Control and Archiving. The laboratory's internal document control procedure is defined in SOP No. HS-QA-WI-002.

The laboratory QA Department also maintains access to various references and document sources integral to the operation of the laboratory. This includes reference methods and regulations. Instrument manuals (hard or electronic copies) are also maintained by the laboratory.

The laboratory maintains control of records for raw analytical data and supporting records such as audit reports and responses, logbooks, standard logs, training files, MDL studies, Proficiency Testing (PT) studies, certifications and related correspondence, and corrective action reports. Raw analytical data consists of bound logbooks, instrument printouts, any other notes, magnetic media, electronic data and final reports.

6.2 Document Approval and Issue

The pertinent elements of a document control system for each document include a unique document title and number, pagination, the total number of pages of the item or an 'end of document' page, the effective date, revision number and the laboratory's name. The QA personnel are responsible for the maintenance of this system.

Controlled documents are authorized by the QA Department. In order to develop a new document, a technical manager submits an electronic draft to the QA Department for suggestions and approval before use. Upon approval, QA personnel add the identifying version information to the document and retains that document as the official document on file. That document is then provided to all applicable operational units (may include electronic access). Controlled documents are identified as such and records of their distribution are kept by the QA Department. Document control may be achieved by either electronic or hardcopy distribution.

The QA Department maintains a list of the official versions of controlled documents.

Quality System Policies and Procedures will be reviewed at a minimum of every two years and revised as appropriate. Changes to documents occur when a procedural change warrants.

6.3 Procedures for Document Control Policy

For changes to the QA Manual, the QA Department will approve the change and will add the identifying version information to the document and retains that document on file. Uncontrolled copies must not be used within the laboratory. Previous revisions and back-up data are stored by the QA department. Electronic copies are stored on the Public server in the SOP folder for the applicable revision.

For changes to SOPs, refer to SOP No. CW-Q-S-002, Writing a Standard Operating Procedure SOP. The SOP identified above also defines the process of changes to SOPs.

Forms, worksheets, work instructions and information are organized by department in the QA office. There is a table of contents. Electronic versions are kept on a hard drive in the QA department; hard copies are kept in QA files.

6.4 Obsolete Documents

All invalid or obsolete documents are removed, or otherwise prevented from unintended use. The laboratory has specific procedures as described above to accomplish this. In general, obsolete documents are collected from employees according to distribution lists and are marked obsolete on the cover or destroyed. At least one copy of the obsolete document is archived according to SOP No. HS-QA-WI-002.

SECTION 7. SERVICE TO THE CLIENT

7.1 Overview

The laboratory has established procedures for the review of work requests and contracts, oral or written. The procedures include evaluation of the laboratory's capability and resources to meet the contract's requirements within the requested time period. All requirements, including the methods to be used, must be adequately defined, documented and understood. For many environmental sampling and analysis programs, testing design is site or program specific and does not necessarily "fit" into a standard laboratory service or product. It is the laboratory's intent to provide both standard and customized environmental laboratory services to our clients.

A thorough review of technical and QC requirements contained in contracts is performed to ensure project success. The appropriateness of requested methods, and the lab's capability to perform them must be established. Projects, proposals and contracts are reviewed for adequately defined requirements and the laboratory's capability to meet those requirements. Alternate test methods that are capable of meeting the clients' requirements may be proposed by the lab. A review of the lab's capability to analyze non-routine analytes is also part of this review process.

All projects, proposals and contracts are reviewed for the client's requirements in terms of compound lists, test methodology requested, sensitivity (detection and reporting levels), accuracy, and precision requirements (% Recovery and RPD). The reviewer ensures that the laboratory's test methods are suitable to achieve these requirements and that the laboratory holds the appropriate certifications and approvals to perform the work. The laboratory and any potential subcontract laboratories must be certified, as required, for all proposed tests.

The laboratory must determine if it has the necessary physical, personnel and information resources to meet the contract, and if the personnel have the expertise needed to perform the testing requested. Each proposal is checked for its impact on the capacity of the laboratory's equipment and personnel. As part of the review, the proposed turnaround time will be checked for feasibility.

Electronic or hard copy deliverable requirements are evaluated against the laboratory's capacity for production of the documentation.

If the laboratory cannot provide all services but intends to subcontract such services, whether to another TestAmerica facility or to an outside firm, this will be documented and discussed with the client prior to contract approval. (Refer to Section 8 for Subcontracting Procedures.)

The laboratory informs the client of the results of the review if it indicates any potential conflict, deficiency, lack of accreditation, or inability of the lab to complete the work satisfactorily. Any discrepancy between the client's requirements and the laboratory's capability to meet those requirements is resolved in writing before acceptance of the contract. It is necessary that the contract be acceptable to both the laboratory and the client. Amendments initiated by the client and/or TestAmerica, are documented in writing.

All contracts, QAPPs, Sampling and Analysis Plans (SAPs), contract amendments, and documented communications become part of the project record.

The same contract review process used for the initial review is repeated when there are amendments to the original contract by the client, and the participating personnel are informed of the changes.

7.2 Review Sequence and Key Personnel

Appropriate personnel will review the work request at each stage of evaluation.

For routine projects and other simple tasks, a review by the Project Manager (PM) is considered adequate. The PM confirms that the laboratory has any required certifications, that it can meet the clients' data quality and reporting requirements and that the lab has the capacity to meet the clients turn around needs. It is recommended that, where there is a sales person assigned to the account, an attempt should be made to contact that sales person to inform them of the incoming samples.

For new, complex or large projects, the proposed contract is given to the Sales Directors, who will decide which lab will receive the work based on the scope of work and other requirements, including certification, testing methodology, and available capacity to perform the work. The contract review process is outlined in TestAmerica's Corporate SOP No. CA-L-P-002, Contract Compliance Policy.

This review encompasses all facets of the operation. The scope of work is distributed to the appropriate personnel, as needed based on scope of contract, to evaluate all of the requirements shown above (not necessarily in the order below):

- Legal & Contracts Director
- General Manager
- The Laboratory Project Management Director
- The Laboratory Operations Manager
- Laboratory and/or Corporate Technical Managers / Directors
- Laboratory and/or Corporate Information Technology Managers/Directors
- Account Executives
- Laboratory and/or Corporate Quality
- Laboratory and/or Corporate Environmental Health and Safety Managers/Directors
- The Laboratory Director reviews the formal laboratory quote and makes final acceptance for their facility.

The ***Sales Director, Legal Contracts Director, Account Executive or Proposal Coordinator*** then submits the final proposal to the client.

In the event that one of the above personnel is not available to review the contract, his or her back-up will fulfill the review requirements.

The Legal & Contracts Director maintains copies of all signed contracts. The Project Manager assigned to the project will also maintain a copy of the contract.

7.3 Documentation

Appropriate records are maintained for every contract or work request. All stages of the contract review process are documented and include records of any significant changes. This information is kept in the client's file maintained by the Project Manager associated with this contract or work request.

The contract will be distributed to and maintained by the appropriate sales/marketing personnel and the Account Executive. A copy of the contract and formal quote will be filed with the laboratory PM and the Laboratory Director.

Records are maintained of pertinent discussions with a client relating to the client's requirements or the results of the work during the period of execution of the contract. The PM keeps a phone log of conversations with the client and/or a record of any emails.

7.3.1 Project-Specific Quality Planning

Communication of contract specific technical and QC criteria is an essential activity in ensuring the success of site specific testing programs. To achieve this goal, the laboratory assigns a PM to each client. It is the PM's responsibility to ensure that project-specific technical and QC requirements are effectively evaluated and communicated to the laboratory personnel before and during the project. QA department involvement may be needed to assist in the evaluation of custom QC requirements.

PM's are the primary client contact and they ensure resources are available to meet project requirements. Although PM's do not have direct reports or staff in production, they coordinate opportunities and work with laboratory management and supervisory staff to ensure available resources are sufficient to perform work for the client's project. Project management is positioned between the client and laboratory resources.

Prior to work on a new project, the dissemination of project information and/or project opening meetings may occur to discuss schedules and unique aspects of the project. Items to be discussed may include the project technical profile, turnaround times, holding times, methods, analyte lists, reporting limits, deliverables, sample hazards, or other special requirements. The PM introduces new projects to the laboratory staff through project kick-off meetings or to the supervisory staff during production meetings. These meetings provide direction to the laboratory staff in order to maximize production and client satisfaction, while maintaining quality. In addition, project notes may be associated with each sample batch as a reminder upon sample receipt and analytical processing.

During the project, any change that may occur within an active project is agreed upon between the client/regulatory agency and the PM/laboratory. These changes (e.g., use of a non-standard method or modification of a method) and approvals must be documented prior to implementation. Documentation pertains to any document, e.g., letter, e-mail, variance, contract addendum, which has been signed by both parties.

Such changes are also communicated to the laboratory during production meetings. Such changes are updated to the project notes and are introduced to the managers at these meetings. The laboratory staff is then introduced to the modified requirements via the PM or the individual

laboratory Technical Manager. After the modification is implemented into the laboratory process, documentation of the modification is made in the case narrative of the data report(s).

The laboratory strongly encourages client visits to the laboratory and for formal/informal information sharing session with employees in order to effectively communicate ongoing client needs as well as project specific details for customized testing programs.

7.4 Special Services

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. It is the laboratory's goal to meet all client requirements in addition to statutory and regulatory requirements. The laboratory has procedures to ensure confidentiality to clients (Section 15 and 25).

Note: ISO/IEC 17025 states that a laboratory "shall afford clients or their representatives cooperation to clarify the client's request". This topic is discussed in Section 7.

The laboratory's standard procedures for reporting data are described in Section 25. Special services are also available and provided upon request. These services include:

- Reasonable access for our clients or their representatives to the relevant areas of the laboratory for the witnessing of tests performed for the client.
- Assist client-specified third party data validators as specified in the client's contract.
- Supplemental information pertaining to the analysis of their samples. Note: An additional charge may apply for additional data/information that was not requested prior to the time of sample analysis or previously agreed upon.

7.5 Client Communication

Project managers are the primary communication link to the clients. They shall inform their clients of any delays in project completion as well as any non-conformances in either sample receipt or sample analysis. Project management will maintain ongoing client communication throughout the entire client project.

Technical Managers / Directors are available to discuss any technical questions or concerns that the client may have.

7.6 Reporting

The laboratory works with our clients to produce any special communication reports required by the contract.

7.7 Client Surveys

The laboratory assesses both positive and negative client feedback. The results are used to improve overall laboratory quality and client service. TestAmerica's Sales and Marketing teams periodically develops lab and client specific surveys to assess client satisfaction.

SECTION 8. SUBCONTRACTING OF TESTS

8.1 Overview

For the purpose of this quality manual, the phrase subcontract laboratory refers to a laboratory external to the TestAmerica laboratories. The phrase "work sharing" refers to internal transfers of samples between the TestAmerica laboratories. The term outsourcing refers to the act of subcontracting tests.

When contracting with our clients, the laboratory makes commitments regarding the services to be performed and the data quality for the results to be generated. When the need arises to outsource testing for our clients because project scope, changes in laboratory capabilities, capacity or unforeseen circumstances, we must be assured that the subcontractors or work sharing laboratories understand the requirements and will meet the same commitments we have made to the client. Refer to TestAmerica's Corporate SOP's on Subcontracting Procedures (CA-L-S-002) and the Work Sharing Process (CA-C-S-001).

When outsourcing analytical services, the laboratory will assure, to the extent necessary, that the subcontract or work sharing laboratory maintains a program consistent with the requirements of this document, the requirements specified in TNI/ISO 17025 and/or the client's Quality Assurance Project Plan (QAPP). All QC guidelines specific to the client's analytical program are transmitted to the subcontractor and agreed upon before sending the samples to the subcontract facility. Additionally, work requiring accreditation will be placed with an appropriately accredited laboratory. The laboratory performing the subcontracted work will be identified in the final report, as will non-TNI accredited work where required.

Project Managers (PMs), Customer Service Managers (CSM), or Account Executives (AE) (or others as defined by the lab) for the Export Lab are responsible for obtaining client approval prior to outsourcing any samples. The laboratory will advise the client of a subcontract or work sharing arrangement in writing and when possible approval from the client shall be retained in the project folder.

Note: In addition to the client, some regulating agencies (e.g, USDA) or contracts (e.g, certain USACE projects) may require notification prior to placing such work. A record of this notification will be documented in the project notes.

8.2 Qualifying and Monitoring Subcontracators

Whenever a PM or Account Executive (AE) or Customer Service Manager (CSM) becomes aware of a client requirement or laboratory need where samples must be outsourced to another laboratory, the other laboratory(s) shall be selected based on the following:

- The first priority is to attempt to place the work in a qualified TestAmerica laboratory;

Firms specified by the client for the task (Documentation that a subcontractor was designated by the client must be maintained with the project file. This documentation can be as simple as placing a copy of an e-mail from the client in the project folder);

- Firms listed as pre-qualified and currently under a subcontract with TestAmerica: A listing of

all approved subcontracting laboratories is available on the TestAmerica intranet site. Supporting documentation is maintained by corporate offices and by the TestAmerica laboratory originally requesting approval of the subcontract lab. Verify necessary accreditation, where applicable, (e.g., on the subcontractors TNI, A2LA accreditation or State Certification).

- Firms identified in accordance with the company's Small Business Subcontracting program as small, women-owned, veteran-owned and/or minority-owned businesses;
- TNI or A2LA accredited laboratories.
- In addition, the firm must hold the appropriate certification to perform the work required.

All TestAmerica laboratories are pre-qualified for work sharing provided they hold the appropriate accreditations, can adhere to the project/program requirements, and the client approved sending samples to that laboratory. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented). The originating laboratory is responsible for communicating all technical, quality, and deliverable requirements as well as other contract needs. (Corporate SOP No. CA-C-S-001, Work Sharing Process).

When the potential sub-contract laboratory has not been previously approved, Account Executives or PMs may nominate a laboratory as a subcontractor based on need. The decision to nominate a laboratory must be approved by the Laboratory Director. The Laboratory Director requests that the QA Manager begin the process of approving the subcontract laboratory as outlined in Corporate SOP No. CA-L-S-002, Subcontracting Procedures. The client must provide acknowledgement that the samples can be sent to that facility (an e-mail is sufficient documentation or if acknowledgement is verbal, the date, time, and name of person providing acknowledgement must be documented).

8.2.1 Once the appropriate accreditation and legal information is received by the laboratory, it is evaluated for acceptability (where applicable) and forwarded to Corporate Contracts for formal contracting with the laboratory. They will add the lab to the approved list on the intranet site and notify the finance group for JD Edwards.

8.2.2 The client will assume responsibility for the quality of the data generated from the use of a subcontractor they have requested the lab to use. The qualified subcontractors on the intranet site are known to meet minimal standards. TestAmerica does not certify laboratories. The subcontractor is on our approved list and can only be recommended to the extent that we would use them.

8.2.3 The status and performance of qualified subcontractors will be monitored periodically by the Corporate Contracts and/or Quality Departments. Any problems identified will be brought to the attention of TestAmerica's Corporate Finance or Corporate Quality personnel.

- Complaints shall be investigated. Documentation of the complaint, investigation and corrective action will be maintained in the subcontractor's file on the intranet site. Complaints are posted using the Vendor Performance Report.
- Information shall be updated on the intranet when new information is received from the subcontracted laboratories.

- Subcontractors in good standing will be retained on the intranet listing. The QA Manager will notify all TestAmerica laboratories, Corporate Quality and Corporate Contracts if any laboratory requires removal from the intranet site. This notification will be posted on the intranet site and e-mailed to all Laboratory Directors, QA Managers and Sales Personnel.

8.3 Oversight and Reporting

The PM must request that the selected subcontractor be presented with a subcontract, if one is not already executed between the laboratory and the subcontractor. The subcontract must include terms which flow down the requirements of our clients, either in the subcontract itself or through the mechanism of work orders relating to individual projects. A standard subcontract and the Lab Subcontractor Vendor Package (posted on the intranet) can be used to accomplish this, and the Legal & Contracts Director can tailor the document or assist with negotiations, if needed. The PM (or EDS, AEs or CSM, etc.) responsible for the project must advise and obtain client consent to the subcontract as appropriate, and provide the scope of work to ensure that the proper requirements are made a part of the subcontract and are made known to the subcontractor.

Prior to sending samples to the subcontracted laboratory, the PM confirms their certification status to determine if it's current and scope-inclusive. The information is documented on a Subcontracted Sample Form (Figure 8-1) and the form is retained in the project folder. For TestAmerica laboratories, certifications can be viewed on the company's TotalAccess Database.

The Sample Control department is responsible for ensuring compliance with QA requirements and applicable shipping regulations when shipping samples to a subcontracted laboratory.

All subcontracted samples must be accompanied by a TestAmerica Chain of Custody (COC). A copy of the original COC sent by the client must also be included with all samples workshared within TestAmerica. Client CoCs are only forwarded to external subcontractors when samples are shipped directly from the project site to the subcontractor lab. Under routine circumstances, client CoCs are not provided to external subcontractors.

Through communication with the subcontracted laboratory, the PM monitors the status of the subcontracted analyses, facilitates successful execution of the work, and ensures the timeliness and completeness of the analytical report.

Non-TNI accredited work must be identified in the subcontractor's report as appropriate. If TNI accreditation is not required, the report does not need to include this information.

Reports submitted from subcontractor laboratories are not altered and are included in their original form in the final project report. This clearly identifies the data as being produced by a subcontractor facility. If subcontract laboratory data is incorporated into the laboratories EDD (i.e., imported), the report must explicitly indicate which lab produced the data for which methods and samples.

Note: The results submitted by a TestAmerica work sharing laboratory may be transferred electronically and the results reported by the TestAmerica work sharing lab are identified on the final report. The report must explicitly indicate which lab produced the data for which methods

and samples. The final report must include a copy of the completed COC for all work sharing reports.

8.4 Contingency Planning

The Laboratory Director may waive the full qualification of a subcontractor process temporarily to meet emergency needs; however, this decision & justification must be documented in the project files, and the 'Purchase Order Terms And Conditions For Subcontracted Laboratory Services' must be sent with the samples and Chain-of-Custody. In the event this provision is utilized, the laboratory (e.g., PM) will be required to verify and document the applicable accreditations of the subcontractor. All other quality and accreditation requirements will still be applicable, but the subcontractor need not have signed a subcontract with TestAmerica at this time. The comprehensive approval process must then be initiated within 30 calendar days of subcontracting.

Figure 8-1.

Example - Subcontracted Sample Form

Date/Time: _____

Subcontracted Laboratory Information:

- Subcontractor's Name: _____
- Subcontractor Point of Contact: _____
- Subcontractor's Address: _____
- Subcontractor's Phone: _____
- Analyte/Method: _____
- Certified for State of Origin: _____
- TNI Certified: Yes_____No_____
- **USDA Permit (__Domestic __ Foreign)** **Yes_____No_____**
- A2LA (or ISO 17025) Certified: Yes_____No_____
- CLP-like Required: (Full doc required) Yes_____No_____
- Requested Sample Due Date: (Must be put on COC) _____
- **Client POC Approval on-file to Subcontract Samples to Sub Laboratory:** **Yes_____No_____**

Project Manager: _____

Laboratory Sample # Range: _____
(Only of Subcontracted Samples)

Laboratory Project Number (Billing Control #): _____

All subcontracted samples are to be sent via bonded carrier and Priority Overnight. Please attach tracking number below and maintain these records in the project files.

PM Signature_____**Date**_____

SECTION 9. PURCHASING SERVICES AND SUPPLIES

9.1 Overview

Evaluation and selection of suppliers and vendors is performed, in part, on the basis of the quality of their products, their ability to meet the demand for their products on a continuous and short term basis, the overall quality of their services, their past history, and competitive pricing. This is achieved through evaluation of objective evidence of quality furnished by the supplier, which can include certificates of analysis, recommendations, and proof of historical compliance with similar programs for other clients. To ensure that quality critical consumables and equipment conform to specified requirements, which may affect quality, all purchases from specific vendors are approved by a member of the supervisory or management staff. Capital expenditures are made in accordance with TestAmerica's Corporate Controlled Purchases Procedure, SOP No. CW-F-S-007.

Contracts will be signed in accordance with TestAmerica's Corporate Authorization Matrix Policy, Policy No. CW-F-P-002. Request for Proposals (RFP's) will be issued where more information is required from the potential vendors than just price. Process details are available in TestAmerica's Corporate Procurement and Contracts Policy (Policy No. CW-F-P-004). RFP's allow TestAmerica to determine if a vendor is capable of meeting requirements such as supplying all of the TestAmerica facilities, meeting required quality standards and adhering to necessary ethical and environmental standards. The RFP process also allows potential vendors to outline any additional capabilities they may offer.

9.2 Glassware

Glassware used for volumetric measurements must be Class A or verified for accuracy according to laboratory procedure. Pyrex (or equivalent) glass should be used where possible. For safety purposes, thick-wall glassware should be used where available.

9.3 Reagents, Standards & Supplies

Purchasing guidelines for equipment and reagents must meet the requirements of the specific method and testing procedures for which they are being purchased. Solvents and acids are pre-tested in accordance with TestAmerica's Corporate SOP on Solvent & Acid Lot Testing & Approval, SOP No. CA-Q-S-001.

9.3.1 Purchasing

Chemical reagents, solvents, glassware, and general supplies are ordered as needed to maintain sufficient quantities on hand. Materials used in the analytical process must be of a known quality. The wide variety of materials and reagents available makes it advisable to specify recommendations for the name, brand, and grade of materials to be used in any determination. This information is contained in the method SOP. The analyst completes the Material Request Sheet when requesting reagents, standards, or supplies. The analyst may check the item out of the on-site consignment system that contains items approved for laboratory use.

The analyst must provide the master item number (from the master item list that has been approved by the Technical Director), item description, package size, catalogue page number, and the quantity needed. If an item being ordered is not the exact item requested, approval must be obtained from the Technical Director prior to placing the order. The purchasing manager places the order.

9.3.2 Receiving

It is the responsibility of the purchasing manager to receive the shipment. It is the responsibility of the analyst who ordered the materials to document the date materials where received. Once the ordered reagents or materials are received, the analyst compares the information on the label or packaging to the original order to ensure that the purchase meets the quality level specified. Material Safety Data Sheets (MSDSs) are available online through the Company's intranet website. Anyone may review these for relevant information on the safe handling and emergency precautions of on-site chemicals.

9.3.3 Specifications

Methods in use in the laboratory specify the grade of reagent that must be used in the procedure. If the quality of the reagent is not specified, analytical reagent grade will be used. It is the responsibility of the analyst to check the procedure carefully for the suitability of grade of reagent.

Chemicals must not be used past the manufacturer's expiration date and must not be used past the expiration time noted in a method SOP. If expiration dates are not provided, the laboratory may contact the manufacturer to determine an expiration date.

The laboratory assumes a five year expiration date on inorganic dry chemicals and solvents unless noted otherwise by the manufacturer or by the reference source method. Chemicals/solvents should not be used past the manufacturer's or SOPs expiration date unless 'verified' (refer to item 3 listed below).

- An expiration date **cannot** be extended if the dry chemical/solvent is discolored or appears otherwise physically degraded, the dry chemical/solvent must be discarded.
- Expiration dates can be extended if the dry chemical/solvent is found to be satisfactory based on acceptable performance of quality control samples (Continuing Calibration Verification (CCV), Blanks, Laboratory Control Sample (LCS), etc.).
- If the dry chemical/solvent is used for the preparation of standards, the expiration dates can be extended 6 months if the dry chemical/solvent is compared to an unexpired independent source in performing the method and the performance of the dry chemical/solvent is found to be satisfactory. The comparison must show that the dry chemical/solvent meets CCV limits. The comparison studies are maintained by the departments.

Wherever possible, standards must be traceable to national or international standards of measurement or to national or international reference materials. Records to that effect are available to the user.

Compressed gases in use are checked for pressure and secure positioning daily. The minimum total pressure must be 500 psig or the tank must be replaced. To prevent a tank from going to dryness, close observation of the tank gauge must take place as pressure decreases towards 500psig, or the tank must be replaced. The quality of the gases must meet method or manufacturer specification or be of a grade that does not cause any analytical interference.

Water used in the preparation of standards or reagents must have a specific conductivity of less than 1- µmh/cm (or specific resistivity of greater than 1.0 megohm-cm) at 25°C. The specific conductivity is checked and recorded daily. If the water's specific conductivity is greater than the specified limit, the Facility Manager and appropriate Technical Managers must be notified immediately in order to notify all departments, decide on cessation (based on intended use) of activities, and make arrangements for correction.

The laboratory may purchase reagent grade (or other similar quality) water for use in the laboratory. This water must be certified "clean" by the supplier for all target analytes or otherwise verified by the laboratory prior to use. This verification is documented.

Standard lots are verified before first time use if the laboratory switches manufacturers or has historically had a problem with the type of standard.

Purchased bottleware used for sampling must be certified clean and the certificates must be maintained. If uncertified sampling bottleware is purchased, all lots must be verified clean prior to use. This verification must be maintained.

Records of manufacturer's certification and traceability statements are maintained in files or binders in each laboratory section. These records include date of receipt, lot number (when applicable), and expiration date (when applicable). Incorporation of the item into the record indicates that the analyst has compared the new certificate with the previous one for the same purpose and that no difference is noted, unless approved and so documented by the Technical Director or QA Manager.

9.3.4 Storage

Reagent and chemical storage is important from the aspects of both integrity and safety. Light-sensitive reagents may be stored in brown-glass containers. Storage conditions are per the Corporate Environmental Health & Safety Manual (Corp. Doc. No. CW-E-M-001) and method SOPs or manufacturer instructions.

9.4 Purchase of Equipment / Instruments / Software

When a new piece of equipment is needed, either for additional capacity or for replacing inoperable equipment, the analyst or supervisor makes a supply request to the Technical Manager/Director and/or the Laboratory Director. If they agree with the request, the procedures outlined in TestAmerica's Corporate Policy No. CA-T-P-001, Qualified Products List, are followed. A decision is made as to which piece of equipment can best satisfy the requirements. The appropriate written requests are completed and purchasing places the order.

Upon receipt of a new or used piece of equipment, an identification name is assigned and added to the equipment list. IT must also be notified so that they can synchronize the

instrument for back-ups. Its capability is assessed to determine if it is adequate or not for the specific application. For instruments, a calibration curve is generated, followed by MDLs, Demonstration of Capabilities (DOCs), and other relevant criteria (refer to Section 19). For software, its operation must be deemed reliable and evidence of instrument verification must be retained by the IT Department or QA Department. Software certificates supplied by the vendors are filed with the LIMS Administrator. The manufacturer's operation manual is retained at the bench.

9.5 Services

Service to analytical instruments (except analytical balances) is performed on an as needed basis. Routine preventative maintenance is discussed in Section 20. The need for service is determined by analysts and/or Technical Managers. The service providers that perform the services are approved by the Technical Manager / Director.

9.6 Suppliers

TestAmerica selects vendors through a competitive proposal / bid process, strategic business alliances or negotiated vendor partnerships (contracts). This process is defined in the Corporate Finance documents on Vendor Selection (SOP No. CW-F-S-018) and Procurement & Contracts Policy (Policy No. CW-F-P-004). The level of control used in the selection process is dependent on the anticipated spending amount and the potential impact on TestAmerica business. Vendors that provide test and measuring equipment, solvents, standards, certified containers, instrument related service contracts or subcontract laboratory services shall be subject to more rigorous controls than vendors that provide off-the-shelf items of defined quality that meet the end use requirements. The JD Edwards purchasing system includes all suppliers/vendors that have been approved for use.

Evaluation of suppliers is accomplished by ensuring the supplier ships the product or material ordered and that the material is of the appropriate quality. This is documented by signing off on packing slips or other supply receipt documents. The purchasing documents contain the data that adequately describe the services and supplies ordered.

Any issues of vendor performance are to be reported immediately by the laboratory staff to the Corporate Purchasing Group by completing a Vendor Performance Report.

The Corporate Purchasing Group will work through the appropriate channels to gather the information required to clearly identify the problem and will contact the vendor to report the problem and to make any necessary arrangements for exchange, return authorization, credit, etc.
As deemed appropriate, the Vendor Performance Reports will be summarized and reviewed to determine corrective action necessary, or service improvements required by vendors

The laboratory has access to a listing of all approved suppliers of critical consumables, supplies and services. This information is provided through the JD Edwards purchasing system.

9.6.1 New Vendor Procedure

TestAmerica employees who wish to request the addition of a new vendor must complete a J.D. Edwards Vendor Add Request Form.

New vendors are evaluated based upon criteria appropriate to the products or services provided as well as their ability to provide those products and services at a competitive cost. Vendors are also evaluated to determine if there are ethical reasons or potential conflicts of interest with TestAmerica employees that would make it prohibitive to do business with them as well as their financial stability. The QA Department and/or the Technology Director are consulted with vendor and product selection that have an impact on quality.

SECTION 10. COMPLAINTS

10.1 Overview

The laboratory considers an effective client complaint handling processes to be of significant business and strategic value. Listening to and documenting client concerns captures 'client knowledge' that enables our operations to continually improve processes and client satisfaction. An effective client complaint handling process also provides assurance to the data user that the laboratory will stand behind its data, service obligations and products.

A client complaint is any expression of dissatisfaction with any aspect of our business services (e.g., communications, responsiveness, data, reports, invoicing and other functions) expressed by any party, whether received verbally or in written form. Client inquiries, complaints or noted discrepancies are documented, communicated to management, and addressed promptly and thoroughly.

The laboratory has procedures for addressing both external and internal complaints with the goal of providing satisfactory resolution to complaints in a timely and professional manner.

The nature of the complaint is identified, documented and investigated, and an appropriate action is determined and taken. In cases where a client complaint indicates that an established policy or procedure was not followed, the QA Department must evaluate whether a special audit must be conducted to assist in resolving the issue. A written confirmation or letter to the client, outlining the issue and response taken is recommended as part of the overall action taken.

The process of complaint resolution and documentation utilizes the procedures outlined in Section 12 (Corrective Actions) and is documented following the procedures in Laboratory SOP number HS-QA-024.

10.2 External Complaints

An employee that receives a complaint initiates the complaint resolution process by first documenting the complaint according to SOP# HS-QA-024.

Complaints fall into two categories: correctable and non-correctable. An example of a correctable complaint would be one where a report re-issue would resolve the complaint. An example of a non-correctable complaint would be one where a client complains that their data was repeatedly late. Non-correctable complaints should be reviewed for preventive action measures to reduce the likelihood of future occurrence and mitigation of client impact.

The general steps in the complaint handling process are:

- Receiving and Documenting Complaints
- Complaint Investigation and Service Recovery
- Process Improvement

The laboratory shall inform the initiator of the complaint of the results of the investigation and the corrective action taken, if any.

10.3 Internal Complaints

Internal complaints include, but are not limited to: errors and non-conformances, training issues, internal audit findings, and deviations from methods. Corrective actions may be initiated by any staff member who observes a nonconformance and shall follow the procedures outlined in Section 12. In addition, Corporate Management, Sales and Marketing and IT may initiate a complaint by contacting the laboratory or through the corrective action system described in Section 12.

10.4 Management Review

The number and nature of client complaints is reported by the QA Manager to the laboratory and QA Director in the QA Monthly report. Monitoring and addressing the overall level and nature of client complaints and the effectiveness of the solutions is part of the Annual Management Review (Section 16).

SECTION 11. CONTROL OF NON-CONFORMING WORK

11.1 Overview

When data discrepancies are discovered or deviations and departures from laboratory SOPs, policies and/or client requests have occurred, corrective action is taken immediately. First, the laboratory evaluates the significance of the nonconforming work. Then, a corrective action plan is initiated based on the outcome of the evaluation. If it is determined that the nonconforming work is an isolated incident, the plan could be as simple as adding a qualifier to the final results and/or making a notation in the case narrative. If it is determined that the nonconforming work is a systematic or improper practices issue, the corrective action plan could include a more in depth investigation and a possible suspension of an analytical method. In all cases, the actions taken are documented using the laboratory's corrective action system (refer to Section 12).

Due to the frequently unique nature of environmental samples, sometimes departures from documented policies and procedures are needed. When an analyst encounters such a situation, the problem is presented to the supervisor for resolution. The supervisor may elect to discuss it with the Technical Director and Quality Manager or have a representative contact the client to decide on a logical course of action. Once an approach is agreed upon, the analyst documents it using the laboratories corrective action system described in Section 12. This information can then be supplied to the client in the form of a footnote or a case narrative with the report.

Project Management may encounter situations where a client may request that a special procedure be applied to a sample that is not standard lab practice. Based on a technical evaluation, the lab may accept or opt to reject the request based on technical or ethical merit. An example might be the need to report a compound that the lab does not normally report. The lab would not have validated the method for this compound following the procedures in Section 19. The client may request that the compound be reported based only on the calibration. Such a request would need to be approved by the Technical Director and QA Manager, documented and included in the project folder. Deviations **must** also be noted on the final report with a statement that the compound is not reported in compliance with TNI (or the analytical method) requirements and the reason. Data being reported to a non- TNI state would need to note the change made to how the method is normally run.

11.2 Responsibilities and Authorities

TestAmerica's Corporate SOP entitled *Internal Investigation of Potential Data Discrepancies and Determination for Data Recall* (SOP No. CW-L-S-002), outlines the general procedures for the reporting and investigation of data discrepancies and alleged incidents of misconduct or violations of TestAmerica's data integrity policies as well as the policies and procedures related to the determination of the potential need to recall data.

Under certain circumstances, the Laboratory Director, a Technical Manager, or a member of the QA team may authorize departures from documented procedures or policies. The departures may be a result of procedural changes due to the nature of the sample; a one-time procedure for a client; QC failures with insufficient sample to reanalyze, etc.. In most cases, the client will be informed of the departure prior to the reporting of the data. Any departures must be well documented using the laboratory's corrective action procedures. This information may also be

documented in logbooks and/or data review checklists as appropriate. Any impacted data must be referenced in a case narrative and/or flagged with an appropriate data qualifier.

Any misrepresentation or possible misrepresentation of analytical data discovered by any laboratory staff member must be reported to facility Senior Management within 24-hours. The Senior Management staff is comprised of the Laboratory Director, the QA Manager, and the Technical Managers. The reporting of issues involving alleged violations of the company's Data Integrity or Manual Integration procedures must be conveyed to an Ethics and Compliance Officer (ECO), Director of Quality & Client Advocacy and the laboratory's Quality Director within 24 hours of discovery.
Whether an inaccurate result was reported due to calculation or quantitation errors, data entry errors, improper practices, or failure to follow SOPs, the data must be evaluated to determine the possible effect.

The Laboratory Director, QA Manager, ECOs, Corporate Quality, the COO, General Managers and the Quality Directors have the authority and responsibility to halt work, withhold final reports, or suspend an analysis for due cause as well as authorize the resumption of work.

11.3 Evaluation of Significance and Actions Taken

For each nonconforming issue reported, an evaluation of its significance and the level of management involvement needed is made. This includes reviewing its impact on the final data, whether or not it is an isolated or systematic issue, and how it relates to any special client requirements.

TestAmerica's Corporate Data Investigation & Recall Procedure (SOP No. CW-L-S-002) distinguishes between situations when it would be appropriate for laboratory management to make the decision on the need for client notification (written or verbal) and data recall (report revision) and when the decision must be made with the assistance of the ECO's and Corporate Management. Laboratory level decisions are documented and approved using the laboratory's standard nonconformance/corrective action reporting in lieu of the data recall determination form contained in TestAmerica's Corporate SOP No. CW-L-S-002.

11.4 Prevention of NonConforming Work

If it is determined that the nonconforming work could recur, further corrective actions must be made following the laboratory's corrective action system. Periodically as defined by the laboratory's preventive action schedule, the QA Department evaluates non-conformances to determine if any nonconforming work has been repeated multiple times. If so, the laboratory's corrective action process may be followed.

11.5 Method Suspension / Restriction (Stop Work Procedures)

In some cases, it may be necessary to suspend/restrict the use of a method or target compound which constitutes significant risk and/or liability to the laboratory. Suspension/restriction procedures can be initiated by any of the persons noted in Section 11.2, Paragraph 5.

Prior to suspension/restriction, confidentiality will be respected, and the problem with the required corrective and preventive action will be stated in writing and presented to the Laboratory Director.

The Laboratory Director shall arrange for the appropriate personnel to meet with the QA Manager as needed. This meeting shall be held to confirm that there is a problem, that suspension/restriction of the method is required and will be concluded with a discussion of the steps necessary to bring the method/target or test fully back on line. In some cases, that may not be necessary if all appropriate personnel have already agreed there is a problem and there is agreement on the steps needed to bring the method, target or test fully back on line.
The QA Manager will also initiate a corrective action report as described in Section 12 if one has not already been started. A copy of any meeting notes and agreed upon steps should be faxed or e-mailed by the laboratory to the appropriate General Manager and member of Corporate QA. This fax/e-mail acts as notification of the incident.

After suspension/restriction, the lab will hold all reports to clients pending review. No faxing, mailing or distributing through electronic means may occur. The report must not be posted for viewing on the internet. It is the responsibility of the Laboratory Director to hold all reporting and to notify all relevant laboratory personnel regarding the suspension/restriction (e.g., Project Management, Log-in, etc...). Clients will NOT generally be notified at this time. Analysis may proceed in some instances depending on the non-conformance issue.

Within 72 hours, the QA Manager will determine if compliance is now met and reports can be released, OR determine the plan of action to bring work into compliance, and release work. A team, with all principals involved (Laboratory Director, Technical Manager/Director, QA Manager) can devise a start-up plan to cover all steps from client notification through compliance and release of reports. Project Management, and the Directors of Client Services and Sales and Marketing must be notified if clients must be notified or if the suspension/restriction affects the laboratory's ability to accept work. The QA Manager must approve start-up or elimination of any restrictions after all corrective action is complete. This approval is given by final signature on the completed corrective action report.

SECTION 12. CORRECTIVE ACTION

12.1 Overview

A major component of TestAmerica's Quality Assurance (QA) Program is the problem investigation and feedback mechanism designed to keep the laboratory staff informed on quality related issues and to provide insight to problem resolution. When nonconforming work or departures from policies and procedures in the quality system or technical operations are identified, the corrective action procedure provides a systematic approach to assess the issues, restore the laboratory's system integrity, and prevent reoccurrence. Corrective actions are documented using Non-Conformance Reports (NCR) and Corrective Action Reports (CAR) (refer to Figure 12-1).

12.2 General

Problems within the quality system or within analytical operations may be discovered in a variety of ways, such as QC sample failures, internal or external audits, proficiency testing (PT) performance, client complaints, staff observation, etc..

The purpose of a corrective action system is to:

- Identify non-conformance events and assign responsibility(s) for investigating.
- Resolve non-conformance events and assign responsibility for any required corrective action.
- Identify systematic problems before they become serious.
- Identify and track client complaints and provide resolution.

12.2.1 Non-Conformance Report (NCR) - is used to document the following types of corrective actions:

- Deviations from an established procedure or SOP
- QC outside of limits (non-matrix related)
- Isolated reporting / calculation errors
- Client complaints
- Discrepancies in materials / goods received vs. manufacturer packing slips.

12.2.2 Corrective Action Report (CAR) - is used to document the following types of corrective actions:

- Questionable trends that are found in the review of NCRs.
- Issues found while reviewing NCRs that warrant further investigation.
- Internal and external audit findings.
- Failed or unacceptable PT results.
- Corrective actions that cross multiple departments in the laboratory.
- Systematic reporting / calculation errors
- Client complaints

- Data recall investigations
- Identified poor process or method performance trends
- Excessive revised reports

This will provide background documentation to enable root cause analysis and preventive action.

12.3 Closed Loop Corrective Action Process

Any employee in the company can initiate a corrective action. There are four main components to a closed-loop corrective action process once an issue has been identified: Cause Analysis, Selection and Implementation of Corrective Actions (both short and long term), Monitoring of the Corrective Actions, and Follow-up.

12.3.1 Cause Analysis

- Upon discovery of a non-conformance event, the event must be defined and documented. An NCR or CAR must be initiated, someone is assigned to investigate the issue and the event is investigated for cause. Table 12-1 provides some general guidelines on determining responsibility for assessment.
- The cause analysis step is the key to the process as a long term corrective action cannot be determined until the cause is determined.
- If the cause is not readily obvious, the Technical Manager, Laboratory Director, or QA Manager (or QA designee) is consulted.

12.3.2 Selection and Implementation of Corrective Actions

- Where corrective action is needed, the laboratory shall identify potential corrective actions. The action(s) most likely to eliminate the problem and prevent recurrence are selected and implemented. Responsibility for implementation is assigned.
- Corrective actions shall be to a degree appropriate to the magnitude of the problem identified through the cause analysis.
- Whatever corrective action is determined to be appropriate, the laboratory shall document and implement the changes. The NCR or CAR is used for this documentation.

12.3.3 Root Cause Analysis

Root Cause Analysis is a class of problem solving (investigative) methods aimed at identifying the basic or causal factor(s) that underlie variation in performance or the occurrence of a significant failure. The root cause may be buried under seemingly innocuous events, many steps preceding the perceived failure. At first glance, the immediate response is typically directed at a symptom and not the cause. Typically, root cause analysis would be best with three or more incidents to triangulate a weakness.

Systematically analyze and document the Root Causes of the more significant problems that are reported. Identify, track, and implement the corrective actions required to reduce the likelihood of recurrence of significant incidents. Trend the Root Cause data from these incidents

to identify Root Causes that, when corrected, can lead to dramatic improvements in performance by eliminating entire classes of problems.

Identify the one event associated with problem and ask why this event occurred. Brainstorm the root causes of failures; for example, by asking why events occurred or conditions existed; and then why the cause occurred 5 consecutive times until you get to the root cause. For each of these sub events or causes, ask why it occurred. Repeat the process for the other events associated with the incident.

Root cause analysis does not mean the investigation is over. Look at technique, or other systems outside the normal indicators. Often creative thinking will find root causes that ordinarily would be missed, and continue to plague the laboratory or operation.

12.3.4 Monitoring of the Corrective Actions

- The Technical Manager and QA Manager are responsible to ensure that the corrective action taken was effective.
- Ineffective actions are documented and re-evaluated until acceptable resolution is achieved. Technical Managers are accountable to the Laboratory Director to ensure final acceptable resolution is achieved and documented appropriately.
- Each NCR and is entered into a database for tracking purposes and a monthly summary of all corrective actions is printed out for review to aid in ensuring that the corrective actions have taken effect. Each CAR is entered into a QA tracking spreadsheet for tracking and root cause analysis.
- The QA Manager reviews monthly NCRs and CARs for trends. Highlights are included in the QA monthly report (refer to Section 16). If a significant trend develops that adversely affects quality, an audit of the area is performed and corrective action implemented.
- Any out-of-control situations that are not addressed acceptably at the laboratory level may be reported to the Corporate Quality Director by the QA Manager, indicating the nature of the out-of-control situation and problems encountered in solving the situation.

12.3.5 Follow-up Audits

- Follow-up audits may be initiated by the QA Manager and shall be performed as soon as possible when the identification of a nonconformance casts doubt on the laboratory's compliance with its own policies and procedures, or on its compliance with state or federal requirements.
- These audits often follow the implementation of the corrective actions to verify effectiveness. An additional audit would only be necessary when a critical issue or risk to business is discovered.

(Also refer to Section 15.1.4, Special Audits.)

12.4 Technical Corrective Actions

In addition to providing acceptance criteria and specific protocols for technical corrective actions in the method SOPs, the laboratory has general procedures to be followed to determine when departures from the documented policies and procedures and quality control have occurred

(refer to Section 11). The documentation of these procedures is through the use of an NCR or CAR.

Table 12-1 includes examples of general technical corrective actions. For specific criteria and corrective actions, refer to the analytical methods or specific method SOPs. The laboratory may also maintain Work Instructions on these items that are available upon request.

Table 12-1 provides some general guidelines for identifying the individual(s) responsible for assessing each QC type and initiating corrective action. The table also provides general guidance on how a data set should be treated if associated QC measurements are unacceptable. Specific procedures are included in Method SOPs, Work Instructions, QAM Sections 19 and 20. All corrective actions are reviewed monthly, at a minimum, by the QA Manager and highlights are included in the QA monthly report.

To the extent possible, samples shall be reported only if all quality control measures are acceptable. If the deficiency does not impair the usability of the results, data will be reported with an appropriate data qualifier and/or the deficiency will be noted in the case narrative. Where sample results may be impaired, the Project Manager is notified by an NCR and appropriate corrective action (e.g., reanalysis) is taken and documented.

12.5 Basic Corrections

When mistakes occur in records, each mistake shall be crossed-out, [not obliterated (e.g. no white-out)], and the correct value entered alongside. All such corrections shall be initialed (or signed) and dated by the person making the correction. In the case of records stored electronically, the original "uncorrected" file must be maintained intact and a second "corrected" file is created.

This same process applies to adding additional information to a record. All additions made later than the initial must also be initialed (or signed) and dated.

When corrections are due to reasons other than obvious transcription errors, the reason for the corrections (or additions) shall also be documented.

Figure 12-1.
Example - Corrective Action Report

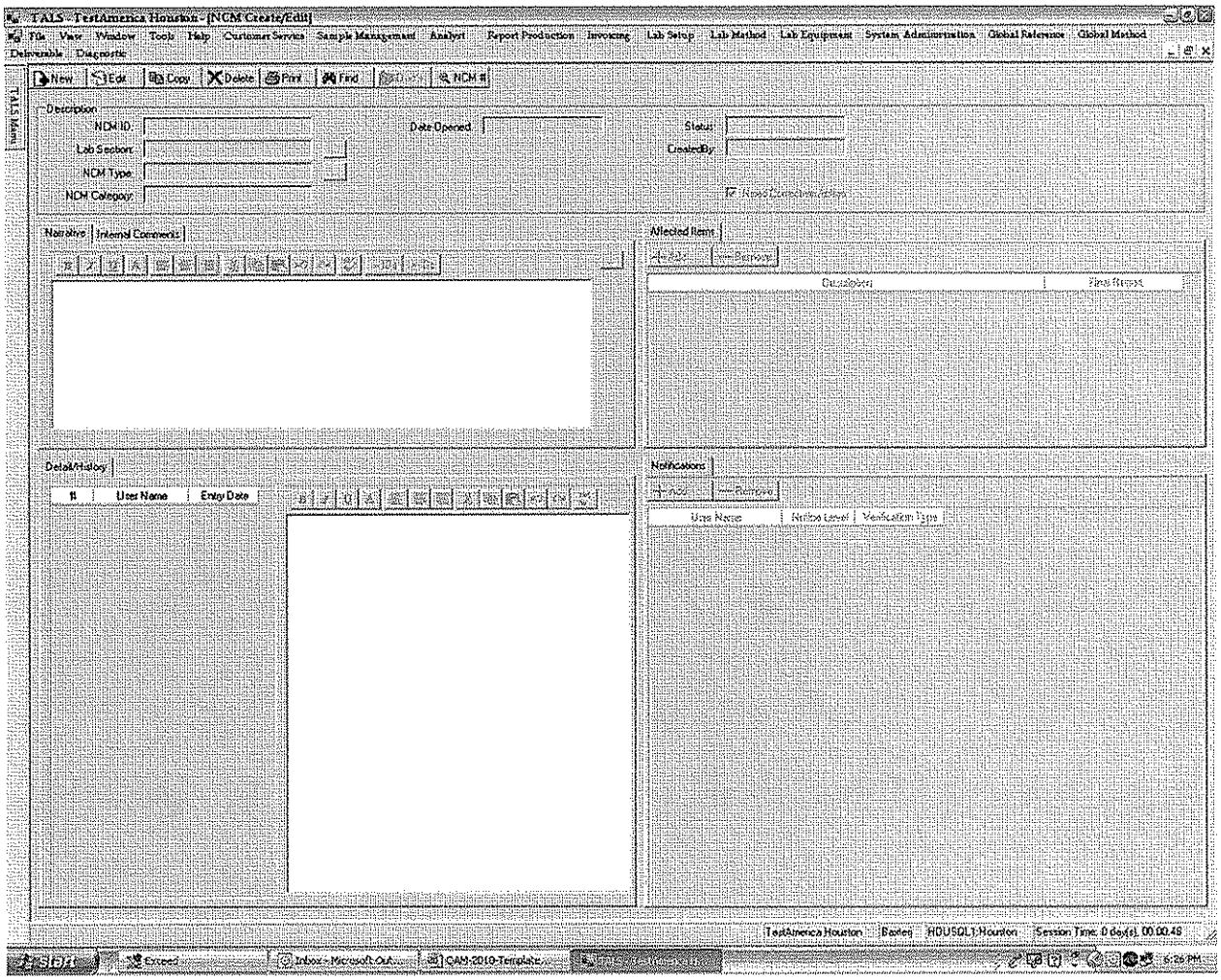


Table 12-1. Example – General Corrective Action Procedures

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Initial Instrument Blank *(Analyst)*	- Instrument response < MDL.	- Prepare another blank. - If same response, determine cause of contamination: reagents, environment, instrument equipment failure, etc..
Initial Calibration Standards *(Analyst, Technical Manager(s))*	- Correlation coefficient > 0.99 or standard concentration value. - % Recovery within acceptance range. - See details in Method SOP.	- Reanalyze standards. - If still unacceptable, remake standards and recalibrate instrument.
Independent Calibration Verification (Second Source) *(Analyst, Technical Manager(s))*	- % Recovery within control limits.	- Remake and reanalyze standard. - If still unacceptable, then remake calibration standards or use new primary standards and recalibrate instrument.
Continuing Calibration Standards *(Analyst, Data Reviewer)*	% Recovery within control limits.	- Reanalyze standard. - If still unacceptable, then recalibrate and rerun affected samples.
Matrix Spike / Matrix Spike Duplicate (MS/MSD) *(Analyst, Data Reviewer)*	- % Recovery within limits documented in ***(state where limits are maintained)***.	- If the acceptance criteria for duplicates or matrix spikes are not met because of matrix interferences, the acceptance of the analytical batch is determined by the validity of the LCS. - If the LCS is within acceptable limits the batch is acceptable. - The results of the duplicates, matrix spikes and the LCS are reported with the data set. - For matrix spike or duplicate results outside criteria the data for that sample shall be reported with qualifiers.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Laboratory Control Sample (LCS) *(Analyst, Data Reviewer)*	- % Recovery within limits specified in ***(state where limits are maintained).***	- Batch must be re-prepared and re-analyzed. This includes any allowable marginal exceedance. When not using marginal exceedances, the following exceptions apply: 1) when the acceptance criteria for the positive control are exceeded high (i.e., high bias) and there are associated samples that are non-detects, then those non-detects may be reported with data qualifying codes; 2) when the acceptance criteria for the positive control are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level with data qualifying codes. **Note:** If there is insufficient sample or the holding time cannot be met, contact client and report with flags.
Surrogates *(Analyst, Data Reviewer)*	- % Recovery within limits of method or within three standard deviations of the historical mean.	- Individual sample must be repeated. Place comment in LIMS. - Surrogate results outside criteria shall be reported with qualifiers.
Method Blank (MB) *(Analyst, Data Reviewer)*	< Reporting Limit [1]	- Reanalyze blank. - If still positive, determine source of contamination. If necessary, reprocess (i.e. digest or extract) entire sample batch. Report blank results. - Qualify the result(s) if the concentration of a targeted analyte in the MB is at or above the reporting limit AND is > 1/10 of the amount measured in the sample.
Proficiency Testing (PT) Samples *(QA Manager, Technical Manager(s))*	- Criteria supplied by PT Supplier.	- Any failures or warnings must be investigated for cause. Failures may result in the need to repeat a PT sample to show the problem is corrected.
Internal / External Audits *(QA Manager, Technical Manager(s))*	- Defined in Quality System documentation such as SOPs, QAM, etc..	- Non-conformances must be investigated through CAR system and necessary corrections must be made.

QC Activity *(Individual Responsible for Initiation/Assessment)*	Acceptance Criteria	Recommended Corrective Action
Reporting / Calculation Errors (Depends on issue – possible individuals include: Analysts, Data Reviewers, Project Managers, Technical Managers, QA Manager, Corporate QA, Corporate Management)	- SOP CW-L-S-002, Internal Investigation of Potential Data Discrepancies and Determination for Data Recall.	- Corrective action is determined by type of error. Follow the procedures in SOP CW-L-S-002.
Client Complaints *(Project Managers, Lab Director/Manager, Sales and Marketing)*	-	- Corrective action is determined by the type of complaint. For example, a complaint regarding an incorrect address on a report will result in the report being corrected and then follow-up must be performed on the reasons the address was incorrect (e.g., database needs to be updated).
QA Monthly Report (Refer to Section 16 for an example) (QA Manager, Lab Director/Manager, *Technical Manager(s)*)	- QAM, SOPs.	- Corrective action is determined by the type of issue. For example, CARs for the month are reviewed and possible trends are investigated.
Health and Safety Violation (Safety Officer, Lab Director/Manager, *Technical Manager(s)*)	- Environmental Health and Safety (EHS) Manual.	- Non-conformance is investigated and corrected through CAR system.

Note:
1. Except as noted below for certain compounds, the method blank should be below the detection limit. Concentrations up to five times the reporting limit will be allowed for the ubiquitous laboratory and reagent contaminants: methylene chloride, toluene, acetone, 2-butanone and phthalates **provided** they appear in similar levels in the reagent blank and samples. This allowance presumes that the detection limit is significantly below any regulatory limit to which the data are to be compared and that blank subtraction will not occur. For benzene and ethylene dibromide (EDB) and other analytes for which regulatory limits are extremely close to the detection limit, the method blank must be below the method detection limit

SECTION 13. PREVENTIVE ACTION / IMPROVEMENT

13.1 Overview

The laboratory's preventive action programs improve or eliminate potential causes of nonconforming product and/or nonconformance to the quality system. This preventive action process is a proactive and continuous process of improvement activities that can be initiated through feedback from clients, employees, business providers, and affiliates. The QA Department has the overall responsibility to ensure that the preventive action process is in place, and that relevant information on actions is submitted for management review.

Dedicating resources to an effective preventive action system emphasizes the laboratory's commitment to its Quality Program. It is beneficial to identify and address negative trends before they develop into complaints, problems and corrective actions. Additionally, customer service and client satisfaction can be improved through continuous improvements to laboratory systems.

Opportunities for improvement may be discovered during management reviews, the monthly QA Metrics Report, evaluation of internal or external audits, results & evaluation of proficiency testing (PT) performance, data analysis & review processing operations, client complaints, staff observation, etc..

The monthly Management Systems Metrics Report shows performance indicators in all areas of the laboratory and quality system. These areas include revised reports, corrective actions, audit findings, internal auditing and data authenticity audits, client complaints, PT samples, holding time violations, SOPs, ethics training, etc.. These metrics are used in evaluating the management and quality system performance on an ongoing basis and provide a tool for identifying areas for improvement.

The laboratory's corrective action process is integral to implementation of preventive actions. A critical piece of the corrective action process is the implementation of actions to prevent further occurrence of a non-compliance event. Historical review of corrective action provides a valuable mechanism for identifying preventive action opportunities.

13.1.1 The following elements are part of a preventive action system:

- Identification of an opportunity for preventive action.
- Process for the preventive action.
- Define the measurements of the effectiveness of the process once undertaken.
- Execution of the preventive action.
- Evaluation of the plan using the defined measurements.
- Verification of the effectiveness of the preventive action.
- Close-Out by documenting any permanent changes to the Quality System as a result of the Preventive Action. Documentation of Preventive Action is incorporated into the monthly QA reports, corrective action process and management review.

13.1.2 Any Preventive Actions undertaken or attempted shall be taken into account during the annual Management Systems Review (Section 16). A highly detailed report is not required; however, a summary of successes and failures within the preventive action program is sufficient to provide management with a measurement for evaluation.

13.2 Management of Change

The Management of Change process is designed to manage significant events and changes that occur within the laboratory. Through these procedures, the potential risks inherent with a new event or change are identified and evaluated. The risks are minimized or eliminated through pre-planning and the development of preventive measures. The types of changes covered under this system include: Facility Changes, Major Accreditation Changes, Addition or Deletion to Division's Capabilities or Instrumentation, Key Personnel Changes, Laboratory Information Management System (LIMS) changes. This process is discussed in further detail in HS-QA-023.

SECTION 14. CONTROL OF RECORDS

The laboratory maintains a records management system appropriate to its needs and that complies with applicable standards or regulations as required. The system produces unequivocal, accurate records that document all laboratory activities. The laboratory retains all original observations, calculations and derived data, calibration records and a copy of the analytical report for a minimum of five years after it has been issued.

14.1 Overview

The laboratory has established procedures for identification, collection, indexing, access, filing, storage, maintenance and disposal of quality and technical records. A record index is listed in Table 14-1. Quality records are maintained by the QA department in a database, which is backed up as part of the regular laboratory backup. Records are of two types; either electronic or hard copy paper formats depending on whether the record is computer or hand generated (some records may be in both formats). Technical records are maintained by the Department Managers.

Table 14-1. Record Index[1]

	Record Types[1]:	Retention Time:
Technical Records	- Raw Data - Logbooks[2] - Standards - Certificates - Analytical Records - MDLs/IDLs/DOCs - Lab Reports	5 Years from analytical report issue*
Official Documents	- Quality Assurance Manual (QAM) - Work Instructions - Policies - SOPs - Policy Memorandums - Manuals	5 Years from document retirement date*
QA Records	- Internal & External Audits/Responses - Certifications - Corrective/Preventive Actions - Management Reviews - Method & Software Validation / Verification Data - Data Investigation	5 Years from archival* **Data Investigation:** 5 years or the life of the affected raw data storage whichever is greater (beyond 5 years if ongoing project or pending investigation)
Project Records	- Sample Receipt & COC Documentation - Contracts and Amendments - Correspondence - QAPP - SAP - Telephone Logbooks - Lab Reports	5 Years from analytical report issue*

	Record Types [1]:	Retention Time:
Administrative Records	Finance and Accounting	10 years
	EH&S Manual, Permits	7 years
	Disposal Records	Indefinitely
	Employee Handbook	Indefinitely
	Personnel files, Employee Signature & Initials, Administrative Training Records (e.g., Ethics)	7 Years (HR Personnel Files must be maintained indefinitely)
	Administrative Policies Technical Training Records	7 years

[1] Record Types encompass hardcopy and electronic records.
[2] Examples of Logbook types: Maintenance, Instrument Run, Preparation (standard and samples), Standard and Reagent Receipt, Archiving, Balance Calibration, Temperature (hardcopy or electronic records).
* Exceptions listed in Table 14-2.

14.1.1 All records are stored and retained in such a way that they are secure and readily retrievable at the laboratory facility that provides a suitable environment to prevent damage or deterioration and to prevent loss. All records shall be protected against fire, theft, loss, environmental deterioration, and vermin. In the case of electronic records, electronic or magnetic sources, storage media are protected from deterioration caused by magnetic fields and/or electronic deterioration.

Access to the data is limited to laboratory and company employees and shall be documented with an access log. Records are maintained for a minimum of five years unless otherwise specified by a client or regulatory requirement.

For raw data and project records, record retention shall be calculated from the date the project report is issued. For other records, such as Controlled Documents, QA, or Administrative Records, the retention time is calculated from the date the record is formally retired. Records related to the programs listed in Table 14-2 have lengthier retention requirements and are subject to the requirements in Section 14.1.3.

14.1.2 Programs with Longer Retention Requirements

Some regulatory programs have longer record retention requirements than the standard record retention time. These are detailed in Table 14-2 with their retention requirements. In these cases, the longer retention requirement is enacted. If special instructions exist such that client data cannot be destroyed prior to notification of the client, the container or box containing that data is marked as to who to contact for authorization prior to destroying the data.

Table 14-2. Example: Special Record Retention Requirements

Program	[1]Retention Requirement
Drinking Water – All States	5 years (project records) 10 years - Radiochemistry (project records)

Program	[1]Retention Requirement
Drinking Water Lead and Copper Rule	12 years (project records)
Commonwealth of MA – All environmental data 310 CMR 42.14	10 years
FIFRA – 40 CFR Part 160	Retain for life of research or marketing permit for pesticides regulated by EPA
Housing and Urban Development (HUD) Environmental Lead Testing	10 years
Alaska	10 years
Louisiana – All	10 years
Michigan Department of Environmental Quality – all environmental data	10 years
Navy Facilities Engineering Service Center (NFESC)	10 years
NY Potable Water NYCRR Part 55-2	10 years
Ohio VAP	10 years and State contacted prior to disposal
TSCA - 40 CFR Part 792	10 years after publication of final test rule or negotiated test agreement

[1]Note: Extended retention requirements must be noted with the archive documents or addressed in facility-specific records retention procedures.

14.1.3 The laboratory has procedures to protect and back-up records stored electronically and to prevent unauthorized access to or amendment of these records. All analytical data is maintained as hard copy or in a secure readable electronic format. For analytical reports that are maintained as copies in PDF format, refer to Section **19.14.1** for more information.

14.1.4 The record keeping system allows for historical reconstruction of all laboratory activities that produced the analytical data, as well as rapid recovery of historical data. The history of the sample from when the laboratory took possession of the samples must be readily understood through the documentation. This shall include inter-laboratory transfers of samples and/or extracts.

- The records include the identity of personnel involved in sampling, sample receipt, preparation, or testing. All analytical work contains the initials (at least) of the personnel involved. The laboratory's copy of the COC is stored in the project folder. The chain of custody would indicate the name of the sampler. If any sampling notes are provided with a work order, they are kept with this package.

- All information relating to the laboratory facilities equipment, analytical test methods, and related laboratory activities, such as sample receipt, sample preparation, or data verification are documented.

- The record keeping system facilitates the retrieval of all working files and archived records for inspection and verification purposes (e.g., set format for naming electronic files, set format for what is included with a given analytical data set). Instrument data is stored sequentially by instrument. A given day's analyses are maintained in the order of the analysis. Run logs are maintained for each instrument or method; a copy of each day's run

long or instrument sequence is stored with the data to aid in re-constructing an analytical sequence. Where an analysis is performed without an instrument, bound logbooks or bench sheets are used to record and file data. Standard and reagent information is recorded in logbooks or entered into the LIMS for each method as required.

- Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.
- The reason for a signature or initials on a document is clearly indicated in the records such as "sampled by," "prepared by," "reviewed by", or "analyzed by".
- All generated data except those that are generated by automated data collection systems, are recorded directly, promptly and legibly in permanent dark ink.
- Hard copy data may be scanned into PDF format for record storage as long as the scanning process can be verified in order to ensure that no data is lost and the data files and storage media must be tested to verify the laboratory's ability to retrieve the information prior to the destruction of the hard copy that was scanned.
- Also refer to Section 19.14.1 'Computer and Electronic Data Related Requirements'.

14.2 Technical and Analytical Records

14.2.1 The laboratory retains records of original observations, derived data and sufficient information to establish an audit trail, calibration records, staff records and a copy of each analytical report issued, for a minimum of five years unless otherwise specified by a client or regulatory requirement. The records for each analysis shall contain sufficient information to enable the analysis to be repeated under conditions as close as possible to the original. The records shall include the identity of laboratory personnel responsible for the sampling, performance of each analysis and reviewing results.

14.2.2 Observations, data and calculations are recorded real-time and are identifiable to the specific task.

14.2.3 Changes to hardcopy records shall follow the procedures outlined in Section 12 and 19. Changes to electronic records in LIMS or instrument data are recorded in audit trails.

The essential information to be associated with analysis, such as strip charts, tabular printouts, computer data files, analytical notebooks, and run logs, include:

- laboratory sample ID code;
- Date of analysis; Time of Analysis is also required if the holding time is seventy-two (72) hours or less, or when time critical steps are included in the analysis (e.g., drying times, incubations, etc.); instrumental analyses have the date and time of analysis recorded as part of their general operations. Where a time critical step exists in an analysis, location for such a time is included as part of the documentation in a specific logbook or on a benchsheet.
- Instrumentation identification and instrument operating conditions/parameters. Operating conditions/parameters are typically recorded in instrument maintenance logs where

available.

- analysis type;
- all manual calculations and manual integrations;
- analyst's or operator's initials/signature;
- sample preparation including cleanup, separation protocols, incubation periods or subculture, ID codes, volumes, weights, instrument printouts, meter readings, calculations, reagents;
- test results;
- standard and reagent origin, receipt, preparation, and use;
- calibration criteria, frequency and acceptance criteria;
- data and statistical calculations, review, confirmation, interpretation, assessment and reporting conventions;
- quality control protocols and assessment;
- electronic data security, software documentation and verification, software and hardware audits, backups, and records of any changes to automated data entries; and
- Method performance criteria including expected quality control requirements. These are indicated both in the LIMS and on specific analytical report formats.

14.3 Laboratory Support Activities

In addition to documenting all the above-mentioned activities, the following are retained QA records and project records (previous discussions in this section relate where and how these data are stored):

- all original raw data, whether hard copy or electronic, for calibrations, samples and quality control measures, including analysts' work sheets and data output records (chromatograms, strip charts, and other instrument response readout records);
- a written description or reference to the specific test method used which includes a description of the specific computational steps used to translate parametric observations into a reportable analytical value;
- copies of final reports;
- archived SOPs;
- correspondence relating to laboratory activities for a specific project;
- all corrective action reports, audits and audit responses;
- proficiency test results and raw data; and
- results of data review, verification, and crosschecking procedures

14.3.1 Sample Handling Records

Records of all procedures to which a sample is subjected while in the possession of the laboratory are maintained. These include but are not limited to records pertaining to:

- sample preservation including appropriateness of sample container and compliance with holding time requirement;
- sample identification, receipt, acceptance or rejection and login;
- sample storage and tracking including shipping receipts, sample transmittal / COC forms; and
- procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

14.4 Administrative Records

The laboratory also maintains the administrative records in either electronic or hard copy form. Refer to Table 14-1.

14.5 Records Management, Storage and Disposal

All records (including those pertaining to test equipment), certificates and reports are safely stored, held secure and in confidence to the client. Certification related records are available upon request.

All information necessary for the historical reconstruction of data is maintained by the laboratory. Records that are stored only on electronic media must be supported by the hardware and software necessary for their retrieval.

Records that are stored or generated by computers or personal computers have hard copy, write-protected backup copies, or an electronic audit trail controlling access.

The laboratory has a record management system (a.k.a., document control) for control of laboratory notebooks, instrument logbooks, standards logbooks, and records for data reduction, validation, storage and reporting. Laboratory notebooks are issued on a per analysis basis, and are numbered sequentially. All data are recorded sequentially within a series of sequential notebooks. Bench sheets are filed sequentially. Standards are maintained in the LIMS – no logbooks are used to record that data. Records are considered archived when noted as such in the records management system (a.k.a., document control.)

14.5.1 Transfer of Ownership

In the event that the laboratory transfers ownership or goes out of business, the laboratory shall ensure that the records are maintained or transferred according to client's instructions. Upon ownership transfer, record retention requirements shall be addressed in the ownership transfer agreement and the responsibility for maintaining archives is clearly established. In addition, in cases of bankruptcy, appropriate regulatory and state legal requirements concerning laboratory records must be followed. In the event of the closure of the laboratory, all records will revert to the control of the corporate headquarters. Should the entire company cease to exist, as much notice as possible will be given to clients and the accrediting bodies who have worked with the laboratory during the previous 5 years of such action.

14.5.2 Records Disposal

Records are removed from the archive and destroyed after 5 years unless otherwise specified by a client or regulatory requirement. On a project specific or program basis, clients may need to be notified prior to record destruction. Records are destroyed in a manner that ensures their confidentiality such as shredding, mutilation or incineration. (Refer to Tables 14-1 and 14-2).

Electronic copies of records must be destroyed by erasure or physically damaging off-line storage media so no records can be read.

If a third party records management company is hired to dispose of records, a "Certificate of Destruction" is required.

SECTION 15. AUDITS

15.1 Internal Audits

Internal audits are performed to verify that laboratory operations comply with the requirements of the lab's quality system and with the external quality programs under which the laboratory operates. Audits are planned and organized by the QA staff. Personnel conducting the audits should be independent of the area being evaluated. Auditors will have sufficient authority, access to work areas, and organizational freedom necessary to observe all activities affecting quality and to report the assessments to laboratory management and, when requested, to corporate management.

Audits are conducted and documented as described in the TestAmerica Corporate SOP on performing Internal Auditing, SOP No. CA-Q-S-004. The types and frequency of routine internal audits are described in Table 15-1. Special or ad hoc assessments may be conducted as needed under the direction of the QA staff.

Table 15-1. Types of Internal Audits and Frequency

Description	Performed by	Frequency
Quality Systems Audits	QA Department, QA approved designee, or Corporate QA	All areas of the laboratory annually
Method Audits	Joint responsibility: a) QA Manager or designee b) Technical Manager or Designee (Refer to CA-Q-S-004)	Methods Audits Frequency: 50% of methods annually 100% of methods annually (DoD Labs)
Special	QA Department or Designee	Surveillance or spot checks performed as needed, e.g., to confirm corrective actions from other audits.
Performance Testing	Analysts with QA oversight	Two successful per year for each TNI field of testing or as dictated by regulatory requirements

15.1.1 Annual Quality Systems Audit

An annual quality systems audit is required to ensure compliance to analytical methods and SOPs, TestAmerica's Data Integrity and Ethics Policies, TNI quality systems, client and state requirements, and the effectiveness of the internal controls of the analytical process, including but not limited to data review, quality controls, preventive action and corrective action. The completeness of earlier corrective actions is assessed for effectiveness & sustainability. The audit is divided into sections for each operating or support area of the lab, and each section is comprehensive for a given area. The area audits may be performed on a rotating schedule throughout the year to ensure adequate coverage of all areas. This schedule may change as situations in the laboratory warrant.

15.1.2 QA Technical Audits

QA technical audits are based on client projects, associated sample delivery groups, and the methods performed. Reported results are compared to raw data to verify the authenticity of results. The validity of calibrations and QC results are compared to data qualifiers, footnotes, and case narratives. Documentation is assessed by examining run logs and records of manual integrations. Manual calculations are checked. Where possible, electronic audit miner programs (e.g., MintMiner and Chrom AuditMiner) are used to identify unusual manipulations of the data deserving closer scrutiny. QA technical audits will include all methods within a two-year period.

15.1.3 SOP Method Compliance

Compliance of all SOPs with the source methods and compliance of the operational groups with the SOPs will be assessed by the Technical or qualified designee at least every two years. It is also recommended that the work of each newly hired analyst is assessed within 3 months of working independently, (e.g., completion of method IDOC). In addition, as analysts add methods to their capabilities, (new IDOC) reviews of the analyst work products will be performed within 3 months of completing the documented training.

15.1.4 Special Audits

Special audits are conducted on an as needed basis, generally as a follow up to specific issues such as client complaints, corrective actions, PT results, data audits, system audits, validation comments, regulatory audits or suspected ethical improprieties. Special audits are focused on a specific issue, and report format, distribution, and timeframes are designed to address the nature of the issue.

15.1.5 Performance Testing

The laboratory participates semi-annually in performance audits conducted through the analysis of PT samples provided by a third party. The laboratory generally participates in the following types of PT studies: Non-potable Water, Hazardous Waste, and UST Soil.

It is TestAmerica's policy that PT samples be treated as typical samples in the production process. Furthermore, where PT samples present special or unique problems, in the regular production process they may need to be treated differently, as would any special or unique request submitted by any client. The QA Manager must be consulted and in agreement with any decisions made to treat a PT sample differently due to some special circumstance.

Written responses to unacceptable PT results are required. In some cases it may be necessary for blind QC samples to be submitted to the laboratory to show a return to control.

15.2 External Audits

External audits are performed when certifying agencies or clients conduct on-site inspections or submit performance testing samples for analysis. It is TestAmerica's policy to cooperate fully with regulatory authorities and clients. The laboratory makes every effort to provide the auditors with access to personnel, documentation, and assistance. Laboratory supervisors are responsible for providing corrective actions to the QA Manager who coordinates the response

for any deficiencies discovered during an external audit. Audit responses are due in the time allotted by the client or agency performing the audit. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

The laboratory cooperates with clients and their representatives to monitor the laboratory's performance in relation to work performed for the client. The client may only view data and systems related directly to the client's work. All efforts are made to keep other client information confidential.

15.2.1 Confidential Business Information (CBI) Considerations

During on-site audits, auditors may come into possession of information claimed as business confidential. A business confidentiality claim is defined as "a claim or allegation that business information is entitled to confidential treatment for reasons of business confidentiality or a request for a determination that such information is entitled to such treatment." When information is claimed as business confidential, the laboratory must place on (or attach to) the information at the time it is submitted to the auditor, a cover sheet, stamped or typed legend or other suitable form of notice, employing language such as "trade secret", "proprietary" or "company confidential". Confidential portions of documents otherwise non-confidential must be clearly identified. CBI may be purged of references to client identity by the responsible laboratory official at the time of removal from the laboratory. However, sample identifiers may not be obscured from the information. Additional information regarding CBI can be found in within the 2009 TNI standards.

15.3 Audit Findings

Audit findings are documented using the corrective action process and database. The laboratory's corrective action responses for both types of audits may include action plans that could not be completed within a predefined timeframe. In these instances, a completion date must be set and agreed to by operations management and the QA Manager.

Developing and implementing corrective actions to findings is the responsibility of the Technical Manager where the finding originated. Findings that are not corrected by specified due dates are reported monthly to management in the QA monthly report. When requested, a copy of the audit report and the labs corrective action plan will be forwarded to Corporate Quality.

If any audit finding casts doubt on the effectiveness of the operations or on the correctness or validity of the laboratory's test results, the laboratory shall take timely corrective action, and shall notify clients in writing if the investigations show that the laboratory results have been affected. Once corrective action is implemented, a follow-up audit is scheduled to ensure that the problem has been corrected.

Clients must be notified promptly in writing, of any event such as the identification of defective measuring or test equipment that casts doubt on the validity of results given in any test report or amendment to a test report. The investigation must begin within 24-hours of discovery of the problem and all efforts are made to notify the client within two weeks after the completion of the investigation.

SECTION 16. MANAGEMENT REVIEWS

16.1 Quality Assurance Report

A comprehensive QA Report shall be prepared each month by the laboratory's QA Department and forwarded to the Laboratory Director, Technical Managers, their Quality Director as well as the General Manager. All aspects of the QA system are reviewed to evaluate the suitability of policies and procedures. During the course of the year, the Laboratory Director, General Manager or Corporate QA may request that additional information be added to the report.

On a monthly basis, Corporate QA compiles information from all the monthly laboratory reports. The Corporate Quality Directors prepare a report that includes a compilation of all metrics and notable information and concerns regarding the QA programs within the laboratories. The report also includes a listing of new regulations that may potentially impact the laboratories. This report is presented to the Senior Management Team and General Managers.

16.2 Annual Management Review

The senior lab management team (Laboratory Director, Technical Managers, QA Manager) conducts a review annually of its quality systems and LIMS to ensure its continuing suitability and effectiveness in meeting client and regulatory requirements and to introduce any necessary changes or improvements. It will also provide a platform for defining goals, objectives and action items that feed into the laboratory planning system. Corporate Operations and Corporate QA personnel is be included in this meeting at the discretion of the Laboratory Director. The LIMS review consists of examining any audits, complaints or concerns that have been raised through the year that are related to the LIMS. The laboratory will summarize any critical findings that can not be solved by the lab and report them to Corporate IT.

This management systems review (Corporate SOP No. CA-Q-S-008 & Work Instruction No. CA-Q-WI-020) uses information generated during the preceding year to assess the "big picture" by ensuring that routine actions taken and reviewed on a monthly basis are not components of larger systematic concerns. The monthly review should keep the quality systems current and effective, therefore, the annual review is a formal senior management process to review specific existing documentation. Significant issues from the following documentation are compiled or summarized by the QA Manager prior to the review meeting:

- Matters arising from the previous annual review.
- Prior Monthly QA Reports issues.
- Laboratory QA Metrics.
- Review of report reissue requests.
- Review of client feedback and complaints.
- Issues arising from any prior management or staff meetings.
- Minutes from prior senior lab management meetings. Issues that may be raised from these meetings include:
    - Adequacy of staff, equipment and facility resources.
    - Adequacy of policies and procedures.
    - Future plans for resources and testing capability and capacity.
- The annual internal double blind PT program sample performance (if performed),

- Compliance to the Ethics Policy and Data Integrity Plan. Including any evidence/incidents of inappropriate actions or vulnerabilities related to data Integrity.

A report is generated by the QA Manager and management. The report is distributed to the appropriate General Manager and the Quality Director. The report includes, but is not limited to:

- The date of the review and the names and titles of participants.
- A reference to the existing data quality related documents and topics that were reviewed.
- Quality system or operational changes or improvements that will be made as a result of the review [e.g., an implementation schedule including assigned responsibilities for the changes (Action Table)].

Changes to the quality systems requiring update to the laboratory QA Manual shall be included in the next revision of the QA Manual.

16.3 Potential Integrity Related Managerial Reviews

Potential integrity issues (data or business related) must be handled and reviewed in a confidential manner until such time as a follow-up evaluation, full investigation, or other appropriate actions have been completed and issues clarified. TestAmerica's Corporate Data Investigation/Recall SOP shall be followed (SOP No. CW-L-S-002). All investigations that result in finding of inappropriate activity are documented and include any disciplinary actions involved, corrective actions taken, and all appropriate notifications of clients.

TestAmerica's COO, VP of Client & Technical Services, General Managers and Quality Directors receive a monthly report from the Director of Quality & Client Advocacy summarizing any current data integrity or data recall investigations. The General Manager's are also made aware of progress on these issues for their specific labs.

SECTION 17. PERSONNEL

17.1 Overview

The laboratory's management believes that its highly qualified and professional staff is the single most important aspect in assuring a high level of data quality and service. The staff consists of professionals and support personnel as outlined in the organization chart in Figure 4-1.

All personnel must demonstrate competence in the areas where they have responsibility. Any staff that is undergoing training shall have appropriate supervision until they have demonstrated their ability to perform their job function on their own. Staff shall be qualified for their tasks based on appropriate education, training, experience and/or demonstrated skills as required.

The laboratory employs sufficient personnel with the necessary education, training, technical knowledge and experience for their assigned responsibilities.

All personnel are responsible for complying with all QA/QC requirements that pertain to the laboratory and their area of responsibility. Each staff member must have a combination of experience and education to adequately demonstrate a specific knowledge of their particular area of responsibility. Technical staff must also have a general knowledge of lab operations, test methods, QA/QC procedures and records management.

Laboratory management is responsible for formulating goals for lab staff with respect to education, training and skills and ensuring that the laboratory has a policy and procedures for identifying training needs and providing training of personnel. The training shall be relevant to the present and anticipated responsibilities of the lab staff.

The laboratory only uses personnel that are employed by or under contract to, the laboratory. Contracted personnel, when used, must meet competency standards of the laboratory and work in accordance to the laboratory's quality system.

17.2 Education and Experience Requirements for Technical Personnel

The laboratory makes every effort to hire analytical staffs that possess a college degree (AA, BA, BS) in an applied science with some chemistry in the curriculum. Exceptions can be made based upon the individual's experience and ability to learn. Selection of qualified candidates for laboratory employment begins with documentation of minimum education, training, and experience prerequisites needed to perform the prescribed task. Minimum education and training requirements for TestAmerica employees are outlined in job descriptions and are generally summarized for analytical staff in the table below.

The laboratory maintains job descriptions for all personnel who manage, perform or verify work affecting the quality of the environmental testing the laboratory performs. Job Descriptions are located on the TestAmerica intranet site's Human Resources web-page (Also see Section 4 for position descriptions/responsibilities).

Experience and specialized training are occasionally accepted in lieu of a college degree (basic lab skills such as using a balance, colony counting, aseptic or quantitation techniques, etc., are also considered).

As a general rule for analytical staff:

Specialty	Education	Experience
Extractions, Digestions, some electrode methods (pH, DO, Redox, etc.), or Titrimetric and Gravimetric Analyses	H.S. Diploma	On the job training (OJT)
GFAA, CVAA, FLAA, Single component or short list Chromatography (e.g., Fuels, BTEX-GC, IC	A college degree in an applied science or 2 years of college and at least 1 year of college chemistry	Or 2 years prior analytical experience is required
ICP, ICPMS, Long List or complex chromatography (e.g., Pesticides, PCB, Herbicides, HPLC, etc.), GCMS	A college degree in an applied science or 2 years of college chemistry	or 5 years of prior analytical experience
Spectra Interpretation	A college degree in an applied science or 2 years of college chemistry	And 2 years relevant experience Or 5 years of prior analytical experience
Technical Managers – **General**	Bachelors Degree in an applied science or engineering with 24 semester hours in chemistry An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years experience in environmental analysis of representative analytes for which they will oversee
Technical Managers – **Wet Chem** only (no advanced instrumentation)	Associates degree in an applied science or engineering or 2 years of college with 16 semester hours in chemistry	And 2 years relevant experience
Technical Managers - Microbiology	Bachelors degree in applied science with at least 16 semester hours in general microbiology and biology An advanced (MS, PhD.) degree may substitute for one year of experience	And 2 years of relevant experience

When an analyst does not meet these requirements, they can perform a task under the direct supervision of a qualified analyst, peer reviewer or Technical Manager, and are considered an analyst in training. The person supervising an analyst in training is accountable for the quality of the analytical data and must review and approve data and associated corrective actions.

17.3 Training

The laboratory is committed to furthering the professional and technical development of employees at all levels.

Orientation to the laboratory's policies and procedures, in-house method training, and employee attendance at outside training courses and conferences all contribute toward employee proficiency. Below are examples of various areas of required employee training:

Required Training	Time Frame	Employee Type
Environmental Health & Safety	Prior to lab work	All
Ethics – New Hires	1 week of hire	All
Ethics – Comprehensive	90 days of hire	All
Data Integrity	30 days of hire	Technical and PMs
Quality Assurance	90 days of hire	All
Ethics – Comprehensive Refresher	Annually	All
Initial Demonstration of Capability (DOC)	Prior to unsupervised method performance	Technical

The laboratory maintains records of relevant authorization/competence, education, professional qualifications, training, skills and experience of technical personnel (including contracted personnel) as well as the date that approval/authorization was given. These records are kept on file at the laboratory. Also refer to "Demonstration of Capability" in Section 19.

The training of technical staff is kept up to date by:

- Each employee must have documentation in their training file that they have read, understood and agreed to follow the most recent version of the laboratory QA Manual and SOPs in their area of responsibility. This documentation is updated as SOPs are updated.
- Documentation from any training courses or workshops on specific equipment, analytical techniques or other relevant topics are maintained in their training file.
- Documentation of proficiency (refer to Section 19).
- An Ethics Agreement signed by each staff member (renewed each year) and evidence of annual ethics training.
- A Confidentiality Agreement signed by each staff member signed at the time of employment.
- Human Resources maintains documentation and attestation forms on employment status & records; benefit programs; timekeeping/payroll; and employee conduct (e.g., ethics). This information is maintained in the employee's secured personnel file.

Evidence of successful training could include such items as:

- Adequate documentation of training within operational areas, including one-on-one technical training for individual technologies, and particularly for people cross-trained.
- Analysts knowledge to refer to QA Manual for quality issues.
- Analysts following SOPs, i.e., practice matches SOPs.
- Analysts regularly communicate to supervisors and QA if SOPs need revision, rather than waiting for auditors to find problems.

Further details of the training program are described in the Laboratory Training SOP (HS-QA-001).

17.4 Data Integrity and Ethics Training Program

Establishing and maintaining a high ethical standard is an important element of a Quality System. Ethics and data integrity training is integral to the success of TestAmerica and is provided for each employee at TestAmerica. It is a formal part of the initial employee orientation within 1 week of hire followed by technical data integrity training within 30 days, comprehensive training within 90 days, and an annual refresher for all employees. Senior management at each facility performs the ethics training for their staff.

In order to ensure that all personnel understand the importance TestAmerica places on maintaining high ethical standards at all times; TestAmerica has established a Corporate Ethics Policy (Policy No. CW-L-P-004) and an Ethics Statement. All initial and annual training is documented by signature on the signed Ethics Statement demonstrating that the employee has participated in the training and understands their obligations related to ethical behavior and data integrity.

Violations of this Ethics Policy will not be tolerated. Employees who violate this policy will be subject to disciplinary actions up to and including termination. Criminal violations may also be referred to the Government for prosecution. In addition, such actions could jeopardize TestAmerica's ability to do work on Government contracts, and for that reason, TestAmerica has a Zero Tolerance approach to such violations.
Employees are trained as to the legal and environmental repercussions that result from data misrepresentation. Key topics covered in the presentation include:

- Organizational mission and its relationship to the critical need for honesty and full disclosure in all analytical reporting.
- Ethics Policy
- How and when to report ethical/data integrity issues. Confidential reporting.
- Record keeping.
- Discussion regarding data integrity procedures.
- Specific examples of breaches of ethical behavior (e.g. peak shaving, altering data or computer clocks, improper macros, etc., accepting/offering kickbacks, illegal accounting practices, unfair competition/collusion)
- Internal monitoring. Investigations and data recalls.
- Consequences for infractions including potential for immediate termination, debarment, or criminal prosecution.
- Importance of proper written narration / data qualification by the analyst and project manager with respect to those cases where the data may still be usable but are in one sense or another partially deficient.

Additionally, a data integrity hotline (1-800-736-9407) is maintained by TestAmerica and administered by the Corporate Quality Department.

SECTION 18. ACCOMMODATIONS AND ENVIRONMENTAL CONDITIONS

18.1 Overview

The laboratory is a 28,000 ft^2 secure laboratory facility with controlled access and designed to accommodate an efficient workflow and to provide a safe and comfortable work environment for employees. All visitors sign in and are escorted by laboratory personnel. Access is controlled by various measures.

The laboratory is equipped with structural safety features. Each employee is familiar with the location, use, and capabilities of general and specialized safety features associated with their workplace. The laboratory provides and requires the use of protective equipment including safety glasses, protective clothing, gloves, etc., OSHA and other regulatory agency guidelines regarding required amounts of bench and fume hood space, lighting, ventilation (temperature and humidity controlled), access, and safety equipment are met or exceeded.

Traffic flow through sample preparation and analysis areas is minimized to reduce the likelihood of contamination. Adequate floor space and bench top area is provided to allow unencumbered sample preparation and analysis space. Sufficient space is also provided for storage of reagents and media, glassware, and portable equipment. Ample space is also provided for refrigerated sample storage before analysis and archival storage of samples after analysis. Laboratory HVAC and deionized water systems are designed to minimize potential trace contaminants.

The laboratory is separated into specific areas for sample receiving, sample preparation, volatile organic sample analysis, non-volatile organic sample analysis, inorganic sample analysis, microbiological sample analysis, and administrative functions.

18.2 Environment

Laboratory accommodation, test areas, energy sources, lighting are adequate to facilitate proper performance of tests. The facility is equipped with heating, ventilation, and air conditioning (HVAC) systems appropriate to the needs of environmental testing performed at this laboratory.

The environment in which these activities are undertaken does not invalidate the results or adversely affect the required accuracy of any measurements.

The laboratory provides for the effective monitoring, control and recording of environmental conditions that may affect the results of environmental tests as required by the relevant specifications, methods, and procedures. Such environmental conditions include humidity, voltage, temperature, and vibration levels in the laboratory.

When any of the method or regulatory required environmental conditions change to a point where they may adversely affect test results, analytical testing will be discontinued until the environmental conditions are returned to the required levels.

Environmental conditions of the facility housing the computer network and LIMS are regulated to protect against raw data loss.

18.3 Work Areas

There is effective separation between neighboring areas when the activities therein are incompatible with each other. Examples include:

- Microbiological culture handling and sample incubation areas.
- Volatile organic chemical handling areas, including sample preparation and waste disposal, and volatile organic chemical analysis areas.

Access to and use of all areas affecting the quality of analytical testing is defined and controlled by secure access to the laboratory building as described below in the Building Security section.

Adequate measures are taken to ensure good housekeeping in the laboratory and to ensure that any contamination does not adversely affect data quality. These measures include regular cleaning to control dirt and dust within the laboratory. Work areas are available to ensure an unencumbered work area. Work areas include:

- Access and entryways to the laboratory.
- Sample receipt areas.
- Sample storage areas.
- Chemical and waste storage areas.
- Data handling and storage areas.
- Sample processing areas.
- Sample analysis areas.

18.4 Floor Plan

A floor plan can be found in Appendix 1.

18.5 Building Security

Building keys and alarm codes are distributed to employees as necessary.

Visitors to the laboratory sign in and out in a visitor's logbook. A visitor is defined as any person who visits the laboratory who is not an employee of the laboratory. In addition to signing into the laboratory, the Environmental, Health and Safety Manual contains requirements for visitors and vendors. There are specific safety forms that must be reviewed and signed. Visitors (with the exception of company employees) are escorted by laboratory personnel at all times, or the location of the visitor is noted in the visitor's logbook.

SECTION 19. TEST METHODS AND METHOD VALIDATION

19.1 Overview

The laboratory uses methods that are appropriate to meet our clients' requirements and that are within the scope of the laboratory's capabilities. These include sampling, handling, transport, storage and preparation of samples, and, where appropriate, an estimation of the measurement of uncertainty as well as statistical techniques for analysis of environmental data.

Instructions are available in the laboratory for the operation of equipment as well as for the handling and preparation of samples. All instructions, Standard Operating Procedures (SOPs), reference methods and manuals relevant to the working of the laboratory are readily available to all staff. Deviations from published methods are documented (with justification) in the laboratory's approved SOPs. SOPs are submitted to clients for review at their request. Significant deviations from published methods require client approval and regulatory approval where applicable.

19.2 Standard Operating Procedures (SOPS)

The laboratory maintains SOPs that accurately reflect all phases of the laboratory such as assessing data integrity, corrective actions, handling customer complaints as well as all analytical methods and sampling procedures. The method SOPs are derived from the most recently promulgated/approved, published methods and are specifically adapted to the laboratory facility. Modifications or clarifications to published methods are clearly noted in the SOPs. All SOPs are controlled in the laboratory.

- All SOPs contain a revision number, effective date, and appropriate approval signatures. Controlled copies are available to all staff.
- Procedures for writing an SOP are incorporated by reference to TestAmerica's Corporate SOP entitled 'Writing a Standard Operating Procedure', No. CW-Q-S-002 or the laboratory's SOP HS-QA-004.
- SOPs are reviewed at a minimum of every 2 years (annually for Drinking Water and DoD SOPs), and where necessary, revised to ensure continuing suitability and compliance with applicable requirements.

19.3 Laboratory Methods Manual

For each test method, the laboratory shall have available the published referenced method as well as the laboratory developed SOP.

Note: If more stringent standards or requirements are included in a mandated test method or regulation than those specified in this manual, the laboratory shall demonstrate that such requirements are met. If it is not clear which requirements are more stringent, the standard from the method or regulation is to be followed. Any exceptions or deviations from the referenced methods or regulations are noted in the specific analytical SOP.

The laboratory maintains an SOP Index for both technical and non-technical SOPs. Technical SOPs are maintained to describe a specific test method. Non-technical SOPs are maintained to describe functions and processes not related to a specific test method.

19.4 Selection of Methods

Since numerous methods and analytical techniques are available, continued communication between the client and laboratory is imperative to assure the correct methods are utilized. Once client methodology requirements are established, this and other pertinent information is summarized by the Project Manager. These mechanisms ensure that the proper analytical methods are applied when the samples arrive for log-in. For non-routine analytical services (e.g., special matrices, non-routine compound lists), the method of choice is selected based on client needs and available technology. The methods selected should be capable of measuring the specific parameter of interest, in the concentration range of interest, and with the required precision and accuracy.

19.4.1 Sources of Methods

Routine analytical services are performed using standard EPA-approved methodology. In some cases, modification of standard approved methods may be necessary to provide accurate analyses of particularly complex matrices. When the use of specific methods for sample analysis is mandated through project or regulatory requirements, only those methods shall be used.

When clients do not specify the method to be used or methods are not required, the methods used will be clearly validated and documented in an SOP and available to clients and/or the end user of the data.

The analytical methods used by the laboratory are those currently accepted and approved by the U. S. EPA and the state or territory from which the samples were collected. Reference methods include:

- *Guidelines Establishing Test Procedures for the Analysis of Pollutants Under the Clean Water Act, and Appendix A-C; 40 CFR Part 136, USEPA Office of Water. Revised as of July 1, 1995, Appendix A to Part 136 - Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater (EPA 600 Series)*
- *Methods for Chemical Analysis of Water and Wastes, EPA 600 (4-79-020), 1983.*
- *Methods for the Determination of Inorganic Substances in Environmental Samples, EPA-600/R-93/100, August 1993.*
- *Methods for the Determination of Metals in Environmental Samples, EPA/600/4-91/010, June 1991. Supplement I: EPA-600/R-94/111, May 1994.*
- *Statement of Work for Inorganics & Organics Analysis, SOM and ISM, current versions, USEPA Contract Laboratory Program Multi-media, Multi-concentration.*
- *Standard Methods for the Examination of Water and Wastewater, 18th/19th /20th/ on-line edition; Eaton, A.D. Clesceri, L.S. Greenberg, A.E. Eds; American Water Works Association, Water Pollution Control Federation, American Public Health Association: Washington, D.C.*
- *Test Methods for Evaluating Solid Waste Physical/Chemical Methods (SW846), Third Edition, September 1986, Final Update I, July 1992, Final Update IIA, August 1993, Final Update II, September 1994; Final Update IIB, January 1995; Final Update III, December 1996; Final Update IV, January 2008.*
- *Annual Book of ASTM Standards, American Society for Testing & Materials (ASTM), Philadelphia, PA.*

- *National Status and Trends Program, National Oceanographic and Atmospheric Administration, Volume I-IV, 1985-1994.*
- *Code of Federal Regulations (CFR) 40, Parts 136, 141, 172, 173, 178, 179 and 261*
- *Texas Risk Reduction Program (TRRP), Texas Commission on Environmental Quality, Texas Administrative Code, Title 30, Part 1, Chapter 350, March, 19, 2007.*

The laboratory reviews updated versions to all the aforementioned references for adaptation based upon capabilities, instrumentation, etc., and implements them as appropriate. As such, the laboratory strives to perform only the latest versions of each approved method as regulations allow or require.

Other reference procedures for non-routine analyses may include methods established by specific states (e.g., Underground Storage Tank methods), ASTM or equipment manufacturers. Sample type, source, and the governing regulatory agency requiring the analysis will determine the method utilized.

The laboratory shall inform the client when a method proposed by the client may be inappropriate or out of date. After the client has been informed, and they wish to proceed contrary to the laboratory's recommendation, it will be documented.

19.4.2 Demonstration of Capability

Before the laboratory may institute a new method and begin reporting results, the laboratory shall confirm that it can properly operate the method. In general, this demonstration does not test the performance of the method in real world samples, but in an applicable and available clean matrix sample. If the method is for the testing of analytes that are not conducive to spiking, demonstration of capability may be performed on quality control samples.

A demonstration of capability (DOC, Lab SOP # HS-QA-WI-009) is performed whenever there is a change in instrument type (e.g., new instrumentation), method or personnel (e.g., analyst hasn't performed the test within the last 12 months).

The initial demonstration of capability must be thoroughly documented and approved by the Technical Director and QA Manager prior to independently analyzing client samples. All associated documentation must be retained in accordance with the laboratories archiving procedures.

The laboratory must have an approved SOP, demonstrate satisfactory performance, and conduct an MDL study (when applicable). There may be other requirements as stated within the published method or regulations (i.e., retention time window study).

Note: In some instances, a situation may arise where a client requests that an unusual analyte be reported using a method where this analyte is not normally reported. If the analyte is being reported for regulatory purposes, the method must meet all procedures outlined within this QA Manual (SOP, MDL, and Demonstration of Capability). If the client states that the information is not for regulatory purposes, the result may be reported as long as the following criteria are met:

- The instrument is calibrated for the analyte to be reported using the criteria for the method and ICV/CCV criteria are met (unless an ICV/CCV is not required by the method or criteria are per project DQOs).
- The laboratory's nominal or default reporting limit (RL) is equal to the quantitation limit (QL), must be at or above the lowest non-zero standard in the calibration curve and must be reliably determined. Project RLs are client specified reporting levels which may be higher than the QL. Results reported below the QL must be qualified as estimated values. Also see Section 19.6.1.3, Relationship of Limit of Detection (LOD) to Quantitation Limit (QL).
- The client request is documented and the lab informs the client of its procedure for working with unusual compounds. The final report must be footnoted: *Reporting Limit based on the low standard of the calibration curve.*

19.4.3 Initial Demonstration of Capability (IDOC) Procedures

19.4.3.1 The spiking standard used must be prepared independently from those used in instrument calibration.

19.4.3.2 The analyte(s) shall be diluted in a volume of clean matrix sufficient to prepare four aliquots at the concentration specified by a method or the laboratory SOP.

19.4.3.3 At least four aliquots shall be prepared (including any applicable clean-up procedures) and analyzed according to the test method (either concurrently or over a period of days).

19.4.3.4 Using all of the results, calculate the mean recovery in the appropriate reporting units and the standard deviations for each parameter of interest.

19.4.3.5 When it is not possible to determine the mean and standard deviations, such as for presence, absence and logarithmic values, the laboratory will assess performance against criteria described in the Method SOP.

19.4.3.6 Compare the information obtained above to the corresponding acceptance criteria for precision and accuracy in the test method (if applicable) or in laboratory generated acceptance criteria (LCS or interim criteria) if there is no mandatory criteria established. If any one of the parameters do not meet the acceptance criteria, the performance is unacceptable for that parameter.

19.4.3.7 When one or more of the tested parameters fail at least one of the acceptance criteria, the analyst must proceed according to either option listed below:

- Locate and correct the source of the problem and repeat the test for all parameters of interest beginning with 19.4.3.3 above.
- Beginning with 19.4.3.3 above, repeat the test for all parameters that failed to meet criteria. Repeated failure, however, will confirm a general problem with the measurement system. If this occurs, locate and correct the source of the problem and repeat the test for all compounds of interest beginning with 19.4.3.1 above.

Note: Results of successive LCS analyses can be used to fulfill the DOC requirement.

A certification statement (refer to Figure 19-1 as an example) shall be used to document the completion of each initial demonstration of capability. A copy of the certification is archived in the analyst's training folder.

Methods on line prior to the effective date of this Section shall be updated to the procedures outlined above as new analysts perform their demonstration of capability. A copy of the new record will replace that which was used for documentation in the past. At a minimum, the precision and accuracy of four mid-level laboratory control samples must have been compared to the laboratory's quality control acceptance limits.

19.5 Laboratory Developed Methods and Non-Standard Methods

Any new method developed by the laboratory must be fully defined in an SOP and validated by qualified personnel with adequate resources to perform the method. Method specifications and the relation to client requirements must be clearly conveyed to the client if the method is a non-standard method (not a published or routinely accepted method). The client must also be in agreement to the use of the non-standard method.

19.6 Validation of Methods

Validation is the confirmation by examination and the provision of objective evidence that the particular requirements for a specific intended use are fulfilled.
All non-standard methods, laboratory designed/developed methods, standard methods used outside of their scope, and major modifications to published methods must be validated to confirm they are fit for their intended use. The validation will be as extensive as necessary to meet the needs of the given application. The results are documented with the validation procedure used and contain a statement as to the fitness for use.

19.6.1 Method Validation and Verification Activities for All New Methods

While method validation can take various courses, the following activities can be required as part of method validation. Method validation records are designated QC records and are archived accordingly.

19.6.1.1 Determination of Method Selectivity

Method selectivity is the demonstrated ability to discriminate the analyte(s) of interest from other compounds in the specific matrix or matrices from other analytes or interference. In some cases to achieve the required selectivity for an analyte, a confirmation analysis is required as part of the method.

19.6.1.2 Determination of Method Sensitivity

Sensitivity can be both estimated and demonstrated. Whether a study is required to estimate sensitivity depends on the level of method development required when applying a particular measurement system to a specific set of samples. Where estimations and/or demonstrations of sensitivity are required by regulation or client agreement, such as the procedure in 40 CFR Part 136 Appendix B, under the Clean Water Act, these shall be followed.

19.6.1.3 Relationship of Limit of Detection (LOD) to the Quantitation Limit (QL)

An important characteristic of expression of sensitivity is the difference in the LOD and the QL. The LOD is the minimum level at which the presence of an analyte can be reliably concluded. The QL is the minimum concentration of analyte that can be quantitatively determined with acceptable precision and bias. For most instrumental measurement systems, there is a region where semi-quantitative data is generated around the LOD (both above and below the estimated MDL or LOD) and below the QL. In this region, detection of an analyte may be confirmed but quantification of the analyte is unreliable within the accuracy and precision guidelines of the measurement system. When an analyte is detected below the QL, and the presence of the analyte is confirmed by meeting the qualitative identification criteria for the analyte, the analyte can be reliably reported, but the amount of the analyte can only be estimated. If data is to be reported in this region, it must be done so with a qualification that denotes the semi-quantitative nature of the result.

19.6.1.4 Determination of Interferences

A determination that the method is free from interferences in a blank matrix is performed.

19.6.1.5 Determination of Range

Where appropriate to the method, the quantitation range is determined by comparison of the response of an analyte in a curve to established or targeted criteria. Generally the upper quantitation limit is defined by highest acceptable calibration concentration. The lower quantitation limit or QL cannot be lower than the lowest non-zero calibration level, and can be constrained by required levels of bias and precision.

19.6.1.6 Determination of Accuracy and Precision

Accuracy and precision studies are generally performed using replicate analyses, with a resulting percent recovery and measure of reproducibility (standard deviation, relative standard deviation) calculated and measured against a set of target criteria.

19.6.1.7 Documentation of Method

The method is formally documented in an SOP. If the method is a minor modification of a standard laboratory method that is already documented in an SOP, an SOP Attachment describing the specific differences in the new method is acceptable in place of a separate SOP.

19.6.1.8 Continued Demonstration of Method Performance

Continued demonstration of Method Performance is addressed in the SOP. Continued demonstration of method performance is generally accomplished by batch specific QC samples such as LCS, method blanks or PT samples.

19.7 Method Detection Limits (MDL) / Limits of Detection (LOD)

Method detection limits (MDL) are initially determined in accordance with 40 CFR Part 136, Appendix B or alternatively by other technically acceptable practices that have been accepted by regulators. MDL is also sometimes referred to as Limit of Detection (LOD). The MDL theoretically represents the concentration level for each analyte within a method at which the Analyst is 99% confident that the true value is not zero. The MDL is determined for each analyte initially during the method validation process and updated as required in the analytical methods, whenever there is a significant change in the procedure or equipment, or based on project specific requirements. Generally, the analyst prepares at least seven replicates of solution spiked at one to five times the estimated method detection limit (most often at the lowest standard in the calibration curve) into the applicable matrix with all the analytes of interest. Each of these aliquots is extracted (including any applicable clean-up procedures) and analyzed in the same manner as the samples. Where possible, the seven replicates should be analyzed over 2-4 days to provide a more realistic MDL.

Refer to the Corporate SOP No. CA-Q-S-006 for details on the laboratory's MDL process.

19.8 Instrument Detection Limits (IDL)

The IDL is sometimes used to assess the reasonableness of the MDLs or in some cases required by the analytical method or program requirements. IDLs are most used in metals analyses but may be useful in demonstration of instrument performance in other areas.

IDLs are calculated to determine an instrument's sensitivity independent of any preparation method. IDLs are calculated either using 7 replicate spike analyses, like MDL but without sample preparation, or by the analysis of 10 instrument blanks and calculating 3 x the absolute value of the standard deviation.

If IDL is > than the MDL, it may be used as the reported MDL.

19.9 Verification of Detection and Reporting Limits

Once an MDL is established, it must be verified, on each instrument, by analyzing a quality control sample (prepared as a sample) at no more than 3 times the calculated MDL for single analyte analyses (e.g. most wet chemistry methods, Atomic Absorption, etc.) and no more than 4 times the calculated MDL for multiple analyte methods (e.g. GC, GCMS, ICP, etc.). The analytes must be qualitatively identified. This verification does not apply to methods that are not readily spiked (e.g. pH, turbidity, etc.) or where the lab does not report to the MDL. If the MDL does not verify, then the lab will not report to the MDL, or redevelop their MDL or use the level where qualitative identification is established. MDLs must be verified at least annually.

When the laboratory establishes a quantitation limit, it must be initially verified by the analysis of a low level standard or QC sample at 1-2 times the reporting limit and annually thereafter. The annual requirement is waved for methods that have an annually verified MDL. The laboratory will comply with any regulatory requirements.

19.10 Retention Time Windows

Most organic analyses and some inorganic analyses use chromatography techniques for qualitative and quantitative determinations. For every chromatography analysis or as specific in the reference method, each analyte will have a specific time of elution from the column to the detector. This is known as the analyte's retention time. The variance in the expected time of elution is defined as the retention time window. As the key to analyte identification in chromatography, retention time windows must be established on every column for every analyte used for that method. These records are kept with the files associated with an instrument for later quantitation of the analytes. Complete details are available in the laboratory SOPs.

19.11 Evaluation of Selectivity

The laboratory evaluates selectivity by following the checks within the applicable analytical methods, which include mass spectral tuning, second column confirmation, ICP interelement interference checks, chromatography retention time windows, sample blanks, spectrochemical, atomic absorption or fluorescence profiles, co-precipitation evaluations and specific electrode response factors.

19.12 Estimation of Uncertainty of Measurement

19.12.1 Uncertainty is "a parameter associated with the result of a measurement, that characterizes the dispersion of the values that could reasonably be attributed to the measurand" (as defined by the International Vocabulary of Basic and General Terms in Metrology, ISO Geneva, 1993, ISBN 92-67-10175-1). Knowledge of the uncertainty of a measurement provides additional confidence in a result's validity. Its value accounts for all the factors which could possibly affect the result, such as adequacy of analyte definition, sampling, matrix effects and interferences, climatic conditions, variances in weights, volumes, and standards, analytical procedure, and random variation. Some national accreditation organizations require the use of an "expanded uncertainty": the range within which the value of the measurand is believed to lie within at least a 95% confidence level with the coverage factor k=2.

19.12.2 Uncertainty is not error. Error is a single value, the difference between the true result and the measured result. On environmental samples, the true result is never known. The measurement is the sum of the unknown true value and the unknown error. Unknown error is a combination of systematic error, or bias, and random error. Bias varies predictably, constantly, and independently from the number of measurements. Random error is unpredictable, assumed to be Gaussian in distribution, and reducible by increasing the number of measurements.

19.12.3 The minimum uncertainty associated with results generated by the laboratory can be determined by using the Laboratory Control Sample (LCS) accuracy range for a given analyte. The LCS limits are used to assess the performance of the measurement system since they take into consideration all of the laboratory variables associated with a given test over time (except for variability associated with the sampling and the variability due to matrix effects). The percent recovery of the LCS is compared either to the method-required LCS accuracy limits or to the statistical, historical, in-house LCS accuracy limits.

19.12.4 To calculate the uncertainty for the specific result reported, multiply the result by the decimal of the lower end of the LCS range percent value for the lower end of the uncertainty

range, and multiply the result by the decimal of the upper end of the LCS range percent value for the upper end of the uncertainty range. These calculated values represent a 99%-certain range for the reported result. As an example, suppose that the result reported is 1.0 mg/l, and the LCS percent recovery range is 50 to 150%. The uncertainty range would be 0.5 to 1.5 mg/l, which could also be written as 1.0 +/- 0.5 mg/l.

19.12.5 In the case where a well recognized test method specifies limits to the values of major sources of uncertainty of measurement (e.g., 524.2, 525, etc.) and specifies the form of presentation of calculated results, no further discussion of uncertainty is required.

19.13 Sample Reanalysis Guidelines

Because there is a certain level of uncertainty with any analytical measurement, a sample re-preparation (where appropriate) and subsequent analysis (hereafter referred to as 'reanalysis') may result in either a higher or lower value from an initial sample analysis. There are also variables that may be present (e.g., sample homogeneity, analyte precipitation over time, etc.) that may affect the results of a reanalysis. Based on the above comments, the laboratory will reanalyze samples at a client's request with the following caveats. **Client specific Contractual Terms & Conditions for reanalysis protocols may supersede the following items.**

- Homogenous samples: If a reanalysis agrees with the original result to within the RPD limits for MS/MSD or Duplicate analyses, or within $\pm$ 1 reporting limit for samples $\leq$ 5x the reporting limit, the original analysis will be reported. At the client's request, both results may be reported on the same report but not on two separate reports.

- If the reanalysis does not agree (as defined above) with the original result, then the laboratory will investigate the discrepancy and reanalyze the sample a third time for confirmation if sufficient sample is available.

- Any potential charges related to reanalysis are discussed in the contract terms and conditions or discussed at the time of the request. The client will typically be charged for reanalysis unless it is determined that the lab was in error.

- Due to the potential for increased variability, reanalysis may not be applicable to Non-homogenous, Encore, and Sodium Bisulfate preserved samples. See the Area Supervisor or Laboratory Director if unsure.

19.14 Control of Data

The laboratory has policies and procedures in place to ensure the authenticity, integrity, and accuracy of the analytical data generated by the laboratory.

19.14.1 Computer and Electronic Data Related Requirements

The three basic objectives of our computer security procedures and policies are shown below. More detail is outlined in SOP #HS-DP-016. The laboratory is currently running the TALS which is a custom in-house developed LIMS system that has been highly customized to meet the needs of the laboratory. It is referred to as LIMS for the remainder of this section. The LIMS

utilizes Microsoft SQL Server which is an industry standard relational database platform. It is referred to as Database for the remainder of this section.

19.14.1.1 **Maintain the Database Integrity:** Assurance that data is reliable and accurate through data verification (review) procedures, password-protecting access, anti-virus protection, data change requirements, as well as an internal LIMS permissions procedure.

- LIMS Database Integrity is achieved through data input validation, internal user controls, and data change requirements.
- Spreadsheets and other software developed in-house must be verified with documentation through hand calculations prior to use. Cells containing calculations must be lock-protected and controlled.
- Instrument hardware and software adjustments are safeguarded through maintenance logs, audit trails and controlled access.

19.14.1.2 **Ensure Information Availability:** Protection against loss of information or service is ensured through scheduled back-ups, stable file server network architecture, secure storage of media, line filter, Uninterruptible Power Supply (UPS), and maintaining older versions of software as revisions are implemented.

19.14.1.3 **Maintain Confidentiality:** Ensure data confidentiality through physical access controls such as password protection or website access approval when electronically transmitting data.

19.14.2 Data Reduction

The complexity of the data reduction depends on the analytical method and the number of discrete operations involved (e.g., extractions, dilutions, instrument readings and concentrations). The analyst calculates the final results from the raw data or uses appropriate computer programs to assist in the calculation of final reportable values.

For manual data entry, e.g., Wet Chemistry, the data is reduced by the analyst and then verified by the Department Manager or alternate analyst prior to updating the data in LIMS. The spreadsheets, or any other type of applicable documents, are signed by both the analyst and alternate reviewer to confirm the accuracy of the manual entry(s).

Manual integration of peaks will be documented and reviewed and the raw data will be flagged in accordance with the TestAmerica Corporate SOP No. CA-Q-S-002, *Acceptable Manual Integration Practices*.

Analytical results are reduced to appropriate concentration units specified by the analytical method, taking into account factors such as dilution, sample weight or volume, etc. Blank correction will be applied only when required by the method or per manufacturer's indication; otherwise, it should not be performed. Calculations are independently verified by appropriate laboratory staff. Calculations and data reduction steps for various methods are summarized in the respective analytical SOPs or program requirements.

19.14.2.1 All raw data must be retained in the worklist folder, computer file (if appropriate), and/or runlog. All criteria pertinent to the method must be recorded. The

documentation is recorded at the time observations or calculations are made and must be signed or initialed/dated (month/day/year). It must be easily identifiable who performed which tasks if multiple people were involved.

19.14.2.2 In general, concentration results are reported in milligrams per liter (mg/l) or micrograms per liter (µg/l) for liquids and milligrams per kilogram (mg/kg) or micrograms per kilogram (µg/kg) for solids. For values greater than 10,000 mg/l, results can be reported in percent, i.e., 10,000 mg/l = 1%. Units are defined in each lab SOP.

19.14.2.3 In reporting, the analyst or the instrument output records the raw data result using values of known certainty plus one uncertain digit. If final calculations are performed external to LIMS, the results should be entered in LIMS with at least three significant figures. In general, results are reported to 2 significant figures on the final report.

19.14.2.4 For those methods that do not have an instrument printout or an instrumental output compatible with the LIMS System, the raw results and dilution factors are entered directly into LIMS by the analyst, and the software calculates the final result for the analytical report. LIMS has a defined significant figure criterion for each analyte.

19.14.2.5 The laboratory strives to import data directly from instruments or calculation spreadsheets to ensure that the reported data are free from transcription and calculation errors. For those analyses with an instrumental output compatible with the LIMS, the raw results and dilution factors are transferred into LIMS electronically after reviewing the quantitation report, and removing unrequested or poor spectrally-matched compounds. The analyst prints a copy of what has been entered to check for errors. This printout and the instrument's printout of calibrations, concentrations, retention times, chromatograms, and mass spectra, if applicable, are retained with the data file. The data file is stored in a monthly folder on the instrument computer; periodically, this file is transferred to the server and, eventually, to a tape file.

19.14.3 Logbook / Worksheet Use Guidelines

Logbooks and worksheets are filled out 'real time' and have enough information on them to trace the events of the applicable analysis/task. (e.g. calibrations, standards, analyst, sample ID, date, time on short holding time tests, temperatures when applicable, calculations are traceable, etc.)

- Corrections are made following the procedures outlined in Section 12.
- Logbooks are controlled by the QA department. A record is maintained of all logbooks in the lab.
- Unused portions of pages must be "Z"'d out, signed and dated.
- Worksheets are created with the approval of the Technical Director/QA Manager at the facility. The QA Manager controls all worksheets following the procedures in Section 6.

19.14.4 Review / Verification Procedures

Review procedures are out lined in several SOPs to ensure that reported data are free from calculation and transcription errors, that QC parameters have been reviewed and evaluated

before data is reported. The laboratory also has an SOP discussing Manual Integrations to ensure the authenticity of the data (SOP# HS-QA-WI-013). The general review concepts are discussed below, more specific information can be found in the SOPs.

19.14.4.1 The data review process at the laboratory starts at the Sample Control level. Sample Control personnel review chain-of-custody forms and input the sample information and required analyses into a computer LIMS. The Sample Control Supervisor reviews the transaction of the chain-of-custody forms and the inputted information. The Project Managers perform final review of the chain-of-custody forms and inputted information.

19.14.4.2 The next level of data review occurs with the Analysts. As results are generated, analysts review their work to ensure that the results generated meet QC requirements and relevant EPA methodologies. The Analysts transfer the data into the LIMS and add data qualifiers if applicable. To ensure data compliance, a different analyst performs a second level of review. Second level review is accomplished by checking reported results against raw data and evaluating the results for accuracy. During the second level review, blank runs, QA/QC check results, initial and continuing calibration results, laboratory control samples, sample data, qualifiers and spike information are evaluated. Where calibration is not required on a daily basis, secondary review of the initial calibration results may be conducted at the time of calibration. Approximately 15% of all sample data from manual methods and from automated methods, all GC/MS spectra and all manual integrations are reviewed. Manual integrations are also electronically reviewed utilizing auditing software to help ensure compliance to ethics and manual integration policies. Issues that deem further review include the following:

- QC data are outside the specified control limits for accuracy and precision
- Reviewed sample data does not match with reported results
- Unusual detection limit changes are observed
- Samples having unusually high results
- Samples exceeding a known regulatory limit
- Raw data indicating some type of contamination or poor technique
- Inconsistent peak integration
- Transcription errors
- Results outside of calibration range

19.14.4.3 Unacceptable analytical results may require reanalysis of the samples. Any problems are brought to the attention of the Laboratory Director, Project Manager, Quality Assurance Director/Manager, Technical Manager, or Supervisor for further investigation. Corrective action is initiated whenever necessary.

19.14.4.4 The results are then entered or directly transferred into the computer database and a .pdf is sent to the client or, upon request, hard copy is printed for the client.

19.14.4.5 As a final review prior to the release of the report, the Project Manager reviews the results for appropriateness and completeness. This review and approval ensures that client requirements have been met and that the final report has been properly completed. The process includes, but is not limited to, verifying that chemical relationships are evaluated, COC is followed, cover letters/ narratives are present, flags are appropriate, and project specific requirements are met.

19.14.4.6 Any project that requires a data package is subject to a tertiary data review for transcription errors and acceptable quality control requirements. The Project Manager then signs the final report. The Project Managers also check the report for any clerical or invoicing errors. When complete, the report is sent out to the client.

19.14.4.7 A visual summary of the flow of samples and information through the laboratory, as well as data review and validation, is presented in Figure 19-2.

19.14.5 Manual Integrations

Computerized data systems provide the analyst with the ability to re-integrate raw instrument data in order to optimize the interpretation of the data. Though manual integration of data is an invaluable tool for resolving variations in instrument performance and some sample matrix problems, when used improperly, this technique would make unacceptable data appear to meet quality control acceptance limits. Improper re-integrations lead to legally indefensible data, a poor reputation, or possible laboratory decertification. Because guidelines for re-integration of data are not provided in the methods and most methods were written prior to widespread implementation of computerized data systems, the laboratory trains all analytical staff on proper manual integration techniques using TestAmerica's Corporate SOP (CA-Q-S-002) as the guideline for our internal SOP No. HS-QA-WI-013, entitled Manual Integration.

19.14.5.1 The analyst must adjust baseline or the area of a peak in some situations, for example when two compounds are not adequately resolved or when a peak shoulder needs to be separated from the peak of interest. The analyst must use professional judgment and common sense to determine when manual integrating is required. Analysts are encouraged to ask for assistance from a senior analyst or manager when in doubt.

19.14.5.2 Analysts shall not increase or decrease peak areas for the sole purpose of achieving acceptable QC recoveries that would have otherwise been unacceptable. The intentional recording or reporting of incorrect information (or the intentional omission of correct information) is against company principals and policy and is grounds for immediate termination.

19.14.5.3 Client samples, performance evaluation samples, and quality control samples are all treated equally when determining whether or not a peak area or baseline should be manually adjusted.

19.14.5.4 All manual integrations receive a second level review. Manual integrations must be indicated on an expanded scale "after" chromatograms such that the integration performed can be easily evaluated during data review. Expanded scale "before" chromatograms are also required for all manual integrations on QC parameters

(calibrations, calibration verifications, laboratory control samples, internal standards, surrogates, etc.) unless the laboratory has another documented corporate approved procedure in place that can demonstrate an active process for detection and deterrence of improper integration practices.

Figure 19-1. Example - Demonstration of Capability Documentation

DEMONSTRATION OF CAPABILITIY (DOC)

Laboratory Name:_____
Laboratory Address:_____
Method:_____ Matrix:_____
Date:_____ Analyst(s):_____
Source of Analyte(s):_____

Analytical Results

Analyst	Conc. (Units)	Rep 1	Rep 2	Rep 3	Rep 4	Avg. % Recovery	% RSD

% RSD = Percent relative standard deviation = standard deviation divided by average % Recovery

Raw data reference: _____

Certification Statement:

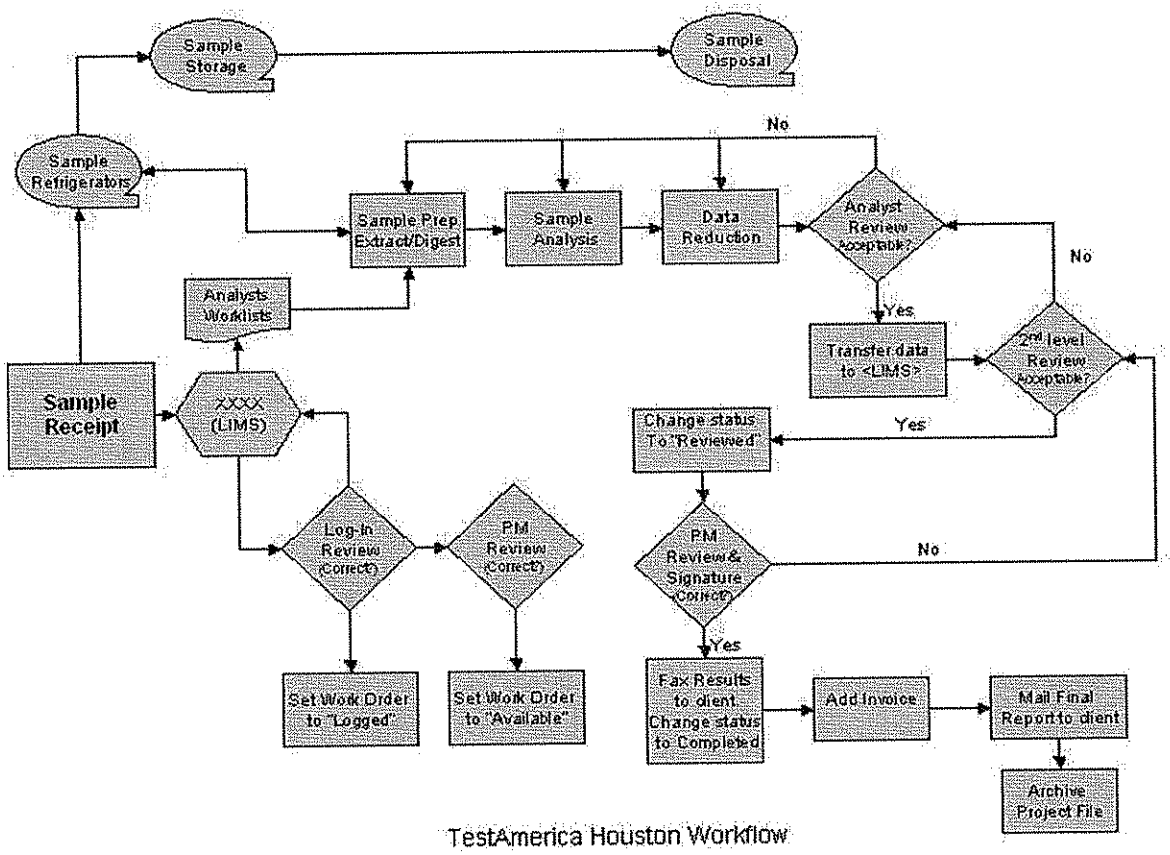
We, the undersigned, certify that:
1. The cited test method has met Demonstration of Capability requirements.
2. The test method was performed by the analyst(s) identified on this certification.
3. A copy of the test method and the laboratory-specific SOPs are available for all personnel on site.
4. The data associated with the method demonstration of capability are true, accurate, complete, and self-explanatory.
5. All raw data necessary to reconstruct and validate these analyses have been retained at the facility, and the associated information is well organized and available for review.
6.

_____ _____
Analyst Signature Date

_____ _____
Technical Director Signature Date

_____ _____
Quality Assurance Coordinator Signature Date

Figure 19-2. Example: Work Flow



SECTION 20. EQUIPMENT and CALIBRATIONS

20.1 Overview

The laboratory purchases the most technically advanced analytical instrumentation for sample analyses. Instrumentation is purchased on the basis of accuracy, dependability, efficiency and sensitivity. Each laboratory is furnished with all items of sampling, preparation, analytical testing and measurement equipment necessary to correctly perform the tests for which the laboratory has capabilities. Each piece of equipment is capable of achieving the required accuracy and complies with specifications relevant to the method being performed. Before being placed into use, the equipment (including sampling equipment) is calibrated and checked to establish that it meets its intended specification. The calibration routines for analytical instruments establish the range of quantitation. Calibration procedures are specified in laboratory SOPs. A list of laboratory instrumentation is presented in Table 20-1.

Equipment is only operated by authorized and trained personnel. Manufacturers instructions for equipment use are readily accessible to all appropriate laboratory personnel.

20.2 Preventive Maintenance

The laboratory follows a well-defined maintenance program to ensure proper equipment operation and to prevent the failure of laboratory equipment or instrumentation during use. This program of preventive maintenance helps to avoid delays due to instrument failure.

Routine preventive maintenance procedures and frequency, such as cleaning and replacements, should be performed according to the procedures outlined in the manufacturer's manual. Qualified personnel must also perform maintenance when there is evidence of degradation of peak resolution, a shift in the calibration curve, loss of sensitivity, or failure to continually meet one of the quality control criteria.

Table 20-2 lists examples of scheduled routine maintenance. It is the responsibility of each Technical Manager to ensure that instrument maintenance logs are kept for all equipment in his/her department. Preventative maintenance procedures may be / are also outlined in analytical SOPs or instrument manuals. (Note: for some equipment, the log used to monitor performance is also the maintenance log. Multiple pieces of equipment may share the same log as long as it is clear as to which instrument is associated with an entry.)

Instrument maintenance logs are controlled and are used to document instrument problems, instrument repair and maintenance activities. Maintenance logs shall be kept for all major pieces of equipment. Instrument maintenance logs may also be used to specify instrument parameters.

- Documentation must include all major maintenance activities such as contracted preventive maintenance and service and in-house activities such as the replacement of electrical components, lamps, tubing, valves, columns, detectors, cleaning and adjustments.
- Each entry in the instrument log includes the Analyst's initials, the date, a detailed description of the problem (or maintenance needed/scheduled), a detailed explanation of the solution or maintenance performed, and a verification that the equipment is functioning properly (state what was used to determine a return to control. e.g. CCV run on *'date'* was acceptable, or

instrument recalibrated on 'date' with acceptable verification, etc.) must also be documented in the instrument records.

- When maintenance or repair is performed by an outside agency, service receipts detailing the service performed can be affixed into the logbooks adjacent to pages describing the maintenance performed. This stapled in page must be signed across the page entered and the logbook so that it is clear that a page is missing if only half a signature is found in the logbook.

If an instrument requires repair (subjected to overloading or mishandling, gives suspect results, or otherwise has shown to be defective or outside of specified limits) it shall be taken out of operation and tagged as out-of-service or otherwise isolated until such a time as the repairs have been made and the instrument can be demonstrated as operational by calibration and/or verification or other test to demonstrate acceptable performance. The laboratory shall examine the effect of this defect on previous analyses.

In the event of equipment malfunction that cannot be resolved, service shall be obtained from the instrument vendor manufacturer, or qualified service technician, if such a service can be tendered. If on-site service is unavailable, arrangements shall be made to have the instrument shipped back to the manufacturer for repair. Back up instruments, which have been approved, for the analysis shall perform the analysis normally carried out by the malfunctioning instrument. If the back up is not available and the analysis cannot be carried out within the needed timeframe, the samples shall be subcontracted.

If an instrument is sent out for service or transferred to another facility, it must be recalibrated and verified (including new initial MDL study) prior to return to lab operations.

20.3 Support Equipment

This section applies to all devices that may not be the actual test instrument, but are necessary to support laboratory operations. These include but are not limited to: balances, ovens, refrigerators, freezers, incubators, water baths, field sampling devices, temperature measuring devices, thermal/pressure sample preparation devices and volumetric dispensing devices if quantitative results are dependent on their accuracy, as in standard preparation and dispensing or dilution into a specified volume. All raw data records associated with the support equipment are retained to document instrument performance.

20.3.1 Weights and Balances

The accuracy of the balances used in the laboratory is checked every working day, before use. All balances are placed on stable counter tops.

Each balance is checked prior to initial serviceable use with at least two certified ASTM type 1 weights spanning its range of use (weights that have been calibrated to ASTM type 1 weights may also be used for daily verification). ASTM type 1 weights used only for calibration of other weights (and no other purpose) are inspected for corrosion, damage or nicks at least annually and if no damage is observed, they are calibrated at least every 5 years by an outside calibration laboratory. Any weights (including ASTM Type 1) used for daily balance checks or other purposes are recalibrated/recertified annually to NIST standards (this may be done internally if laboratory maintains "calibration only" ASTM type 1 weights).

All balances are serviced annually by a qualified service representative, who supplies the laboratory with a certificate that identifies traceability of the calibration to the NIST standards.

All of this information is recorded in logs, and the recalibration/recertification certificates are kept on file.

20.3.2 pH, Conductivity, and Turbidity Meters

The pH meters used in the laboratory are accurate to ± 0.1 pH units, and have a scale readability of at least 0.05 pH units. The meters automatically compensate for the temperature, and are calibrated with at least two working range buffer solutions before each use.

Conductivity meters are also calibrated before each use with a known standard to demonstrate the meters do not exceed an error of 1% or one umhos/cm.

Turbidity meters are also calibrated before each use. All of this information is documented in logs.

Consult pH and Conductivity, and Turbidity SOPs for further information.

20.3.3 Thermometers

All thermometers are calibrated on an annual basis with a NIST-traceable thermometer. IR thermometers, digital probes and thermocouples are calibrated quarterly.

The mercury/digital NIST thermometer is recalibrated every year (unless thermometer has been exposed to temperature extremes or apparent separation of internal liquid) by an approved outside service and the provided certificate of traceability is kept on file. The NIST thermometer(s) have increments of 1 degree (0.5 degree or less increments are required for drinking water microbiological laboratories), and have ranges applicable to method and certification requirements. The NIST traceable thermometer is used for no other purpose than to calibrate other thermometers.

All of this information is documented in logbooks. Monitoring method-specific temperatures, including incubators, heating blocks, water baths, and ovens, is documented in method-specific logbooks. More information on this subject can be found in the method SOPs.

20.3.4 Refrigerators/Freezer Units, Waterbaths, Ovens and Incubators

The temperatures of all refrigerator units and freezers used for sample and standard storage are monitored each working day.

Ovens, waterbaths and incubators are monitored on days of use.

All of this equipment has a unique identification number, and is assigned a unique thermometer for monitoring.

Sample storage refrigerator temperatures are kept between > 0°C and ≤ 6 °C.

Specific temperature settings/ranges for other refrigerators, ovens waterbaths, and incubators can be found in method specific SOPs.

All of this information is documented in Daily Temperature Logbooks and method-specific logbooks.

20.3.5 Autopipettors, Dilutors, and Syringes

Mechanical volumetric dispensing devices including burettes (except Class A Glassware and Glass microliter syringes) are given unique identification numbers and the delivery volumes are verified gravimetrically, at a minimum, on a quarterly basis.

For those dispensers that are not used for analytical measurements, a label is / can be applied to the device stating that it is not calibrated. Any device not regularly verified can not be used for any quantitative measurements. More information may be found in laboratory SOP# HS-QA-026.

Micro-syringes are purchased from Hamilton Company. Each syringe is traceable to NIST. The laboratory keeps on file an "Accuracy and Precision Statement of Conformance" from Hamilton attesting established accuracy.

20.4 Instrument Calibrations

Calibration of analytical instrumentation is essential to the production of quality data. Strict calibration procedures are followed for each method. These procedures are designed to determine and document the method detection limits, the working range of the analytical instrumentation and any fluctuations that may occur from day to day.

Sufficient raw data records are retained to allow an outside party to reconstruct all facets of the initial calibration. Records contain, but are not limited to, the following: calibration date, method, instrument, analyst(s) initials or signatures, analysis date, analytes, concentration, response, type of calibration (Avg RF, curve, or other calculations that may be used to reduce instrument responses to concentration.)

Sample results must be quantitated from the initial calibration and may not be quantitated from any continuing instrument calibration verification unless otherwise required by regulation, method or program.

If the initial calibration results are outside of the acceptance criteria, corrective action is performed and any affected samples are reanalyzed if possible. If the reanalysis is not possible, any data associated with an unacceptable initial calibration will be reported with appropriate data qualifiers (refer to Section 12).

Note: Instruments are calibrated initially and as needed after that and at least annually.

20.4.1 Calibration Standards

Calibration standards are prepared using the procedures indicated in the Reagents and Standards section of the determinative method SOP. If a reference method does not specify

the number of calibration standards, a minimum of 3 calibration points (exception being ICP and ICP/MS methods) will be used.

Standards for instrument calibration are obtained from a variety of sources. All standards are traceable to national or international standards of measurement, or to national or international standard reference materials.

The lowest concentration calibration standard that is analyzed during an initial calibration must be at or below the stated reporting limit for the method based on the final volume of extract (or sample).

The other concentrations define the working range of the instrument/method or correspond to the expected range of concentrations found in actual samples that are also within the working range of the instrument/method. Results of samples not bracketed by initial instrument calibration standards (within calibration range to at least the same number of significant figures used to report the data) must be reported as having less certainty, e.g., defined qualifiers or flags (additional information may be included in the case narrative). The exception to these rules is ICP methods or other methods where the referenced method does not specify two or more standards.

All initial calibrations are verified with a standard obtained from a second source and traceable to a national standard, when available (or vendor certified different lot if a second source is not available). For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst at a different time or a different preparation would be considered a second source. This verification occurs immediately after the calibration curve has been analyzed, and before the analysis of any samples.

20.4.1.1 Calibration Verification

The calibration relationship established during the initial calibration must be verified initially and at least daily as specified in the laboratory method SOPs in accordance with the referenced analytical methods and in the 2009 TNI Standard. The process of calibration verification applies to both external standard and internal standard calibration techniques, as well as to linear and non-linear calibration models. Initial calibration verification is with a standard source secondary (second source standard) to the calibration standards, but continuing calibration verifications may use the same source standards as the calibration curve.

Note: The process of calibration verification referred to here is fundamentally different from the approach called "calibration" in some methods. As described in those methods, the calibration factors or response factors calculated during calibration are used to update the calibration factors or response factors used for sample quantitation. This approach, while employed in other EPA programs, amounts to a daily single-point calibration.

All target analytes and surrogates, including those reported as non-detects, must be included in periodic calibration verifications for purposes of retention time confirmation and to demonstrate that calibration verification criteria are being met, i.e., RPD, per 2009 TNI Std. EL-V1M4 Sec. 1.7.2.

All samples must be bracketed by periodic analyses of standards that meet the QC acceptance criteria (e.g., calibration and retention time). The frequency is found in the determinative methods or SOPs.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

Generally, the initial calibrations must be verified at the beginning of each 12-hour analytical shift during which samples are analyzed. (Some methods may specify more or less frequent verifications). The 12-hour analytical shift begins with the injection of the calibration verification standard (or the MS tuning standard in MS methods). The shift ends after the completion of the analysis of the last sample, QC, or standard that can be injected within 12 hours of the beginning of the shift.

A continuing instrument calibration verification (CCV) must be repeated at the beginning and, for methods that have quantitation by external calibration models, at the end of each analytical batch. Some methods have more frequent CCV requirements see specific SOPs. Most Inorganic methods require the CCV to be analyzed after ever 10 samples or injections, including matrix or batch QC samples.

Note: If an internal standard calibration is being used (basically GCMS) then bracketing standards are not required, only daily verifications are needed. The results from these verification standards must meet the calibration verification criteria and the retention time criteria (if applicable).

If the results of a CCV are outside the established acceptance criteria and analysis of a second consecutive (and immediate) CCV fails to produce results within acceptance criteria, corrective action shall be performed. Once corrective actions have been completed & documented, the laboratory shall demonstrate acceptable instrument / method performance by analyzing two consecutive CCVs, or a new initial instrument calibration shall be performed.

Sample analyses and reporting of data may not occur or continue until the analytical system is calibrated or calibration verified. However, data associated with an unacceptable calibration verification may be fully useable under the following special conditions: **and reported based upon discussion and approval of the client:**

a). when the acceptance criteria for the CCV are exceeded high (i.e., high bias) and the associated samples within the batch are non-detects, then those non-detects may be reported with a footnote or case narrative explaining the high bias. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted; or

b). when the acceptance criteria for the CCV are exceeded low (i.e., low bias), those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise the samples affected by the unacceptable CCV shall be re-analyzed after a new calibration curve has been established, evaluated and accepted.

Samples reported by the 2 conditions identified above will be appropriately flagged.

20.4.1.2 Verification of Linear and Non-Linear Calibrations

Calibration verification for calibrations involves the calculation of the percent drift or the percent difference of the instrument response between the initial calibration and each subsequent analysis of the verification standard. (These calculations are available in the laboratory method SOPs. Verification standards are evaluated based on the % Difference from the average CF or RF of the initial calibration or based on % Drift or % Recovery if a linear or quadratic curve is used.

Regardless of whether a linear or non-linear calibration model is used, if initial verification criterion is not met, then no sample analyses may take place until the calibration has been verified or a new initial calibration is performed that meets the specifications listed in the method SOPs. If the calibration cannot be verified after the analysis of a single verification standard, then adjust the instrument operating conditions and/or perform instrument maintenance, and analyze another aliquot of the verification standard. If the calibration cannot be verified with the second standard, then a new initial calibration is performed.

- When the acceptance criteria for the calibration verification are exceeded high, i.e., high bias, and there are associated samples that are non-detects, then those non-detects may be reported. Otherwise, the samples affected by the unacceptable calibration verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted.

- When the acceptance criteria for the calibration verification are exceeded low, i.e., low bias, those sample results may be reported if they exceed a maximum regulatory limit/decision level. Otherwise, the samples affected by the unacceptable verification shall be reanalyzed after a new calibration curve has been established, evaluated and accepted. Alternatively, a reporting limit standard may be analyzed to demonstrate that the laboratory can still support non-detects at their reporting limit.

20.5 Tentatively Identified Compounds (TICs) – GC/MS Analysis

For samples containing components not associated with the calibration standards, a library search may be made for the purpose of tentative identification. The necessity to perform this type of identification will be determined by the purpose of the analyses being conducted. Data system library search routines should not use normalization routines that would misrepresent the library or unknown spectra when compared to each other.

Note: If the TIC compound is not part of the client target analyte list but is calibrated by the laboratory and is both qualitatively and/or quantitatively identifiable, it should not be reported as a TIC. If the compound is reported on the same form as true TICs, it should be qualified and/or narrated that the reported compound is qualitatively and quantitatively (if verification in control) reported compared to a known standard that is in control (where applicable).

For example, the RCRA permit or waste delisting requirements may require the reporting of non-target analytes. Only after visual comparison of sample spectra with the nearest library searches may the analyst assign a tentative identification.

20.6 GC/MS Tuning

Prior to any GCMS analytical sequence, including calibration, the instrument parameters for the tune and subsequent sample analyses within that sequence must be set.

Prior to tuning/auto-tuning the mass spec, the parameters may be adjusted within the specifications set by the manufacturer or the analytical method. These generally don't need any adjustment but it may be required based on the current instrument performance. If the tune verification does not pass it may be necessary to clean the source or perform additional maintenance. Any maintenance is documented in the maintenance log.

Table 20-1. Example: Instrumentation List

GC	GC/MS	ICP	HPLC	AutoAnalyzer	IC	Automated Specs.	TOC
13	12	2	1	1	2	3	2

Table 20-2. Example: Schedule of Routine Maintenance

Instrument / Equipment Type	Maintenance	Frequency
Gas Chromatograph	Replace Gas line dryers and filters	Annually or As needed*
	Replace Gas cylinders	As needed*
	ECD Ni63 Foil wipe test	6 months
	Check or adjust column gas flow and/or detector make-up flow	As needed*
	Replace Injection port Septa	As needed*
	Replace Injection port liners/re-silonize liners	As needed*
	Replace injection port liner o-ring	As needed*
	Replace inlet seal and ring	As needed*
	Replace column ferrules	GC, As needed; *
	Clip column (injector and detector end)	As needed*
	Replace syringes on autosamplers	As needed*
	Replace heated-zones heaters and sensors	As needed*
	Replace inlet assembly	As needed*
	Empty solvent rinse and solvent rinse-waste vials (on autosampler tower)	Daily or as needed
	Replace column	As needed*
Flame Ionization Detector (FID)	Clean/replace jet	As needed*
	Clean collector	As needed*
	Check and/or adjust gas flows	As needed*
	Replace graphite ferrule	After each cleaning (OI detectors only)
Photoionization Detector (PID)	Clean window	As needed*
	Replace o-ring seat	As needed*
	Replace Lamp	As needed*
	Check and/or adjust gas flows	As needed*
	Adjust Lamp power supply intensity	As needed*
Mass Spectrometer (MS)	Clean source, replace source parts, replace filaments	As needed*
	Clean analyzer	As needed*
	Replace electron multiplier	As needed*
	Change rough pump oil	After each source cleaning or annually
	Refill calibration compound (PFTBA) vial	As needed
	Replace Peristaltic pump tubing	As needed*

Instrument / Equipment Type	Maintenance	Frequency
	Clean autosampler, change tubing	As needed*
	Clean nebulizer and torch assembly	Daily
	Replace nitrogen and argon tanks	As needed*
	Check spray chamber for debris	Monthly
	Refill rinse water receptacle	Daily
	Empty waste receptacle	Daily
	Check for internal standard and sample flow through peristaltic pump tubing	As often as possible
	Replace internal standard solution receptacle	As needed
	Operate and check vents	Daily
	Perform Hg alignment	Daily*
	Check water level and water filter on recirculating-cooling unit, refill and replace filter	Check daily, refill and replace as needed
	Check purge windows	Daily, replace as needed
	Replace nebulizer and o-rings	As needed*
	Replace torch	As needed*
	Drain air compressor	Weekly
	Replace mixing chambers	As needed*
	Clean or replace air filters	Weekly
	Check pneumatic filters	Weekly, replace as needed
	Perform wave calibration (UV and Vis)	Quarterly*
	Calibrate Detector	Quarterly*
	Replace pre-column filter	As needed*
	Refill Solvent reservoirs	Daily or as needed
	Reverse column and rinse with solvents	Daily or as needed*
	Replace column	As needed*
	Clean solvent reservoir filters	As needed*
	UV Detector-check intensity	6 months or as needed
	Replace ball-valve cartridges on high pressure pump	As needed*

Instrument / Equipment Type	Maintenance	Frequency
	Replace DAD flow cell windows	As needed*
	Check system solvent pressure	Daily
	Clean or replace electrode	As needed
	Refill electrode electrolyte	As needed
	Clean or replace Column	As needed*
	Replace Suppressor	As needed*
	Replace seals/valves/lamps	As needed*

SECTION 21. MEASUREMENT TRACEABILITY

21.1 Overview

Traceability of measurements shall be assured using a system of documentation, calibration, and analysis of reference standards. Laboratory equipment that are peripheral to analysis and whose calibration is not necessarily documented in a test method analysis or by analysis of a reference standard shall be subject to ongoing certifications of accuracy. At a minimum, these must include procedures for checking specifications of ancillary equipment: balances, thermometers, temperature, Deionized (DI) and Reverse Osmosis (RO) water systems, automatic pipettes and other volumetric measuring devices. (Refer to Section 20.3). With the exception of Class A Glassware and Glass microliter syringes, quarterly accuracy checks are performed for all mechanical volumetric devices. Microsyringes are verified at least semi-annually or disposed of after 6 months of use. Wherever possible, subsidiary or peripheral equipment is checked against standard equipment or standards that are traceable to national or international standards. Class A Glassware and Glass microliter syringes should be routinely inspected for chips, acid etching or deformity (e.g., bent needle). If the Class A glassware or syringe is suspect, the accuracy of the glassware will be assessed prior to use.

21.2 NIST-Traceable Weights and Thermometers

Reference standards of measurement shall be used for calibration only and for no other purpose, unless it can be shown that their performance as reference standards would not be invalidated.

For NIST-traceable weights and thermometers, the laboratory requires that all calibrations be conducted by a calibration laboratory accredited by A2LA, NVLAP (National Voluntary Laboratory Accreditation Program), APLAC (Asia-Pacific Laboratory Accreditation Cooperation), or EA (European Cooperation for Accreditation). A certificate and scope of accreditation is kept on file at the laboratory.

21.3 Reference Standards / Materials

Reference standards/materials, where commercially available, are traceable to certified reference materials. Commercially prepared standard materials are purchased from vendors accredited by A2LA, NVLAP, with an accompanying Certificate of Analysis that documents the standard purity. If a standard cannot be purchased from a vendor that supplies a Certificate of Analysis, the purity of the standard is documented by analysis. The receipt of all reference standards must be documented. Reference standards are labeled with a unique Standard Identification Number and expiration date. All documentation received with the reference standard is retained as a QC record and references the Standard Identification Number.

All reference, primary and working standards/materials, whether commercially purchased or laboratory prepared, must be checked regularly to ensure that the variability of the standard or material from the 'true' value does not exceed method requirements. The accuracy of calibration standards is checked by comparison with a standard from a second source. In cases where a second standard manufacturer is not available, a vendor certified different lot is acceptable for use as a second source. For unique situations, such as air analysis where no other source or lot is available, a standard made by a different analyst would be considered a second source. The appropriate Quality Control (QC) criteria for specific standards are defined in laboratory

SOPs. In most cases, the analysis of an Initial Calibration Verification (ICV) or LCS (where there is no sample preparation) is used as the second source confirmation. These checks are generally performed as an integral part of the analysis method (e.g. calibration checks, laboratory control samples).

All standards and materials must be stored and handled according to method or manufacturer's requirements in order to prevent contamination or deterioration. Refer to the Corporate Environmental Health & Safety Manual or laboratory SOPs. For safety requirements, please refer to method SOPs and the laboratory Environmental Health and Safety Manual.

Standards and reference materials shall not be used after their expiration dates unless their reliability is verified by the laboratory and their use is approved by the Quality Assurance Manager. The laboratory must have documented contingency procedures for re-verifying expired standards.

21.4 Documentation and Labeling of Standards, Reagents, and Reference Materials

Reagents must be at a minimum the purity required in the test method. The date of reagent receipt and the expiration date are documented. The lots for most of the common solvents and acids are tested for acceptability prior to company wide purchase. [Refer to TestAmerica's Corporate SOP (CA-Q-S-001), Solvent and Acid Lot Testing and Approval.]

All manufacturer or vendor supplied Certificate of Analysis or Purity must be retained, stored appropriately, and readily available for use and inspection. These records are maintained in the Department Manager's office. Records must be kept of the date of receipt and date of expiration of standards, reagents and reference materials. In addition, records of preparation of laboratory standards, reagents, and reference materials must be retained, stored appropriately, and be readily available for use and inspection. For detailed information on documentation and labeling, please refer to method specific SOPs.

Commercial materials purchased for preparation of calibration solutions, spike solutions, etc.., are usually accompanied with an assay certificate or the purity is noted on the label. If the assay purity is 96% or better, the weight provided by the vendor may be used without correction. If the assay purity is less than 96% a correction will be made to concentrations applied to solutions prepared from the stock commercial material (for 1613B dioxin/furan analyses the purity must be 98% or corrections must be made).

21.4.1 All standards, reagents, and reference materials must be labeled in an unambiguous manner. Standards are logged into the laboratory's LIMS system, and are assigned a unique identification number. The following information is typically recorded in the electronic database within the LIMS.

- Standard ID
- Description of Standard
- Department
- Preparer's name
- Final volume and number of vials prepared
- Solvent type and lot number

- Preparation Date
- Expiration Date
- Standard source type (stock or daughter)
- Standard type (spike, surrogate, other)
- Parent standard ID (if applicable)
- Parent Standard Analyte Concentration (if applicable)
- Parent Standard Amount used (if applicable)
- Component Analytes
- Final concentration of each analyte
- Comment box (text field)

Records are maintained electronically for standard and reference material preparation. These records show the traceability to purchased stocks or neat compounds. These records also include method of preparation, date of preparation, expiration date and preparer's name or initials. Preparation procedures are provided in the Method SOPs.

21.4.2 All standards, reagents, and reference materials must be clearly labeled with a minimum of the following information:

- Expiration Date (include prep date for reagents)
- Standard ID ***(from LIMS)***
- Special Health/Safety warnings if applicable

Records must also be maintained of the date of receipt for commercially purchased items or date of preparation for laboratory prepared items. Special Health/Safety warnings must also be available to the analyst. This information is maintained on the TestAmerica Intranet and the Local Area Network.

21.4.3 In addition, the following information may be helpful:

- Date opened (for multi-use containers, if applicable)
- Description of standard (if different from manufacturer's label or if standard was prepared in the laboratory)
- Recommended Storage Conditions
- Concentration (if applicable)
- Initials of analyst preparing standard or opening container

All containers of prepared reagents must include an expiration date and an ID number to trace back to preparation. Procedures for preparation of reagents can be found in the Method SOPs. Standard ID numbers must be traceable through associated logbooks, worksheets and raw data. All reagents and standards must be stored in accordance to the following priority: 1) with the manufacturer's recommendations; 2) with requirements in the specific analytical methods as specified in the laboratory SOP.

SECTION 22. SAMPLING

22.1 Overview

The laboratory does not provide sampling services. The laboratory's responsibility in the sample collection process lies in supplying the sampler with the necessary coolers, reagent water, sample containers, preservatives, sample labels, custody seals, COC forms, ice, and packing materials required to properly preserve, pack, and ship samples to the laboratory.

22.2 Sampling Containers

The laboratory offers clean sampling containers for use by clients. These containers are obtained from reputable container manufacturers and meet EPA specifications as required. Any certificates of cleanliness that are provided by the supplier are maintained at the laboratory.

22.2.1 Preservatives

Upon request, preservatives are provided to the client in pre-cleaned sampling containers. In some cases containers may be purchased pre-preserved from the container supplier. Whether prepared by the laboratory or bought pre-preserved, the grades of the preservatives are at a minimum:

- Hydrochloric Acid – Reagent ACS (Certified VOA Free) or equivalent
- Methanol – Purge and Trap grade
- Nitric Acid – Instra-Analyzed or equivalent
- Sodium Bisulfate – ACS Grade or equivalent
- Sodium Hydroxide – Instra-Analyzed or equivalent
- Sulfuric Acid – Instra-Analyzed or equivalent
- Sodium Thiosulfate – ACS Grade or equivalent

22.3 Definition of Holding Time

The date and time of sampling documented on the COC form establishes the day and time zero. As a general rule, when the maximum allowable holding time is expressed in "days" (e.g., 14 days, 28 days), the holding time is based on calendar day measured. Holding times expressed in "hours" (e.g., 6 hours, 24 hours, etc.) are measured from date and time zero. The first day of holding time ends twenty-four hours after sampling. Holding times for analysis include any necessary reanalysis. However, there are some programs that determine holding time compliance based on the date and specific time of analysis compared to the time of sampling regardless of how long the holding time is.

22.4 Sampling Containers, Preservation Requirements, Holding Times

The preservation and holding time criteria specified in the laboratory SOPs are derived from the source documents for the methods. If method required holding times or preservation requirements are not met, the reports will be qualified using a flag, footnote or case narrative. As soon as possible or "ASAP" is an EPA designation for tests for which rapid analysis is advised, but for which neither EPA nor the laboratory have a basis for a holding time.

22.5 Sample Aliquots / Subsampling

Taking a representative sub-sample from a container is necessary to ensure that the analytical results are representative of the sample collected in the field. The size of the sample container, the quantity of sample fitted within the container, and the homogeneity of the sample need consideration when sub-sampling for sample preparation. It is the laboratory's responsibility to take a representative subsample or aliquot of the sample provided for analysis.

Analysts should handle each sample as if it is potentially dangerous. At a minimum, safety glasses, gloves, and lab coats must be worn when preparing aliquots for analysis.

Guidelines on taking sample aliquots & subsampling are located in SOP # HS-SA-017.

SECTION 23. HANDLING OF SAMPLES

Sample management procedures at the laboratory ensure that sample integrity and custody are maintained and documented from sampling/receipt through disposal.

23.1 Chain of Custody (COC)

The COC form is the written documented history of any sample and is initiated when bottles are sent to the field, or at the time of sampling. This form is completed by the sampling personnel and accompanies the samples to the laboratory where it is received and stored under the laboratory's custody. The purpose of the COC form is to provide a legal written record of the handling of samples from the time of collection until they are received at the laboratory. It also serves as the primary written request for analyses from the client to the laboratory. The COC form acts as a purchase order for analytical services when no other contractual agreement is in effect. An example of a COC form may be found in Figure 23-1.

23.1.1 Field Documentation

The information the sampler needs to provide at the time of sampling on the container label is:

- Sample identification
- Date and time
- Preservative

During the sampling process, the COC form is completed and must be legible (see Figure 23-1). This form includes information such as:

- Client name, address, phone number and fax number (if available)
- Project name and/or number
- The sample identification
- Date, time and location of sampling **(V1M2 5.7.4)**
- Sample collectors name
- The matrix description
- The container description
- The total number of each type of container
- Preservatives used
- Analysis requested
- Requested turnaround time (TAT)
- Any special instructions
- Purchase Order number or billing information (e.g. quote number) if available
- The date and time that each person received or relinquished the sample(s), including their signed name.

When the sampling personnel deliver the samples directly to TestAmerica personnel, the samples are stored in a cooler with ice, as applicable, and remain solely in the possession of the client's field technician until the samples are delivered to the laboratory personnel. The

sample collector must assure that each container is in his/her physical possession or in his/her view at all times, or stored in such a place and manner to preclude tampering. The field technician relinquishes the samples in writing on the COC form to the sample control personnel at the laboratory or to a TestAmerica courier. When sampling personnel deliver the samples through a common carrier (Fed-Ex, UPS), the CoC relinquished date/time is completed by the field personnel and samples are released to the carrier. Samples are only considered to be received by lab when personnel at the fixed laboratory facility have physical contact with the samples.

Note: Independent couriers are not required to sign the COC form. The COC is usually kept in the sealed sample cooler. The receipt from the courier is stored in log-in by date; it lists all receipts each date.

23.1.2 Legal / Evidentiary Chain-of-Custody

If samples are identified for legal/evidentiary purposes on the COC, login will complete the custody seal retain the shipping record with the COC, and initiate an internal COC for laboratory use by analysts and a sample disposal record.

23.2 Sample Receipt

Samples are received at the laboratory by designated sample receiving personnel and a unique laboratory project identification number is assigned. Each sample container shall be assigned a unique sample identification number that is cross-referenced to the client identification number such that traceability of test samples is unambiguous and documented. Each sample container is affixed with a durable sample identification label. Sample acceptance, receipt, tracking and storage procedures are summarized in the following sections.

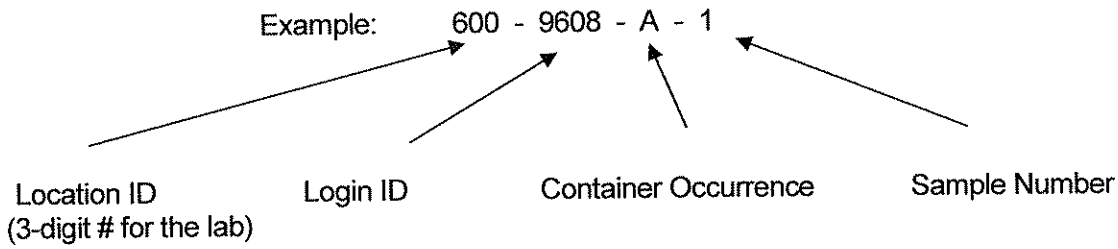
23.2.1 Laboratory Receipt

When samples arrive at the laboratory, sample receiving personnel inspect the coolers and samples. The integrity of each sample must be determined by comparing sample labels or tags with the COC and by visual checks of the container for possible damage. Any non-conformance, irregularity, or compromised sample receipt must be documented on a Sample Receipt Checklist, entered into the LIMS in an NCM, and brought to the immediate attention of the client. The COC, shipping documents, documentation of any non-conformance, irregularity, or compromised sample receipt, record of client contact, and resulting instructions become part of the project record.

23.2.1.1 Unique Sample Identification

All samples that are processed through the laboratory receive a unique sample identification to ensure that there can be no confusion regarding the identity of such samples at anytime. This system includes identification for all samples, subsamples and subsequent extracts and/or digestates.

The laboratory assigns a unique identification (e.g., Sample ID) code to each sample container received at the laboratory. This Primary ID is made up of the following information (consisting of 4 components):



The above example states that TestAmerica Houston Laboratory (Location 600). Login ID is 9608 (unique to a particular client/job occurrence). The container code indicates it is the first container ("A") of Sample #1.

If the primary container goes through a prep step that creates a "new" container, then the new container is considered secondary and gets another ID. An example of this being a client sample in a 1-Liter amber bottle is sent through a Liquid/Liquid Extraction and an extraction vial is created from this step. The vial would be a SECONDARY container. The secondary ID has 5 components.

Example: 600 - 9608 - A - 1 - **A** ←——**Secondary Container Occurrence**

Example: 600-9608-A-1-A, would indicate the PRIMARY container listed above that went through a step that created the 1st occurrence of a Secondary container.

With this system, a client sample can literally be tracked throughout the laboratory in every step from receipt to disposal.

23.3 Sample Acceptance Policy

The laboratory has a written sample acceptance policy (Figure 23-2) that clearly outlines the circumstances under which samples shall be accepted or rejected. These include:

- a COC filled out completely;
- samples must be properly labeled;
- proper sample containers with adequate volume for the analysis (Sampling Guide) and necessary QC;
- samples must be preserved according to the requirements of the requested analytical method (Sampling Guide);
- sample holding times must be adhered to (Sampling Guide);
- the project manager will be notified if any sample is received in damaged condition.

Data from samples which do not meet these criteria are flagged and the nature of the variation from policy is defined. A copy of the sample acceptance policy is provided to each client prior to shipment of samples.

23.3.1 After inspecting the samples, the sample receiving personnel sign and date the COC form, make any necessary notes of the samples' conditions and store them in appropriate refrigerators or storage locations.

23.3.2 Any deviations from these checks that question the suitability of the sample for analysis, or incomplete documentation as to the tests required will be resolved by consultation with the client. If the sample acceptance policy criteria are not met, the laboratory shall either:

- Retain all correspondence and/or records of communications with the client regarding the disposition of rejected samples, or
- Fully document any decision to proceed with sample analysis that does not meet sample acceptance criteria.

Note: North Carolina requires that they be notified when samples are processed that do not meet sample acceptance criteria.

Once sample acceptance is verified, the samples are logged into the LIMS according SOP No. HS-SA-001.

23.4 Sample Storage

In order to avoid deterioration, contamination or damage to a sample during storage and handling, from the time of receipt until all analyses are complete, samples are stored in refrigerators, freezers or protected locations suitable for the sample matrix. Samples for metals analysis are stored unrefrigerated. In addition, samples to be analyzed for volatile organic parameters are stored in separate refrigerators designated for volatile organic parameters only. Samples are never to be stored with reagents, standards or materials that may create contamination.

To ensure the integrity of the samples during storage, refrigerator blanks are maintained in the volatile sample refrigerators and analyzed every two weeks.

Analysts and technicians retrieve the sample container allocated to their analysis from the designated refrigerator and place them on carts, analyze the sample, and return the remaining sample or empty container to the refrigerator from which it originally came. All unused portions of samples, including empty sample containers, are returned to the secure sample control area. All samples are kept in the refrigerators for two to four weeks after analysis, which meets or exceeds most sample holding times. After two to four weeks the samples are moved to dry room temperature, sample archive area where they are stored for an additional four weeks before they are disposed of. This eight week holding period allows samples to be checked if a discrepancy or question arises. Special arrangements may be made to store samples for longer periods of time. This extended holding period allows additional metal analyses to be performed on the archived sample and assists clients in dealing with legal matters or regulatory issues.

Access to the laboratory is controlled such that sample storage need not be locked at all times unless a project specifically demands it. Samples are accessible to laboratory personnel only. Visitors to the laboratory are prohibited from entering the refrigerator and laboratory areas unless accompanied by an employee of TestAmerica.

23.5 Hazardous Samples and Foreign Soils

To minimize exposure to personnel and to avoid potential accidents, hazardous and foreign soil samples are stored in an isolated area designated for hazardous waste only. For any sample that is known to be hazardous at the time of receipt or, if after completion of analysis the result exceeds the acceptable regulatory levels, a Hazardous Sample Notice must be completed by the analyst. This form may be completed by Sample Control, Project Managers, or analysts and must be attached to the report. The sample itself is clearly marked with a red stamp, stamped on the sample label reading "HAZARDOUS" or "FOREIGN SOIL" and placed in a colored and/or marked bag to easily identify the sample. The date, log number, lab sample number, and the result or brief description of the hazard are all written on the Hazardous & Foreign Soil Sample Notice. A copy of the form must be included with the original COC and Work Order and the original must be given to the Sample Control Custodian. Analysts will notify Sample Control of any sample determined to be hazardous after completion of analysis by completing a Hazardous Sample Notice. All hazardous samples are either returned to the client or disposed of appropriately through a hazardous waste disposal firm that lab-packs all hazardous samples and removes them from the laboratory. Foreign soil samples are sent out for incineration by a USDA-approved waste disposal facility.

23.6 Sample Shipping

In the event that the laboratory needs to ship samples, the samples are placed in a cooler with enough ice to ensure the samples remain just above freezing and at or below 6.0°C during transit. The samples are carefully surrounded by packing material to avoid breakage (yet maintain appropriate temperature). A trip blank is enclosed for those samples requiring water/solid volatile organic analyses (see Note). The chain-of-custody form is signed by the sample control technician and attached to the shipping paperwork. Samples are generally shipped overnight express or hand-delivered by a TestAmerica courier to maintain sample integrity. All personnel involved with shipping and receiving samples must be trained to maintain the proper chain-of-custody documentation and to keep the samples intact and on ice. The Environmental, Health and Safety Manual contains additional shipping requirements.

Note: If a client does not request trip blank analysis on the COC or other paperwork, the laboratory will not analyze the trip blanks that were supplied. However, in the interest of good client service, the laboratory will advise the client at the time of sample receipt that it was noted that they did not request analysis of the trip blank; and that the laboratory is providing the notification to verify that they are not inadvertently omitting a key part of regulatory compliance testing.

23.7 Sample Disposal

Samples should be retained for a minimum of 30 days after the project report is sent, however, provisions may be made for earlier disposal of samples once the holding time is exceeded.

Some samples are required to be held for longer periods based on regulatory or client requirements (e.g., 60 days after project report is sent). The laboratory must follow the longer sample retention requirements where required by regulation or client agreement. Several possibilities for sample disposal exist: the sample may be consumed completely during analysis, the sample may be returned to the customer or location of sampling for disposal, or the sample may be disposed of in accordance with the laboratory's waste disposal procedures (SOP: HS-ST-014). All procedures in the laboratory Environmental, Health and Safety Manual are followed during disposal. Samples are normally maintained in the laboratory no longer than two months from receipt unless otherwise requested. Unused portions of samples found or suspected to be hazardous according to state or federal guidelines may be returned to the client upon completion of the analytical work.

If a sample is part of a known litigation, the affected legal authority, sample data user, and/or submitter of the sample must participate in the decision about the sample's disposal. All documentation and correspondence concerning the disposal decision process must be kept on file. Pertinent information includes the date of disposal, nature of disposal (such as sample depletion, hazardous waste facility disposal, return to client), names of individuals who conducted the arrangements and physically completed the task. The laboratory will remove or deface sample labels prior to disposal unless this is accomplished through the disposal method (e.g., samples are incinerated). A Waste Disposal Record should be completed.

Figure 23-1. **Example: Chain of Custody (COC)**

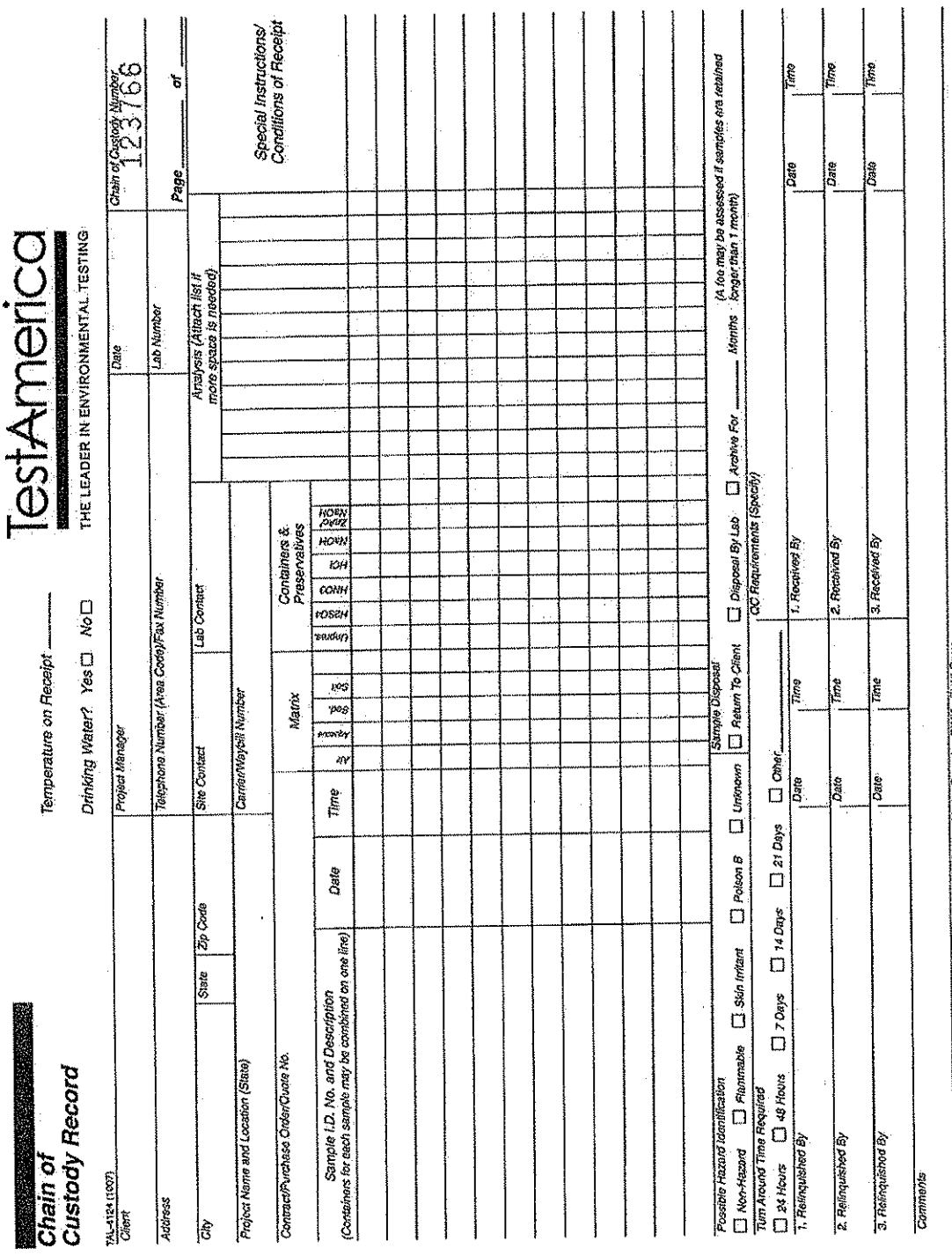


Figure 23-2. Example: Sample Acceptance Policy

All incoming work will be evaluated against the criteria listed below. Where applicable, data from any samples that do not meet the criteria listed below will be noted on the laboratory report defining the nature and substance of the variation. In addition the client will be notified either by telephone, fax or e-mail ASAP after the receipt of the samples.

1) Samples must arrive with labels intact with a Chain of Custody filled out completely. The following information must be recorded.
   - *Client name, address, phone number and fax number (if available)*
   - *Project name and/or number*
   - *The sample identification*
   - *Date, time and location of sampling* (V1M2 5.7.4)
   - *The collectors name*
   - *The matrix description*
   - *The container description*
   - *The total number of each type of container*
   - *Preservatives used*
   - *Analysis requested*
   - *Requested turnaround time (TAT)*
   - *Any special instructions*
   - *Purchase Order number or billing information (e.g. quote number) if available*
   - *The date and time that each person received or relinquished the sample(s), including their signed name.*
   - *The date and time of receipt must be recorded between the last person to relinquish the samples and the person who receives the samples in the lab, and they must be exactly the same.*
   - Information must be legible

2) Samples must be properly labeled.
   - Use durable labels (labels provided by TestAmerica are preferred)
   - Include a unique identification number
   - Include sampling date and time & sampler ID
   - Include preservative used.
   - Use indelible ink
   - Information must be legible

3) Proper sample containers with adequate volume for the analysis and necessary QC are required for each analysis requested. See Lab Sampling Guide.

4) Samples must be preserved according to the requirements of the requested analytical method (See Sampling Guide.

5) Most analytical methods require chilling samples to 4° C (other than water samples for metals analysis). For these methods, the criteria are met if the samples are chilled to below 6° C and above freezing (0°C). For methods with other temperature criteria (e.g. some bacteriological methods require ≤ 10 °C), the samples must arrive within ± 2° C of the required temperature or within the method specified range. **Note:** Samples that are hand delivered to the laboratory immediately after collection may not have had time to cool sufficiently. In this case the samples will be considered acceptable as long as there is evidence that the chilling process has begun (arrival on ice).

5i.) Samples that are delivered to the laboratory on the same day they are collected may not meet the requirements of Section 5. In these cases, the samples shall be considered acceptable if the samples were received on ice.

5ii.) If sample analysis is begun within fifteen (15) minutes of collection, thermal preservation is not required.

5iii.)Thermal preservation is not required in the field if the laboratory receives and refrigerates the sample within fifteen (15) minutes of collection.

- Chemical preservation (pH) will be verified prior to analysis and documented, either in sample control or at the analyst's level. The project manager will be notified immediately if there is a discrepancy. If analyses will still be performed, all affected results will be flagged to indicate improper preservation.

- **FOR WATER SAMPLES TESTED FOR CYANIDE (by Standard Methods or EPA 335)**
  - In the Field: Samples are to be tested for Sulfide using lead acetate paper prior to the addition of Sodium Hydroxide (NaOH). If sulfide is present, the sample must be treated with Cadmium Chloride and filtered prior to the addition of NaOH.
    - If the sulfide test and treatment is not performed in the field, the lab will test the samples for sulfide using lead acetate paper at the time of receipt and if sulfide is present in the sample, the client will be notified and given the option of retaking the sample and treating in the field per the method requirements or the laboratory can analyze the samples as delivered and qualify the results in the final report.
  - It is the responsibility of the client to notify the laboratory if thiosulfate, sulfite, or thiocyanate are known or suspected to be present in the sample. This notification may be on the chain of custody. The samples may need to be subcontracted to a laboratory that performs a UV digestion. If the lab does not perform the UV digestion on samples that contain these compounds, the results must be qualified in the final report.
  - The laboratory must test the sample for oxidizing agents (e.g. Chlorine) prior to analysis and treat according to the methods prior to distillation. (ascorbic acid or sodium arsenite are the preferred choice).

6) Sample Holding Times
   - TestAmerica will make every effort to analyze samples within the regulatory holding time. Samples must be received in the laboratory with enough time to perform the sample analysis. Except for short holding time samples (< 48hr HT) sample must be received with at least 48 hrs (working days) remaining on the holding time for us to ensure analysis.

   - Analyses that are designated as "field" analyses (Odor, pH, Dissolved Oxygen, Disinfectant Residual; a.k.a. Residual Chlorine, and Redox Potential) should be analyzed ASAP by the field sampler prior to delivering to the lab (within 15 minutes). However, if the analyses are to be performed in the laboratory, TestAmerica will make every effort to analyze the samples within 24 hours from receipt of the samples in the testing laboratory. Samples for "field" analyses received after 4:00 pm on Friday or on the weekend will be analyzed no later than the next business day

after receipt (Monday unless a holiday). Samples will remain refrigerated and sealed until the time of analysis. The actual times of all "field" sample analyses are noted on the "Short Hold Time Detail Report" in the final report. Samples analyzed in the laboratory will be qualified on the final report with an 'H' to indicate holding time exceedance.

7) All samples submitted for Volatile Organic analyses must have a Trip Blank submitted at the same time. TestAmerica will supply a blank with the bottle order.

8) The project manager will be notified if any sample is received in damaged condition. TestAmerica will request that a sample be resubmitted for analysis.

9) Recommendations for packing samples for shipment.

   - Pack samples in Ice rather than "Blue" ice packs.
   - Soil samples should be placed in plastic zip-lock bags. The containers often have dirt around the top and do not seal very well and are prone to intrusion from the water from melted ice.
   - Water samples would be best if wrapped with bubble-wrap or paper (newspaper, or paper towels work) and then placed in plastic zip-lock bags.
   - Fill extra cooler space with bubble wrap.

Figure 23-3. Example: Cooler Receipt Form

TestAmerica
THE LEADER IN ENVIRONMENTAL TESTING

DATE / TIME RECEIVED

Sample Receipt Checklist

CLIENT: _____

UNPACKED BY: _____

CARRIER/DRIVER: _____

Number of Coolers Received: _____

Custody Seal Present: ☐YES ☐NO JOB NUMBER: _____

IR THERMOMETER #: _____ THERMOMETER CORRECTION FACTOR : _____

Temperature of the samples(s):
Temp taken by: TB = Temp. Blank and/or SC = Sample Container

Cooler ID									
Temp	TB SC	TB SC	TB SC	TB SC	TB SC	TB SC	TB SC	TB SC	TB SC
Corrected Temp									

PRESERVATION OF SAMPLES REQUIRED: ☐NA ☐YES ☐VOA Samples

VOA headspace acceptable: ☐YES ☐NO VOA trip blanks included: ☐YES ☐NO

Base samples are>pH 12: ☐YES ☐NO Acid preserved are<pH 2: ☐YES ☐NO

Lot #_____ Lot #_____

	YES	NO
Did samples meet the laboratory's standard conditions of sample acceptability upon receipt?		

COMMENTS:

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SECTION 24. ASSURING THE QUALITY OF TEST RESULTS

24.1 Overview

In order to assure our clients of the validity of their data, the laboratory continuously evaluates the quality of the analytical process. The analytical process is controlled not only by instrument calibration as discussed in Section 20, but also by routine process quality control measurements (e.g. Blanks, Laboratory Control Samples (LCS), Matrix Spikes (MS), duplicates (DUP), surrogates, Internal Standards (IS)). These quality control checks are performed as required by the method or regulations to assess precision and accuracy. In addition to the routine process quality control samples, Proficiency Testing (PT) Samples (concentrations unknown to laboratory) are analyzed to help ensure laboratory performance.

24.2 Controls

Sample preparation or pre-treatment is commonly required before analysis. Typical preparation steps include homogenization, grinding, solvent extraction, sonication, acid digestion, distillation, reflux, evaporation, drying and ashing. During these pre-treatment steps, samples are arranged into discreet manageable groups referred to as preparation (prep) batches. Prep batches provide a means to control variability in sample treatment. Control samples are added to each prep batch to monitor method performance and are processed through the entire analytical procedure with investigative/field samples.

24.3 Negative Controls

Table 24-1. Example – Negative Controls

Control Type	Details
Method Blank (MB)	are used to assess preparation and analysis for possible contamination during the preparation and processing steps.
	The specific frequency of use for method blanks during the analytical sequence is defined in the specific standard operating procedure for each analysis. Generally it is 1 for each batch of samples; not to exceed 20 environmental samples.
	The method blank is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (e.g., Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The method blank goes through all of the steps of the process (including as necessary: filtration, clean-ups, etc.).
	Reanalyze or qualify associated sample results when the concentration of a targeted analyte in the blank is at or above the reporting limit as established by the method or by regulation, AND is greater than 1/10 of the amount measured in the sample.
Calibration Blanks	are prepared and analyzed along with calibration standards where applicable. They are prepared using the same reagents that are used to prepare the standards. In some analyses the calibration blank may be included in the calibration curve.
Instrument Blanks	are blank reagents or reagent water that may be processed during an analytical sequence in order to assess contamination in the analytical system. In general, instrument blanks are used to differentiate between contamination caused by the analytical system and that caused by the sample handling or sample prep process. Instrument blanks may also be inserted throughout the analytical sequence to minimize the effect of carryover from samples with high analyte content.

Table 24-1. Example – Negative Controls

Control Type	Details
Trip Blank [1]	are required to be submitted by the client with each shipment of samples requiring aqueous and solid volatiles analyses (or as specified in the client's project plan). Additionally, trip blanks may be prepared and analyzed for volatile analysis of air samples, when required by the client. A trip blank may be purchased (certified clean) or is prepared by the laboratory by filling a clean container with pure deionized water that has been purged to remove any volatile compounds. Appropriate preservatives are also added to the container. The trip blank is sent with the bottle order and is intended to reflect the environment that the containers are subjected to throughout shipping and handling and help identify possible sources if contamination is found. The field sampler returns the trip blank in the cooler with the field samples.
Field Blanks [1]	are sometimes used for specific projects by the field samplers. A field blank prepared in the field by filling a clean container with pure reagent water and appropriate preservative, if any, for the specific sampling activity being undertaken. (EPA OSWER)
Equipment Blanks [1]	are also sometimes created in the field for specific projects. An equipment blank is a sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures. (**TNI**)
Holding Blanks	also referred to as refrigerator or freezer blanks, are used to monitor the sample storage units for volatile organic compounds during the storage of VOA samples in the laboratory

[1] When known, these field QC samples should not be selected for matrix QC as it does not provide information on the behavior of the target compounds in the field samples. Usually, the client sample ID will provide information to identify the field blanks with labels such as "FB", "EB", or "TB."

Evaluation criteria and corrective action for these controls are defined in the specific standard operating procedure for each analysis.

24.4 Positive Controls

Control samples (e.g., QC indicators) are analyzed with each batch of samples to evaluate data based upon (1) Method Performance (Laboratory Control Sample (LCS) or Blank Spike (BS)), which entails both the preparation and measurement steps; and (2) Matrix Effects (Matrix Spike (MS) (Matrix spikes are not applicable to air) or Sample Duplicate (MD, DUP), which evaluates field sampling accuracy, precision, representativeness, interferences, and the effect of the matrix on the method performed. Each regulatory program and each method within those programs specify the control samples that are prepared and/or analyzed with a specific batch

Note that frequency of control samples vary with specific regulatory, methodology and project specific criteria. Complete details on method control samples are as listed in each analytical SOP.

24.4.1 Method Performance Control - Laboratory Control Sample (LCS)

The LCS measures the accuracy of the method in a blank matrix and assesses method performance independent of potential field sample matrix affects in a laboratory batch.

The LCS is prepared from a clean matrix similar to that of the associated samples that is free from target analytes (for example: Reagent water, Ottawa sand, glass beads, etc.) and is processed along with and under the same conditions as the associated samples. The LCS is spiked with verified known amounts of analytes or is made of a material containing known and verified amounts of analytes, taken through all preparation and analysis steps along with the

field samples. Where there is no preparation taken for an analysis (such as in aqueous volatiles), or when all samples and standards undergo the same preparation and analysis process (such as Phosphorus), a calibration verification standard is reported as the LCS. In some instances where there is no practical clean solid matrix available, aqueous LCS's may be processed for solid matrices; final results may be calculated as mg/kg or ug/kg, assuming 100% solids and a weight equivalent to the aliquot used for the corresponding field samples, to facilitate comparison with the field samples.

Certified pre-made reference material purchased from a NIST/A2LA accredited vendor may also be used for the LCS when the material represents the sample matrix or the analyte is not easily spiked (e.g. solid matrix LCS for metals, TDS, etc.).

The specific frequency of use for LCS during the analytical sequence is defined in the specific standard operating procedure for each analysis. It is generally 1 for each batch of samples; not to exceed 20 environmental samples.

If the mandated or requested test method, or project requirements, do not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample (and Matrix Spike) where applicable (e.g. no spike of pH). However, in cases where the components interfere with accurate assessment (such as simultaneously spiking chlordane, toxaphene and PCBs in Method 608), the test method has an extremely long list of components or components are incompatible, at a minimum, a representative number of the listed components (see below) shall be used to control the test method. The selected components of each spiking mix shall represent all chemistries, elution patterns and masses, permit specified analytes and other client requested components. However, the laboratory shall ensure that all reported components are used in the spike mixture within a two-year time period.

- For methods that have 1-10 target analytes, spike all components.
- For methods that include 11-20 target analytes, spike at least 10 or 80%, whichever is greater.
- For methods with more than 20 target analytes, spike at least 16 components.
- Exception: Due to analyte incompatibility in pesticides, Toxaphene and Chlordane are only spiked at client request based on specific project needs.
- Exception: Due to analyte incompatibility between the various PCB aroclors, aroclors 1016 and 1260 are used for spiking as they cover the range of all of the aroclors. Specific aroclors may be used by request on a project specific basis.

24.5 Sample Matrix Controls

Table 24-3. Sample Matrix Control

Control Type	Details	
Matrix Spikes (MS)	Use	used to assess the effect sample matrix of the spiked sample has on the precision and accuracy of the results generated by the method used;

Table 24-3. Sample Matrix Control

Control Type	Details	
	Typical Frequency [1]	At a minimum, with each matrix-specific batch of samples processed, an MS is carried through the complete analytical procedure. Unless specified by the client, samples used for spiking are randomly selected and rotated between different client projects.If the mandated or requested test method does not specify the spiking components, the laboratory shall spike all reportable components to be reported in the Laboratory Control Sample and Matrix Spike. Refer to the method SOP for complete details
	Description	essentially a sample fortified with a known amount of the test analyte(s).
Surrogate	Use	Measures method performance to sample matrix (organics only).
	Typical Frequency [1]	Are added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. The recovery of the surrogates is compared to the acceptance limits for the specific method. Poor surrogate recovery may indicate a problem with sample composition and shall be reported, with data qualifiers, to the client whose sample produced poor recovery.
	Description	Are similar to matrix spikes except the analytes are compounds with properties that mimic the analyte of interest and are unlikely to be found in environment samples.
Duplicates[2]	Use	For a measure of analytical precision, with each matrix-specific batch of samples processed, a matrix duplicate (MD or DUP) sample, matrix spike duplicate (MSD), or LCS duplicate (LCSD) is carried through the complete analytical procedure.
	Typical Frequency [1]	Duplicate samples are usually analyzed with methods that do not require matrix spike analysis.
	Description	Performed by analyzing two aliquots of the same field sample independently or an additional LCS.
Internal Standards	Use	Are spiked into all environmental and quality control samples (including the initial calibration standards) to monitor the qualitative aspect of organic and some inorganic analytical measurements.
	Typical Frequency [1]	All organic and ICP methods as required by the analytical method.
	Description	Used to correct for matrix effects and to help troubleshoot variability in analytical response and are assessed after data acquisition. Possible sources of poor internal standard response are sample matrix, poor analytical technique or instrument performance.

[1] See the specific analytical SOP for type and frequency of sample matrix control samples.
[2] LCSD's are normally not performed except when regulatory agencies or client specifications require them. The recoveries for the spiked duplicate samples must meet the same laboratory established recovery limits as the accuracy QC samples. If an LCSD is analyzed both the LCS and LCSD must meet the same recovery criteria and be included in the final report. The precision measurement is reported as "Relative Percent Difference" (RPD). Poor precision between duplicates (except LCS/LCSD) may indicate non-homogeneous matrix or sampling.

24.6 Acceptance Criteria (Control Limits)

As mandated by the test method and regulation, each individual analyte in the LCS, MS, or Surrogate Spike is evaluated against the control limits published in the test method. Where there are no established acceptance criteria, the laboratory calculates in-house control limits with the use of control charts or, in some cases, utilizes client project specific control limits. When this occurs, the regulatory or project limits will supersede the laboratory's in-house limits.

Note: For methods, analytes and matrices with very limited data (e.g., unusual matrices not analyzed often), interim limits are established using available data or by analogy to similar methods or matrices.

Once control limits have been established, they are verified, reviewed, and updated if necessary on an annual basis unless the method requires more frequent updating. Control limits are

established per method (as opposed to per instrument) regardless of the number of instruments utilized.

Laboratory generated % Recovery acceptance (control) limits are generally established by taking ± 3 Standard Deviations (99% confidence level) from the average recovery of a minimum of 20-30 data points (more points are preferred).

- Regardless of the calculated limit, the limit should be no tighter than the Calibration Verification (ICV/CCV). (Unless the analytical method specifies a tighter limit).
- In-house limits cannot be any wider than those mandated in a regulated analytical method. Client or contract required control limits are evaluated against the laboratory's statistically derived control limits to determine if the data quality objectives (DQOs) can be achieved. If laboratory control limits are not consistent with DQOs, then alternatives must be considered, such as method improvements or use of an alternate analytical method.
- The lowest acceptable recovery limit will be 10% (the analyte must be detectable and identifiable). Exception: The lowest acceptable recovery limit for Benzidine will be 5% and the analyte must be detectable and identifiable.
- The maximum acceptable recovery limit will be 150%.
- The maximum acceptable RPD limit will be 35% for waters and 40% for soils. The minimum RPD limit is 10%.
- If either the high or low end of the control limit changes by ≤ 5% from previous, the control chart is visually inspected and, using professional judgment, they may be left unchanged if there is no affect on laboratory ability to meet the existing limits.

24.6.1 The lab must be able to generate a current listing of their control limits and track when the updates are performed. In addition, the laboratory must be able to recreate historical control limits. The LIMS maintains a record of the historical control limits including the dates and times that updates were made.

24.6.2 A LCS that is within the acceptance criteria establishes that the analytical system is in control and is used to validate the process. Samples that are analyzed with an LCS with recoveries outside of the acceptance limits may be determined as out of control and should be reanalyzed if possible. If reanalysis is not possible, then the results for all affected analytes for samples within the same batch must be qualified when reported. The internal corrective action process (see Section 12) is also initiated if an LCS exceeds the acceptance limits. Sample results may be qualified and reported without reanalysis if:

- Analyte results are below the reporting limit and the LCS is above the upper control limit.
- If the analytical results are above the relevant regulatory limit and the LCS is below the lower control limit.

For TNI and Department Of Defense (DOD) work, there are an allowable number of Marginal Exceedances (ME):

<11 analytes	0 marginal exceedances are allowed.
11 – 30 Analytes	1 marginal exceedance is allowed
31-50 Analytes	2 marginal exceedances are allowed
51-70 Analytes	3 marginal exceedances are allowed
71-90 Analytes	4 marginal exceedances are allowed
> 90 Analytes	5 marginal exceedances are allowed

- Marginal exceedances are recovery exceedances between 3 SD and 4 SD from the mean recovery limit (TNI).

- Marginal exceedances must be random. If the same analyte exceeds the LCS control limit repeatedly, it is an indication of a systematic problem. The source of the error must be located and corrective action taken. The laboratory has a system to monitor marginal exceedances to ensure that they are random.

Though marginal exceedences may be allowed, the data must still be qualified to indicate it is outside of the normal limits.

24.6.3 If the MS/MSDs do not meet acceptance limits, the MS/MSD and the associated spiked sample is reported with a qualifier for those analytes that do not meet limits. If obvious preparation errors are suspected, or if requested by the client, unacceptable MS/MSDs are reprocessed and reanalyzed to prove matrix interference. A more detailed discussion of acceptance criteria and corrective action can be found in the lab's method SOPs and in Section 12.

24.6.4 If a surrogate standard falls outside the acceptance limits, if there is not obvious chromatographic matrix interference, reanalyze the sample to confirm a possible matrix effect. If the recoveries confirm or there was obvious chromatographic interference, results are reported from the original analysis and a qualifier is added. If the reanalysis meets surrogate recovery criteria, the second run is reported (or both are reported if requested by the client). Under certain circumstances, where all of the samples are from the same location and share similar chromatography, the reanalysis may be performed on a single sample rather than all of the samples and if the surrogate meets the recovery criteria in the reanalysis, all of the affected samples would require reanalysis.

24.7 Additonal Procedures to Assure Quality Control

The laboratory has written and approved method SOPs to assure the accuracy of the test method including calibration (see Section 20), use of certified reference materials (see Section 21) and use of PT samples (see Section 15).

A discussion regarding MDLs, Limit of Detection (LOD) and Limit of Quantitation (LOQ) can be found in Section 19.

- Use of formulae to reduce data is discussed in the method SOPs and in Section 20.
- Selection of appropriate reagents and standards is included in Section 9 and 21.
- A discussion on selectivity of the test is included in Section 5.
- Constant and consistent test conditions are discussed in Section 18.
- The laboratories sample acceptance policy is included in Section 23.

SECTION 25. REPORTING RESULTS

25.1 Overview

The results of each test are reported accurately, clearly, unambiguously, and objectively in accordance with State and Federal regulations as well as client requirements. Analytical results are issued in a format that is intended to satisfy customer and laboratory accreditation requirements as well as provide the end user with the information needed to properly evaluate the results. Where there is conflict between client requests and laboratory ethics or regulatory requirements, the laboratory's ethical and legal requirements are paramount, and the laboratory will work with the client during project set up to develop an acceptable solution. Refer to Section 7.

A variety of report formats are available to meet specific needs.

In cases where a client asks for simplified reports, there must be a written request from the client. There still must be enough information that would show any analyses that were out of conformance (QC out of limits) and there should be a reference to a full report that is made available to the client. Review of reported data is included in Section 19.

25.2 Test Reports

Analytical results are reported in a format that is satisfactory to the client and meets all requirements of applicable accrediting authorities and agencies. A variety of report formats are available to meet specific needs. The report is printed on laboratory letterhead, reviewed, and signed by the appropriate project manager. At a minimum, the standard laboratory report shall contain the following information:

25.2.1 A report title (e.g. Analytical Report For Samples) with a "sample results" column header.

25.2.2 Each report cover page printed on company letterhead, which includes the laboratory name, address and telephone number.

25.2.3 A unique identification of the report (e.g. work order number) and on each page an identification in order to ensure the page is recognized as part of the report and a clear identification of the end.
Note: Page numbers of report are represented as page # of ##. Where the first number is the page number and the second is the total number of pages.

25.2.4 A copy of the chain of custody (COC).

- Any COCs involved with Subcontracting are included.
- The applicable COC is paginated as part of the report. A .pdf of the COC is created and attached to the job number in the LIMS to become part of the report as it is generated.
- Any additional addenda to the report must be treated in a similar fashion so it is a recognizable part of the report and cannot accidentally get separated from the report (e.g., Sampling information).

25.2.5 The name and address of client and a project name/number, if applicable.

25.2.6 Client project manager or other contact

25.2.7 Description and unambiguous identification of the tested sample(s) including the client identification code.

25.2.8 Date of receipt of sample, date and time of collection, and date(s) of test preparation and performance, and time of preparation or analysis if the required holding time for either activity is less than or equal to 72 hours.

25.2.9 Date reported or date of revision, if applicable.

25.2.10 Method of analysis including method code (EPA, Standard Methods, etc).

25.2.11 Practical quantitation limits or reporting limit.

25.2.12 Method detection limits (if requested)

25.2.13 Definition of Data qualifiers and reporting acronyms (e.g. ND).

25.2.14 Sample results.

25.2.15 QC data consisting of method blank, surrogate, LCS, and MS/MSD recoveries and control limits.

25.2.16 Condition of samples at receipt including temperature. This may be accomplished in a narrative or by attaching sample login sheets (Refer to Sec. 25.2.4 – Item 3 regarding additional addenda).

25.2.17 A statement expressing the validity of the results, that the source methodology was followed and all results were reviewed for error.

25.2.18 A statement to the effect that the results relate only to the items tested and the sample as received by the laboratory.

25.2.19 A statement that the report shall not be reproduced except in full, without prior express written approval by the laboratory coordinator.

25.2.20 A signature and title of the person(s) accepting responsibility for the content of the report and date of issue. Signatories are appointed by the Lab Director.

25.2.21 When TNI accreditation is required, the lab shall certify that the test results meet all requirements of TNI or provide reasons and/or justification if they do not.

25.2.22 The laboratory includes a cover letter.

25.2.23 Where applicable, a narrative to the report that explains the issue(s) and corrective action(s) taken in the event that a specific accreditation or certification requirement was not met.

25.2.24 When soil samples are analyzed, a specific identification as to whether soils are reported on a "wet weight" or "dry weight" basis.

25.2.25 Appropriate laboratory certification number for the state of origin of the sample, if applicable.

25.2.26 If only part of the report is provided to the client (client requests some results before all of it is complete), it must be clearly indicated on the report (e.g., partial report, or how your lab identifies it). A complete report must be sent once all of the work has been completed.

25.2.27 Any non-TestAmerica subcontracted analysis results are provided as a separate report on the official letterhead of the subcontractor. All TestAmerica subcontracting is clearly identified on the report as to which laboratory performed a specific analysis.

25.2.28 A clear statement notifying the client that non-accredited tests were performed and directing the client to the laboratory's accreditation certificates of approval shall be provided when non-accredited tests are included in the report.

Note: Refer to the Corporate SOP on Electronic Reporting and Signature Policy (No. CA-I-P-002) for details on internally applying electronic signatures of approval.

25.2.28 Reports for Ohio VAP work require a VAP affidavit be completed and included with the report.

25.3 Reporting Level or Report Type

The laboratory offers four levels of quality control reporting. Each level, in addition to its own specific requirements, contains all the information provided in the preceding level. The packages provide the following information in addition to the information described above:

- Level I is a report with the features described in Section 25.2 above.
- Level II is a Level I report plus summary information, including results for the method blank reported to the laboratory MDL, percent recovery for laboratory control samples and matrix spike samples, and the RPD values for all MSD and sample duplicate analyses.
- Level III contains all the information supplied in Level II, but presented on the CLP-like summary forms, and relevant calibration information. A Level II report is not included, unless specifically requested. No raw data is provided.
- Level IV is the same as Level III with the addition of all raw supporting data.

In addition to the various levels of QC packaging, the laboratory also provides reports in diskette deliverable form. Initial reports may be provided to clients by facsimile. All faxed reports are followed by hardcopy. Procedures used to ensure client confidentiality are outlined in Section 25.6.

25.3.1 Electronic Data Deliverables (EDDs)

EDDs are routinely offered as part of TestAmerica's services. Houston offers a variety of EDD formats including Environmental Restoration Information Management System (ERPIMS), New Agency Standard (NAS), Format A, Excel, Dbase, GISKEY, and Text Files.

EDD specifications are submitted to the IT department by the PM for review and undergo the contract review process. Once the facility has committed to providing data in a specific electronic format, the coding of the format may need to be performed. This coding is documented and validated. The validation of the code is retained by the IT staff coding the EDD.

EDDs shall be subject to a review to ensure their accuracy and completeness. If EDD generation is automated, review may be reduced to periodic screening if the laboratory can demonstrate that it can routinely generate that EDD without errors. Any revisions to the EDD format must be reviewed until it is demonstrated that it can routinely be generated without errors. If the EDD can be reproduced accurately and if all subsequent EDDs can be produced error-free, each EDD does not necessarily require a review.

25.4 Supplemental Information for Test

The lab identifies any unacceptable QC analyses or any other unusual circumstances or observations such as environmental conditions and any non-standard conditions that may have affected the quality of a result. This is typically in the form of a footnote or a qualifier and/or a narrative explaining the discrepancy in the front of the report.

Numeric results with values outside of the calibration range, either high or low are qualified as 'estimated'.

Where quality system requirements are not met, a statement of compliance/non-compliance with requirements and/or specifications is required, including identification of test results derived from any sample that did not meet TNI sample acceptance requirements such as improper container, holding time, or temperature.

Where applicable, a statement on the estimated uncertainty of measurements; information on uncertainty is needed when a client's instructions so require.

Opinions and Interpretations - The test report contains objective information, and generally does not contain subjective information such as opinions and interpretations. If such information is required by the client, the Laboratory Director will determine if a response can be prepared. If so, the Laboratory Director will designate the appropriate member of the management team to prepare a response. The response will be fully documented, and reviewed by the Laboratory Director, before release to the client. There may be additional fees charged to the client at this time, as this is a non-routine function of the laboratory.

Note: Review of data deliverable packages for submittal to regulatory authorities requires responses to non-conforming data concerning potential impact on data quality. This necessitates a limited scope of interpretation, and this work is performed by the QA Department. This is the only form of "interpretation" of data that is routinely performed by the laboratory.

When opinions or interpretations are included in the report, the laboratory provides an explanation as to the basis upon which the opinions and interpretations have been made. Opinions and interpretations are clearly noted as such and where applicable, a comment should be added suggesting that the client verify the opinion or interpretation with their regulator.

25.5 Environmental Testing Obtained From Subcontractors

If the laboratory is not able to provide the client the requested analysis, the samples would be subcontracted following the procedures outlined in the Corporate SOP on Subcontracting (SOP No. CA-L-S-002).

Data reported from analyses performed by a subcontractor laboratory are clearly identified as such on the analytical report provided to the client. Results from a subcontract laboratory outside of TestAmerica are reported to the client on the subcontract laboratory's original report stationary and the report includes any accompanying documentation.

25.6 Client Confidentiality

In situations involving the transmission of environmental test results by telephone, facsimile or other electronic means, client confidentiality must be maintained.

TestAmerica will not intentionally divulge to any person (other than the Client or any other person designated by the Client in writing) any information regarding the services provided by TestAmerica or any information disclosed to TestAmerica by the Client. Furthermore, information known to be potentially endangering to national security or an entity's proprietary rights will not be released.

Note: This shall not apply to the extent that the information is required to be disclosed by TestAmerica under the compulsion of legal process. TestAmerica will, to the extent feasible, provide reasonable notice to the client before disclosing the information.

Note: Authorized representatives of an accrediting authority are permitted to make copies of any analyses or records relevant to the accreditation process, and copies may be removed from the laboratory for purposes of assessment.

25.6.1 Report deliverable formats are discussed with each new client. If a client requests that reports be faxed or e-mailed, the reports are faxed with a cover sheet or e-mailed with the following note that includes a confidentiality statement similar to the following:

This material is intended only for the use of the individual(s) or entity to whom it is addressed, and may contain information that is privileged and confidential. If you are not the intended recipient, or the employee or agent responsible for delivering this material to the intended recipient, you are hereby notified that any dissemination, distribution or copying of this communication is strictly prohibited. If you have received this communication in error, please notify us immediately by e-mail or by phone and delete this material from any computer.

25.7 Format of Reports

The format of reports is designed to accommodate each type of environmental test carried out and to minimize the possibility of misunderstanding or misuse.

25.8 Amendments to Test Reports

Corrections, additions, or deletions to reports are only made when justification arises through supplemental documentation. Justification is documented using the laboratory's corrective action system (refer to Section 12).

The revised report is retained on the Archive data server, as is the original report. The revised report is stored in the Archive data server under the sample number followed by "R". The revised report will have the word "revised" or "amended" next to the date rather than the word "reported".

When the report is re-issued, a notation of "report re-issue "is placed on the cover/signature page of the report *or at the top of the narrative page* with a brief explanation of reason for the re-issue and a reference back to the last final report generated. *For Example: Report was revised on 11/3/08 to include toluene in sample NQA1504 per client's request. This final report replaces the final report generated on 10/27/08 at 10:47am.*

25.9 Policies on Client Requests for Amendments

25.9.1 Policy on Data Omissions or Reporting Limit Increases

Fundamentally, our policy is simply to not omit previously reported results (including data qualifiers) or to not raise reporting limits and report sample results as ND. This policy has few exceptions. Exceptions are:

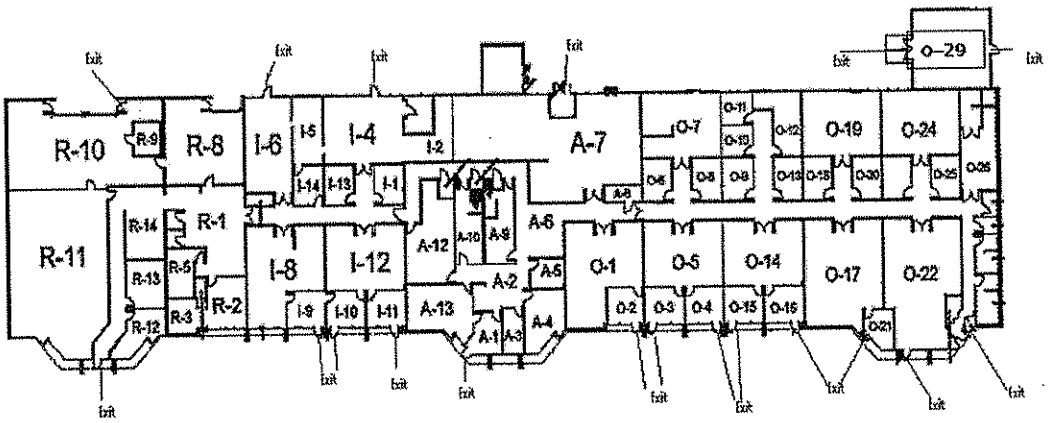
- Laboratory error.
- Sample identification is indeterminate (confusion between COC and sample labels).
- An incorrect analysis (not analyte) was requested (e.g., COC lists 8315 but client wanted 8310). A written request for the change is required.
- Incorrect limits reported based on regulatory requirements.
- The requested change has absolutely *no possible* impact on the interpretation of the analytical results and there is *no possibility* of the change being interpreted as misrepresentation by anyone inside or outside of our company.

25.9.2 Multiple Reports

TestAmerica does not issue multiple reports for the same work order where there is different information on each report (this does not refer to copies of the same report) unless required to meet regulatory needs and approved by QA.

Appendix 1. Laboratory Floor Plan

Floor Plan of TestAmerica Houston



PRIMARY MEETING PLACE

To Vacant lot Across Bethany

RETENTION POND

Key Areas *

- R1. Data Packaging
- R8. Bottle Prep room
- R10. Bottle & supply storage
- R11. Data Storage
- I4. Wet Chem RM.1
- I5. Wet Chem RM.2
- I6. Wet Chem RM.3
- I12. QA Office
- A7. Sample Admin.
- O1. GC VOA
- O5. GC VOA/MS
- O14. GCSV/MS
- O17. Organic prep RM.1
- O18. Project Mgt.
- O22. Organic prep RM.2
- O19. Extract. GC
- O24. Bottle wash
- O29. Gas cylinder storage

Appendix 2. Glossary/Acronyms (EL-V1M2 Sec. 3.1)

Glossary:

Acceptance Criteria: Specified limits placed on characteristics of an item, process, or service defined in requirement documents. (ASQC)

Accreditation: The process by which an agency or organization evaluates and recognizes a laboratory as meeting certain predetermined qualifications or standards, thereby accrediting the laboratory.

Accuracy: The degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random error (precision) and systematic error (bias) components which are due to sampling and analytical operations; a data quality indicator. (QAMS)

Analyst: The designated individual who performs the "hands-on" analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

Analytical Uncertainty: A subset of Measurement Uncertainty that includes all laboratory activities performed as part of the analysis. (TNI)

Assessment: The evaluation process used to measure or establish the performance, effectiveness, and conformance of an organization and/or its systems to defined criteria (to the standards and requirements of laboratory accreditation). (TNI)

Audit: A systematic and independent examination of facilities, equipment, personnel, training, procedures, record-keeping, data validation, data management, and reporting aspects of a system to determine whether QA/QC and technical activities are being conducted as planned and whether these activities will effectively achieve quality objectives. (TNI)

Batch: Environmental samples that are prepared and/or analyzed together with the same process and personnel, using the same lot(s) of reagents. A **preparation batch** is composed of one (1) to twenty (20) environmental samples of the same quality systems matrix, meeting the above mentioned criteria and with a maximum time between the start of processing of the first and last sample in the batch to be twenty-four (24) hours. An **analytical batch** is composed of prepared environmental samples (extracts, digestates or concentrates) which are analyzed together as a group. An analytical batch can include prepared samples originating from various quality system matrices and can exceed twenty (20) samples. (TNI)

Bias: The systematic or persistent distortion of a measurement process, which causes errors in one direction (i.e., the expected sample measurement is different from the sample's true value). (TNI)

Blank: A sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sampling, transport, storage or analysis. The blank is subjected to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results. (ASQC)

Calibration: A set of operations that establish, under specified conditions, the relationship between values of quantities indicated by a measuring instrument or measuring system, or values represented by a material measure or a reference material, and the corresponding values realized by standards. (TNI)

1) In calibration of support equipment the values realized by standards are established through the use of reference standards that are traceable to the International System of Units (SI).

2) In calibration according to methods, the values realized by standards are typically established through the use of Reference Materials that are either purchased by the laboratory with a certificate of analysis or purity, or prepared by the laboratory using support equipment that has been calibrated or verified to meet specifications.

Calibration Curve: The mathematical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response. (TNI)

Calibration Standard: A substance or reference material used to calibrate an instrument (QAMS)

Certified Reference Material (CRM): A reference material accompanied by a certificate, having a value, measurement uncertainty, and stated metrological traceability chain to a national metrology institute. (TNI)

Chain of Custody (COC) Form: Record that documents the possession of the samples from the time of collection to receipt in the laboratory. This record generally includes: the number and types of containers; the mode of collection; the collector; time of collection; preservation; and requested analyses. (TNI)

Compromised Samples: Those samples which are improperly sampled, insufficiently documented (chain of custody and other sample records and/or labels), improperly preserved, collected in improper containers, or exceeding holding times when delivered to a laboratory. Under normal conditions, compromised samples are not analyzed. If emergency situation require analysis, the results must be appropriately qualified.

Confidential Business Information (CBI): Information that an organization designates as having the potential of providing a competitor with inappropriate insight into its management, operation or products. TNI and its representatives agree to safeguarding identified CBI and to maintain all information identified as such in full confidentiality.

Confirmation: Verification of the identity of a component through the use of an approach with a different scientific principle from the original method. These may include, but are not limited to Second Column Confirmation; Alternate wavelength; Derivatization; Mass spectral interpretation; Alternative detectors or Additional Cleanup procedures. (TNI)

Conformance: An affirmative indication or judgment that a product or service has met the requirements of the relevant specifications, contract, or regulation; also the state of meeting the requirements. (ANSI/ASQC E4-1994)

Correction: Actions necessary to correct or repair analysis specific non-conformances. The acceptance criteria for method specific QC and protocols as well as the associated corrective actions. The analyst will most frequently be the one to identify the need for this action as a result of calibration checks and QC sample analysis. No significant action is taken to change behavior, process or procedure.

Corrective Action: The action taken to eliminate the causes of an existing nonconformity, defect or other undesirable situation in order to prevent recurrence. (ISO 8402)

Data Audit: A qualitative and quantitative evaluation of the documentation and procedures associated with environmental measurements to verify that the resulting data re of acceptable quality (i.e., that they meet specified acceptance criteria).

Data Reduction: The process of transforming the number of data items by arithmetic or statistical calculations, standard curves, and concentration factors, and collation into a more useable form. (TNI)

Deficiency: An unauthorized deviation from acceptable procedures or practices, or a defect in an item. (ASQC)

Demonstration of Capability: A procedure to establish the ability of the analyst to generate analytical results of acceptable accuracy and precision. (TNI)

Document Control: The act of ensuring that documents (and revisions thereto) are proposed, reviewed for accuracy, approved for release by authorized personnel, distributed properly, and controlled to ensure use of the correct version at the location where the prescribed activity if performed. (ASQC)

Duplicate Analyses: The analyses or measurements of the variable of interest performed identically on two subsamples of the same sample. The results from duplicate analyses are used to evaluate analytical or measurement precision but not the precision of sampling, preservation or storage internal to the laboratory. (EPA-QAD)

Equipment Blank: Sample of analyte-free media which has been used to rinse common sampling equipment to check effectiveness of decontamination procedures.

External Standard Calibration: Calibrations for methods that do not utilize internal standards to compensate for changes in instrument conditions.

Field Blank: Blank prepared in the field by filing a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken (EPA OSWER)

Field of Accreditation: Those matrix, technology/method, and analyte combinations for which the accreditation body offers accreditation.

Holding Times: The maximum time that samples may be held prior to analyses and still be considered valid or not compromised. (40 CFR Part 136)

Internal Standard: A known amount of standard added to a test portion of a sample as a reference for evaluating and controlling the precision and bias of the applied analytical test method. (TNI)

Internal Standard Calibration: Calibrations for methods that utilize internal standards to compensate for changes in instrument conditions.

Instrument Blank: A clean sample (e.g., distilled water) processed through the instrumental steps of the measurement process; used to determine instrument contamination. (EPA-QAD)

Instrument Detection Limit (IDL): The minimum amount of a substance that can be measured with a specified degree of confidence that the amount is greater than zero using a specific instrument. The IDL is associated with the instrumental portion of a specific method only, and sample preparation steps are not considered in its derivation. The IDL is a statistical estimation at a specified confidence interval of the concentration at which the relative uncertainty is $\pm$ 100%. The IDL represents a range where qualitative detection occurs on a specific instrument. Quantitative results are not produced in this range.

Laboratory Control Sample (however named, such as laboratory fortified blank, spiked blank, or QC check sample): A sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes, taken through all preparation and analysis steps of the procedure unless otherwise noted in a reference method. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

An LCS shall be prepared at a minimum of 1 per batch of 20 or less samples per matrix type per sample extraction or preparation method except for analytes for which spiking solutions are not available such as total suspended solids, total dissolved solids, total volatile solids, total solids, pH, color, odor, temperature, dissolved oxygen or turbidity. The results of these samples shall be used to determine batch acceptance.

Least Squares Regression (1st Order Curve): The least squares regression is a mathematical calculation of a straight line over two axes. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The regression calculation will generate a correlation coefficient (r) that is a measure of the "goodness of fit" of the regression line to the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r must be greater than or equal to 0.99 for organics and 0.995 for inorganics.

Limit(s) of Detection (LOD) [a.k.a., Method Detection Limit (MDL)]: A laboratory's estimate of the minimum amount of an analyte in a given matrix that an analytical process can reliably detect in their facility. (TNI)

LOD Verification [a.k.a., MDL Verification]: A processed QC sample in the matrix of interest, spiked with the analyte at no more than 3X the LOD for single analyte tests and 4X the LOD for multiple analyte tests and processed through the entire analytical procedure.

Limit(s) of Quantitation (LOQ) [a.k.a., Reporting Limit]: The minimum levels, concentrations, or quantities of a target variable (e.g., target analyte) that can be reported with a specified degree of confidence. (TNI)

(QS) Matrix: The component or substrate that contains the analyte of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

Aqueous: Any aqueous sample excluded from the definition of Drinking Water or Saline/Estuarine. Includes surface water, groundwater, effluents, and TCLP or other extracts.

Drinking Water: Any aqueous sample that has been designated as a potable or potential potable water source.

Saline/Estuarine: Any aqueous sample from an ocean or estuary, or other salt water source such as the Great Salt Lake.

Non-Aqueous Liquid: Any organic liquid with <15% settleable solids.

Biological Tissue: Any sample of a biological origin such as fish tissue, shellfish, or plant material. Such samples shall be grouped according to origin.

Solids: Includes soils, sediments, sludges, and other matrices with >15% settleable solids.

Chemical Waste: A product or by-product of an industrial process that results in a matrix not previously defined.

Air & Emissions: Whole gas or vapor samples including those contained in flexible or rigid wall containers and the extracted concentrated analytes of interest from a gas or vapor that are collected with a sorbant tube, impinger solution, filter, or other device. (TNI)

Matrix Spike (spiked sample or fortified sample): A sample prepared, taken through all sample preparation and analytical steps of the procedure unless otherwise noted in a referenced method, by adding a known amount of target analyte to a specified amount of sample for which an independent test result of target analyte concentration is available. Matrix spikes are used, for example, to determine the effect of the matrix on a method's recovery efficiency.

Matrix Spike Duplicate (spiked sample or fortified sample duplicate): A replicate matrix spike prepared and analyzed to obtain a measure of the precision of the recovery for each analyte.

Method Blank: A sample of a matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedures, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

Method Detection Limit: The minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte. (40 CFR Part 136, Appendix B)

Negative Control: Measures taken to ensure that a test, its components, or the environment do not cause undesired effects, or produce incorrect test results.

Non-conformance: An indication, judgment, or state of not having met the requirements of the relevant specifications, contract, or regulation.

Performance Audit: The routine comparison of independently obtained qualitative and quantitative measurement system data with routinely obtained data in order to evaluate the proficiency of an analyst or laboratory.

Positive Control: Measures taken to ensure that a test and/or its components are working properly and producing correct or expected results from positive test subjects.

Precision: The degree to which a set of observations or measurements of the same property, obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms. (TNI)

Preservation: Any conditions under which a sample must be kept in order to maintain chemical and/or biological integrity prior to analysis. (TNI)

Proficiency Testing: A means of evaluating a laboratory's performance under controlled conditions relative to a given set of criteria through analysis of unknown samples provided by an external source. (TNI)

Proficiency Testing Program: The aggregate of providing rigorously controlled and standardized environmental samples to a laboratory for analysis, reporting of results, statistical evaluation of the results and the collective demographics and results summary of all participating laboratories. (TNI)

Proficiency Test Sample (PT): A sample, the composition of which is unknown to the laboratory and is provided to test whether the laboratory can produce analytical results within specified acceptance criteria. (TNI)

Quality Assurance: An integrated system of management activities involving planning, implementation, assessment, reporting and quality improvement to ensure that a process, item, or service is of the type of quality needed and expected by the client. (TNI)

Quality Assurance [Project] Plan (QAPP): A formal document describing the detailed quality control procedures by which the quality requirements defined for the data and decisions pertaining to a specific project are to be achieved. (EAP-QAD)

Quality Control: The overall system of technical activities that measures the attributes and performance of a process, item, or service against defined standards to verify that they meet the stated requirements established by the customer; operational techniques and activities that are used to fulfill requirements for quality; also the system of activities and checks used to ensure that measurement systems are maintained within prescribed limits, providing protection against "out of control" conditions and ensuring that the results are of acceptable quality. (TNI)

Quality Control Sample: A sample used to assess the performance of all or a portion of the measurement system. One of any number of samples, such as Certified Reference Materials, a quality system matrix fortified by spiking, or actual samples fortified by spiking, intended to demonstrate that a measurement system or activity is in control. (TNI)

Quality Manual: A document stating the management policies, objectives, principles, organizational structure and authority, responsibilities, accountability, and implementation of an agency, organization, or laboratory, to ensure the quality of its product and the utility of its product to its users. (TNI)

Quality System: A structured and documented management system describing the policies, objectives, principles, organizational authority, responsibilities, accountability, and implementation plan of an organization for ensuring quality in its work processes, products (items), and services. The quality system provides the framework for planning, implementing, and assessing work performed by the organization and for carrying out required QA and QC activities. (TNI)

Raw Data: The documentation generated during sampling and analysis. This documentation includes, but is not limited to, field notes, electronic data, magnetic tapes, untabulated sample results, QC sample results, print outs of chromatograms, instrument outputs, and handwritten records. (TNI)

Record Retention: The systematic collection, indexing and storing of documented information under secure conditions.

Reference Material: Material or substance one or more properties of which are sufficiently homogeneous and well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials. (TNI)

Reference Standard: Standard used for the calibration of working measurement standards in a given organization or a given location. (TNI)

Sampling: Activity related to obtaining a representative sample of the object of conformity assessment, according to a procedure.

Second Order Polynomial Curve (Quadratic): The 2nd order curves are a mathematical calculation of a slightly curved line over two axis. The y axis represents the instrument response (or Response ratio) of a standard or sample and the x axis represents the concentration. The 2nd order regression will generate a coefficient of determination (COD or r^2) that is a measure of the "goodness of fit" of the quadratic curvature the data. A value of 1.00 indicates a perfect fit. In order to be used for quantitative purposes, r^2 must be greater than or equal to 0.99.

Selectivity: The ability to analyze, distinguish, and determine a specific analyte or parameter from another component that may be a potential interferent or that may behave similarly to the target analyte or parameter within the measurement system. (TNI)

Sensitivity: The capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest. (TNI)

Spike: A known mass of target analyte added to a blank, sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

Standard: The document describing the elements of laboratory accreditation that has been developed and established within the consensus principles of standard setting and meets the approval requirements of standard adoption organizations procedures and policies. (TNI)

Standard Operating Procedures (SOPs): A written document which details the method for an operation, analysis, or action, with thoroughly prescribed techniques and steps. SOPs are officially approved as the methods for performing certain routine or repetitive tasks. (TNI)

Storage Blank: A blank matrix stored with field samples of a similar matrix (volatiles only) that measures storage contribution to any source of contamination.

Surrogate: A substance with properties that mimic the analyte of interest. It is unlikely to be found in environment samples and is added to them for quality control purposes.

Surrogate compounds must be added to all samples, standards, and blanks, for all organic chromatography methods except when the matrix precludes its use or when a surrogate is not available. Poor surrogate recovery may indicate a problem with sample composition and shall be reported to the client whose sample produced poor recovery. (QAMS)

Systems Audit (also Technical Systems Audit): A thorough, systematic, qualitative on-site assessment of the facilities, equipment, personnel, training, procedures, record keeping, data validation, data management, and reporting aspects of a total measurement system. (EPA-QAD)

Technical Manager: A member of the staff of an environmental laboratory who exercises actual day-to-day supervision of laboratory operations for the appropriate fields of accreditation and reporting of results

Technology: A specific arrangement of analytical instruments, detection systems, and/or preparation techniques.

Traceability: The ability to trace the history, application, or location of an entity by means of recorded identifications. In a calibration sense, traceability relates measuring equipment to national or international standards, primary standards, basic physical constants or properties, or reference materials. In a data collection sense, it relates calculations and data generated throughout the project back to the requirements for the quality of the project. (TNI)

Trip Blank: A blank matrix placed in a sealed container at the laboratory that is shipped, held unopened in the field, and returned to the laboratory in the shipping container with the field samples.

Uncertainty: A parameter associated with the result of a measurement that characterizes the dispersion of the value that could reasonably be attributed to the measured value.

Acronyms:

CAR – Corrective Action Report
CCV – Continuing Calibration Verification
CF – Calibration Factor
CFR – Code of Federal Regulations
COC – Chain of Custody
DOC – Demonstration of Capability
DQO – Data Quality Objectives
DUP - Duplicate
EHS – Environment, Health and Safety
EPA – Environmental Protection Agency
GC - Gas Chromatography
GC/MS - Gas Chromatography/Mass Spectrometry
HPLC - High Performance Liquid Chromatography
ICP - Inductively Coupled Plasma Atomic Emission Spectroscopy
ICP/MS – ICP/Mass Spectrometry
ICV – Initial Calibration Verification
IDL – Instrument Detection Limit
IH – Industrial Hygiene
IS – Internal Standard
LCS – Laboratory Control Sample
LCSD – Laboratory Control Sample Duplicate
LIMS – Laboratory Information Management System
LOD – Limit of Detection
LOQ – Limit of Quantitation
MDL – Method Detection Limit
MDLCK – MDL Check Standard
MDLV – MDL Verification Check Standard
MRL – Method Reporting Limit Check Standard
MS – Matrix Spike
MSD – Matrix Spike Duplicate
MSDS - Material Safety Data Sheet
NELAP - National Environmental Laboratory Accreditation Program
PT – Performance Testing
TNI – The NELAC Institute
QAM – Quality Assurance Manual
QA/QC – Quality Assurance / Quality Control
QAPP – Quality Assurance Project Plan
RF – Response Factor
RPD – Relative Percent Difference
RSD – Relative Standard Deviation
SD – Standard Deviation
SOP – Standard Operating Procedure
TAT – Turn-Around-Time
VOA – Volatiles
VOC – Volatile Organic Compound

Appendix 3. Laboratory Certifications, Accreditations, Validations

TestAmerica Houston maintains accreditations, certifications, and approvals with numerous state and national entities. Programs vary but may include on-site audits, reciprocal agreements with other entities, performance testing evaluations, review of the QA Manual, Standard Operating Procedures, Method Detection Limits, training records, etc. At the time of this QA Manual revision, the laboratory has accreditation / certification / licensing with the following organizations:

Organization	Laboratory ID Number or Agency Interest Number	Certificate Number
Texas Commission on Environmental Quality (TCEQ)	TX00083	T104704223-09-2
Louisiana Department of Environmental Quality (LDEQ)	30643	01967
Arkansas Department of Environmental Quality (ADEQ)	88-0759	09-036-0
Oklahoma Department of Environmental Quality (OKDEQ)	9503	2009-136
Utah Department of Health	GULF	NA

The certificates and parameter lists (which may differ) are available, upon request, from a laboratory representative. for each organization may be found on the corporate web site, the laboratory's public server, the final report review table, and in the following offices: QA, marketing, and project management.

Appendix D

Health and Safety Plan

HEALTH AND SAFETY PLAN
for Field Activities at

Transwestern Pipeline Company

Roswell Compressor Station

Chaves County, New Mexico

Prepared by
Cypress Engineering Services, Inc.

Prepared by: _____ Date: 2-5-13

Reviewed by: _____ Date: 2-5-13

Approved by: _____ Date: 2-5-13

Cypress Engineering
7171 Highway 6 North, Suite 102
Houston, Texas 77095-2422
(281) 797-3420 office
(281) 859-1881 fax

SITE SAFETY PLAN

1. INTRODUCTION

This health and safety plan contains guidelines for *Cypress Engineering Services, Inc. (CES)* worker safety during soil and ground water monitoring and remediation efforts at Transwestern Pipeline Company's Roswell Compressor Station No. 9. The purpose of this plan is to familiarize field personnel with safe operating procedures.

1.1 General Information

Project number:	None
Project name:	Roswell Remediation Site
Site name:	Roswell Compressor Station No. 9
Site Address:	Transwestern Pipeline Company Roswell Compressor Station 6381 North Main Roswell, NM 88201
Work description:	Drilling using air rotary or hollow stem auger methods, including field headspace analysis for volatile organic compounds. Operation of soil vapor extraction system. Operation of groundwater recovery, treatment and irrigation system. Collection of air, soil and groundwater samples.
Project Manager:	George Robinson

CES Site Safety Officer: George Robinson (or other CES personnel on-site)

Plan updated by:	Sandra Sharp	Date:	01/28/13
Work start date:	On-going	Work Hours:	No restrictions
Primary contact:	George Robinson	Telephone #	(281) 797-3420
Alternate contact:	Sandra Sharp	Telephone #	(281) 797-3421

Describe special site entry procedures, if any: Check-in with TW Operations Office

Work will be performed on property under the control of: Transwestern Pipeline Company

Warning method/signal for site evacuation: Verbal

7171 Highway 6 North, Suite 102
Houston, Texas 77095-2422
(281) 797-3420 office
(281) 859-1881 fax

Presence of hazardous materials: ( ) Potential (X) Confirmed

The exact location of hazardous material is: ( ) Known (X) Assumed ( ) Unknown

Distance, location and number of nearest phone: On-site cellular phone

Nearest public road: Hwy 285

Nearest water: On site

Nearest fire extinguisher: Station Operation's Office

Nearest first aid kit: Station Operation's Office

1.2 Potential Contamination

The subsurface soil and/or groundwater, may contain pipeline condensate, a petroleum hydrocarbon liquid similar to gasoline consisting primarily of saturated hydrocarbons in the C7-C11 range. The hydrocarbon contamination may be in liquid and/or gaseous (vapor) phase. Compounds such as n-octane, i-nonane, and n-decane are the most abundant components of pipeline condensate. Benzene, a major gasoline component, is generally only a minor constituent of pipeline condensate. However, benzene has been identified and is a recognized carcinogen, and thus is given special consideration.

Other site specific comments:

Previous water samples revealed the presence of BTEX, 1,1-Dichloroethane, 1,2-Dichloroethane, 1,1-Dichloroethene, 1,1,1-Trichloroethane and 1,2,4-Trimethylbenzene.

Polychlorinated biphenyl's (PCBs) are not expected at this site.

Most likely route to body entry and characterization for potential contaminants:

Material	Route to Body Entry	Characterization
Hydrocarbons	Inhalation, ingestion, and dermal contact	Irritant, asphyxiant, possible carcinogen
Benzene	Inhalation, ingestion, and dermal contact	Irritant, carcinogen
1,1-Dichloroethene	Inhalation, ingestion, and dermal contact	Irritant, carcinogen
PCBs	Physical contact (skin, eyes)	Irritant, carcinogen

7171 Highway 6 North, Suite 102
Houston, Texas 77095-2422
(281) 797-3420 office
(281) 859-1881 fax

Potential material hazards to worker: Contact with pipeline condensate hydrocarbons may result in dermal irritation due to desiccation. Inhalation of hydrocarbon and other organic vapors may result in oxygen deficiency and/or mucus membrane irritation. Mixtures of air and hydrocarbon vapors may reach explosive concentrations, thus creating an explosive hazard. Equally important are all of the physical hazards commonly associated with field activities, including pinch and trip hazards, back injuries, burns, excessive noise, high-pressure hazards, hot/cold temperatures, and snake/insect bites.

First Aid:	VOCs and PSH	Eyes:	Rinse immediately and thoroughly
		Skin:	Soap wash immediately and thoroughly
		Inhalation:	Fresh air
		Ingestion:	Medical attention

Flammability Limits: The flammable range for pipeline condensate vapors is variable and generally unknown. The following ranges are provided for comparison:

Diesel Fuel	LEL = 0.7%,	UEL = 5.0%;	Range: 7,000 - 50,000 ppmv
Gasoline	LEL = 1.3%,	UEL = 6.0%;	Range: 13,000 - 60,000 ppmv
n-octane	LEL = 1.0%,	UEL = 6.5%;	Range: 10,000 - 65,000 ppmv
Aroclors	LEL/UEL = nonflammable		

Flashpoint: Gasoline: 100° F @ 100% LEL

Hazard Type:	Liquid (X)	Solid (X)	Sludge ( )	Vapor/Gas ( )
Hazard Level:	High ( )	Moderate (X)	Low ( )	Unknown ( )
Characteristics:	Corrosive ( )	Ignitable (X)	Toxic (X)	Reactive ( )
	Volatile (X)	Radioactive ( )	Biological Agent ( )	

Field Monitoring: During drilling and excavation activities, a portable photo ionization detector (PID) will be used to monitor the breathing zone, as well as the area around and within the borehole. Concentrations within the breathing zone are not expected to be above background during the drilling and excavation activities.

Compound	STEL	IDLH	OSHA PEL
Benzene	1 ppm	500 ppm	1 ppm
n-Octane	385 ppm	1,000 ppm	500 ppm
Aroclor 1242	data not available	5 mg/m^3 (skin)	1 mg/m^3 (skin)
Petroleum distillates	450 ppm	1,100 ppm	500 ppm

(1) STEL = Short Term Exposure Limit (15 minutes)
(2) IDLH = Immediately Dangerous to Life and Health
(3) PEL = Permissible Exposure Limit
Source: NIOSH Pocket Guide to Chemical Hazards (Version available online February 2013)

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1.3 Project Hazard Checklist

In addition to potential chemical contamination, the following hazards may be present during drilling, excavation, sampling, and other O&M activities:

Physical Hazards Present: ☐ None	☒ Heat (Seasonal) ☒ Cold (Seasonal) ☒ Noise ☒ Slip, Trip, Fall hazard ☒ Airborne Dust ☒ Holes/Pits ☒ Electricity	☒ Severe Weather ☒ Poor lighting ☒ Overhead Hazards ☐ Natural Occurring Radioactive Material ☐ Chemical Usage ☐ Other:
Environmental/Equipment Hazards Present: ☐ None	☒ Heavy Machinery ☒ Trenching/excavation ☒ Drilling ☐ Forklifts ☐ Elevated heights (includes fall protection) ☐ Overhead/Underground utilities ☐ Confined Spaces ☒ Drums and containers ☐ Traffic/Roadway/Railway	☒ Power tools ☒ Cranes/Hoists/Rigging ☒ Ladders ☐ Scaffolding ☐ Man lifts ☐ Welding ☒ Gas cylinders ☒ Energized equipment ☒ Pressurized equipment ☐ Other:
Biological Hazards Present: ☐ None	☒ Poisonous/irritating plants ☒ Insects/rodents/snakes	☐ Other:
Ergonomic Hazards Present: ☐ None	☒ Repetitive motion ☒ Awkward position ☒ Heavy lifting ☒ Frequent lifting	☐ Forceful exertions ☐ Vibration ☐ Other:
Personal Safety/Security: ☐ None	☒ Personal safety ☐ Security issue ☐ Project site in isolated area ☒ Employees working alone ☒ Employees working early/late	☐ Potentially dangerous wildlife ☐ Guard or stray dogs in area ☐ No/limited cell phone service ☐ Other:
Driving Safety ☐ None	☒ Driving early/late ☒ Driving long trip ☒ Driving off-road	☐ City driving ☐ Pulling trailer ☐ Other:

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2. SAFETY GUIDELINES FOR SITE FIELD ACTIVITIES

The following guidelines are meant to cover operations by CES field staff during soil and groundwater monitoring and remediation activities. Safety guidelines for third party contractors are not included in this plan. Health and safety issues for third party contractor personnel working on site are the responsibility of their employer, not **CES.**

2.1 Personal Health and Safety

The following **CES** personnel will be involved in the project:

George Robinson	Project Manager
Sandra Sharp	Project Manager (on-site sampling)
Clayton Barnhill	Consulting Geologist (on-site O&M)

2.1.1 Protective Equipment

The following personal protective equipment **(PPE)** shall be used during site activities whenever field personnel are within the 25 foot work zone:

Leather boots
Hard hat
Protective eyewear
Hearing protection (if needed)

In addition, a half-face respirator with organic vapor cartridges and dust/mist prefilters, Tyvek coveralls, and work gloves shall be available for use whenever conditions require. The half-face respirator will be worn whenever organic vapors concentrations exceed levels outlined in Section 2.2 of this plan. Tyvek coveralls and work gloves will be worn whenever conditions require the CES field personnel to come in direct contact with potentially contaminated materials. Work areas will be established upwind of drilling activities to avoid unnecessary exposure to dust and/or organic vapors.

2.1.2 Hypothermia and/or Frostbite

Hypothermia and frostbite can result from exposure to low temperatures, high winds, long duration of exposure, and high humidity. When working out of doors during cold weather, the best prevention is to dress appropriately, minimize skin exposure, observe and be observed by coworkers, and take warm up breaks periodically. If conditions are extremely cold, body temperature and heart rate should be monitored hourly.

2.1.3 Eating and Drinking

No eating, drinking, smoking, or gum or tobacco chewing is allowed within the 25 foot work zone.

2.1.4 Eye Protection

Approved protective eyewear will be worn at all times when within the 25 foot radius work zone. The minimum eyewear protection required will be shatter-proof glasses, goggles, or face shields.

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2.1.5 Dust Protection

When blowing dust makes it necessary to protect personnel, disposable-type dust masks will be worn, or the dust/mist prefilter will be used if the half-face respirator is being worn.

2.1.6 Disposal of Contaminated Clothing or Equipment

All potentially contaminated clothing, Tyvek coveralls, gloves, paper towels, and other expendable items should be placed in garbage bags for disposal. As necessary, fresh Tyvek coveralls and work gloves should be donned to prevent accidental contact with potentially contaminated soil material.

2.2 Vapor Monitoring

During drilling activities, the CES health & safety officer or consulting geologist will be present near the drilling rig to monitor the work area for the presence of organic vapors using a PID. Readings will be taken at a minimum of once every 5 feet of drilling advancement, or every 15 minutes of drilling, whichever occurs first. The borehole and the breathing zone within the work area will be monitored. If the readings exceed or are anticipated to exceed 5 ppm above background in the breathing zone for 5 minutes, continuous monitoring will begin, and the half-face respirator will be worn by all CES personnel within the work zone until organic vapor levels dissipate. If sustained organic vapor levels exceed 200 ppm within the hollow stem auger, borehole, or within the breathing space, all CES personnel will evacuate the work zone until vapor levels dissipate. If the reading remains greater than 20 ppm above background within the breathing zone for one hour, drilling operations will be temporarily halted, and the on-site CES health and safety officer should contact the CES project manager for further instructions. The drilling supervisor will be notified of all readings, and is responsible for decisions regarding drilling contractor personnel safety.

If monitoring with the PID indicates a potential explosive hazard, a combustible gas meter will also be used to monitor the atmosphere within the boreholes and/or monitor wells. If the values exceed 10% LEL, continuous monitoring will begin. If the meter exceeds 25% of the LEL, work will cease immediately and the area will be evacuated until the vapors dissipate.

2.3 Drilling Activities

All CES field personnel are to maintain a safe distance from the immediate area of the drill rig. A 25-foot radius work area around the drill rig shall be designated. CES personnel shall enter this work zone only when necessary for the performance of the task at hand. CES personnel will avoid overhead equipment and will work cautiously to avoid slips and falls. Caution will be maintained and loose clothing will not be worn near rotating machinery. Under no circumstance shall CES personnel become directly involved in drilling operations, other than that immediately required for sample collection and for performance of vapor monitoring and geologic logging. **All kill switches and safety devices on the drill rig shall be located and tested prior to drilling.**

If the equipment is owned by a contractor, CES's supervisor in charge of the job should properly and thoroughly instruct the contractor on exactly what results are to be accomplished and point out all known safety hazards. Personnel should be sure they have eye contact with the mechanical equipment operator before approaching the equipment. Never approach heavy equipment from an operator's blind spots.

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3. INITIAL H&S BRIEFING

A H&S briefing will be conducted upon arriving at the site. The initial H&S briefing will be conducted by the CES on-site H&S officer, and will be attended by all CES personnel involved. The H&S plan and all pertinent H&S issues will be discussed during the briefing. All attendees will initial the H&S briefing form.

4. DAILY SAFETY MEETINGS

Prior to commencing each day's work, a "tailgate" safety meeting will be conducted by the CES on-site safety officer. All personnel directly involved in the work operations will be required to attend. The meeting will address specific issues regarding on-site health and safety, including: recent problems, near misses, work planned for the day and associated hazards, etc.

5. ACKNOWLEDGMENTS

I certify that I have read, understand, and will abide by the safety requirements outlined in the HASP.

NAME	TITLE	SIGNATURE	DATE
George Robinson	President		2-5-13
Sandy Sharp	Project Manager		2-5-13

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HEALTH & SAFETY BRIEFING FORM

Project Number: _____ Date: _____

Field Location: _____

Purpose of Work: _____

_____

Task to be Accomplished: _____

_____

_____

SOPs Required: _____

Health & Safety Issues Discussed: _____

_____

_____

_____

CES Health and Safety Officer: _____

Personnel Sign-in List

NAME	TITLE	SIGNATURE	DATE

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EMERGENCY PLANNING

AMBULANCE: 911 FIRE DEPARTMENT: 911

POLICE: 911 AIR EVACUATION: Call Hospital

DIRECTIONS TO LOCAL HOSPITAL:

Take Hwy 285 South to Roswell, NM. Turn west on Country Club Rd. Go approximately one block and the hospital will be on your right. It is on the corner of Country Club and Kentucky. (See following map)

HOSPITAL NAME: Eastern New Mexico Medical Center

ADDRESS: 405 West Country Club Road

TELEPHONE: (575) 622- 8170

EMERGENCY ROOM #: (575) 622-8170 ext 5070

NEAREST PHONE: On-site cellular phone (CES)

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