US Army Corps
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RESTORATION OF ABANDONED MINES PROGRAM
WILLOW CREEK MONITORING WELL INSTALLATION PROJECT
CREEDE, COLORADO
APRIL 2003

Restoration of Abandoned Mines
Willow Creek Monitoring Well Installation Project
Creede, Colorado

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April 2003

TABLE OF CONTENTS

List of Acronyms & Abbreviations II
1.0 Introduction 1
2.0 Project Location and Description 1
3.0 Physiography and Geology 1
4.0 Drilling and Well Installation 2
4.1 Monitoring Well Installation 2
4.2 Soil Boring 4
5.0 Tailings Pile Sample Analytical Results 5
6.0 Groundwater Sample Analysis Results 5
7.0 Groundwater Gradient and Metals Plume 7
7.1 Groundwater Gradient and Movement 7
7.2 Lead in Groundwater 8
8.0 Conclusions and Recommendations 8
9.0 References 9

LIST OF TABLES

Table 1 Monitoring Well Coordinates, Screened Intervals and Stick-Up Height above Ground Level 3
Table 2 Monitoring Well Development Final Measurements 4
Table 3: Tailings Pile Analytical Results 5
Table 4: Tailings Pile Wet Chemistry Result 5
Table 5: Monitoring Well Purge Log (final readings) 6
Table 6: Groundwater Sample Analytical Results for Metals 6
Table 7: Groundwater Sample Wet Chemistry Results 7
Table 8: Groundwater and Well Elevation Data of Pre-Existing Wells 8

LIST OF FIGURES

Figure 1: Regional Location Map 10
Figure 2: Site Map 11
Figure 3: Groundwater Zinc Concentrations 12
Figure 4: pH Plume 13
Figure 5: Groundwater Lead Concentrations 14

APPENDICES

Appendix A: Chemical Data Quality Assessment Report
Appendix B: Well Logs
Appendix C: Well Diagrams
Appendix D: Photo Log
Appendix E: Field Log Books

List of Acronyms & Abbreviations

bgs	below ground surface
CDMG	Colorado Division of Mining and Geology
DO	Dissolved Oxygen
DQCR	Daily Quality Control Report
DQO	Data Quality Objective
GPS	Global Positioning System
ID	Identification
"J"	Estimate Code
K	Saturated Hydraulic Conductivity
MCL	EPA Maximum Contaminant Level
MCLG	EPA Maximum Contaminant Level Goal
mL	Milliliter
mg/L	Milligram per Liter
mg/Kg	Milligram per Kilogram
mm	Millimeter
MSL	Mean Sea Level
MW	Monitoring Well
MWMP	Meteoric Water Mobility Procedure
NSDWR	EPA National Secondary Drinking Water Regulations
NAD	North American Datum
NTU	Nephelometric Turbidity Unit
pH	A measure of the Hydrogen Ion Concentration of materials
ppm	Parts Per Million
QA	Quality Assurance
QC	Quality Control
“R”	Unusable Code
R	Percent Recovery
RAMS	Restoration of Abandoned Mine Sites
SB	Soil Boring
USDAFS	United States Department of Agriculture - Forest Service

USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UTM	Universal Transverse Mercator Coordinates
WRDA	Water Resources Development Act
µs/cm	Microsiemen per Centimeter (a measure of conductivity)
µg/Kg	Microgram per Kilogram
µg/L	Microgram per Liter
µmho/cm	µs/cm (Microsiemen per Centimeter (a measure of conductivity)

1.0 Introduction

The United States Army Corps of Engineers (USACE) is provided authority for Restoration of Abandoned Mine Sites (RAMS) through the Water Resource Development Act (WRDA) 1999, Section 560. This program is a regionally focused and stakeholder responsive program for the restoration of abandoned and inactive non-coal mines where water resources (ecosystem/habitat) were degraded by past mining practices. This authority is intended to allow the USACE to provide support to agencies that manage lands impacted by past mining.

The objective of the project was to determine metals loading from a tailings pile on the Willow Creek drainage basin, approximately 1 mile south of the town of Creede. This project was also intended to enhance past and future Willow Creek Restoration Committee studies. In cooperation with the Willow Creek Restoration Committee, United States Department of Agriculture - Forest Service (USDAFS), Colorado Division of Mining and Geology (CDMG), United States Environmental Protection Agency (USEPA), and the current landowner (Creede Resources Inc.), the USACE installed five monitoring wells, one soil boring, and collected soil and groundwater samples for chemical analysis.

2.0 Project Location and Description

Willow Creek is a tributary to the Rio Grande, located south of Creede, in southwestern Colorado. Refer to Figure 1 for regional project location and Figure 2 for general location. Tailings from silver mines of the Creede Silver Mining District are located in a large waste/tailings pile in the alluvial valley of Willow Creek, downstream from the town. It is suspected that the tailings are a source of metals contamination to groundwater that may discharge to groundwater, impacting Willow Creek and then migrating down stream to the Rio Grande, thereby degrading the water quality. This project was the top priority for funding by the CDMG. The contaminants of concern (mainly zinc) from Willow Creek may affect the Rio Grande River. To assist in evaluating the possible release of zinc to the Willow Creek from the tailings, the USACE implemented the Willow Creek Site-Specific Addendum (SSA) to the RAMS Work Plan. All work performed during this investigation was performed in accordance with the approved SSA.

3.0 Physiography and Geology

The town of Creede is situated in the San Juan Mountains in Mineral County, CO. Elevation of Creede is approximately 8800 feet above Mean Sea Level (MSL). The Willow Creek flows through the center of town in a concrete lined channel. The creek originates about four miles north of Creede, at the Continental Divide in the San Juan Mountains. Creede is situated at the base of steeply sloped mountains and cliffs, on the northern portion of the Creede Lake Beds. The Creede Lake Beds were derived from the collapsed Creede Caldera. The surrounding foothills, mountains and cliffs are comprised mostly of faulted igneous formations and reflect the Tertiary volcanic activity of the San Juan Mountain Range and the caldera collapse.

4.0 Drilling and Well Installation

The USACE arrived on site during the week on October 21, 2002. Six borings were advanced; five were made in to monitoring wells. One soil boring was advanced in the waste pile for chemical profiling and backfilled. All borings were advanced with a Gus Peck 1300C with hollow-stem auger and was adapted to air and direct-rotary drilling when needed. Because of the large size gravel and cobble encountered during drilling, air and direct-rotary was used in some of the borings at depths where auger refusal was encountered. Air was also used to cleanout the bottom of the boreholes to assist in setting casing and sand pack. Borings were primarily drilled with a 4.25-inch auger. All the monitoring wells were completed with 2-inch diameter schedule 40, Poly Vinyl Chloride (PVC) pipe casing with o-ring joints, and 10 feet of 10-slot screen with a 20/40 silica sand pack. Because of large sized gravel and cobbles, samples could not be collected except in the one soil boring (SB1) and the top 5 feet of monitor well 18 (MW18). All other boring material descriptions were based on cuttings.

Because of the shallow nature of these wells and geologic conditions, grout was not used during completion. In all cases, with the exception of MW17, borings only had 3 to 5 feet of open borehole to the surface above the sand pack. In all cases, the gravel would cave in if augers were removed from the borings. For these reasons, the wells were completed with hydrated bentonite through hollow-stem augers from the top of the sand pack to the surface.

4.1 Monitoring Well Installation

The following monitoring well installation descriptions include casing depths and total depth (TD) of the borings. Casing depth was measured and reported from TOC and boring TD was measure and recorded from ground surface.

MW16 has a casing depth of 19.3 feet below the top of casing (TOC). The well is located near the toe of the tailings pile, between the pile and the railroad tracks See Figure 2 for locations and Table 1 for Universal Transverse Mercator (UTM) coordinates. During advancement of the first foot, tailings were observed in the cuttings. At 5 feet bgs, an approximate 1-foot layer of silty-clay was noted. The remainder of the boring contained gravel with about a 50% sand. Groundwater was encountered at 7.7 feet below ground surface (bgs). Boring TD measured at 18 feet bgs. Refer to drilling logs and completion diagrams for further description.

MW17 has a casing depth of 24.95 feet below the TOC. The well is located south of the tailings piles, approximately ¼ mile, in a dry channel. Refer the Figure 2 and Table 1. Gravel up to 40 mm in size was encountered in the first five feet. The remainder of the boring contained gravel with approximately 50% sand. Groundwater was encountered at 12.3 feet bgs. Boring TD was measured at 23.6 feet bgs. During the completion of this well, the borehole collapsed above the sand pack. A bentonite seal was placed above the collapsed segment to the surface. Because of the geologic nature of this area, it is doubtful that the collapse will cause adverse functionality of the well. The well developed adequately, and when groundwater samples were collected, turbidity was

measured at 2.9 Nephelometric Turbidity Units (NTU), a measure of water clarity. Refer to the drilling log and completion diagram for further description.

MW18 has a casing depth of 17.25 feet below the TOC. The well is located south of the tailings piles, approximately 500 feet north of MW17. Refer to Figure 2 and Table 1. Because the location of MW18 is located on soil, a continuous core barrel was used during the advancement of the first 5 feet. 1-½ feet of topsoil was collected in the core barrel. The core barrel then plugged with gravel, and additional recovery of samples was not feasible. Other than the first 1-½ feet, the boring contained gravel with 50% sand. Groundwater was encountered at 6.5 feet bgs. Boring TD was measured at 15.5 feet bgs. Refer to the drilling log and completion diagram for further description.

MW19 is located on the west side of the railroad tracks, approximately 400 feet south of the tailings piles. Refer to Figure 2 and Table 1. After drilling the boring to TD at the original location, gravel at the bottom heaved up into the hollow-stem auger. While attempting to set the screen and casing, the borehole collapsed. The borehole could not be salvaged. 10 feet of casing was recovered (see photo log, Appendix D). The remainder, the screen, was drilled out. The borehole was then allowed to cave-in on itself. A new location was selected approximately 3 feet to the south of the original location. Cuttings were the same as noted in other well borings, gravel with approximately 50% sand. Groundwater depth was not noted during drilling, but during development, groundwater was measured at 7.7 feet below the TOC. Boring TD was measured at 15.5 feet bgs, and depth of the casing was measured at 16.4 feet below TOC. Refer to the drilling log and completion diagram for further description.

MW20 has a casing depth of 18.38 feet below the TOC. The well is located just southwest of the tailings pile, on the east side of the railroad tracks. Refer to Figure 2 and Table 1. This well boring also contained mostly gravel (ranging up to 24mm in size) with approximately 50% sand to TD. Groundwater was encountered at 7.7 feet bgs. Boring TD was measured at 20.5 feet bgs. Refer to the drilling log and completion diagram for further description.

Table 1 Monitoring Well Coordinates, Screened Intervals and Stick-Up Height above Ground Level

Well	Easting	Northing	Stick-Up	Screen Interval
MW16	330904	4189823	2 feet	4.0 to 14 feet bgs
MW17	331464	4189073	2.3 feet	12.6 to 22.6 feet bgs
MW18	331398	4189224	2 feet	5.4 to 15.4 feet bgs
MW19	331150	4189336	2 feet	4.0 to 14 feet bgs
MW20	331050	4188564	1.8 feet	7.5 to 17.5 feet bgs
SB1	331002	4189710	N/A	N/A

Note: Coordinates are in UTM zone 13, collected by a hand held GPS unit and have a 5-meter (~15-foot) accuracy; bgs =below ground surface

After the completion of the monitoring wells, each well was developed using a direct current (DC) battery powered purge pump (see photo log). Table 2 below shows the volume of purged groundwater and the final groundwater quality parameters measured during development.

Table 2 Monitoring Well Development Final Measurements

Well	PH	Conductivity	Temperature (˚C)	Color	Gallons Purged
MW16	4.02	5450 µs/cm	9.9	Milky	80
MW17	6.30	333 µs/cm	10.6	Milky	56
MW18	5.61	$\underline{2.9 \times 10^6}$ µs/cm	9.6	Milky	30
MW19	4.02	1480 µs/cm	11.7	Clear	40
MW20	4.62	4842 µs/cm	9.9	Clear	60

Microsiemens per centimeter (µs/cm) = a measure of conductivity, Temperature recorded in Celsius (˚C); the underlined value for conductivity at MW 18 was most likely an instrument error or the meter was read incorrectly.

4.2 Soil Boring

One soil boring (SB1) was advanced into the tailings pile. The purpose of the boring was to collect samples for chemical profiling. The boring was advanced to 15 feet below the top of the tailings pile. The entire boring was advanced with a continuous core barrel, and a total of five soil samples and one blind duplicate sample were collected. Samples were collected at 5 inches below the surface, just below the cap material, at 3 feet, 7 feet, 10 feet and 15 feet. The duplicate sample was taken at 3 feet. Sample identification is CO-WC-SB1-05 for the sample collected at 5 inches, and the remaining samples are identified as CO-WC-SB1-3 for 3 feet, SB1-7 for 7 feet, etc… The blind duplicate sample was identified as CO-WC-SB1-20

Three, 5-foot continuous core barrels were advanced to a total depth of 15 feet. The first 5-foot core barrel returned about 50% recovery of very fine grained, light brown tailings. The second 5-foot core barrel also returned about 50% recovery of the same tailings as noted in first core barrel. The third core barrel advanced returned 100% recovery; however, only the first 0.2 feet of the core contained tailings. From 10.2 feet to 14.4 feet, representing 0.2 to 4.4 feet of the 5-foot core barrel contained a gray silty-clay. The remaining 0.6 feet was organic soil and black, with small roots. Small green stains were also noted in the organic soil. Sample CO-WC-SB1-15 was collected from the organic soil portion of this core. Sample CO-WC-SB1-10 was collected from the top of the silty-clay, in the tailings portion (at 10 feet). The silty-clay was considered anomalous and assumed to be an engineered layer. The same silty-clay layer was noted in MW16 at 5 to 6 feet bgs. MW16 was near the toe of the tailings pile. None of the other borings advanced in this investigation contained clay or silt.

During the planning phase of the investigation, available boring information from previously drilled wells was reviewed. None of the drilling logs for the existing wells indicated clay or silt at any depth. The depth of the silty-clay layer may correlate between MW16 and SB1. Ground surface of SB1 is approximately 5 to 8 feet higher than that of MW16. However, an elevation survey would have to be performed to make any definitive conclusion. No groundwater was encountered during the advancement of this soil boring.

Extra care was taken while backfilling SB1 due to the silty-clay layer. When the core barrel was removed from the soil boring, the borehole remained open and integrity was maintained. To maintain the integrity of the silty-clay layer, hydrated bentonite pellets

were placed in the borehole from TD to 9.8 feet below the top of the tailings pile. The thickness of the bentonite encompassed the entire thickness of the silty-clay layer, plus 0.4 feet above and 0.6 feet below. The tailings that were removed during the advancement of the soil boring were placed back in the borehole above the bentonite plug to a depth of 1.5 feet below the top of the tailings pile. The top 1.5 feet was then filled with the cap material. The drilling rig was used to compact the cap material to ground level. Refer to the drilling log and abandonment diagram for further detail (Appendices B and C).

5.0 Tailings Pile Sample Analytical Results

The results of the tailings pile sample chemical analytical results are presented in Table 3. Each sample was given a unique identification corresponding to sample depth. Sample ID CO-WC-SB01-3 was thoroughly homogenized and split. The split sample was labeled CO-WC-SB01-20 and submitted to the laboratory as a blind duplicate. Of the samples collected, lead and cadmium were elevated, compared to region 6 and 9 soil screening guidance (EPA 2000; EPA 2002). Lead appeared to decrease in organic soil as indicated by the samples collected at 15 feet below the top of the tailings pile. Cadmium was only detected at an elevated concentration in the sample collected from 15 feet below the top of the tailings pile, in the organic soil. Additionally, leachate pH was measured in each tailings pile sample. With the exception of CO-WC-SB01-05, all collected samples exhibited low pH (refer to table 4).

Table 3: Tailings Pile Analytical Results

Analyte	CO-WC-SB01-05	CO-WC-SB01-3	CO-WC-SB01-7	CO-WC-SB01-10	CO-WC-SB01-15	*CO-WC-SB01-20
Aluminum	3630	635	1220	1100	1100	614
Cadmium	2.0	9.49	4.0	13.4	**2560**	11
Calcium	911	190	230	570	1430	72
Copper	123	78.1	33.8	157	18	86.8
Iron	14100	6490	15300	16400	10500	7430
Lead	**3170**	**3460**	**6260**	**4190**	314	**3690**
Magnesium	917	20 J	37	38	2570	20 J
Manganese	210	9.77	10.3	11.0	247	9.47
Zinc	517	1620 B	622 B	2960 B	3920 B	1860 B

Note: B = Analyte also detected in method blank; J = Estimated concentration below laboratory limit; * = Duplicate sample of CO-WC-SB01-3; all values reported in milligrams per kilogram (mg/Kg); bolded values indicate above regulatory limits

Table 4: Tailings Pile Wet Chemistry Result

Parameter	CO-WC-SB01-05	CO-WC-SB01-3	CO-WC-SB01-7	CO-WC-SB01-10	CO-WC-SB01-15	*CO-WC-SB01-20
PH	8.45	3.74	2.75	3.25	3.97	3.34
Conductivity	93.9µmho/cm	249µmho/cm	1400µmho/cm	914µmho/cm	2320µmho/cm	330µmho/cm

Note: µmho/cm = µs/cm which is Microsiemens per centimeter (a measure of conductivity)

6.0 Groundwater Sample Analysis Results

Groundwater samples were collected from the newly installed monitoring wells on November 17 and 18, 2002. Samples were collected after groundwater was thoroughly purged from each monitoring well and groundwater quality parameters stabilized. A Geopump™ 2, peristaltic pump was used to purge the wells. Monitoring well purging

parameters are shown in Table 5. When collected, each groundwater sample was given a unique sample identification number corresponding to the monitoring well identification. For example, the sample collected from MW16 was identified as CO-WC-MW16. The groundwater sample collected from MW20 was split and submitted to the lab as a blind duplicate. This blind duplicate groundwater sample was labeled CO-WC-MW21. Results of the groundwater analytical analysis are presented in Table 6. Table 7 presents wet chemistry results that include values for chloride, sulfate and alkalinity.

Table 5: Monitoring Well Purge Log (final readings)

Parameters	CO-WC-MW16	CO-WC-MW17	CO-WC-MW18	CO-WC-MW19	CO-WC-MW20
Water Level (feet below TOC)	8.96	13.24	8.07	7.67	8.27
PH	**2.97**	**5.33**	**5.06**	**3.93**	**4.22**
Conductivity (µs/cm)	4380	380	3240	1116	4230
Temp (˚C)	10.3	10.2	8.6	10.8	9.3
Turbidity (NTU)	7	2.9	10	8	15
Gallons Pumped	6	6.5	7	5.5	6

Bolded values exceed National Secondary Drinking Water Regulations (NSDWR) – ph secondary standard is 6.5 to 8.5; Microsiemens per centimeter (µs/cm) = a measure of conductivity; Nephelometric Turbidity Unit (NTU) = A measure of clarity

Table 6: Groundwater Sample Analytical Results for Metals

Analytes	Regulatory Limit	CO-WC MW16	CO-WC MW17	CO-WC MW18	CO-WC MW19	CO-WC MW20	*CO-WC MW21
Aluminum	200 NSDWR	**174000**	**1120**	**17200**	**28200**	**38200**	**38200**
Cadmium	5.0 MCL	**1490**	**37.1**	**723**	**586**	**834**	**840**
Calcium	NA	71300	41900	528000	59400	197000	201000
Copper	1.3 MCL	**4180**	5 J	700	488	271	261
Iron	NA	110000	40 J	160	140 J	619000	618000
Lead	15 MCLG	**30**	U	4J	7 J	**36**	**35**
Magnesium	NA	41200	4680	57000	14600	53900	54700
Manganese	0.5 NSDWR	**92800**	**275**	**132000**	**31600**	**144000**	**143000**
Zinc	5.0 NSDWR	**339000**	**26600**	**366000**	**132000**	**458000**	**425000**

Note: J = Estimated concentration below laboratory limit; u = analyte was analyzed for but not detected at or above the sample reporting limit; * = Duplicate sample of CO-WC-MW-20; all values reported in micrograms per liter (µg/L); bolded values indicate above regulatory limits (Maximum Contaminant Level (MCL), Maximum Contaminant Level Goal (MCLGs) and NSDWR)

Table 7: Groundwater Sample Wet Chemistry Results

Parameter	Regulatory Limit	CO-WC MW16	CO-WC MW17	CO-WC MW18	CO-WC MW19	CO-WC MW20	*CO-WC MW21
Sulfate	250 NSDWR	**3600 D**	**170 D**	**2300 D**	**690 D**	**3300 D**	**3380 D**
Chloride	250 NSDWR	4. J	u	7.7	2. J	4. J	4. J
Alkalinity (as $CaCO_3$)	NA	u	u	58.	u	56.	54.
Bicarbonate Alkalinity (as $CaCO_3$)	NA	u	u	58.	u	56.	54.
Carbonate Alkalinity (as $CaCO_3$)	NA	u	u	u	u	u	u

Note: J = Estimated concentration below laboratory limit; u = analyte was analyzed for but not detected at or above the sample reporting limit; D = Result quantitative from a 1:2 dilution; * = Duplicate sample of CO-WC-MW20; all values reported in mg/L; Bolded values exceed NSDWR.

7.0 Groundwater Gradient and Metals Plume

Based on the chemical analytical results of groundwater obtained during this investigation, zinc could not be correlated between the newly installed monitoring wells. Zinc concentrations were above the NSDWRs, but the distribution of concentrations among the newly installed wells was not conclusive as to plume movement and origin (See Figure 3). Additionally, zinc concentrations in groundwater did not correlate with the direction of groundwater movement. Lead concentrations correlate to groundwater movement. See section 7.2.

7.1 Groundwater Gradient and Movement

Based on the historic elevation data collected from pre-existing monitoring wells, (MW1 through MW15) groundwater flow is in a southerly direction with a slope of ~ 0.04 feet/feet, based on survey data obtained from the Willow Creek Restoration Committee (Refer to Figure 2). The groundwater contours shown in Figure 2 were representative of groundwater depths collected during November 2001 through November 2002. It appears that groundwater flows with the surface topography. Table 7 below contains the data points used to construct the groundwater contours represented in Figure 2.

Based on the grain size of geologic material encountered during drilling, saturated hydraulic conductivity of distributed data is estimated at $10^{2.5}$ to $10^{4.5}$ feet/day (USGS, 1995). Porosity of geologic material, groundwater slope, and saturated hydraulic conductivity were estimated to determine the groundwater velocity. Coarse gravel has a porosity of 25% to 40% (Driscoll, 1995). Groundwater velocity is determined as:

$$v = (K \div n) \times \text{slope of water table}$$

where:

v = velocity
K = saturated hydraulic conductivity
n = porosity (USGS, 1995)

Groundwater velocity was estimated at .04 feet/minute to 2.2 feet/minute. Hydrogeological testing would be required to determine a more precise estimate of groundwater velocity.

Table 8: Groundwater and Well Elevation Data of Pre-Existing Wells

Well ID	UTM Coordinates Zone 13 / WGS 1984		Elevation of Monitoring Wells in feet From TOC	Groundwater Elevations in feet from MSL		
	Northing	Easting		11-2001	4-2002	11-2002
MW1	4188119.670	332063.001	8616.265	8597.965	8597.065	8597.265
MW2	4188833.768	331680.472	8657.605	8644.805	8647.555	8646.478
MW3	4188612.161	331312.807	8652.747	8649.447	8649.447	8649.507
MW5	4189118.920	331317.488	8681.643	8674.883	8677.443	8676.256
MW7	4189300.679	331161.933	8698.722	8690.872	8691.422	8691.222
MW8	4189384.654	331184.927	8697.023	8694.093	8694.423	8694.506
MW9	4189556.154	331078.995	8718.465	8712.465	8712.565	8712.418
MW10	4189545.859	331028.133	8714.224	8712.034	8712.174	8712.101
MW11	4189697.661	330980.669	8728.557	8723.287	8723.507	8723.250
MW12	4189800.085	330869.110	8733.356	8732.136	8730.856	8731.743
MW13	4190000.896	330732.788	8748.614	8746.504	8746.814	8746.621
MW14	4190132.107	330771.897	8758.389	8756.039	8756.989	8756.372
MW15	4190276.992	330832.974	8768.682	8763.102	8763.932	8763.309

Source: Willow Creek Restoration Committee

7.2 Lead in Groundwater

Soil samples collected in the tailing pile contained elevated levels of lead. The lead may be leaching from the piles as noted by the groundwater chemical analytical results (refer to Figure 5).

8.0 Conclusions and Recommendations

With groundwater data received from the Willow Creek Restoration Committee, the USACE estimated the general flow of groundwater at the site. However, to determine groundwater flow velocity, transmisivity and other groundwater hydraulic characteristics, pump tests need to be performed. Elevated levels of lead and zinc were detected in the groundwater. Zinc could not be related to an origin, nor could a migration direction be determined. Lead appears to migrate with the groundwater, observing that the newly installed monitoring wells furthest from the tailings pile contained the least concentrations of lead.

The soil boring in the tailing pile contained elevated levels of cadmium, lead and zinc. The one sample collected in organic soil, beneath the tailings pile contained less lead than that detected in the tailings. Concentrations of zinc in the organic soil and the tailings

pile were similar. Concentrations of cadmium were higher in the organic soil than the tailings pile.

USACE recommends that the Willow Creek Restoration Committee compare their groundwater chemical data with these data presented in this report. By correlating the two sets of data, the migration of lead and zinc in groundwater may be better understood.

9.0 References

1. Fletcher G. Driscoll, Ph.D. (Driscoll, 1995), Groundwater and Wells, Johnson Screens, St. Paul, Minnesota, 1995.

2. United States Environmental Protection Agency, Region 9 (EPA, 2000), Preliminary Remediation Goals, San Francisco, CA, 2002.

3. United States Environmental Protection Agency, Region 6 (EPA, 2002), Human Health Medium - Specific Screening Levels, Dallas, TX, 2002.

4. United State Environmental Protection Agency (EPA, 2001), National Primary Drinking Water Regulations, Washington DC, 2001.

5. United States Geological Survey (USGS, 1995), Water-Supply Paper 2220 – Basic Ground-Water Hydrology, United States Printing Office, 1995.

6. United States Geological Survey, Creede 7.5 Minute Quadrangle Topographic Map, Denver, CO., 1986.

7. Willow Creek Restoration Committee, Personal Communication, Groundwater Elevation Data from December 2001 to December 2002, Creede, CO, 2003.

Figure 1: Regional Location Map

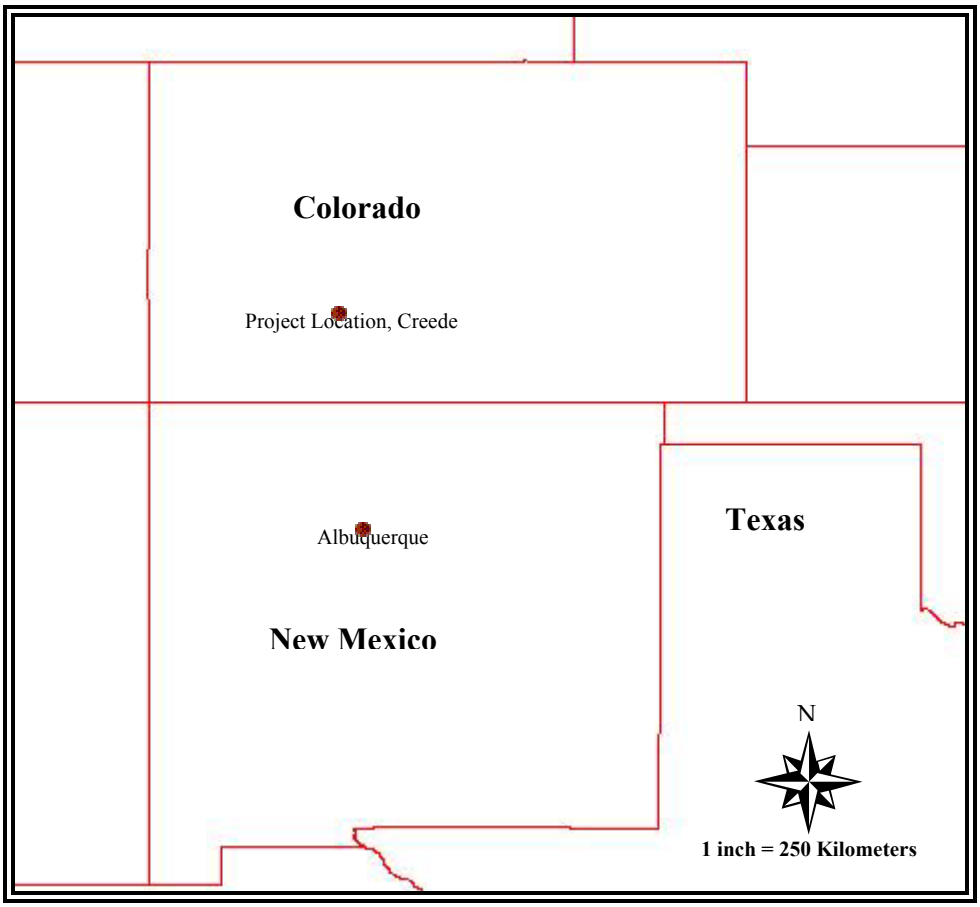
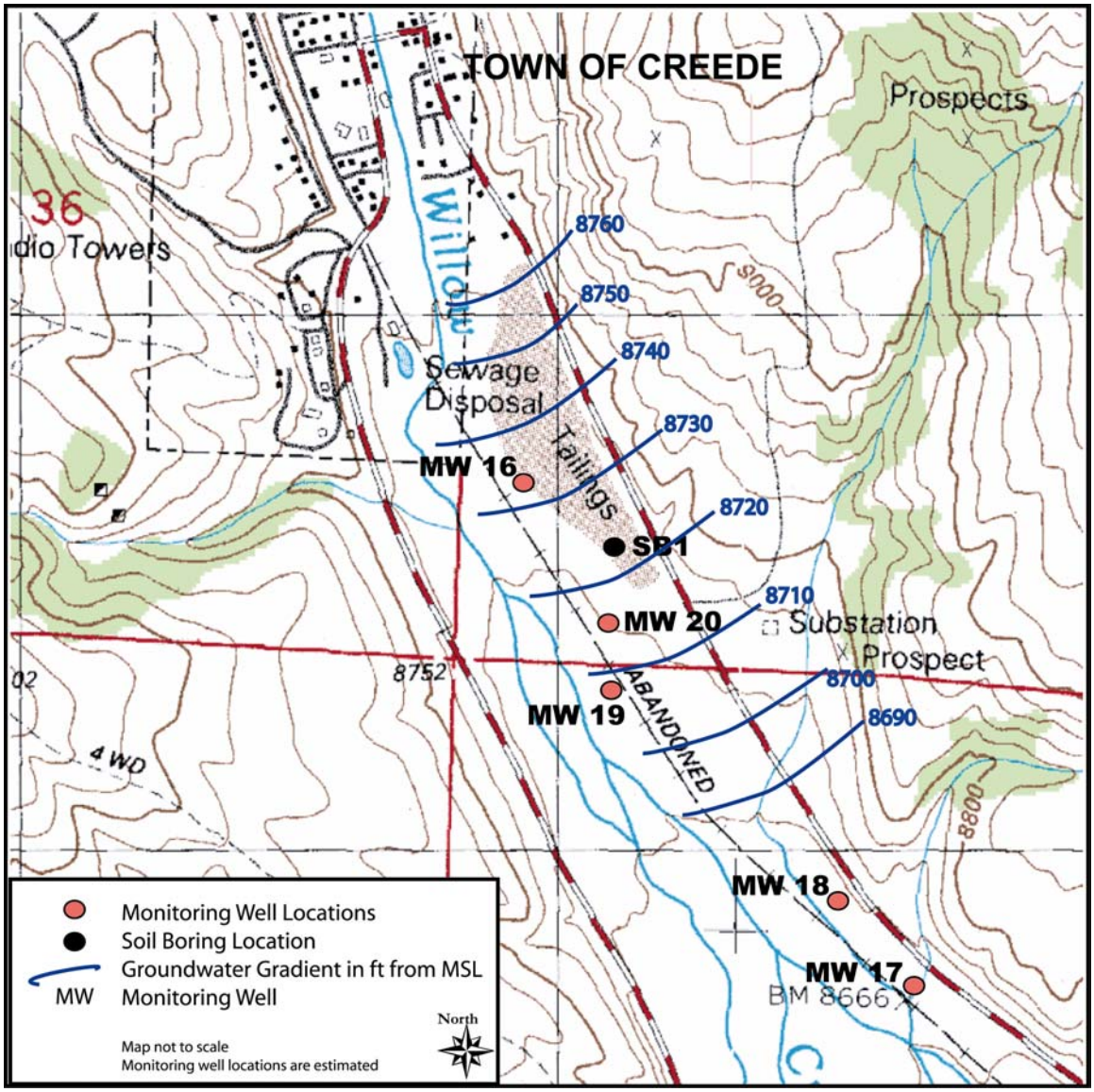


Figure 2: Site Map



Source: USGS Topographic Map, 7.5 Minute Quadrangle, Creede CO.

Figure 3: Groundwater Zinc Concentrations

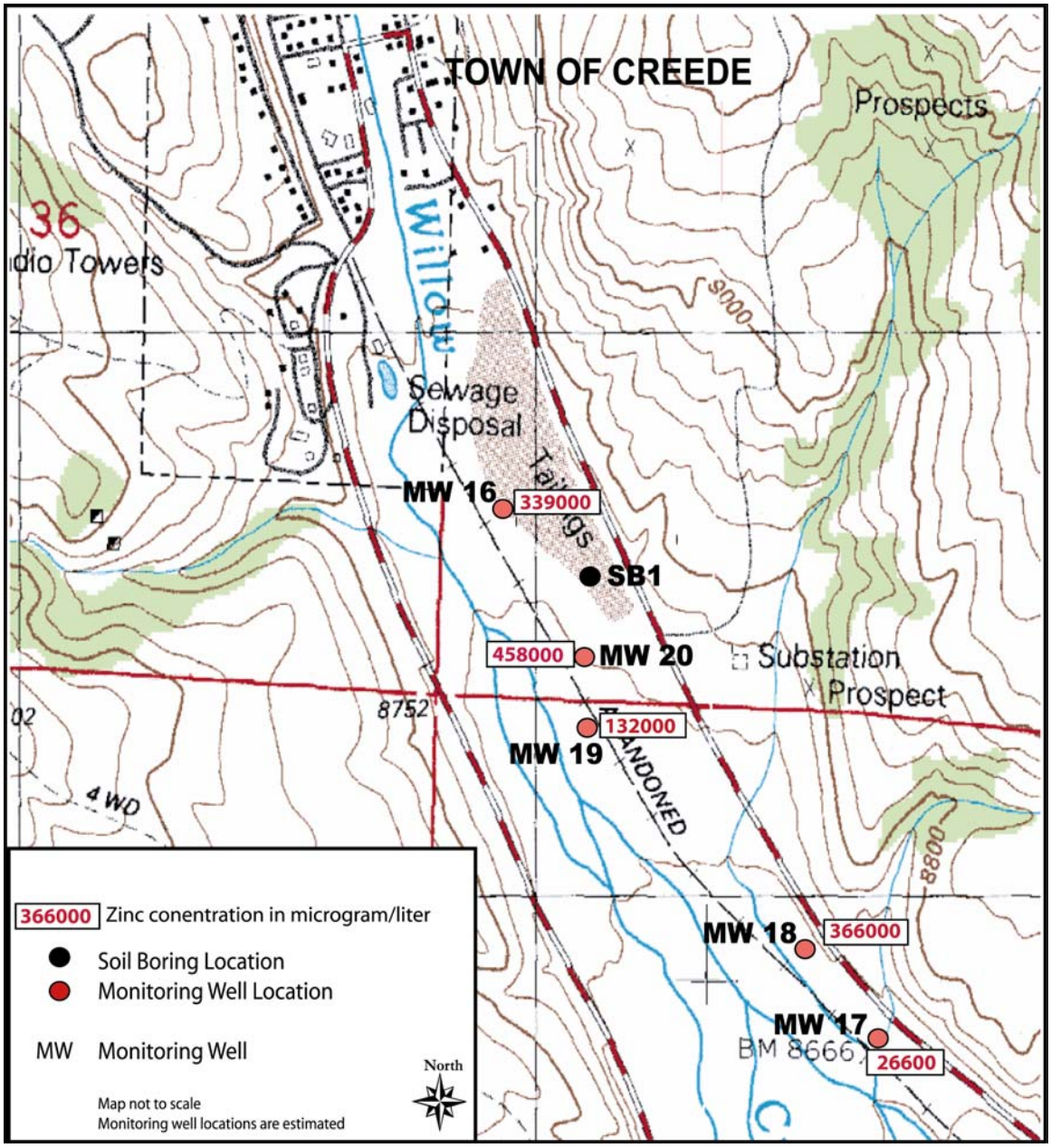


Figure 4: pH Plume

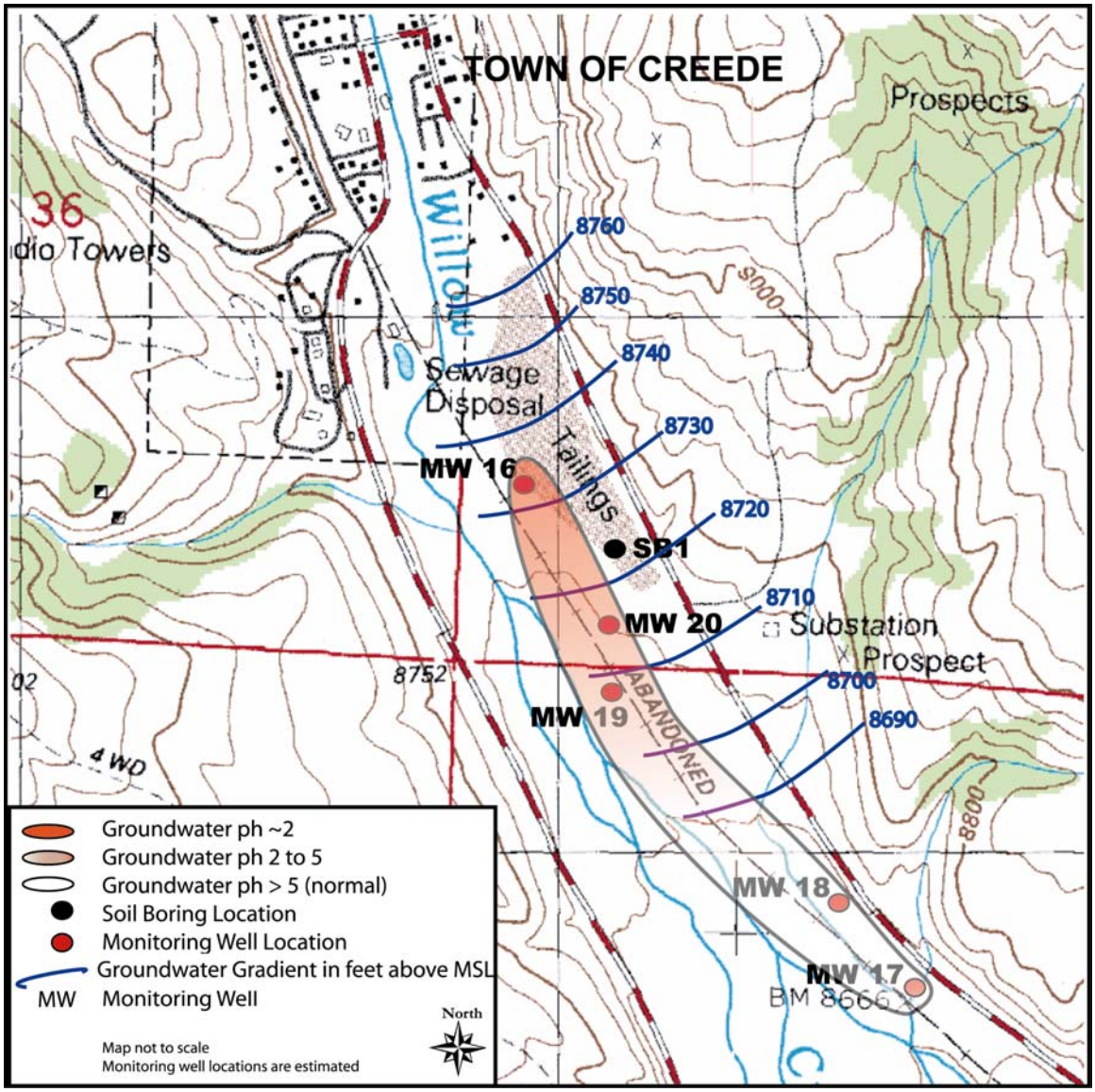
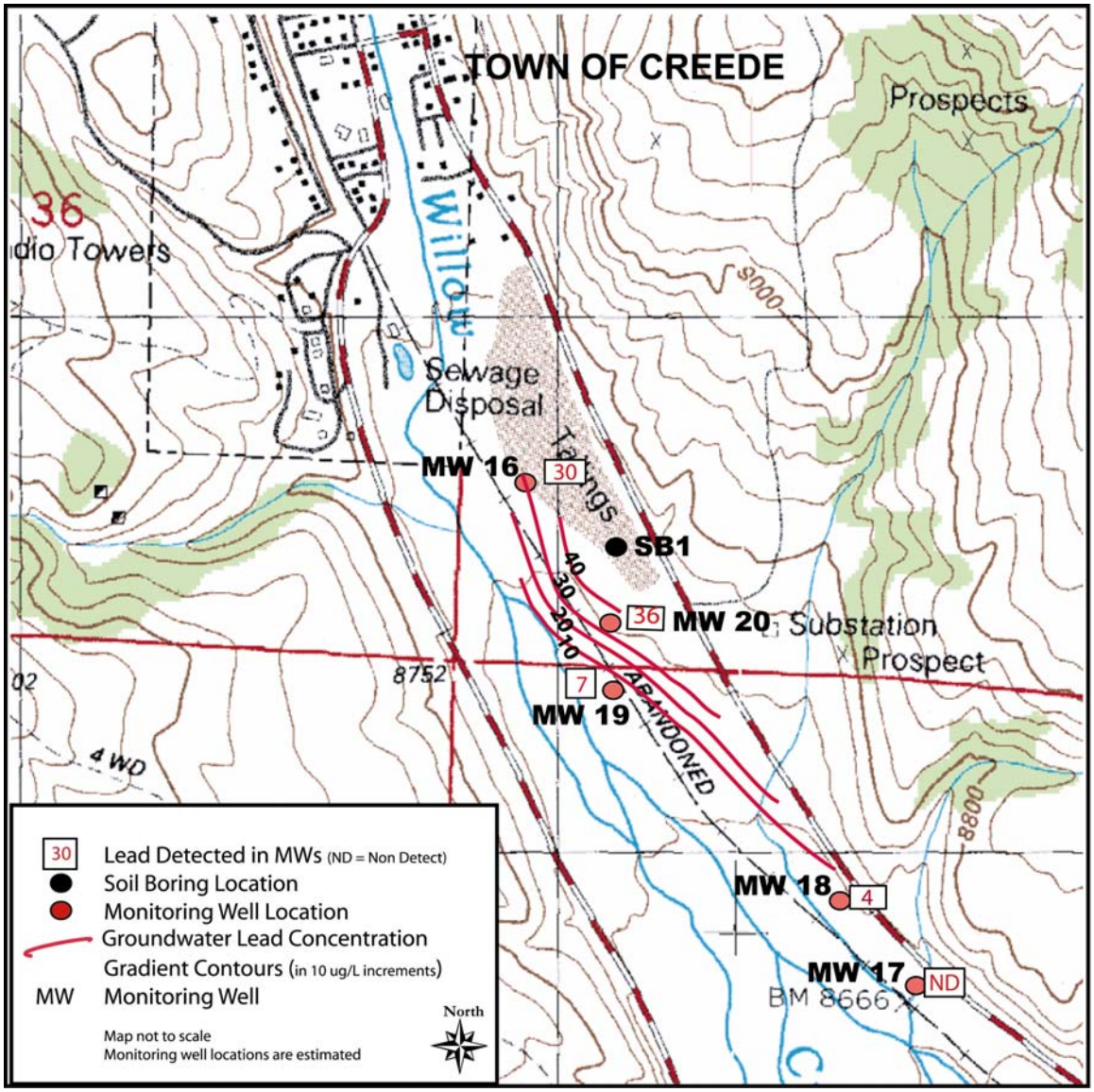


Figure 5: Groundwater Lead Concentrations



Source: USGS Topographic Map, 7.5 Minute Quadrangle, Creede CO.

APPENDICES

APPENDIX A: CHEMICAL DATA QUALITY ASSESSMENT REPORT

OMAHA DISTRICT
U.S. ARMY
CORPS OF ENGINEERS

Chemical Data Quality Assessment Report (CDQAR)

For

Soil and Groundwater Samples Obtained at

Willow Creek-Creede, Colorado

February 2003

TABLE OF CONTENTS

Section Page

LIST OF TABLES and APPENDICES ii

LIST OF ABBREVIATIONS AND ACRONYMS iv - v

1 INTRODUCTION 1-1

1.1 QUALITY CONTROL SUMMARY 1-1
1.2 REPORT ORGANIZATION 1-1

2 PROJECT DESCRIPTION 2-1

2.1 PROJECT PURPOSE 2-1
2.2 DATA QUALITY OBJECTIVES 2-1
2.2.1 Data Collected 2-1

3 FIELD QUALITY ONTROL PROCEDURES 3-1

3.1 PROJECT PLANNING 3-1
3.2 DOCUMENTED FIELD ACTIVITIES 3-1
3.2.1 Samples 3-1
3.2.2 Management of Investigation Derived Waste (IDW) 3-1
No IDW was generated during this investigation except for disposable sampling equipment such as gloves, plastic cups, etc., which were disposed of in a dumpster. 3-1
3.2.3 Decontamination Procedures 3-1
3.2.4 Other Documentation and Reporting of Field Activities 3-1
3.2.5 Sample Labeling, Handling, and Shipping 3-1
3.3 FIELD QUALITY CONTROL SAMPLES 3-2

4 EVALUATION OF DATA QUALITY 4-2

4.1 LABORATORY QUALITY CONTROL SAMPLES 4-3
4.1.1 Laboratory Control Samples (LCS) 4-3
4.1.2 Method Blank Analyses 4-3
4.1.3 Surrogate Spike Analyses 4-3
4.1.4 Matris Spike/Matrix Spike Duplicate (MS/MSD) 4-3
4.2 LABORATORY DATA VALIDATION ACTIVITIES 4-3
4.3 PROJECT CHEMIST QUALITY EVALUATION 4-5

5 RESULTS OF QUALITY CONTROL ACTIVITIES AND ANALYSES 5-1

5.1 FIELD QC PROCEDURES AND FIELD QC ANALYSES 5-1
5.1.1 Documentation of Field Quality Procedures 5-1
5.1.2 Field Duplicate Analyses 5-1
5.2 LABORATORY QC PROCEDURES AND LABORATORY QC ANALYSES 5-1
5.2.1 Initial Sample Inspection and COC Documentation 5-1
5.2.2 Holding Times 5-2
5.2.3 Method Blank Analyses 5-2
5.2.4 Laboratory Control Samples 5-2
5.2.5 Surrogate Recovery 5-3
5.2.6 MS/MSD Recovery 5-3
5.2.7 Completeness of Data Packages 5-3
5.3 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS AND COMPARABILITY (PARCC) 5-3

5.4 DATA TABLES 5-4
THE QUALIFIED DATA IS GIVEN IN TABLE 1, 2, 3, AND 4 OF APPENDIX A. 5-4
5.5 ANALYTICAL DATA PACKAGE 5-4
DATA SHEETS AS OBTAINED FROM THE ENVIRONMENTAL CHEMISTRY LABORATORY ARE GIVEN AS A HARD COPY OF THE ANALYTICAL DATA PACKAGE. 5-4
6 CONCLUSIONS 6-1

LIST OF TABLES

Table 3-1 Sample Containers Preservation, and Holding Times For Surface water Samples
Table 4-1 Analytical Batches

LIST OF APPENDICES

Appendix A Data Tables of validated data from soil and groundwater samples

ACRONYMS/ABBREVIATIONS

ADP	Analytical Data Package
ASTM	American Standard Testing Materials
^{o}C	Degrees Celsius
CDQAR	Chemical Data Quality Assessment Report
CENWO	Corps of Engineers, Omaha District
COC	Chain-of-Custody
DQCR	Daily Quality Control Report
DQOs	Data Quality Objectives
DUP	Duplicate
ECB	Environmental Chemistry Branch
eV	Electron volt
EPA	Environmental Protection Agency
FSP	Field Sampling Plan
Ft	Foot/Feet
I.D.	Inner Diameter
IDW	Investigative Derived Waste
Kg	Kilogram
L	Liter
LCS	Laboratory Control Sample
LCSD	Laboratory Control Sample Duplicate
LIMS	Laboratory Information Management System
MDL	Method Detection Limit
mg/kg	Milligrams per kilogram
mg/L	Milligrams per Liter
mg	Milligram
Min	Minute
ml	Milliliters
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	Mean Sea Level
MW	Monitoring Well
N/A	Not Applicable
ND	non-detect
PID	Photoionization Detector
ppb	Parts per Billion (measured in water as ug/L)
PQL	Practical Quantitation Limit
QA	Quality Assurance
QAPP	Quality Assurance Project Plan
QC	Quality Control
RL	Reporting Limit
RPD	Relative Percent Difference
SSHP	Site Safety Health Plan
SOP	Standard Operating Procedure

ug/L	Micrograms per Liter
U.S.	United States
USACE	United States Army Corps of Engineers

1 INTRODUCTION

1.1 QUALITY CONTROL SUMMARY

This Chemical Data Quality Assessment Report (CDQAR) describes the operations and procedures followed by U. S. ARMY Corps of Engineers (USACE) to conduct the investigation of the surface soil and groundwater samples obtained from Willow Creek. Field work was performed by USACE Omaha District personnel. Analytical services were provided by the U. S. Army Corps of Engineers, the Environmental Chemistry Branch (ECB) Laboratory, located in Omaha, Nebraska and selected analyses at Continental Analytical Services, Inc., Salina Kansas.

The field and sample analyses were performed in accordance with the Work Plan for the Restoration of Abandoned Mine Sites prepared by U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska, July 2002 and the Site Specific Addendum for the Willow Creek area, 4 Oct, 2002.

This CDQAR includes a summary of the quality assurance (QA) and quality control (QC) procedures and an evaluation of data quality and data usability with respect to Data Quality Objectives (DQOs) established for this field investigation.

1.2 REPORT ORGANIZATION

Section 2 of this report provides a discussion of project and data quality objectives. Procedures employed to control and evaluate the quality of sample collection, transportation, storage, and analysis are presented in Section 3. Section 4 discusses data evaluation, and the results of QC evaluations are in Section 5. Conclusions and recommendations are presented in Section 6.

2 PROJECT DESCRIPTION

2.1 PROJECT PURPOSE

The purpose of this investigation is to collect soil samples from within a mine tailings pile to determine metals loading from the tailings into Willow Creek. Groundwater samples are obtained from monitoring wells that are located in an area to try to define a suspected groundwater contaminant plume migrating from the tailings pile. The metals, alkalinity, chloride, and sulfate analysis of groundwater and the soil and water leachate analysis of the mine tailings will determine the effect on the adjacent willow creek. Laboratory addresses are given below:

US Army Corps of Engineers
Environmental Chemistry Branch (ECB) Laboratory
420 South 18th Street
Omaha, NE 68102

Continental Analytical Services, Inc
1804 Glendale Road
Salina, Kansas 67401

The laboratories report all non-detect results as "u". The non-detect values are given in the data tables as "u" meaning less than the Method Detection limits (MDL). The MDL is the minimum concentration of a substance that can be measured and reported with 99 per cent confidence that the analyte concentration is greater than zero, and is determined from analysis of a sample in a given matrix containing the analyte. The Reporting Limit (RL) is determined by the laboratory and takes into account impacts from sample matrix, sample preparation, and instrument limitations. The RL represents the concentration at which the laboratory can both determine the presence of an analyte and accurately quantify the amount present. The sample quantitation limit or laboratory reporting limit are reported interchangeably. The laboratory reported detections below the RL and higher than the MDL with a "J" laboratory qualifier, which indicates a greater degree of uncertainty associated with the quantitative result. The " J" values are considered valid and useable. Reporting limits may increase for an individual environmental sample due to high concentrations of target analytes, matrix effects, or other interferences.

2.2 DATA QUALITY OBJECTIVES

The DQOs for this site are based on the data objective and sensitivity criteria as given in the General Work Plan, July 2002. The data is not compared to environmental regulations, but is obtained to give an indication of the metals contamination migrating from the mine tailings pile.

2.2.1 Data Collected

The data collected from the mine tailings and groundwater from the Willow Creek area is designated as definitive data. Field measurements obtained during groundwater monitoring such as pH, temperature, conductivity, and turbidity are reported in the field logs and is not a

part of this data package.

Definitive level data from the monitoring wells and soil samples were analyzed at off-site laboratories, and following sections present the quality control procedures, and validation procedures. The result of the quality control process is presented in Section 5.

3 FIELD QUALITY ONTROL PROCEDURES

3.1 PROJECT PLANNING

The field investigation was conducted as described in the Site Specific Addendum for Willow Creek, 4 October, 2002. The plan was written by CENWO to ensure the quality of data derived from the investigation. The plan provides a discussion of the project work and general procedures to be followed for field and laboratory activities.

3.2 DOCUMENTED FIELD ACTIVITIES

This section summarizes the equipment, procedures, and methods undertaken to insure quality sample collection activities. Investigation activities and QC procedures were recorded and documented in the field using appropriate field forms. Prior to sample collection, as well as between sample locations, field equipment was decontaminated.

3.2.1 Samples

A total of five (5) groundwater samples plus one (1) duplicates were obtained by CENWO personnel between November 17 and 18, 2002. Five (5) soil samples plus one (1) duplicate were obtained October 23, 2002.

3.2.2 Management of Investigation Derived Waste (IDW)

No IDW was generated during this investigation except for disposable sampling equipment such as gloves, plastic cups, etc., which were disposed of in a dumpster.

3.2.3 Decontamination Procedures

The field instruments were decontaminated in the field as described in the Standard Operating procedures given in the General RAMS Work Plan, July 2002..

3.2.4 Other Documentation and Reporting of Field Activities

All field activities were thoroughly documented in indelible ink using the following forms:

- Field Notebook
- Chain of Custody Record

CENWO field personnel initiated Chain of Custody (COC) documentation as samples were collected and selected for laboratory analysis. Sample custody was maintained from sample collection through the completion of the laboratory analysis.

3.2.5 Sample Labeling, Handling, and Shipping

The sampling team performed sample collection, sample labeling, and sample shipping. Samples were collected in the appropriate sample containers provided by the ECB Laboratory. The sample containers were identified with waterproof labels and all writing was completed in indelible ink.

Labeled samples were placed in sealed Ziplock brand bags and packed in waterproof plastic ice

chests with sufficient packaging material placed around and between the sample jars. Ice was double bagged and placed on the bottom of the cooler, and around the sample containers, and on top of the sample containers to achieve and maintain preservation at 4 degrees Celsius from the time of collection until receipt by the laboratory. Sample containers, preservatives, and holding times used for this project are shown in Table 3-1 and Table 3-2.

Every cooler contained a COC form, prepared in triplicate, which identified all of the sample containers, analytical requirements, time and date sampled, preservatives, and other pertinent field data. Samples were shipped by an overnight courier to the ECB Laboratory to enable analysis within the specified holding times. Upon receipt in the laboratory, the Sample Custodian opened the shipping containers, compared the contents with the COC record, ensured that the document control information was accurate and complete, and dated the form. A Sample Receipt Form was also used by the laboratory to log in samples and document their integrity upon arrival. These forms are provided in the Analytical Data Packages.

3.3 FIELD QUALITY CONTROL SAMPLES

Duplicate samples were analyzed at the rate of one for each analytical batch. The results of the field QC samples and their impact on data quality are discussed in Section 4.0.

Table 3-1 Sample Containers, Preservation, and Holding Times for Groundwater Samples

Parameter	Container'	Preservation	Maximum Holding Times:	
			Extraction	Analysis
Total Metals	1 - 500 ml plastic	HNO3 to pH<2 Ice to 4°C	6 months	6 months
Dissolved Metals	1 - 500 ml plastic	Ice to 4°C*	6 months (Hg-28 days)	6 months (Hg-28 days)
Alkalinity Chloride sulfate	1- 500 ml plastic	Ice to 4°C		14 days 28 days 28 days

* Acid preserved after filtration through 0.45 micron filter.

Table 3-2 Sample Containers, Preservation, and Holding Times for Soil Samples

Parameter	Container'	Preservation	Maximum Holding Times:	
			Extraction	Analysis
Total Metals	1 x 8 oz Glass	Ice to 4°C	6 months	6 months

4 EVALUATION OF DATA QUALITY

The laboratory analytical data was reviewed and verified by the ECB Laboratory and then

evaluated by the CENWO project chemist for compliance with project objectives.

The following section is a description of the laboratory review procedures used to ensure data quality and the project chemists' assessment of project deliverables. Data usability was determined by comparing the project DQOs against the quality of the final analytical results.

4.1 LABORATORY QUALITY CONTROL SAMPLES

This section provides a description of laboratory QC samples: laboratory control samples, method blanks, and matrix spike/matrix spike duplicate.

4.1.1 Laboratory Control Samples (LCS)

The laboratory analyzed a spike blank sample in duplicate to evaluate the precision and accuracy within an analytical batch. The nomenclature for these samples is a laboratory control sample (LCS). LCS sample pairs consisted of analyte-free water which was spiked with selected target compounds. LCS results are included in the QC section of each laboratory's data package which are included in the Analytical Data Packages.

4.1.2 Method Blank Analyses

A laboratory method blank is a contaminant free matrix sample (e.g. a method blank is often a volume of distilled water carried through the entire analytical scheme) that is subjected to the same analytical procedures as the field samples. The method blank is used in all analyses to verify that the determined concentrations do not reflect contamination. One method blank is performed with every batch of samples (approximately 20 samples). If consistent high blank values are observed, laboratory glassware and reagents are checked for contamination and the analysis is halted until adequate blank results are obtained.

4.1.3 Surrogate Spike Analyses

An organic surrogate compounds is spiked into all investigative samples for organic analyses. The surrogate is compared to QC limits to evaluate the matrix effect of each sample and monitor the overall system performance. Low surrogate recoveries are indicative of problems in instrument performance, extraction procedures, or severe matrix effects. Samples which have a surrogate recovery above the laboratory control limits typically do not demonstrate performance problems unless the recoveries are high enough to indicate double spiking of surrogate compounds or extremely low internal standard recoveries.

4.1.4 Matris Spike/Matrix Spike Duplicate (MS/MSD)

The laboratory analyzed a spiked environmental sample and duplicate to evaluate the precision and accuracy within an analytical batch. The matrix spike (MS) is used to assess the performance of the method as applied to a particular project matrix. The MS is an environmental sample io which known concentrations of certain target analytes have been added before sample manipulation from the preparation, cleanup, and determinative procedures have been implemented. The results of the MS are evaluated in conjunction with other QC information to determine the effect of the matrix on the bias of the analysis.

4.2 LABORATORY DATA VALIDATION ACTIVITIES

All analytical data generated by ECB Laboratory was checked for completeness and evaluated for overall quality prior to final report generation as outlined in the Quality Assurance Program

Plan (QAPP) and specified in the laboratory's Standard Operating Procedures (SOPs). This process consisted of data generation and reduction plus three levels of documented review. Each step of the review process involved evaluation of data quality based on QC data results and the professional judgement of the reviewer(s). All reviews were documented by the reviewer's signature and the date reviewed.

The first level review was performed by the analyst who generated the raw analytical data. Primary emphasis of the review was on correctness and completeness of the data set. All data were generated and reduced following method-specific SOPs. Each analyst reviewed the quality of the work based on the guidelines established in the SOP. The first review ensured that:

- Sample preparation and analysis information was correct and complete;
- The appropriate SOPs had been followed;
- QC parameters were within method control limits; and
- Documentation was complete

The second level review was structured so that all calibration data and QC sample results were reviewed and 10 percent of the analytical results were confirmed against the bench and instrument sheets. This includes a complete review of instrument data scans to ensure accurate peaks and retention time, and correct peak integrations have been performed. If no problems were found with the data package, the review was considered complete. If any problems were found with the data package, an additional 10 percent of the samples were checked to the bench sheet. The process was continued for each batch until no errors were found or until each data package was reviewed in its entirety. All second level reviews were performed by a laboratory supervisor, data review specialist, or QA officer to ensure that:

- Calibration data were appropriate to the method and completely documented;
- QC samples were within established guidelines;
- Qualitative identification of sample components was correct;
- Quantitative values were calculated correctly;
- Documentation was complete and correct;
- The data were ready for final reporting; and;
- The data package was complete and ready for data archive.

An important element of the second review was the documentation of any errors identified and corrected during the review process.

Before the final report was released, a third review was performed to check each data package for completeness and to ensure that the data met the overall objectives of the project. This review was done by the laboratory Program Administrator, as stated in the QAPP. The review was performed to ensure that:

- Target analyte lists were complete as specified in the sampling and analysis plan;
- Data package checklist items were present;
- Case narratives accurately documented analytical conditions;

- All non-conformances were addressed and closed.

The Analytical Data Packages (ADPs) contain the following:

- Cover page, identifying project and remarks;
- Summary and discussion of method QC and shipping and/or chain-of-custody errors;
- Sample receipt information including copies of Cooler Receipt Forms;
- Chain-of-Custody (COC) information including copies of COCs;
- Analytical Test Results;

As part of the review process, the laboratory applied data qualifiers to specific results to indicate usability and/or special analytical conditions. The following qualifiers were used to flag data:

B	The compound was also observed in the method blank.
J	Estimated concentration below the Reporting Limit.
u	The compound was not detected.
M	Reporting limit higher than normal due to matrix interferences.
D	Derived from a dilution of extract.

All investigative and QC sample summary results have been submitted in the Analytical Data Packages in the form of the Case Narrative.

4.3 PROJECT CHEMIST QUALITY EVALUATION

In addition to the internal validation conducted by the ECB Laboratory, the project chemist performed data validation of the data set. This included an evaluation and validation of samples based on:

- Initial sample inspection and COC documentation;
- Holding Times;
- Field Duplicate Analyses;
- Laboratory Control Samples;
- Method Blank Analyses;
- Matrix Spike/Matrix Spike Duplicate recoveries;
- Surrogate recoveries;
- Precision, accuracy, representativeness, completeness, and comparability (PARCC) parameters as they apply to this CDQAR; and
- An overall assessment of data compared to the project DQOs.

The CENWO project chemist received data from the laboratory in hard copy format. The USACE Guidance for the Review of Performance-Based Definitive Chemical Data was used to perform the review and validation of the data.

The first step in evaluating and validating the data was to group the samples according to analytical batch or work group. A table was generated which show all analytical batches (project samples and laboratory QC samples). The batches are shown on Table 4-1. After analytical

batching, the batches were reviewed to ensure that the proper QC (type and frequency) was analyzed according to the QAPP for each batch. Next, sample duplicate frequency was evaluated for compliance with the QAPP. Chain-of-custody forms and Cooler Receipt Forms were then reviewed. Any problems found were documented and the impact on sample results was determined and explained.

Holding times were evaluated for compliance with extraction and analysis holding time requirements. Matrix spike recoveries were evaluated for all samples. MS/MSD results were re-calculated on at least one sample per batch. Data qualifier flags were applied as appropriate. Surrogate spike recoveries were evaluated for all samples and surrogate recoveries were re-calculated on at least one sample per batch for organic analyses.

Next, LCS results were reviewed for all samples. LCS recoveries were re-calculated on one sample per batch. Relative Percent Differences (RPDs) for MS/MSD and LCS/LCSD pair calculations were verified for all batches. The 5X and 10X rule (as discussed in the Functional Guidelines for the Evaluation of Chemical Data) was used for evaluation of method blank results. The completeness percentage for surrogates, LCS, MS/MSD and holding times was then calculated.

A summary of the data review/validation results are given in Section 5.

As discussed previously, data qualifier flags were applied to out-of-control data as appropriate. The following qualifiers were used to indicate data usability:

u: The analyte was not detected relative to the method reporting limit.

UN: The result is reported as a tentative nondetection. There is uncertainty with whether or not the non detection is valid at the stated method reporting limit.

X: The data is tentatively rejected because project-specific data quality objectives have not been met or have not been demonstrated.

J: The target analyte is positively identified but the quantitative result is an estimate and the direction of bias is unknown. The flag indicates a significant quantitative (rather than a qualitative) uncertainty exists.

J-: The target analyte is present but the reported concentration is an estimated value that is believed to be biased low. (i.e. the actual concentration in the environmental sample believed to be higher than the reported concentration)

J+: The target analyte is present but the reported concentration is an estimated value that is believed to be biased high. (i.e. the actual concentration in the environmental sample is believed to be lower than the reported concentration)

R: Data is rejected due to the serious deficiencies in the ability to analyze the sample and

meet quality control criteria. The presence or absence of the analyte cannot be verified. The data is not useable.

Field and COC documentation were compared against laboratory reports to check conformity of sample identification numbers. Analytical results were compared to daily activity logs to identify sampling procedures/activities that may have impacted data quality.

Table 4-1 Analytical Batches
Willow Creek

Batch	Analyses	Sample ID
WG11586	Metals (soil)	CO-WC-SB01-05
		CO-WC-SB01-03
		CO-WC-SB01-07
		CO-WC-SB01-10
		CO-WC-SB01-15
		CO-WC-SB01-20 dup of -03
		Method Blank
		Laboratory Matrix Duplicate
		Matrix Spike (MS)/Matrix Spike Duplicate (MSD)
		Laboratory Control Sample (LCS)
WG11556	Metals (water leachate)	CO-WC-SB01-05
		CO-WC-SB01-03
		CO-WC-SB01-07
		CO-WC-SB01-10
		CO-WC-SB01-15
		CO-WC-SB01-20 dup of -03
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS
M021066	pH (water leachate)	CO-WC-SB01-05
		CO-WC-SB01-03
		CO-WC-SB01-07
		CO-WC-SB01-10
		CO-WC-SB01-15
		CO-WC-SB01-20 dup of -03
		pH (4 standard)
		pH (7 standard)
M021066	Conductivity (water leachate)	CO-WC-SB01-05
		CO-WC-SB01-03
		CO-WC-SB01-07
		CO-WC-SB01-10
		CO-WC-SB01-15
		CO-WC-SB01-20 dup of -03
		Method Blank
		Laboratory Matrix Duplicate
		LCS

Batch	Analyses	Sample ID
M021066	Acidity (water leachate)	CO-WC-SB01-05
		CO-WC-SB01-03
		CO-WC-SB01-07
		CO-WC-SB01-10
		CO-WC-SB01-15
		CO-WC-SB01-20 dup of -03
		Method Blank
		MS/MSD
		LCS
WG11706	Metals (groundwater filtered)	CO-WC-MW21 (diss) *
		CO-WC-MW20 (diss)
		CO-WC-MW16 (diss)
		CO-WC-MW18 (diss)
		CO-WC-MW19 (diss)
		CO-WC-MW17 (diss)
		Method Blank
		Laboratory Matrix Duplicate
		MS/MSD
		LCS
WG11677	Metals (groundwater unfiltered)	CO-WC-MW21*
		CO-WC-MW20
		CO-WC-MW16
		CO-WC-MW18
		CO-WC-MW19
		CO-WC-MW17
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
WG11728	Sulfate (groundwater unfiltered)	CO-WC-MW21*
		CO-WC-MW20
		CO-WC-MW16
		CO-WC-MW18
		CO-WC-MW19
		CO-WC-MW17
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
WG11713	Chloride (groundwater	CO-WC-MW21*

Batch	Analyses	Sample ID
	unfiltered)	CO-WC-MW20
		CO-WC-MW16
		CO-WC-MW18
		CO-WC-MW19
		CO-WC-MW17
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS
WG11697	Alkalinity (groundwater unfiltered)	CO-WC-MW21*
		CO-WC-MW20
		CO-WC-MW16
		CO-WC-MW18
		CO-WC-MW19
		CO-WC-MW17
		Method Blank
		Lab Matrix Dup
		MS/MSD
		LCS

* duplicate of CO-WC-MW20

5 RESULTS OF QUALITY CONTROL ACTIVITIES AND ANALYSES

Field QC activities consisted of collecting appropriate field QC samples (field duplicates, trip blanks), daily communication between the CENWO field team and the ECB Lab, and consistent interaction between the CENWO field team and CENWO Technical Manager.

5.1 FIELD QC PROCEDURES AND FIELD QC ANALYSES

5.1.1 Documentation of Field Quality Procedures

Daily field notes were completed to summarize daily investigation procedures and document QC activities. These reports summarize samples collected, environmental conditions, instrument problems, and any non-routine situations which may have impacted sample integrity. These reports were reviewed concurrently with the COC forms and the analytical results from the laboratory to identify potential sampling anomalies or confirm sample identifications. These reports show collection procedures were adequate to ensure data results met project objectives.

5.1.2 Field Duplicate Analyses

Field duplicate samples were collected during the sampling event to evaluate sampling and laboratory precision. The duplicate groundwater sample was analyzed for total and dissolved metals and sulfate, alkalinity, and chloride on the unfiltered sample. The duplicate soil samples were analyzed for total metals and the water leachate was analyzed for total metals, pH, acidity, and conductivity.

The analytical data agreed between the field sample and the field duplicate sample were within set criteria. See results in the data tables of Appendix A. See Table 4-1 for the duplicate samples obtained.

5.2 LABORATORY QC PROCEDURES AND LABORATORY QC ANALYSES

A review of laboratory QC procedures was conducted by the USACE project chemist. All issues identified, and their respective solutions are discussed below and required qualifications are discussed and are included in the data tables of Appendix A.

5.2.1 Initial Sample Inspection and COC Documentation

The ECB Laboratory inspected all shipping containers and compared the contents with the appropriate COC documentation. Information from the sample check-in procedures was recorded on the Cooler Receipt Form. This form was used to document that samples listed on the COC forms agreed with samples contained in the coolers, COC forms were filled out properly, samples were not broken, custody seals were intact, and cooler temperatures were less than or equal to 4^{o}C. These forms are included in the Analytical Data Packages. No problems or deficiencies were found with the sample shipments or COC documentation except the date on the soil samples were written as Oct 24, 2002 and on the COC as Oct 23, 2002. No qualification were needed.

5.2.2 Holding Times

Samples were delivered daily by the overnight courier to ECB Laboratory to ensure all analyses were completed within the required holding times. Part of the CENWO chemist evaluation included reviewing sample extraction and analysis dates to ensure holding times were met. Based on CENWO's review of the laboratory data, all samples were extracted and analyzed within the required holding times.

5.2.3 Method Blank Analyses

Method blanks were analyzed to assess existence and magnitude of contamination problems and measure the representativeness of the analytical process. Blanks reflect the amount of contamination introduced into the environmental samples during sample collection, transfer from the site to the laboratory or analysis. In particular, method blanks reflect laboratory contamination from both the determinative and preparatory method. At least one method blank must be reported for each preparation batch of samples. All blanks were clean except in the following:

Analytical Batch: WG11568. This method blanks contained Zinc at 0.6 J mg/kg. All samples had Zinc values of >100 mg.kg so no qualification was applied the samples were greater than 5 time the blank.

5.2.4 Laboratory Control Samples

Laboratory control samples are evaluated to assess overall method performance and are the primary indicators of laboratory performance. Laboratory control samples are method blanks which are typically spiked with all target analytes of interest. The percent recovery is used as a measure of accuracy and bias. The relative percent difference (RPD) for duplicate LCS recoveries is normally used as a measure of precision. When both a laboratory control sample (LCS) and laboratory control sample duplicate (LCSD) are processed for a batch of samples, there is no significant physical distinction between the LCS and the LCSD. Both the LCS and the LCSD must satisfy the same recovery acceptance criteria. At least one LCS must be reported with each batch of samples. Multiple LCSs may be required to evaluate method precision. For example, a laboratory control sample and a laboratory control sample duplicate (LCSD) may be analyzed to provide information on the precision of the analytical method. The generation of control chart limits for precision via the analysis of LCS/LCSD pairs is an effective means to measure method precision. LCS and LCSD results are included in the QC section of the laboratory's data package.

Metals: An LCS was analyzed with each metals analytical batch. The percent recovery was compared to set criteria for each analyte. The LCS percent recoveries were all within set criteria for the soil and water samples, so no qualifications were applied to metals results.

Sulfate: An LCS was analyzed as part of the sulfate quality control to determine precision. The % Recovery results met set criteria so no qualification was applied to the sulfate results.

Alkalinity: An LCS was analyzed as part of the alkalinity quality control to determine

precision. The % Recovery results met set criteria so no qualification was applied to the alkalinity results.

Chloride: An LCS was analyzed as part of the chloride quality control to determine precision. The % Recovery results met set criteria so no qualification was applied to the chloride results.

Conductivity and Acidity of Water Leachate Samples: An LCS was analyzed as part of the conductivity and Acidity quality control to determine precision. The % Recovery results met set criteria so no qualification was applied to the chloride results.

5.2.5 Surrogate Recovery

Surrogates are organic compounds which are similar in chemical composition to the analytes of interest. Surrogates are spiked into environmental and batch QC samples prior to sample preparation and analysis. Surrogate recoveries for environmental samples are used to evaluate matrix interference on a sample-specific basis. High or low surrogate recoveries indicate problems in instrument performance, extraction procedures, or severe matrix effects. Samples for this project were not spiked with surrogate analytes.

5.2.6 MS/MSD Recovery

Matrix Spike (MS) and matrix spike duplicate (MSD) results are examined to evaluate the impact of matrix effects on overall analytical performance. A matrix spike is a representative environmental sample which is spiked with target analytes of interest prior to being taken through the entire analytical process in order to evaluate analytical bias for an actual matrix. A matrix duplicate is a collocated or a homogenized sample which is processed through the entire analytical procedure in order to evaluate overall precision for an actual matrix.

It should be noted that MS recovery failure and poor precision may arise because of (i) poor sampling technique, (ii) inadequate homogenization, or (iii) from matrix effects associated with the preparatory or determinative portion of an analytical method. Matrix interferences may be "positive" or "negative" in nature. Results of MS/MSD analyses are included in the Analytical Data Packages. The percent recovery and RPD for the MS/MSD for the metals, sulfate, alkalinity, and chloride were within criteria so no qualification was applied to the data.

5.2.7 Completeness of Data Packages

The CENWO Chemist reviewed the data package and confirmed the completeness of the data package. All the planned sampling activities were executed and all the laboratory analyses were performed.

5.3 PRECISION, ACCURACY, REPRESENTATIVENESS, COMPLETENESS AND COMPARABILITY (PARCC)

DQOs and their corresponding measurement indicators were specified in the Site Specific Addendum for the Willow Creek, Colorado, 4, October, 2002. To achieve the project

DQOs, specific PARCC goals are established for laboratory and field sampling procedures. These PARCC parameters are the measurement tools for determining the usability of generated data.

Precision and accuracy goals were based on knowledge of each analytical measurement system. For this CDQAR, precision was measured using the RPD between two replicated sample analyses. The precision evaluation encompassed laboratory precision (LCS samples), and combined field/laboratory precision (MS/MSD samples).

Accuracy was measured using the percent recovery of surrogates, MS/MSD samples, and LCS sample pairs. Spike recoveries form field samples and laboratory QC samples are compared to established control limits to determine a laboratory's ability to accurately determine both qualitative and quantitative results.

Representativeness is the degree to which the data accurately and precisely portrayed the environmental conditions being studied. For the site investigation, sampling procedures and sample locations were selected to bias samples in areas of potential places of contamination. All sampling was conducted using known approved field procedures to minimize variability.

Completeness refers to the amount of valid data obtainable from a measurement system compared to the expected amount of data. The SAP established a completeness goal of 90 percent for laboratory QC requirements. This goal was attained by the data for this project.

5.4 Data Tables

The qualified data is given in Table 1, 2, 3, and 4 of Appendix A.

5.5 Analytical Data Package

Data Sheets as obtained from the Environmental Chemistry Laboratory are given as a hard copy of the Analytical Data package.

6 CONCLUSIONS

This CDQAR presents, in specific terms, the quality control practices utilized to achieve the goals of the site investigation at Willow Creek-Creede, Colorado. The analytical program for this project conformed with the General Work Plan for the Restoration of Abandoned Mines Sites prepared by U.S. Army Corps of Engineers, Omaha District, Omaha, Nebraska, July 2002 and the Site Specific Addendum for Willow Creek-Creede, Colorado, 4 October, 2002. Samples were also collected and analyzed in accordance with ASTM and EPA methods and laboratory specific QA/QC procedures were used. These procedures were followed to generate high quality data.

The quality issues addressed in this report do not impact the usability of the data. These issues have all been addressed on Section 5 and the qualified data is given in Appendix A. The reviewed data are usable and are suitable for addressing the overall objective of this investigation.

Appendix A

ECB Project No. 6704

DEPARTMENT OF THE ARMY
CORPS OF ENGINEERS
ENVIRONMENTAL CHEMISTRY BRANCH
OMAHA, NEBRASKA 68102

23 JAN 2003

Subject: Certificate of Analysis

Project: Willow Creek, CO
Intended Use: Special
Source of Material:

Submitted by: Kim Mulhern, CENWO-ED-GG
Date Sampled: 23 Oct - 18 Nov 02 **Date Received:** 24 Oct - 19 Nov 02
Method of Test or Specification: See attached test result sheets

References: Omaha District Request No. W59XQG23105113 dated 6 Nov 02

-- REMARKS --

1. Review comments for project data are presented on the following pages.

2. Sample receipt information and analytical data are provided in the following parts of the report.

   Part A: Sample Receipt Information (2 page)
   Part B: Chain-of-Custody Information (6 pages)
   Part C: Analytical Test Results (94 pages)

3. The Quality Assurance Test Results are attached; if you have any questions please contact Laura Percifield at (402)444-4313.

Submitted by:

for DOUGLAS B. TAGGART
Chief, Environmental
Chemistry Branch

LP

Percifield/glr

TEST RESULTS

1. SUMMARY

ECB compiled the data package according to the USACE HTRW minimum chemistry reporting requirements. ECB and Continental Analytical Services, Inc. (CAS) performed the analyses using EPA methods. Proper quality control procedures were followed and documented. The method quality control results outlined below support the usability of the data.

2. DISCUSSION

a. Six soil and six water samples were received by ECB between 24 Oct 02 to 19 Nov 02. The samples were analyzed for one or more of the following:
   - Metals by EPA method 6010 for aluminum, cadmium, calcium, copper, iron, lead, magnesium, manganese, and zinc.
   - TCLP metals by the EPA methods listed above along with the TCLP extraction method of 1311.
   - Alkalinity (Alk) by EPA method 310.2.
   - Chloride (Cl) by EPA method 325.2.
   - Sulfate (SO4) by EPA method 375.2.
   - pH by EPA method 150.1.
   - Conductivity (Cond) by EPA method 120.1.
   - Acidity by EPA method

   The 100 and 300 series methods are from EPA 600/4-79-020 (1983 "Methods for Chemical Analysis of Water and Wastes." All othe methods are from SW-846 (1986), "Test Methods for Evaluation o Solid Waste."

   Part "A" of this report lists all of the samples received.

b. The following shipping and chain-of-custody errors were note for the sample shipments received by ECB.

   1) The times sampled on the sample containers were not the as those on the custody paper that was received on 24 Oct 02.

   2) The samples for dissolved metals analysis were filtere preserved at ECB.

   Part "B" of this report contains the chain-of-custody information.

c. The samples were analyzed by ECB and CAS.

   Part "C" of this report lists the analytical test resul

3. METHOD QUALITY CONTROL

a. Metals:
   1) The method blanks were free of contamination except for an estimated concentration of zinc (page C7).
   2) Laboratory duplicate results matched the results from the original field samples except for aluminum whose relative percent difference (RPD) was above acceptable limits (page C38).
   3) Matrix spike/matrix spike duplicate (MS/MSD) recoveries were within acceptable limits except for calcium whose recoveries were outside acceptable limits (page C9). Relative percent differences (RPD) for MS/MSD recoveries were within acceptable limits.
   4) Laboratory control sample (LCS) recoveries were within acceptable limits.
   5) Holding times were met.

b. WQ parameters:
   1) The method blanks were free of contamination.
   2) Laboratory duplicate results matched the results from the original field samples.
   3) The MS/MSD recoveries were within acceptable limits. RPD for MS/MSD recoveries were within acceptable limits.
   4) LCS recoveries were within acceptable limits.
   5) Holding times were met.

A1

PART A

SAMPLE RECEIPT INFORMATION

Sample Number	Customer Sample ID	Date Sampled	Matrix	ECB # Assigned	Tests Assigned	Test Results Page Number
001	CO-WC-SB01-05	23 Oct 02	Soil	M021066-001	Metals	C1
				M021066-002	Metals	C11
				M021066-002	Cond	C77
				M021066-002	pH	C71
				M021066-002	Acidity	C86
002	CO-WC-SB01-3	23 Oct 02	Soil	M021066-003	Metals	C2
				M021066-004	Metals	C12
				M021066-004	Cond	C78
				M021066-004	pH	C72
				M021066-004	Acidity	C87
003	CO-WC-SB01-7	23 Oct 02	Soil	M021066-005	Metals	C3
				M021066-006	Metals	C13
				M021066-006	Cond	C79
				M021066-006	pH	C73
				M021066-006	Acidity	C88
004	CO-WC-SB01-10	23 Oct 02	Soil	M021066-007	Metals	C4
				M021066-008	Metals	C14
				M021066-008	Cond	C80
				M021066-008	pH	C74
				M021066-008	Acidity	C89
005	CO-WC-SB01-15	23 Oct 02	Soil	M021066-009	Metals	C5
				M021066-010	Metals	C15
				M021066-010	Cond	C81
				M021066-010	pH	C75
				M021066-010	Acidity	C90
006	CO-WC-SB01-20	23 Oct 02	Soil	M021066-011	Metals	C6
				M021066-012	Metals	C16
				M021066-012	Cond	C82
				M021066-012	pH	C76
				M021066-012	Acidity	C91
007	CO-WC-MW17	17 Nov 02	Water	M021175-012	Alk	C66
				M021175-012	Cl	C56
				M021175-012	SO4	C46
				M021175-011	Metals	C26
				M021175-012	Metals	C36
008	CO-WC-MW18	17 Nov 02	Water	M021175-008	Metals	C34
				M021175-008	Alk	C64
				M021175-008	Cl	C54
				M021175-008	SO4	C44
				M021175-007	Metals	C24
009	CO-WC-MW19	17 Nov 02	Water	M021175-010	Metals	C35
				M021175-010	Alk	C65
				M021175-010	Cl	C55
				M021175-010	SO4	C45
				M021175-009	Metals	C25
010	CO-WC-MW20	18 Nov 02	Water	M021175-003	Metals	C32
				M021175-003	Alk	C62
				M021175-003	Cl	C52
				M021175-003	SO4	C42
				M021175-004	Metals	C22
011	CO-WC-MW21	18 Nov 02	Water	M021175-002	Metals	C31
				M021175-002	Alk	C61
				M021175-002	Cl	C51
				M021175-002	SO4	C41
				M021175-001	Metals	C21

A2

Sample Number	Customer Sample ID	Date Sampled	Matrix	ECB # Assigned	Tests Assigned	Test Results Page Number
012	CO-WC-MW16	18 Nov 02	Water	M021175-006	Metals	C33
				M021175-006	Alk	C63
				M021175-006	Cl	C53
				M021175-006	SO4	C43
				M021175-005	Metals	C23

PART B

CHAIN-OF-CUSTODY INFORMATION

Page No.	Chain-of-Custody No.	Date Signed
B1	10083	23 Oct 02
B3	3864	18 Dec 02
B5	4948	18 Dec 02

U.S. ARMY CORPS OF ENGINEERS

CHAIN OF CUST Y RECORD

PROJ. NO.	PROJECT NAME
LIMS 6704	Willow Creek (RAMS)

SAMPLERS: *(Signature)*

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	EPA 3500/6010B	Cold DM6 Leachate	USDA 8C	EPA 305.1	EPA 375.2/9050A	EPA 300S/601B	REMARKS
SB01	10/23/02	0800		✓	CO-WC-SB01-05	1	✓	✓	✓	✓	✓	✓	EPA 3500/6010B Require Soil + Leachate Water
SB01	10/23/02	0810		✓	CO-WC-SB01-3	1	✓	✓	✓	✓	✓	✓	
SB01	10/23/02	0815		✓	CO-WC-SB01-7	1	✓	✓	✓	✓	✓	✓	
SB01	10/23/02	0825		✓	CO-WC-SB01-10	1	✓	✓	✓	✓	✓	✓	
SB01	10/23/02	0825		✓	CO-WC-SB01-15	1	✓	✓	✓	✓	✓	✓	
SB01	10/23/02	0840		✓	CO-WC-SB01-20	1	✓	✓	✓	✓	✓	✓	EPA 3500/6010B requires soil + Leachate water

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
	10/23/02 1400				
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)* Shelly Swink	Date / Time 10/24/02 0900	Remarks	

Distribution: Original Accompanies Shipment; Copy to Coordinator Field Files

10083

B2

COOLER RECEIPT FORM
Chemistry Quality Assurance Branch Laboratory

S # 6704 CQAB Cooler # _____ Number of Coolers _____ Contractor Cooler _____

Project: Willow Creek Date received: 10/24/02

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Date cooler opened: 10/24/02 C-of-C Number: 10083

by (print) Shelly Swink (sign) Shelly Swink

1. Did cooler come with a shipping slip (air bill, etc.)? ..... (YES) NO

   If YES, enter carrier name & air bill number here: UPSA

2. Were custody seals on outside of cooler? ..... (YES) NO

   How many & where: 2 (1 ea side) seal date: 10/23/02 seal name: illegible

3. Were custody seals unbroken and intact at the date and time of arrival? ..... (YES) NO

4. Did you screen samples for radioactivity using the Geiger Counter? ..... (YES) NO

5. Were custody papers sealed in a plastic bag & taped inside to the lid? ..... (YES) NO

6. Were custody papers filled out in the appropriate place? ..... (YES) NO

7. Did you sign custody papers in the appropriate place? ..... (YES) NO

8. Was project identifiable from custody papers? ..... (YES) NO

9. Type of ice: Ice Temperature: 4.5 Date temperature measured: 10/24/02

10. Describe type of packing in cooler: bubble wrap

11. Were all bottles sealed in separate plastic bags? ..... 5 (YES) NO

B. LOG-IN PHASE: Date samples were logged-in: 10/24/02

by (print) Shelly Swink (sign) Shelly Swink

12. Did all bottles arrive unbroken & were labels in good condition? ..... (YES) NO

13. Were all bottle labels complete (ID, date, time, signature, preservative, etc.)? ..... (YES) NO

14. Did all bottle labels agree with custody papers? 0825 time on samples (YES) NO

15. Were correct containers used for the tests indicated? 9, 10, 15, 20 ..... (YES) NO

16. Were correct preservatives added to samples? ..... (YES) NO

17. Was a sufficient amount of sample sent for tests indicated? ..... (YES) NO

18. Was headspace absent in volatile samples? If NO, list by QA#: _____ YES NO

19. Were the custody papers checked against the sample receipt form? By whom? RP Date: 10/29/02

U.S. ARMY CORPS OF ENGINEERS

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
LMS6704	Colorado RAMS - Willow Creek

SAMPLERS: *(Signature)* R. Gralnick

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Total Metals	Dissolved Metals	Alkalinity, Chloride, Sulfate				REMARKS
	11/17/02	1541		X	CO-WC-MW19	1	X						HNO_3, 4°C
	11/17/02	1541		X	CO-WC-MW19	1		X					Filter and preserve upon receipt, 4°C
	11/17/02	1541		X	CO-WC-MW19	1			X				4°C
	11/17/02	1314		X	CO-WC-MW17	1	X						HNO_3, 4°C
	11/17/02	1314		X	CO-WC-MW17	1		X					Filter and preserve upon receipt, 4°C
	11/17/02	1314		X	CO-WC-MW17	1			X				4°C

Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
R. Gralnick	11/18/02 1500				
Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*	Relinquished by: *(Signature)*	Date / Time	Received by: *(Signature)*
Relinquished by: *(Signature)*	Date / Time	Received for Laboratory by: *(Signature)*	Date / Time	Remarks	
		[illegible]	11/19/02 1000		

Distribution: Original Accompanies Shipment; Copy to Coordinator Field File

3861

COOLER RECEIPT FORM
Chemistry Quality Assurance Branch Laboratory

L # 6704 CQAB Cooler # — Number of Coolers 1 of 2 Contractor Cooler —

Project: Willow Creek Date received: 11/19/02

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Date cooler opened: 11/19/02 C-of-C Number: 3864

by (print) Laura Percifield (sign) Laura Percifield

1. Did cooler come with a shipping slip (air bill, etc.)? ..... (YES) NO

   If YES, enter carrier name & air bill number here: FEDX

2. Were custody seals on outside of cooler? ..... (YES) NO

   How many & where: 1 front side seal date: 11/18/02 seal name: Rick Grabowski

3. Were custody seals unbroken and intact at the date and time of arrival? ..... (YES) NO

4. Did you screen samples for radioactivity using the Geiger Counter? ..... (YES) NO

5. Were custody papers sealed in a plastic bag & taped inside to the lid? ..... (YES) NO

6. Were custody papers filled out in the appropriate place? ..... (YES) NO

7. Did you sign custody papers in the appropriate place? ..... (YES) NO

8. Was project identifiable from custody papers? ..... (YES) NO

9. Type of ice: regular Temperature: 2.4°C Date temperature measured: 11/19/02

10. Describe type of packing in cooler: NONE

11. Were all bottles sealed in separate plastic bags? ..... (YES) NO

B. LOG-IN-PHASE: Date samples were logged-in: 11/19/02

by (print) Shelly Swink (sign) Shelly Swink

12. Did all bottles arrive unbroken & were labels in good condition? ..... (YES) NO

13. Were all bottle labels complete (ID, date, time, signature, preservative, etc.)? ..... (YES) NO

14. Did all bottle labels agree with custody papers? ..... (YES) NO

15. Were correct containers used for the tests indicated? ..... (YES) NO

16. Were correct preservatives added to samples? diss metals filtered & preserved at ECB ..... (YES) NO

17. Was a sufficient amount of sample sent for tests indicated? ..... (YES) NO

18. Was headspace absent in volatile samples? If NO, list by QA#: ..... (YES) NO

19. Were the custody papers checked against the sample receipt form? By whom? RP Date: 11/25/02

U.S. ARMY CORPS OF ENGINEERS

CHAIN OF CUSTODY RECORD

PROJ. NO.	PROJECT NAME
Lims 6704	Colorado RAMS- Willow Creek

SAMPLERS: (Signature) K. Grabinski

STA. NO.	DATE	TIME	COMP.	GRAB	STATION LOCATION	NO. OF CONTAINERS	Total Metals	Dissolved Metals	Alkalinity	Chloride	Sulfate		REMARKS
	11/18/02	0910		X	CO-WC-MW21	1	X						HNO_3, 4°C
	11/18/02	0910		X	CO-WC-MW21	1		X					Filter and preserve upon receipt, 4°C
	11/18/02	0910		X	CO-WC-MW21	1			X				4°C
	11/18/02	0910		X	CO-WC-MW20	1	X						HNO_3, 4°C
	11/18/02	0910		X	CO-WC-MW20	1		X					Filter and preserve upon receipt, 4°C
	11/18/02	0910		X	CO-WC-MW20	1			X				4°C
	11/18/02	1022		X	CO-WC-MW16	1	X						HNO_3, 4°C
	11/18/02	1022		X	CO-WC-MW16	1		X					Filter and preserve upon receipt, 4°C
	11/18/02	1022		X	CO-WC-MW16	1			X				4°C
	11/17/02	1442		X	CO-WC-MW18	1	X						HNO_3, 4°C
	11/17/02	1442		X	CO-WC-MW18	1		X					Filter and preserve upon receipt, 4°C
	11/17/02	1442		X	CO-WC-MW18	1			X				4°C

Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
K. Grabinski	12/18/02 1500				
Relinquished by: (Signature)	Date / Time	Received by: (Signature)	Relinquished by: (Signature)	Date / Time	Received by: (Signature)
Relinquished by: (Signature)	Date / Time	Received for Laboratory by: (Signature)	Date / Time	Remarks	
		Teresa Penfield	11/19/02 1000		

Distribution: Original Accompanies Shipment; Copy to Coordinator Field File

A0A8

B6

COOLER RECEIPT FORM
Chemistry Quality Assurance Branch Laboratory

LIMS # 6704 CQAB Cooler # ____ Number of Coolers 2 of 2 Contractor Cooler ____

Project: Willow Creek Date received: 11/19/02

USE OTHER SIDE OF THIS FORM TO NOTE DETAILS CONCERNING CHECK-IN PROBLEMS.

A. PRELIMINARY EXAMINATION PHASE: Date cooler opened: 11/19/02 C-of-C Number: 4948

by (print) Laura Percifield (sign) Laura Percifield

1. Did cooler come with a shipping slip (air bill, etc.)? ..... (YES) NO

   If YES, enter carrier name & air bill number here: FEDX

2. Were custody seals on outside of cooler? ..... (YES) NO

   How many & where: 1 front side seal date: 11/18/02 seal name: Rick Grabowski

3. Were custody seals unbroken and intact at the date and time of arrival? ..... (YES) NO

4. Did you screen samples for radioactivity using the Geiger Counter? ..... (YES) NO

5. Were custody papers sealed in a plastic bag & taped inside to the lid? ..... (YES) NO

6. Were custody papers filled out in the appropriate place? ..... (YES) NO

7. Did you sign custody papers in the appropriate place? ..... (YES) NO

8. Was project identifiable from custody papers? ..... (YES) NO

9. Type of ice: regular Temperature: 2.8°C Date temperature measured: 11/19/02

10. Describe type of packing in cooler: NONE

11. Were all bottles sealed in separate plastic bags? ..... (YES) NO

B. LOG-IN-PHASE: Date samples were logged-in: 11/19/02

by (print) Shelly Swink (sign) Shelly Swink

12. Did all bottles arrive unbroken & were labels in good condition? ..... (YES) NO

13. Were all bottle labels complete (ID, date, time, signature, preservative, etc.)? ..... (YES) NO

14. Did all bottle labels agree with custody papers? ..... (YES) NO

15. Were correct containers used for the tests indicated? ..... (YES) NO

16. Were correct preservatives added to samples? diss metals filtered & preserved at ECB (YES) NO

17. Was a sufficient amount of sample sent for tests indicated? ..... (YES) NO

18. Was headspace absent in volatile samples? If NO, list by QA#: _____ ~~YES~~ ~~NO~~

19. Were the custody papers checked against the sample receipt form? By whom? _____ Date: _____

PART C

ANALYTICAL TEST RESULTS

C1

DEPARTMENT OF THE ARMY
Corps of Engineers
Environmental Chemistry Branch
Omaha Laboratory

Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-05
Sample ID: M021066-001

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/13/02

Matrix: Soil
Units: mg/kg
% Solids: 86.2

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	3630	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	1	2.0	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	1	911.	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	1	123.	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	1	14100	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	4	3170	8.0	2.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	1	917.	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	1	210.	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	1	517. B	2.0	0.6	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

B: Analyte also present in the method blank.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11568-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11568-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11568-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11568-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11568-5
GFAA MSD ID: NA
CVAA MSD ID: NA

420 South 18th Street Omaha, NE 68102
FAX: (402) 341-5448
PHONE: (402) 444-4300

C2

DEPARTMENT OF THE ARMY
Corps of Engineers
Environmental Chemistry Branch
Omaha Laboratory

Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-3
Sample ID: M021066-003

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/13/02

Matrix: Soil
Units: mg/kg
% Solids: 93.9

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	635.	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	1	9.49	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	1	190	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	1	78.1	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	1	6490	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	1	3460	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	1	20 J	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	1	9.77	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	1	1620 B	2.0	0.6	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

J: Estimated concentration below laboratory reporting limit.

B: Analyte also present in the method blank.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11568-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11568-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11568-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11568-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11568-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C3

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-7
Sample ID: M021066-005

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/13/02

Matrix: Soil
Units: mg/kg
% Solids: 81.3

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	1220	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	1	4.0	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	1	230	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	1	33.8	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	1	15300	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	6	6260	12.	2.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	1	37.	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	1	10.3	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	1	622. B	2.0	0.6	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

B: Analyte also present in the method blank.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11568-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11568-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11568-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11568-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11568-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C4

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-10
Sample ID: M021066-007

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/13/02

Matrix: Soil
Units: mg/kg
% Solids: 86.4

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	1100	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	1	13.4	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	1	570	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	1	157.	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	1	16400	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	4	4190	8.0	2.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	1	38.	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	1	11.0	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	4	2960 B	8.0	2.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

B: Analyte also present in the method blank.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11568-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11568-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11568-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11568-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11568-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C5

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-15
Sample ID: M021066-009

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/13/02

Matrix: Soil
Units: mg/kg
% Solids: 75.7

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	11000	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	2	2560	1.0	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	1	1430	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	1	18.	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	1	10500	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	1	314.	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	1	2570	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	1	247.	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	2	3920 B	4.0	1.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

B: Analyte also present in the method blank.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11568-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11568-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11568-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11568-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11568-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C6

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-20
Sample ID: M021066-011

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/13/02

Matrix: Soil
Units: mg/kg
% Solids: 93.9

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	614.	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	1	11.0	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	1	72.	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	1	86.8	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	1	7430	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	4	3690	8.0	2.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	1	20 J	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	1	9.47	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	4	1860 B	8.0	2.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

J: Estimated concentration below laboratory reporting limit.

B: Analyte also present in the method blank.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11568-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11568-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11568-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11568-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11568-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C7

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Method Blank

Method Blank ICP Sample ID: WG11568-1
Method Blank GFAA Sample ID:
Method Blank CVAA Sample ID:

Matrix: Soil
Units: mg/kg

CAS Number	Analyte	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	u	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	u	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	u	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	u	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	u	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	u	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	u	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	u	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	0.6 J	2.0	0.6	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit

J: Estimated concentration below laboratory reporting limit

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C8

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Laboratory Matrix Duplicate

Matrix Duplicate ICP Sample ID: WG11568-3 Matrix: Soil
Matrix Duplicate GFAA Sample ID: Units: mg/kg
Matrix Duplicate CVAA Sample ID:

CAS Number	Analyte	Sample Result	Dup Result	RPD	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	9810	9810	0	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	0.52	0.4 J	17	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	3000	2380	23	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	22.8	23.2	2	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	26900	28500	6	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	54.4	55.5	2	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	2290	2270	1	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	693.	650.	6	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	76.4 B	78.6 B	3	2.0	0.6	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

J: Estimated concentration below laboratory reporting limit
B: Analyte also present in the method blank.

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C9

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Matrix Spike, Matrix Spike Duplicate

MS ICP Sample ID: WG11568-4 MSD ICP Sample ID: WG11568-5 Matrix: Soil
MS GFAA Sample ID: MSD GFAA Sample ID: Units: mg/kg
MS CVAA Sample ID: MSD CVAA Sample ID:

CAS Number	Analyte	Sample Result	MS Conc	Spike Added	%Rec MS	MSD Conc	%Rec MSD	RPD	Method	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	9810	12500	600.	NC(1)	12800	NC(1)	NC	EPA 6010B	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	0.52	47.8	50.0	94	47.6	94	0	EPA 6010B	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	3000	3980	1500	65 *	3740	49 *	6	EPA 6010B	11-06-02	11-07-02	Shannon
7440-50-8	Copper	22.8	122.	100.	99	122.	99	0	EPA 6010B	11-06-02	11-07-02	Shannon
7439-89-6	Iron	26900	27900	600.	NC(1)	30500	NC(1)	NC	EPA 6010B	11-06-02	11-07-02	Shannon
7439-92-1	Lead	54.4	148.	100.	94	148.	93	1	EPA 6010B	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	2290	3870	1500	105	3870	106	0	EPA 6010B	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	693.	767.	100.	74 &*	758.	65 &*	1	EPA 6010B	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	76.4 B	180.	100.	103	180.	103	0	EPA 6010B	11-06-02	11-07-02	Shannon

%Rec: Percent of the spike recovered from the matrix

*: Indicates the value is outside control limits (80-120) for %Rec.

&: = High original analyte concentration may prevent accurate determination of the spike recovery.

B: Analyte also present in method blank

NC(1): Not calculated; original analyte concentration too large to accurately determine recovery.

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C10

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Laboratory Control Sample

LCS ICP Sample ID: WG11568-2
LCS GFAA Sample ID:
LCS CVAA Sample ID:

Matrix: Soil
Units: mg/kg

CAS Number	Analyte	LCS Result	True Value	%Rec	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	601.	600.	100	18.	6.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-43-9	Cadmium	51.3	50.0	103	0.50	0.1	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-70-2	Calcium	1490	1500	99	60.	20	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-50-8	Copper	101.	100.	101	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-89-6	Iron	607.	600.	101	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-92-1	Lead	101.	100.	101	2.0	0.4	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-95-4	Magnesium	1480	1500	99	24.	8.	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7439-96-5	Manganese	102.	100.	102	0.80	0.2	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon
7440-66-6	Zinc	108.	100.	108	2.0	0.6	EPA 6010B	WG11568	11-06-02	11-07-02	Shannon

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C11

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-05
Sample ID: M021066-002
Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/06/02
Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	2050	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	1	3.4	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	1	4930	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	1	57.	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	1	3800	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	1	1540	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	1	440	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	1	260.	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	1	499.	10.	3.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11556-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11556-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11556-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11556-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11556-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-3
Sample ID: M021066-004

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	490	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	1	21.	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	1	13900	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	1	33.	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	1	170	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	1	4660	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	1	100 J	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	1	79.3	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	1	3910	10.	3.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11556-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11556-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11556-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11556-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11556-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C13

DEPARTMENT OF THE ARMY
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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-7
Sample ID: M021066-006
Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/06/02
Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	4720	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	1	129.	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	1	36800	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	1	1780	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	1	78800	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	1	3230	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	1	590	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	1	324.	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	10	21700	100	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11556-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11556-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11556-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11556-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11556-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C14

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-10
Sample ID: M021066-008

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	5000	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	1	434.	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	1	78000	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	1	4190	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	1	25500	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	1	3020	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	1	950	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	1	941.	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	10	19500	100	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11556-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11556-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11556-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11556-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11556-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C15

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-15
Sample ID: M021066-010

Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	94700	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	10	3650	25.	5.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	1	36200	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	1	11.	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	1	157000	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	1	748.	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	1	31900	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	10	21900	40.	10	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	10	96200	100	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11556-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11556-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11556-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11556-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11556-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C16

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-SB01-20
Sample ID: M021066-012
Date Sampled: 10/23/02
Date Received: 10/24/02
Date Reported: 11/06/02
Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	540	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	1	23.	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	1	9260	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	1	29.	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	1	150	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	1	3700	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	1	100 J	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	1	51.1	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	1	4400	10.	3.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11556-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11556-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11556-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11556-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11556-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C17

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Method Blank

Method Blank ICP Sample ID: WG11556-1 Matrix: Water
Method Blank GFAA Sample ID: Units: ug/L
Method Blank CVAA Sample ID:

CAS Number	Analyte	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	u	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	u	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	u	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	u	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	u	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	u	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	u	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	u	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	u	10.	3.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit

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C18

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Laboratory Matrix Duplicate

Matrix Duplicate ICP Sample ID: WG11556-3
Matrix Duplicate GFAA Sample ID:
Matrix Duplicate CVAA Sample ID:

Matrix: Water
Units: ug/L

CAS Number	Analyte	Sample Result	Dup Result	RPD	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	u	u	NC	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	u	u	NC	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	18000	17900	0	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	u	u	NC	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	60 J	60 J	1	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	u	u	NC	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	3730	3730	0	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	2. J	2. J	1	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	u	u	NC	10.	3.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit
NC: Not Calculable
J: Estimated concentration below laboratory reporting limit

CVAA Sample: M021076-005

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C19

DEPARTMENT OF THE ARMY
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Matrix Spike, Matrix Spike Duplicate

MS ICP Sample ID: WG11556-4 MSD ICP Sample ID: WG11556-5 Matrix: Water
MS GFAA Sample ID: MSD GFAA Sample ID: Units: ug/L
MS CVAA Sample ID: MSD CVAA Sample ID:

CAS Number	Analyte	Sample Result	MS Conc	Spike Added	%Rec MS	MSD Conc	%Rec MSD	RPD	Method	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	u	6050	6000	101	6040	101	0	EPA 6010B	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	u	514.	500.	103	511.	102	1	EPA 6010B	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	18000	32600	15000	98	32300	95	1	EPA 6010B	11-04-02	11-05-02	Shannon
7440-50-8	Copper	u	1010	1000	101	1010	101	0	EPA 6010B	11-04-02	11-05-02	Shannon
7439-89-6	Iron	60 J	5700	6000	94	5670	94	1	EPA 6010B	11-04-02	11-05-02	Shannon
7439-92-1	Lead	u	1020	1000	102	1010	101	1	EPA 6010B	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	3730	19000	15000	102	18900	101	0	EPA 6010B	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	2. J	1020	1000	102	1020	102	0	EPA 6010B	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	u	1110	1000	111	1100	110	1	EPA 6010B	11-04-02	11-05-02	Shannon

%Rec: Percent of the spike recovered from the matrix

NC: Not Calculable

J: Estimated concentration below laboratory reporting limit
ICP Sample: M021076-005

CVAA Sample:

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C20

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Laboratory Control Sample

LCS ICP Sample ID: WG11556-2
LCS GFAA Sample ID:
LCS CVAA Sample ID:

Matrix: Water
Units: ug/L

CAS Number	Analyte	LCS Result	True Value	%Rec	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	5940	6000	99	90.	30	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-43-9	Cadmium	520.	500.	104	2.5	0.5	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-70-2	Calcium	15000	15000	100	300	100	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-50-8	Copper	995.	1000	100	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-89-6	Iron	5610	6000	94	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-92-1	Lead	1010	1000	101	10.	2.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-95-4	Magnesium	14800	15000	99	120	40	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7439-96-5	Manganese	1010	1000	101	4.0	1.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon
7440-66-6	Zinc	1090	1000	109	10.	3.	EPA 6010B	WG11556	11-04-02	11-05-02	Shannon

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C21

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW21 (DISS)
Sample ID: M021175-001

Date Sampled: 11/18/02
Date Received: 11/19/02
Date Reported: 12/10/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	38000	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	1	790.	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	1	196000	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	1	273.	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	20	612000	2400	800	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	1	37.	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	1	53600	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	20	141000	80.	20	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	30	427000	300	90	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11706-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11706-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11706-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11706-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11706-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C 22

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW20 (DISS)
Sample ID: M021175-004

Date Sampled: 11/18/02
Date Received: 11/19/02
Date Reported: 12/10/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	37700	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	1	785.	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	1	194000	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	1	269.	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	20	607000	2400	800	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	1	35.	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	1	53100	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	20	139000	80.	20	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	30	410000	300	90	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11706-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11706-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11706-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11706-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11706-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C23

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW16 (DISS)
Sample ID: M021175-005

Date Sampled: 11/18/02
Date Received: 11/19/02
Date Reported: 12/10/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	175000	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	1	1480	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	1	70200	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	1	4130	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	1	109000	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	1	31.	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	1	41100	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	20	86900	80.	20	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	30	318000	300	90	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11706-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11706-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11706-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11706-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11706-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C 24

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW18 (DISS)
Sample ID: M021175-007

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 12/10/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	17300	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	1	665.	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	1	472000	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	1	700.	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	1	610	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	1	2 J	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	1	54300	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	20	124000	80.	20	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	30	349000	300	90	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11706-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11706-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11706-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11706-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11706-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C 25

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW19 (DISS)
Sample ID: M021175-009

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 12/10/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	28700	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	1	560.	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	1	56500	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	1	504.	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	1	100 J	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	1	7 J	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	1	14700	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	20	31200	80.	20	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	30	129000	300	90	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11706-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11706-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11706-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11706-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11706-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C 26

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW17 (DISS)
Sample ID: M021175-011

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 12/10/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	1130	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	1	34.8	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	1	38900	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	1	6 J	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	1	430	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	1	u	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	1	4610	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	1	345.	4.0	1.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	30	25900	300	90	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11706-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11706-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11706-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11706-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11706-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C 27

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Method Blank

Method Blank ICP Sample ID: WG11706-1 Matrix: Water
Method Blank GFAA Sample ID: Units: ug/L
Method Blank CVAA Sample ID:

CAS Number	Analyte	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	u	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	u	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	u	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	u	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	u	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	u	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	u	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	u	4.0	1.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	u	10.	3.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit

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C 32

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Laboratory Matrix Duplicate

Matrix Duplicate ICP Sample ID: WG11706-3
Matrix Duplicate GFAA Sample ID:
Matrix Duplicate CVAA Sample ID:

Matrix: Water
Units: ug/L

CAS Number	Analyte	Sample Result	Dup Result	RPD	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1300	1290	0	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	u	u	NC	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	109000	109000	0	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	u	u	NC	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	1300	1490	14	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	u	u	NC	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	31400	31400	0	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	114.	113.	1	4.0	1.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	u	22.	NC	10.	3.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit
NC: Not Calculable
** Indicates the value is outside control limits (25) for RPD.

CVAA Sample: M021201-002

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C 39

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Matrix Spike, Matrix Spike Duplicate

MS ICP Sample ID: WG11706-4 MSD ICP Sample ID: WG11706-5 Matrix: Water
MS GFAA Sample ID: MSD GFAA Sample ID: Units: ug/L
MS CVAA Sample ID: MSD CVAA Sample ID:

CAS Number	Analyte	Sample Result	MS Conc	Spike Added	%Rec MS	MSD Conc	%Rec MSD	RPD	Method	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1300	7570	6000	105	7500	103	1	EPA 6010B	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	u	495.	500.	99	496.	99	0	EPA 6010B	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	109000	123000	15000	94&	123000	95 &	0	EPA 6010B	11-27-02	12-03-02	Shannon
7440-50-8	Copper	u	1020	1000	102	1020	102	0	EPA 6010B	11-27-02	12-03-02	Shannon
7439-89-6	Iron	1300	6790	6000	91	6720	90	1	EPA 6010B	11-27-02	12-03-02	Shannon
7439-92-1	Lead	u	983.	1000	98	985.	99	0	EPA 6010B	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	31400	45200	15000	92	45300	93	0	EPA 6010B	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	114.	1120	1000	100	1110	100	0	EPA 6010B	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	u	1040	1000	104	1040	104	0	EPA 6010B	11-27-02	12-03-02	Shannon

%Rec: Percent of the spike recovered from the matrix

NC: Not Calculable

&: = High original analyte concentration may prevent accurate determination of the spike recovery.

ICP Sample: M021201-002

CVAA Sample:

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C 30

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Laboratory Control Sample

LCS ICP Sample ID: WG11706-2 Matrix: Water
LCS GFAA Sample ID: Units: ug/L
LCS CVAA Sample ID:

CAS Number	Analyte	LCS Result	True Value	%Rec	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	6080	6000	101	90.	30	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-43-9	Cadmium	505.	500.	101	2.5	0.5	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-70-2	Calcium	15000	15000	100	300	100	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-50-8	Copper	1020	1000	102	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-89-6	Iron	5640	6000	94	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-92-1	Lead	994.	1000	99	10.	2.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-95-4	Magnesium	15200	15000	101	120	40	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7439-96-5	Manganese	1010	1000	101	4.0	1.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon
7440-66-6	Zinc	1050	1000	105	10.	3.	EPA 6010B	WG11706	11-27-02	12-03-02	Shannon

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C31

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW21
Sample ID: M021175-002

Date Sampled: 11/18/02
Date Received: 11/19/02
Date Reported: 12/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	38200	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	1	840.	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	1	201000	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	1	261.	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	30	618000	3600	1000	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	1	35.	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	1	54700	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	30	143000	120	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	30	425000	300	90	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11677-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11677-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11677-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11677-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11677-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C32

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW20
Sample ID: M021175-003

Date Sampled: 11/18/02
Date Received: 11/19/02
Date Reported: 12/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	38200	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	1	834.	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	1	197000	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	1	271.	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	30	619000	3600	1000	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	1	36.	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	1	53900	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	30	144000	120	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	30	458000	300	90	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11677-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11677-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11677-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11677-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11677-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C33

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW16
Sample ID: M021175-006
Date Sampled: 11/18/02
Date Received: 11/19/02
Date Reported: 12/06/02
Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	174000	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	1	1490	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	1	71300	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	1	4080	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	30	110000	3600	1000	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	1	30.	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	1	41200	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	1	92800	4.0	1.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	30	339000	300	90	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

Quality Assurance / Quality Control

ICP Method Blank ID: WG11677-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11677-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11677-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11677-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11677-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C34

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW18
Sample ID: M021175-008

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 12/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	17200	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	1	723.	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	1	528000	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	1	700.	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	1	160	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	1	4 J	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	1	57000	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	30	132000	120	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	30	366000	300	90	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11677-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11677-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11677-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11677-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11677-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C35

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW19
Sample ID: M021175-010

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 12/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	28200	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	1	586.	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	1	59400	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	1	488.	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	1	140	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	1	7 J	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	1	14600	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	30	31600	120	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	30	132000	300	90	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11677-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11677-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11677-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11677-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11677-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C36

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Total Metals

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW17
Sample ID: M021175-012

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 12/06/02

Matrix: Water
Units: ug/L

CAS Number	Analyte	Dilution	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	1	1120	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	1	37.1	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	1	41900	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	1	5 J	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	1	40 J	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	1	u	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	1	4680	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	1	275.	4.0	1.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	30	26600	300	90	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit

J: Estimated concentration below laboratory reporting limit.

Quality Assurance / Quality Control

ICP Method Blank ID: WG11677-1
GFAA Method Blank ID: NA
CVAA Method Blank ID: NA

ICP LCS ID: WG11677-2
GFAA LCS ID: NA
CVAA LCS ID: NA

ICP LD ID: WG11677-3
GFAA LD ID: NA
CVAA LD ID: NA

ICP MS ID: WG11677-4
GFAA MS ID: NA
CVAA MS ID: NA

ICP MSD ID: WG11677-5
GFAA MSD ID: NA
CVAA MSD ID: NA

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C 37

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Method Blank

Method Blank ICP Sample ID: WG11677-1
Method Blank GFAA Sample ID:
Method Blank CVAA Sample ID:

Matrix: Water
Units: ug/L

CAS Number	Analyte	Result	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	u	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	u	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	u	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	u	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	u	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	u	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	u	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	u	4.0	1.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	u	10.	3.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit

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C38

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Laboratory Matrix Duplicate

Matrix Duplicate ICP Sample ID: WG11677-3
Matrix Duplicate GFAA Sample ID:
Matrix Duplicate CVAA Sample ID:

Matrix: Water
Units: ug/L

CAS Number	Analyte	Sample Result	Dup Result	RPD	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	30 J	50 J	54**	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	u	u	NC	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	76400	75600	1	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	u	16.883	NC	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	660	750	13	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	u	u	NC	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	31200	30800	1	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	253.	249.	2	4.0	1.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	16.	15.	6	10.	3.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

u: Analyte was analyzed for but not detected at or above the sample reporting limit
NC: Not Calculable
J: Estimated concentration below laboratory reporting limit
** Indicates the value is outside control limits (25) for RPD.

CVAA Sample: M021162-002

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C39

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Matrix Spike, Matrix Spike Duplicate

MS ICP Sample ID: WG11677-4 MSD ICP Sample ID: WG11677-5 Matrix: Water
MS GFAA Sample ID: MSD GFAA Sample ID: Units: ug/L
MS CVAA Sample ID: MSD CVAA Sample ID:

CAS Number	Analyte	Sample Result	MS Conc	Spike Added	%Rec MS	MSD Conc	%Rec MSD	RPD	Method	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	30 J	5990	6000	99	5990	99	0	EPA 6010B	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	u	545.	500.	109	541.	108	1	EPA 6010B	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	76400	91100	15000	98&	90600	95 &	0	EPA 6010B	11-21-02	11-27-02	Shannon
7440-50-8	Copper	u	983.	1000	98	983.	98	0	EPA 6010B	11-21-02	11-27-02	Shannon
7439-89-6	Iron	660	6600	6000	99	6550	98	1	EPA 6010B	11-21-02	11-27-02	Shannon
7439-92-1	Lead	u	1050	1000	105	1040	104	1	EPA 6010B	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	31200	45300	15000	94	45300	94	0	EPA 6010B	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	253.	1310	1000	105	1300	105	1	EPA 6010B	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	16.	1130	1000	112	1130	111	0	EPA 6010B	11-21-02	11-27-02	Shannon

%Rec: Percent of the spike recovered from the matrix

&: = High original analyte concentration may prevent accurate determination of the spike recovery.

J: Estimated concentration below laboratory reporting limit
ICP Sample: M021162-002

CVAA Sample:

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C40

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Laboratory Control Sample

LCS ICP Sample ID: WG11677-2 Matrix: Water
LCS GFAA Sample ID: Units: ug/L
LCS CVAA Sample ID:

CAS Number	Analyte	LCS Result	True Value	%Rec	Sample Quant Limit	Sample Det Limit	Method	Batch ID	Date Digested	Date Analyzed	Analyst
7429-90-5	Aluminum	6080	6000	101	90.	30	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-43-9	Cadmium	507.	500.	101	2.5	0.5	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-70-2	Calcium	15100	15000	101	300	100	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-50-8	Copper	1020	1000	102	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-89-6	Iron	5640	6000	94	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-92-1	Lead	996.	1000	100	10.	2.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-95-4	Magnesium	15300	15000	102	120	40	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7439-96-5	Manganese	1020	1000	102	4.0	1.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon
7440-66-6	Zinc	1080	1000	108	10.	3.	EPA 6010B	WG11677	11-21-02	11-27-02	Shannon

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C41

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW21	Date Reported:	12/03/02	Sample ID:	M021175-002

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	3300 D	400	6	EPA 375.2	WG11728	12/02/02	Laubscher

D: Result quantitated from a 1:20 dilution.

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C42

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW20	Date Reported:	12/03/02	Sample ID:	M021175-003

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	3300 D	400	6	EPA 375.2	WG11728	12/02/02	Laubscher

D: Result quantitated from a 1:20 dilution.

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C43

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW16	Date Reported:	12/03/02	Sample ID:	M021175-006

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	3600 D	400	6	EPA 375.2	WG11728	12/02/02	Laubscher

D: Result quantitated from a 1:20 dilution.

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C44

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/17/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW18	Date Reported:	12/03/02	Sample ID:	M021175-008

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	2300 D	400	6	EPA 375.2	WG11728	12/02/02	Laubscher

D: Result quantitated from a 1:20 dilution.

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C45

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/17/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW19	Date Reported:	12/03/02	Sample ID:	M021175-010

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	690 D	400	6	EPA 375.2	WG11728	12/02/02	Laubscher

D: Result quantitated from a 1:20 dilution.

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C46

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/17/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW17	Date Reported:	12/03/02	Sample ID:	M021175-012

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	170 D	40	6	EPA 375.2	WG11728	12/02/02	Laubscher

D: Result quantitated from a 1:2 dilution.

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C47

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Wet Chemistry (Method Blank) Report

Method Blank Sample ID: WG11728-1
Units: mg/L

Matrix: Water

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	u	20	6	EPA 375.2	WG11728	12/02/02	Laubscher

QC Sample:

u: Below Method Detection Limit

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C48

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Wet Chemistry (Laboratory Matrix Duplicate) Report

Project Name: Willow Creek
Project Number: 6704
Units: mg/L
Client ID: Batch Specific

LD Sample ID: WG11728-3
Matrix: Water
Analysis Date: 12/02/02

CAS Number	Analyte	Sample Result	Dup Result	RPD	QC Limits	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	270	270	0.6	25	20	6	EPA 375.2	WG11728	12/02/02	Laubscher

QC Sample: M021117-002

Batch Specific: The sample used for batch QC was from another project within this work group.

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C49

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Wet Chemistry (Matrix Spike, Matrix Spike Duplicate) Report

Project Name: Willow Creek
Project Number: 6704
Client ID: Batch Specific
Units: mg/L
Analysis Date: 12/02/02

MS Sample ID: WG11728-4
MSD Sample ID: WG11728-5
Matrix: Water
Analyst: Laubscher

CAS Number	Analyte	Sample Result	Spike Added	Conc MS	%Rec MS	Conc MSD	%Rec MSD	RPD	Method	Batch ID	Acceptance Range(%)
MRL-02	Sulfate	270	60	320	102	330	116	12	EPA 375.2	WG11728	80-120

Note: 94 mL sample & 6 mL of standard [(270) x (0.94)] = 260 used in calculation of %Rec.
Results are rounded to 2 significant figures.

Comments: The RPD limit is 20.

QC Sample: M021117-002

%Rec: Percent of the spike recovered from the matrix

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C 50

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Wet Chemistry (Laboratory Control Sample) Report

LCS Sample ID: WG11728-2
Analysis Date: 12/02/02

Matrix: Water
Units: mg/L

CAS Number	Analyte	LCS Result	True Value	%Rec	QC % Limits	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-02	Sulfate	59.	60	98	80-120	20	6	EPA 375.2	WG11728	12/02/02	Laubscher

QC Sample:

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C51

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW21	Date Reported:	11/29/02	Sample ID:	M021175-002

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	4. J	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

J: Estimated Concentration below laboratory reporting limit.

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C52

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW20	Date Reported:	11/29/02	Sample ID:	M021175-003

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	4. J	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

J: Estimated Concentration below laboratory reporting limit.

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW16	Date Reported:	11/29/02	Sample ID:	M021175-006

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	4. J	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

J: Estimated Concentration below laboratory reporting limit.

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C54

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/17/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW18	Date Reported:	11/29/02	Sample ID:	M021175-008

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	7.7	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

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C55

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/17/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW19	Date Reported:	11/29/02	Sample ID:	M021175-010

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	2. J	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

J: Estimated Concentration below laboratory reporting limit.

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C56

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/17/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW17	Date Reported:	11/29/02	Sample ID:	M021175-012

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	u	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

u: Below Method Detection Limit

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C57

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Wet Chemistry (Method Blank) Report

Method Blank Sample ID: WG11713-1
Units: mg/L

Matrix: Water

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	u	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

QC Sample:

u: Below Method Detection Limit

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C58

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Wet Chemistry (Laboratory Matrix Duplicate) Report

Project Name: Willow Creek
Project Number: 6704
Units: mg/L
Client ID: Batch Specific

LD Sample ID: WG11713-3
Matrix: Water
Analysis Date: 11/27/02

CAS Number	Analyte	Sample Result	Dup Result	RPD	QC Limits	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	80.	81.	2	25	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

QC Sample: M021147-003

Batch Specific: The sample used for batch QC was from another project within this work group.

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C59

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Wet Chemistry (Matrix Spike, Matrix Spike Duplicate) Report

Project Name: Willow Creek
Project Number: 6704
Client ID: Batch Specific
Units: mg/L
Analysis Date: 11/27/02

MS Sample ID: WG11713-4
MSD Sample ID: WG11713-5
Matrix: Water
Analyst: Laubscher

CAS Number	Analyte	Sample Result	Spike Added	Conc MS	%Rec MS	Conc MSD	%Rec MSD	RPD	Method	Batch ID	Acceptance Range(%)
MRL-01	Chloride	80.	30	110	95	110	103	7	EPA 325.2	WG11713	80-120

Note: 97 mL sample & 3 mL of standard [(80.) x (0.97)] = 78. used in calculation of %Rec.
Results are rounded to 2 significant figures.

Comments: The RPD limit is 20.

QC Sample: M021147-003

%Rec: Percent of the spike recovered from the matrix

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C60

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Wet Chemistry (Laboratory Control Sample) Report

LCS Sample ID: WG11713-2
Analysis Date: 11/27/02

Matrix: Water
Units: mg/L

CAS Number	Analyte	LCS Result	True Value	%Rec	QC % Limits	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
MRL-01	Chloride	30.	30	100	80-120	5.0	1	EPA 325.2	WG11713	11/27/02	Laubscher

QC Sample:

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C61

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW21	Date Reported:	11/25/02	Sample ID:	M021175-002

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	54.	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Bicarbonate Alkalinity (as CaCO3)	54.	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Carbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

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C62

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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW20	Date Reported:	11/25/02	Sample ID:	M021175-003

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	56.	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Bicarbonate Alkalinity (as CaCO3)	56.	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Carbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

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C63

DEPARTMENT OF THE ARMY
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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/18/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW16	Date Reported:	11/25/02	Sample ID:	M021175-006

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Bicarbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Carbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

u: Below Method Detection Limit

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C64

DEPARTMENT OF THE ARMY
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Wet Chemistry Sample Report

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW18

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 11/25/02

Matrix: Water
Units: mg/L
Sample ID: M021175-008

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	53.	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Bicarbonate Alkalinity (as CaCO3)	53.	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Carbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

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C65

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Wet Chemistry Sample Report

Project Name: Willow Creek
Project Number: 6704
Client Sample ID: CO-WC-MW19

Date Sampled: 11/17/02
Date Received: 11/19/02
Date Reported: 11/25/02

Matrix: Water
Units: mg/L
Sample ID: M021175-010

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Bicarbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Carbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

u: Below Method Detection Limit

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C606

DEPARTMENT OF THE ARMY
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Wet Chemistry Sample Report

Project Name:	Willow Creek	Date Sampled:	11/17/02	Matrix:	Water
Project Number:	6704	Date Received:	11/19/02	Units:	mg/L
Client Sample ID:	CO-WC-MW17	Date Reported:	11/25/02	Sample ID:	M021175-012

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Bicarbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher
1317-65-3	Carbonate Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

u: Below Method Detection Limit

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C67

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Wet Chemistry (Method Blank) Report

Method Blank Sample ID: WG11697-1
Units: mg/L

Matrix: Water

CAS Number	Analyte	Result	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	u	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

QC Sample:

u: Below Method Detection Limit

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C68

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Wet Chemistry (Laboratory Matrix Duplicate) Report

Project Name: Willow Creek
Project Number: 6704
Units: mg/L
Client ID: CO-WC-MW17

LD Sample ID: WG11697-3
Matrix: Water
Analysis Date: 11/25/02

CAS Number	Analyte	Sample Result	Dup Result	RPD	QC Limits	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	u	u	NC	25	20	7.0	EPA 310.2	WG11697	11/25/02	Laubscher

QC Sample: M021175-012

NC: Parameter is Not Calculable
u: Below Method Detection Limit

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C69

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Wet Chemistry (Matrix Spike, Matrix Spike Duplicate) Report

Project Name: Willow Creek
Project Number: 6704
Client ID: CO-WC-MW17
Units: mg/L
Analysis Date: 11/25/02

MS Sample ID: WG11697-4
MSD Sample ID: WG11697-5
Matrix: Water
Analyst: Laubscher

CAS Number	Analyte	Sample Result	Spike Added	Conc MS	%Rec MS	Conc MSD	%Rec MSD	RPD	Method	Batch ID	Acceptance Range(%)
1317-65-3	Alkalinity (as CaCO3)	u	100	86	86	82	82	4	EPA 310.2	WG11697	80-120

Note: 99 mL sample & 1 mL of standard [(u) x (0.99)] = 0 used in calculation of %Rec.
Results are rounded to 2 significant figures.

Comments: The RPD limit is 20.

QC Sample: M021175-012

%Rec: Percent of the spike recovered from the matrix
u: Below Method Detection Limit

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C70

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Wet Chemistry (Laboratory Control Sample) Report

LCS Sample ID: WG11697-2
Analysis Date: 11/25/02

Matrix: Water
Units: mg/L

CAS Number	Analyte	LCS Result	True Value	%Rec	QC % Limits	LRL	MDL	Method	Batch ID	Date Analyzed	Analyst
1317-65-3	Alkalinity (as CaCO3)	99.	100	99	80-120	20	7	EPA 310.2	WG11697	11/25/02	Laubscher

QC Sample:

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C71

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Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-002
Client Sample ID: CO-WC-SB01-05

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result pH units	Date Analyzed
EPA-150.1	pH	8.47	01 Nov 02

Laboratory Comments:

Approved By: Lewis N. Ann Date: 11.7.02

C72

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Omaha, Nebraska

Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-004
Client Sample ID: CO-WC-SB01-3

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result pH units	Date Analyzed
EPA-150.1	pH	3.74	01 Nov 02

Laboratory Comments:

Approved By: Lynn W. Arnn Date: 11.7.02

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Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-006
Client Sample ID: CO-WC-SB01-7

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result pH units	Date Analyzed
EPA-150.1	pH	2.75	01 Nov 02

Laboratory Comments:

Approved By: [signature]

Date: 11.7.02

C74

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Omaha, Nebraska

Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-008
Client Sample ID: CO-WC-SB01-10

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result pH units	Date Analyzed
EPA-150.1	pH	3.25	01 Nov 02

Laboratory Comments:

Approved By: [signature]

Date: 11.7.02

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Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-010
Client Sample ID: CO-WC-SB01-15

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result pH units	Date Analyzed
EPA-150.1	pH	3.97	01 Nov 02

Laboratory Comments:

Approved By: [signature]

Date: 11.7.02

C76

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Omaha, Nebraska

Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-012
Client Sample ID: CO-WC-SB01-20

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result pH units	Date Analyzed
EPA-150.1	pH	3.34	01 Nov 02

Laboratory Comments:

Approved By: [signature] Date: 11.7.02

C77

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Omaha, Nebraska

Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-002
Client Sample ID: CO-WC-SB01-05

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result µmho/cm	Date Analyzed
EPA-120.1	Conductivity	93.9	01 Nov 02

Laboratory Comments:

Approved By: Tom W. Brown

Date: 11.7.02

C78

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Omaha, Nebraska

Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-004
Client Sample ID: CO-WC-SB01-3

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result µmho/cm	Date Analyzed
EPA-120.1	Conductivity	249	01 Nov 02

Laboratory Comments:

Approved By: Tom W. Brown

Date: 11.7.02

C79

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Omaha, Nebraska

Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-006
Client Sample ID: CO-WC-SB01-7

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result µmho/cm	Date Analyzed
EPA-120.1	Conductivity	1400	01 Nov 02

Laboratory Comments:

Approved By: Fremont Brown

Date: 11.7.02

C80

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Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-008
Client Sample ID: CO-WC-SB01-10

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result µmho/cm	Date Analyzed
EPA-120.1	Conductivity	914	01 Nov 02

Laboratory Comments:

Approved By: Lewis W. Ann

Date: 11.7.02

C81

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Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-010
Client Sample ID: CO-WC-SB01-15

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result µmho/cm	Date Analyzed
EPA-120.1	Conductivity	2320	01 Nov 02

Laboratory Comments:

Approved By: Frank M. Arm

Date: 11.7.02

C32

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Omaha, Nebraska

Wet Chemistry

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-012
Client Sample ID: CO-WC-SB01-20

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

Procedure	Analysis	Result µmho/cm	Date Analyzed
EPA-120.1	Conductivity	330	01 Nov 02

Laboratory Comments:

Approved By: Erin N. Arms

Date: 11.7.02

C83

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Wet Chemistry

Method Blank

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Method Blank ID: WG11559-1
Analyst: J. Bond

Procedure	Analysis	Result µmho/cm	Date Analyzed
EPA-120.1	Conductivity	0.935	01 Nov 02

Laboratory Comments:

Approved By: _____ Date: 11.7.02

C84

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Wet Chemistry

Laboratory Duplicate

FAMIS Number: 6704
Project Name: Willow Creek

Sample Description: Water
Lab Sample No.: M021066-002
Client Sample ID: CO-WC-SB01-05
Lab Duplicate ID: WG11559-2

Date Sampled: 23 Oct 02
Date Received: 24 Oct 02
Analyst: J. Bond

RESULTS (µmho/cm)

Procedure	Analysis	Sample Result	Duplicate Result	RPD	Date Analyzed
EPA-120.1	Conductivity	93.9	93.6	0.3	01 Nov 02

Laboratory Comments:

Approved By: Frem-N. Arna

Date: 1-16-03

C85

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Omaha, Nebraska

Wet Chemistry

Laboratory Control Sample (LCS)

FAMIS Number: 6704
Project Name: Willow Creek

Procedure: EPA-120.1
LCS ID: WG11559-3 (100 µmho/cm), WG11559-4 (1000 µmho/cm)
Analyst: J. Bond

RESULTS (µmho/cm)

Sample	Known Concentration	LCS Result	Percent Recovery	Date Analyzed
WG11559-3	100	102	102	01 Nov 02
WG11559-4	1000	986	98.6	01 Nov 02

Laboratory Comments:

Control Limits: 80-120% for Percent Recovery.

Approved By: Pam W. Arms Date: 11.7.02

Continental
Analytical Services, Inc.

Client: US Army Corps of Engineers
Attn: Laura Percifield
420 South 18th Street
Omaha, NE 68102-2586

Date Sample Rptd: 11/14/2002
Date Sample Recd: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

Lab Number: 02110526
Sample Description: M021066-002

Date Sampled: 10/23/2002
Time Sampled:

Analysis	Concentration	Units	Dilution Factor	Reporting Limit
Acidity, as CaCO3	31.	mg/L at pH=8.3	1.0	20

Analysis	Date Prepared	Date Analyzed	QC Batch	Analyst	Method(s)
Acidity, as CaCO3	N/A	11/12/2002	021112-1	KLM	SM 2310B

Laboratory analyses were performed on samples utilizing procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA Publication, SW-846, 3rd edition, September, 1986 and the latest promulgated update. ND(), where noted, indicates none detected with the reporting limit in parentheses. Samples will be retained for thirty days unless otherwise notified.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

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Continental Analytical Services, Inc.

Client: US Army Corps of Engineers
Attn: Laura Percifield
420 South 18th Street
Omaha, NE 68102-2586

Date Sample Rptd: 11/14/2002
Date Sample Recd: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

Lab Number: 02110527
Sample Description: M021066-004

Date Sampled: 10/23/2002
Time Sampled:

Analysis	Concentration	Units	Dilution Factor	Reporting Limit
Acidity, as CaCO3	56.	mg/L at pH=8.3	1.0	20

Analysis	Date Prepared	Date Analyzed	QC Batch	Analyst	Method(s)
Acidity, as CaCO3	N/A	11/12/2002	021112-1	KLM	SM 2310B

Laboratory analyses were performed on samples utilizing procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA Publication, SW-846, 3rd edition, September, 1986 and the latest promulgated update. ND(), where noted, indicates none detected with the reporting limit in parentheses. Samples will be retained for thirty days unless otherwise notified.

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Technical Manager

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Continental Analytical Services, Inc.

Client: US Army Corps of Engineers
Attn: Laura Percifield
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Omaha, NE 68102-2586

Date Sample Rptd: 11/14/2002
Date Sample Recd: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

Lab Number: 02110528
Sample Description: M021066-006

Date Sampled: 10/23/2002
Time Sampled:

Analysis	Concentration	Units	Dilution Factor	Reporting Limit
Acidity, as CaCO3	350.	mg/L at pH=8.3	1.0	20

Analysis	Date Prepared	Date Analyzed	QC Batch	Analyst	Method(s)
Acidity, as CaCO3	N/A	11/12/2002	021112-1	KLM	SM 2310B

Laboratory analyses were performed on samples utilizing procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA Publication, SW-846, 3rd edition, September, 1986 and the latest promulgated update. ND(), where noted, indicates none detected with the reporting limit in parentheses. Samples will be retained for thirty days unless otherwise notified.

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Continental Analytical Services, Inc.

Client: US Army Corps of Engineers
Attn: Laura Percifield
420 South 18th Street
Omaha, NE 68102-2586

Date Sample Rptd: 11/14/2002
Date Sample Recd: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

Lab Number: 02110529
Sample Description: M021066-008

Date Sampled: 10/23/2002
Time Sampled:

Analysis	Concentration	Units	Dilution Factor	Reporting Limit
Acidity, as CaCO3	179.	mg/L at pH=8.3	1.0	20

Analysis	Date Prepared	Date Analyzed	QC Batch	Analyst	Method(s)
Acidity, as CaCO3	N/A	11/12/2002	021112-1	KLM	SM 2310B

Laboratory analyses were performed on samples utilizing procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA Publication, SW-846, 3rd edition, September, 1986 and the latest promulgated update. ND(), where noted, indicates none detected with the reporting limit in parentheses. Samples will be retained for thirty days unless otherwise notified.

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Technical Manager

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Continental Analytical Services, Inc.

Client: US Army Corps of Engineers
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420 South 18th Street
Omaha, NE 68102-2586

Date Sample Rptd: 11/14/2002
Date Sample Recd: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

Lab Number: 02110530
Sample Description: M021066-010

Date Sampled: 10/23/2002
Time Sampled:

Analysis	Concentration	Units	Dilution Factor	Reporting Limit
Acidity, as CaCO3	1520.	mg/L at pH=8.3	1.0	20

Analysis	Date Prepared	Date Analyzed	QC Batch	Analyst	Method(s)
Acidity, as CaCO3	N/A	11/12/2002	021112-1	KLM	SM 2310B

Laboratory analyses were performed on samples utilizing procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA Publication, SW-846, 3rd edition, September, 1986 and the latest promulgated update. ND(), where noted, indicates none detected with the reporting limit in parentheses. Samples will be retained for thirty days unless otherwise notified.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

Quality Ethics Service
ACIL Seal of Excellence

Client: US Army Corps of Engineers
Attn: Laura Percifield
420 South 18th Street
Omaha, NE 68102-2586

Date Sample Rptd: 11/14/2002
Date Sample Recd: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

Lab Number: 02110531
Sample Description: M021066-012

Date Sampled: 10/23/2002
Time Sampled:

Analysis	Concentration	Units	Dilution Factor	Reporting Limit
Acidity, as CaCO3	82.	mg/L at pH=8.3	1.0	20

Analysis	Date Prepared	Date Analyzed	QC Batch	Analyst	Method(s)
Acidity, as CaCO3	N/A	11/12/2002	021112-1	KLM	SM 2310B

Laboratory analyses were performed on samples utilizing procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA Publication, SW-846, 3rd edition, September, 1986 and the latest promulgated update. ND(), where noted, indicates none detected with the reporting limit in parentheses. Samples will be retained for thirty days unless otherwise notified.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

Continental
Analytical Services, Inc.

QUALITY CONTROL REPORT
METHOD BLANK DATA

Client: US Army Corps of Engineers
Attn: Laura Percifield
420 South 18th Street
Omaha, NE 68102-2586

Date Sample Reported: 11/15/2002
Date Sample Received: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

QC Batch	Lab Number	Analysis	Concentration	Units	Book/Page
021112-1	021112BLK1	Acidity, as CaCO3	ND(20)	mg/L at pH=8.3	5300/54

Quality control analyses were performed on samples at time of analysis in accordance with procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA publication, SW-846, 3rd edition, Nov. 1986 and the latest promulgated update.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

Jacqueline Cairo
Quality Assurance Officer

Quality Ethics Service
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C93

Continental Analytical Services, Inc.

QUALITY CONTROL REPORT
LABORATORY CONTROL SAMPLE / LABORATORY CONTROL SAMPLE DUPLICATE DATA

Client: US Army Corps of Engineers
Attn: Laura Percifield
420 South 18th Street
Omaha, NE 68102-2586

Date Sample Reported: 11/15/2002
Date Sample Received: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

QC Batch	Lab Number	Analysis	Spike Level	Units	LCS	Accuracy Data (% Recovery) Limits
021112-1	021112LCS1	Acidity, as CaCO3	0.00	mg/L a	N/A	#

N/A - Not Applicable

- Accuracy and/or precision control limits are either not available for this analysis or not applicable to this analysis.

Quality control analyses were performed on samples at time of analysis in accordance with procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA publication, SW-846, 3rd edition, Nov. 1986 and the latest promulgated update.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

Jacqueline Cairo
Quality Assurance Officer

1804 Glendale Road • Salina, Kansas 67401-6675
785-827-1273 • 800-535-3076 • FAX 785-823-7830

Quality Ethics Service
ACIL Seal of Excellence

C94

Continental Analytical Services, Inc.

QUALITY CONTROL REPORT
MATRIX SPIKE / MATRIX SPIKE DUPLICATE DATA

Client: US Army Corps of Engineers
Attn:Laura Percifield
420 South 18th Street
Omaha, NE 68102-2586

Date Sample Reported: 11/15/2002
Date Sample Received: 11/08/2002
Continental File No: 5409
Continental Order No: 82898
Client P.O.: 6704

Matrix Spike/Matrix Spike Duplicate Data from Sample Batch:

Analysis	QC Batch	Spike Level	Units	Accuracy Data (% Recovery) MS	MSD	Limits	Precision Data RPD	Limit	Laboratory Number
Acidity, as CaCO3	021112-1	0.00	mg/L a	179J	180J	#	0.6	#	02110529 +

J - MS/MSD cannot be performed for this analysis. Value shown is the result of a duplicate analysis of the sample.

- Accuracy control limits are not applicable to duplicate analysis or control limits are currently unavailable for this analysis.

+ - The MS/MSD sample analyses were performed on this sample from this Continental order number.

Quality control analyses were performed on samples at time of analysis in accordance with procedures published in Title 40 of the Code of Federal Regulations, Parts 136 or 141, or in EPA publication, SW-846, 3rd edition, Nov. 1986 and the latest promulgated update.

CONTINENTAL ANALYTICAL SERVICES, INC.

Clifford J. Baker
Technical Manager

Jacqueline Cairo
Quality Assurance Officer

Quality Ethics Service
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APPENDIX B: WELL LOGS

Hole No. SB1

DRILLING LOG	DIVISION N/A	INSTALLATION N/A	SHEET 1 OF 1 SHEETS

1. PROJECT	RAMS - WILLOW CREEK, CREEDE, CO.
2. LOCATION (Coordinates or Station)	UTM 13, 331002E, 4189710N
3. DRILLING AGENCY	US Army Corps of Engineers
4. HOLE NO. (As shown on drawing title and title number)	SB01
5. NAME OF DRILLER	Joe Morrisey
6. DIRECTION OF HOLE	[X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN	N/A
8. DEPTH DRILLED INTO ROCK	N/A
9. TOTAL DEPTH OF HOLE	15 feet bgs
10. SIZE AND TYPE OF BIT	4.5" Bulldog Cutter with Center Bit
11. DATUM FOR ELEVATION SHOWN (TBM or MSL)	MSL
12. MANUFACTURERS DESIGNATION OF DRILL	Guss Peck 1300C
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN	N/A; DISTURBED; UNDISTURBED
14. TOTAL NUMBER CORE BOXES	N/A
15. ELEVATION GROUND WATER	Not Encountered
16. DATE HOLE	STARTED 10-22-02; COMPLETED 10-22-02
17. ELEVATION TOP OF HOLE	Elevation not Surveyed
18. TOTAL CORE RECOVERY FOR BORING	N/A
19. SIGNATURE OF INSPECTOR	David Henry, USACE Field Geologist

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Cap material <5in thick			
			Fine grained, light brown tailings	50%		CO-WC-SB01-05 collected just below the cap material. Fine grained, light brown tailings
	5 feet					CO-WC-SB01-3 collected @ ~3 feet bgs
			Fine grained, light brown tailings	50%		CO-WC-SB01-7 collected @ ~7 feet bgs
	10 feet		Same as above			
			Silty clay, gray	100%		CO-WC-SB01-10 collected @ ~10 feet bgs. The sample was collect just above the clay, in the the tailings.
	15 feet		Dark, black organic rich soil			CO-WC-SB01-15 collected @ ~15 feet bgs in native soil
			TOTAL DEPTH = 15.0 feet bgs			

Hole No. MW20

DRILLING LOG	DIVISION N/A	INSTALLATION N/A	SHEET 1 OF 1 SHEETS

1. PROJECT: RAMS - WILLOW CREEK, CREEDE, CO.
2. LOCATION *(Coordinates or Station)*: UTM 13, 331050E, 4189336N
3. DRILLING AGENCY: US Army Corps of Engineers
4. HOLE NO. *(As shown on drawing title and title number)*: MW20
5. NAME OF DRILLER: Joe Morrisey
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: N/A
8. DEPTH DRILLED INTO ROCK: N/A
9. TOTAL DEPTH OF HOLE: 20.5 feet bgs
10. SIZE AND TYPE OF BIT: 4.5" Bulldog Cutter with Center Bit
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: MSL
12. MANUFACTURERS DESIGNATION OF DRILL: Guss Peck 1300C
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: N/A — DISTURBED: — UNDISTURBED: —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: ~7.7 feet bgs
16. DATE HOLE — STARTED: 10-21-02 — COMPLETED: 10-21-02
17. ELEVATION TOP OF HOLE: Elevation not Surveyed
18. TOTAL CORE RECOVERY FOR BORING: N/A
19. SIGNATURE OF INSPECTOR: David Henry, USACE Field Geologist

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
	5 feet		Gravel With approximatley 50% Sand Gravel Size from >2mm to 24mm			No Sampler used because gravel is to large. Sampler cloggs up. Classification of material was done by observing cuttings.
	10 feet					
	15 feet					
	20 feet					
			TOTAL DEPTH = 20.5 feet bgs			

Hole No. MW19

DRILLING LOG	DIVISION N/A	INSTALLATION N/A	SHEET 1 OF 1 SHEETS

1. PROJECT: RAMS - WILLOW CREEK, CREEDE, CO.
2. LOCATION *(Coordinates or Station)*: UTM 13, 331150E, 4189336N
3. DRILLING AGENCY: US Army Corps of Engineers
4. HOLE NO. *(As shown on drawing title and title number)*: MW19
5. NAME OF DRILLER: Joe Morrisey
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: N/A
8. DEPTH DRILLED INTO ROCK: N/A
9. TOTAL DEPTH OF HOLE: 15.5 feet bgs
10. SIZE AND TYPE OF BIT: 4.5" Bulldog Cutter with Center Bit
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: MSL
12. MANUFACTURERS DESIGNATION OF DRILL: Guss Peck 1300C
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: N/A — DISTURBED: — UNDISTURBED: —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: ~7.7 feet bgs
16. DATE HOLE — STARTED: 10-21-02 — COMPLETED: 10-21-02
17. ELEVATION TOP OF HOLE: Elevation not Surveyed
18. TOTAL CORE RECOVERY FOR BORING: N/A
19. SIGNATURE OF INSPECTOR: David Henry, USACE Field Geologist

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
	5 feet		Gravel With approximatley 50% Sand Gravel Size from >2mm to 24mm			No Sampler used because gravel is to large. Sampler cloggs up. Classification of material was done by observing cuttings.
	10 feet					
	15 feet					
	20 feet		TOTAL DEPTH = 15.5 feet bgs			

Hole No. MW18

DRILLING LOG	DIVISION N/A	INSTALLATION N/A	SHEET 1 OF 1 SHEETS

1. PROJECT: RAMS - WILLOW CREEK, CREEDE, CO.
2. LOCATION (Coordinates or Station): UTM 13, 331398E, 4189224N
3. DRILLING AGENCY: US Army Corps of Engineers
4. HOLE NO. (As shown on drawing title and title number): MW18
5. NAME OF DRILLER: Joe Morrisey
6. DIRECTION OF HOLE: [X] VERTICAL [ ] INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: N/A
8. DEPTH DRILLED INTO ROCK: N/A
9. TOTAL DEPTH OF HOLE: 15.5 feet bgs
10. SIZE AND TYPE OF BIT: 4.5" Bulldog Cutter with Center Bit
11. DATUM FOR ELEVATION SHOWN (TBM or MSL): MSL
12. MANUFACTURERS DESIGNATION OF DRILL: Guss Peck 1300C
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: N/A; DISTURBED: ; UNDISTURBED:
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: ~6.5 feet bgs
16. DATE HOLE: STARTED 10-22-02; COMPLETED 10-22-02
17. ELEVATION TOP OF HOLE: Elevation not Surveyed
18. TOTAL CORE RECOVERY FOR BORING: N/A
19. SIGNATURE OF INSPECTOR: David Henry, USACE Field Geologist

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS (Description) d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS (Drilling time, water loss, depth of weathering, etc., if significant) g
			Top Soil	20%		Sample collected with core barrel
	5 feet		Gravel With approximatley 50% Sand			No Sampler used because gravel is to large. Sampler cloggs up. Classification of material was done by observing cuttings.
	10 feet					
	15 feet		TOTAL DEPTH = 15.5 feet bgs			

Hole No. MW17

DRILLING LOG	DIVISION N/A	INSTALLATION N/A	SHEET 1 OF 1 SHEETS

1. PROJECT: RAMS - WILLOW CREEK, CREEDE, CO.
2. LOCATION *(Coordinates or Station)*: UTM 13, 331464E, 4189073N
3. DRILLING AGENCY: US Army Corps of Engineers
4. HOLE NO. *(As shown on drawing title and title number)*: MW17
5. NAME OF DRILLER: Joe Morrisey
6. DIRECTION OF HOLE: ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.
7. THICKNESS OF OVERBURDEN: N/A
8. DEPTH DRILLED INTO ROCK: N/A
9. TOTAL DEPTH OF HOLE: 23.6 feet bgs
10. SIZE AND TYPE OF BIT: 4.5" Bulldog Cutter with Center Bit
11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)*: MSL
12. MANUFACTURERS DESIGNATION OF DRILL: Guss Peck 1300C
13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN: N/A — DISTURBED: — UNDISTURBED: —
14. TOTAL NUMBER CORE BOXES: N/A
15. ELEVATION GROUND WATER: ~12.3 feet bgs
16. DATE HOLE — STARTED: 10-22-02 — COMPLETED: 10-22-02
17. ELEVATION TOP OF HOLE: Elevation not Surveyed
18. TOTAL CORE RECOVERY FOR BORING: N/A
19. SIGNATURE OF INSPECTOR: David Henry, USACE Field Geologist

ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOVERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
	5 feet		Gravel With approximatley 50% Sand Gravel ranges in size from >2mm to 40mm			No Sampler used because gravel is to large. Sampler cloggs up. Classification of material was done by observing cuttings.
	10 feet					
	15 feet					
	20 feet					
	25 feet		TOTAL DEPTH = 23.6 feet bgs			

Hole No. MW16

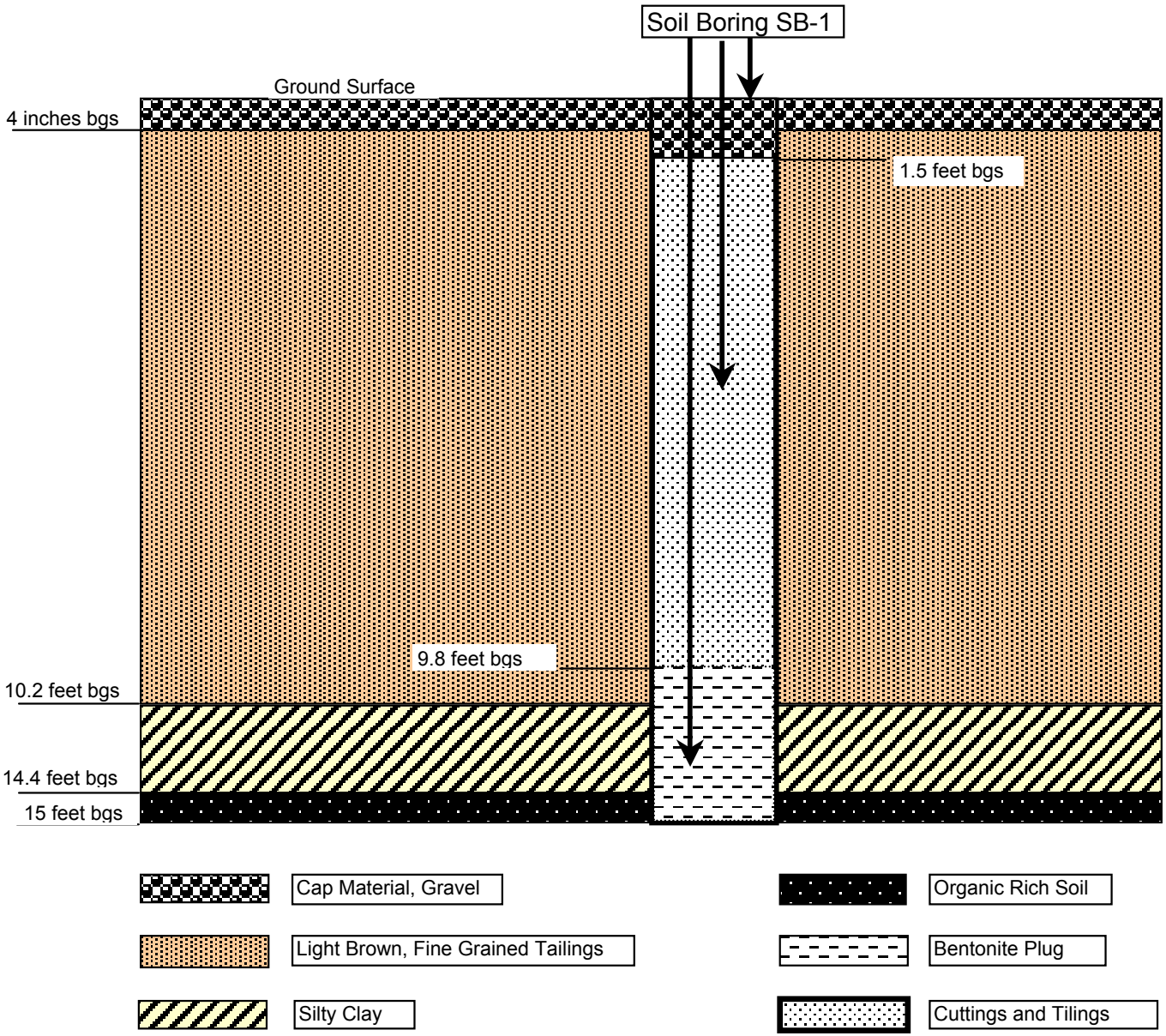
DRILLING LOG	DIVISION N/A	INSTALLATION N/A	SHEET 1 OF 1 SHEETS

1. PROJECT RAMS - WILLOW CREEK, CREEDE, CO.	10. SIZE AND TYPE OF BIT 4.5" Bulldog Cutter with Center Bit
2. LOCATION *(Coordinates or Station)* UTM 13, 330904E, 4189823N	11. DATUM FOR ELEVATION SHOWN *(TBM or MSL)* MSL
3. DRILLING AGENCY US Army Corps of Engineers	12. MANUFACTURERS DESIGNATION OF DRILL Guss Peck 1300C
4. HOLE NO. *(As shown on drawing title and title number)* MW16	13. TOTAL NO. OF OVERBURDEN SAMPLES TAKEN N/A; DISTURBED; UNDISTURBED
5. NAME OF DRILLER Joe Morrisey	14. TOTAL NUMBER CORE BOXES N/A
6. DIRECTION OF HOLE ☒ VERTICAL ☐ INCLINED _____ DEG. FROM VERT.	15. ELEVATION GROUND WATER ~8.79 feet bgs
7. THICKNESS OF OVERBURDEN N/A	16. DATE HOLE STARTED 10-24-02 COMPLETED 10-24-02
8. DEPTH DRILLED INTO ROCK N/A	17. ELEVATION TOP OF HOLE Elevation not Surveyed
9. TOTAL DEPTH OF HOLE 18 feet bgs	18. TOTAL CORE RECOVERY FOR BORING N/A
	19. SIGNATURE OF INSPECTOR David Henry, USACE Field Geologist

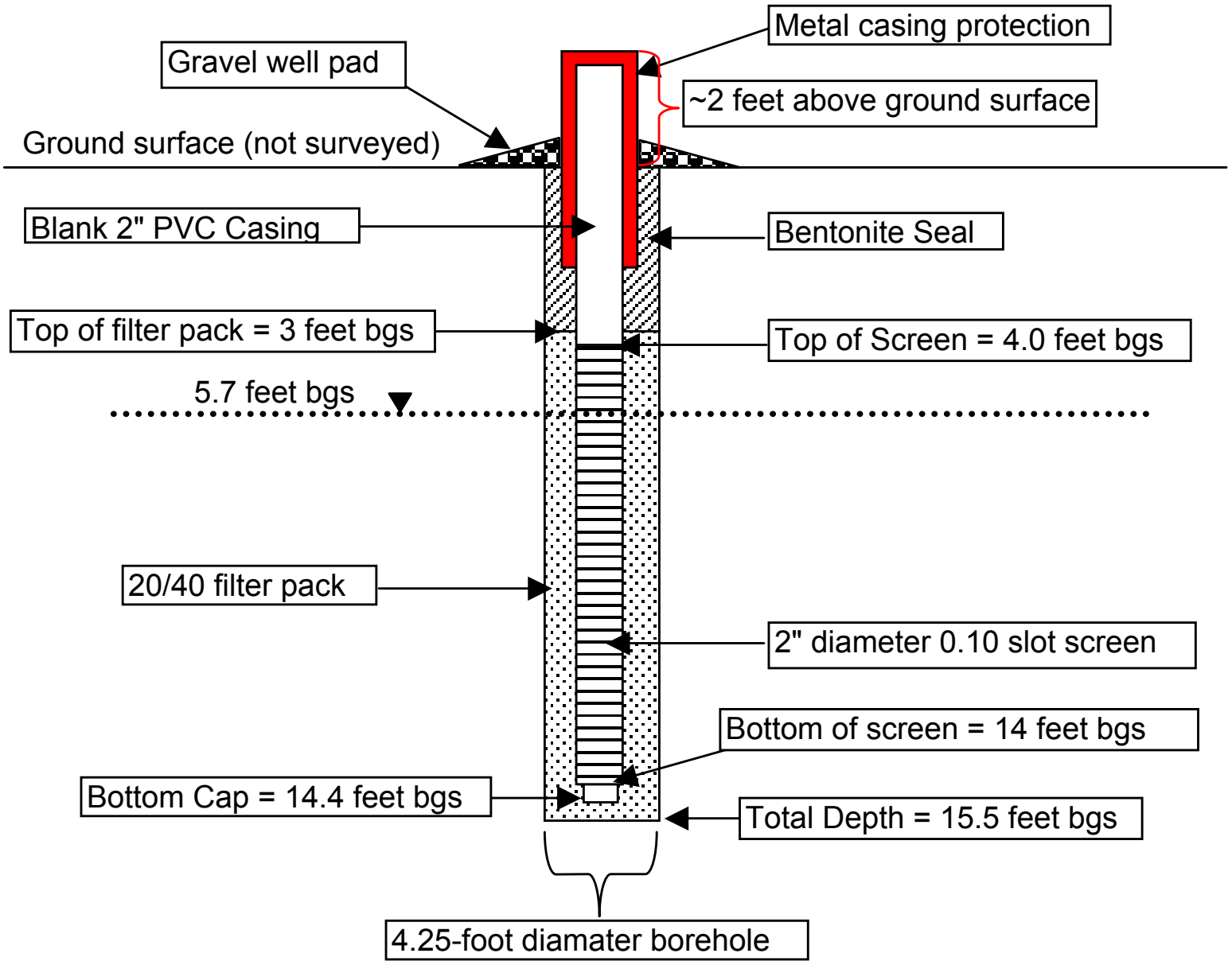
ELEVATION a	DEPTH b	LEGEND c	CLASSIFICATION OF MATERIALS *(Description)* d	% CORE RECOV-ERY e	BOX OR SAMPLE NO. f	REMARKS *(Drilling time, water loss, depth of weathering, etc., if significant)* g
			Tailings			
			Gravel With approximatley 50% Sand			
	5 feet		Silty Clay (Same as noted in SB1)			
						No Sampler used because gravel is to large. Sampler cloggs up. Classification of material was done by observing cuttings.
	10 feet		Gravel With approximatley 50% Sand From > 2 mm to 24 mm			
	15 feet					
			TOTAL DEPTH = 18.0 feet bgs			
	20 feet					

APPENDIX C: WELL DIAGRAMS

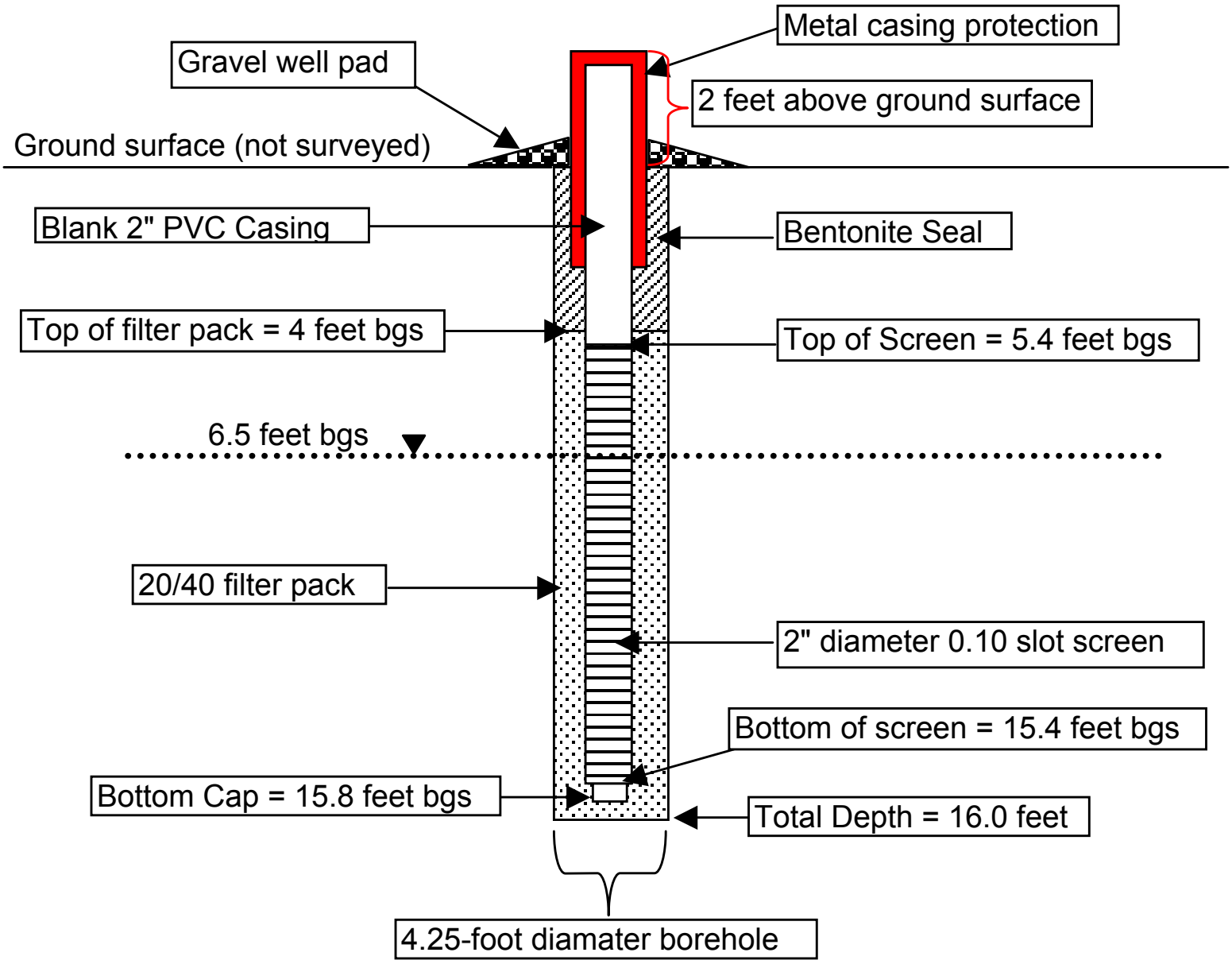
SOIL BORING (SB1) ABANDONMENT DIAGRAM



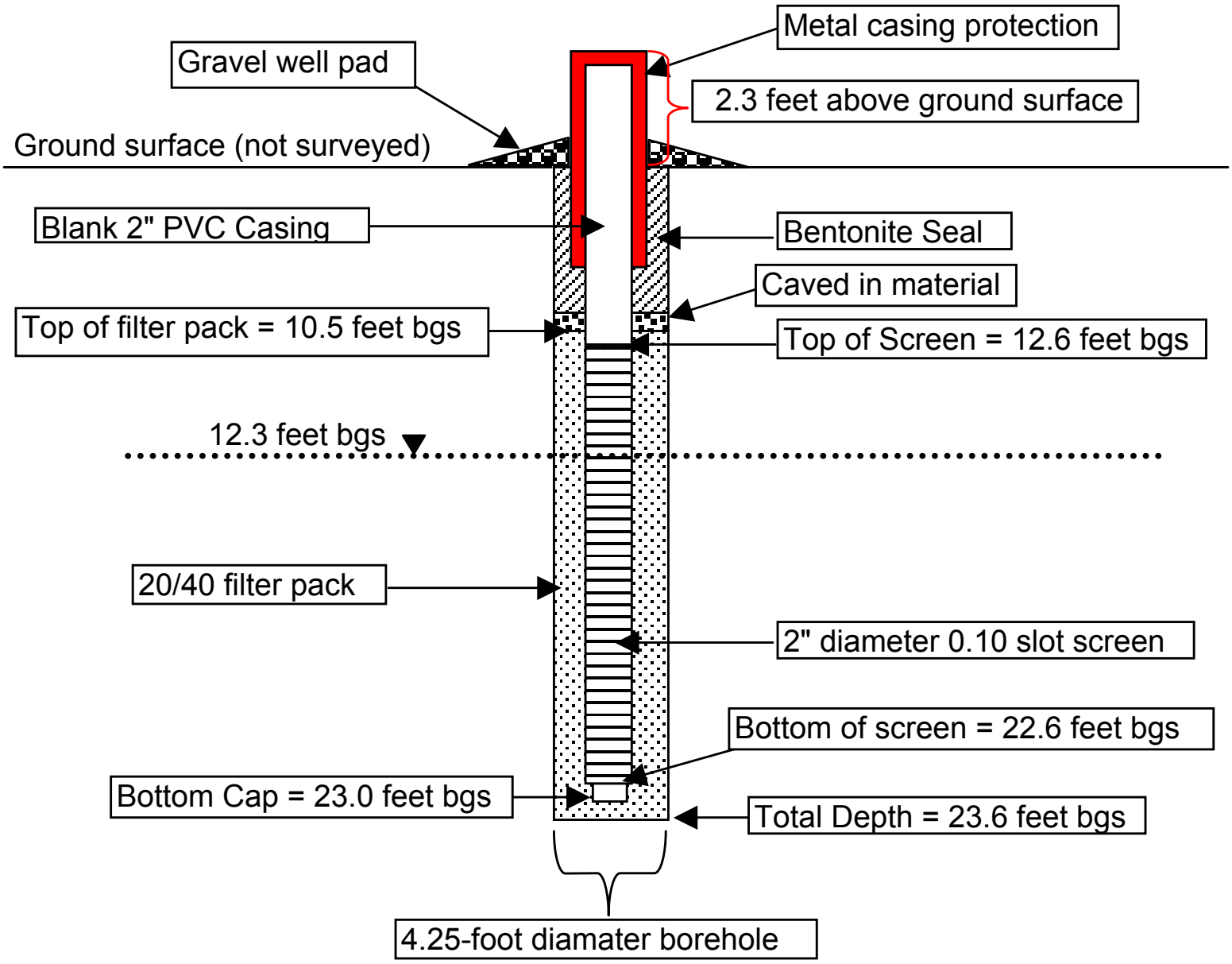
WELL CONSTRUCTION DIAGRAM
MW 19



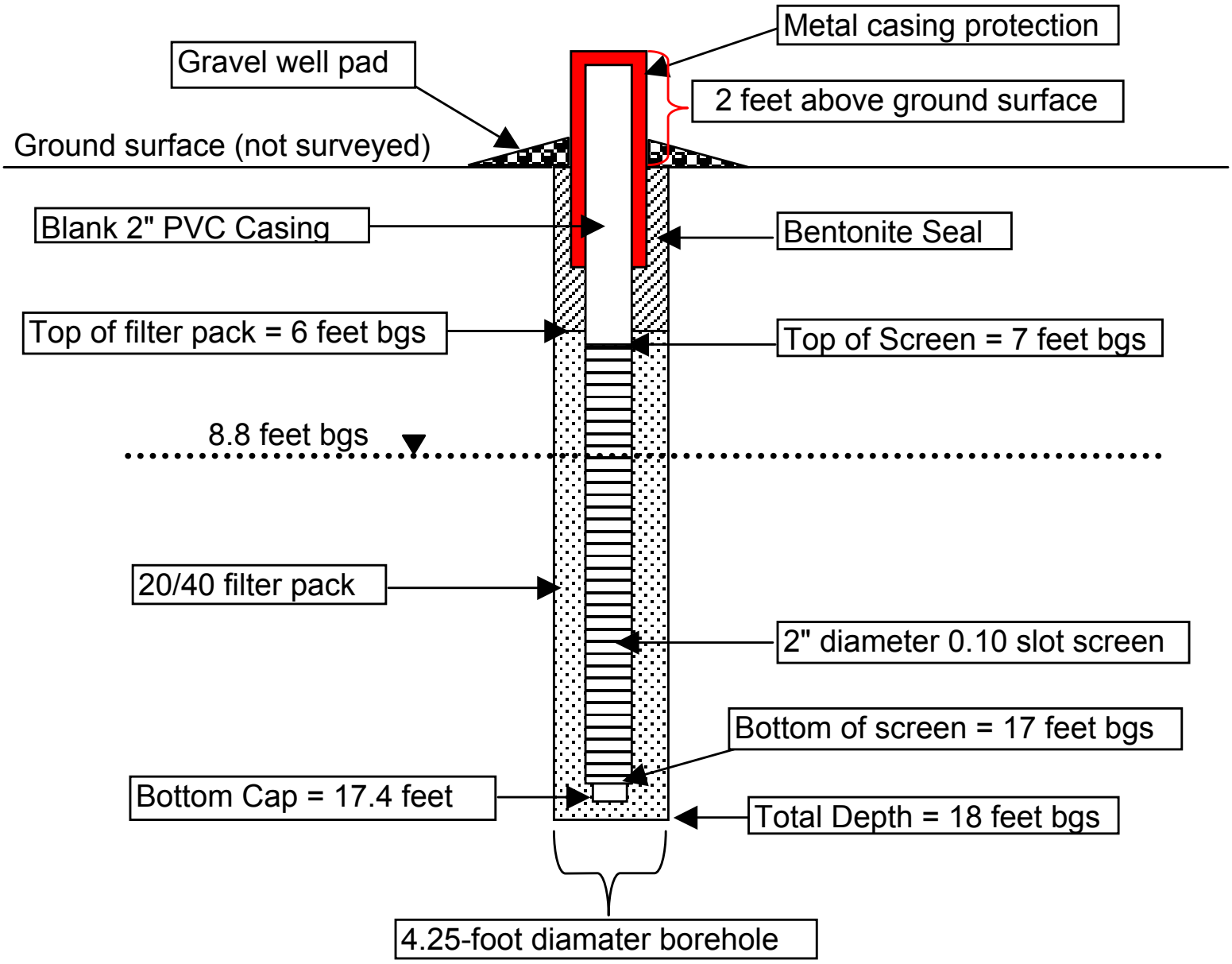
WELL CONSTRUCTION DIAGRAM
MW 18



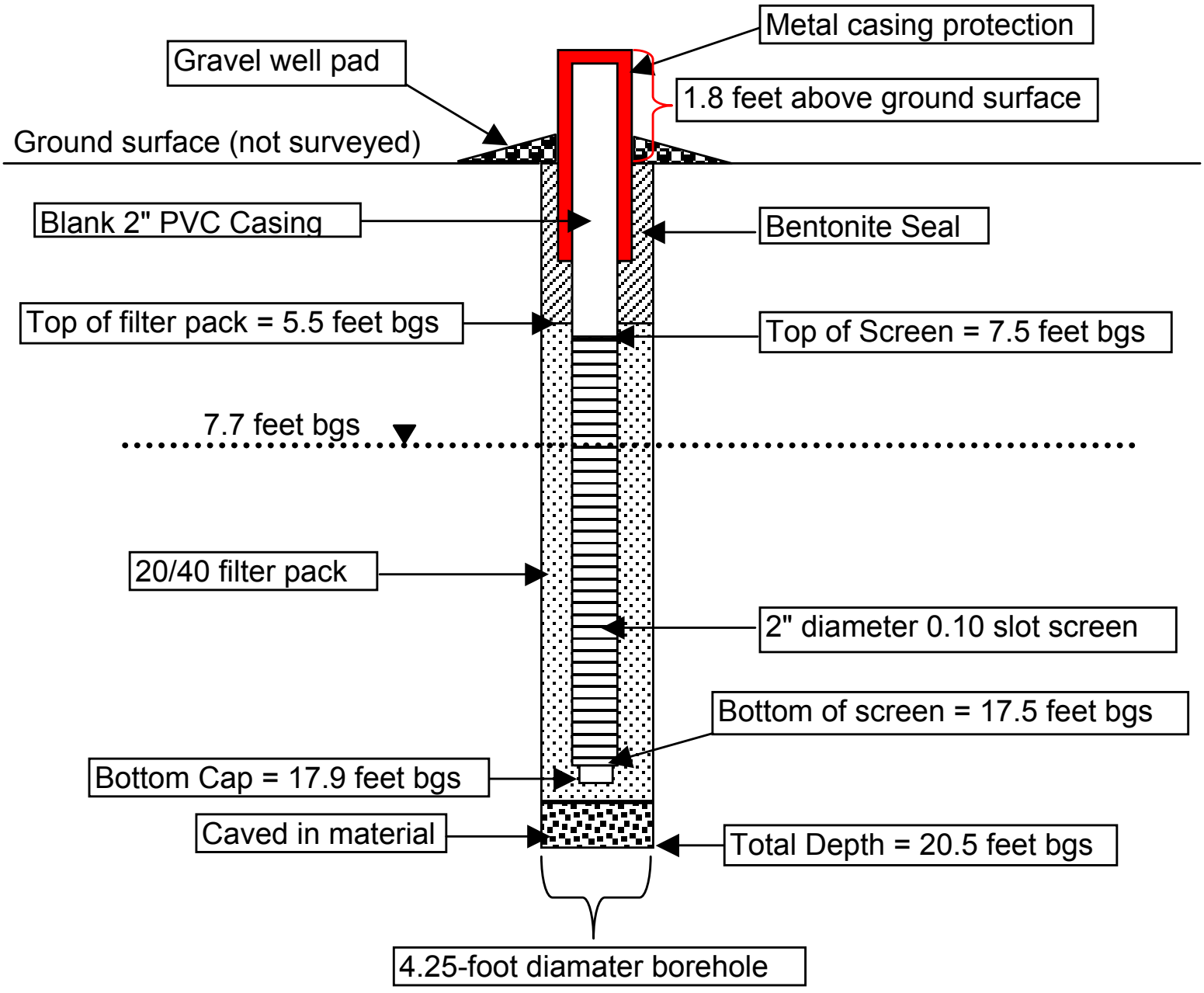
WELL CONSTRUCTION DIAGRAM
MW 17



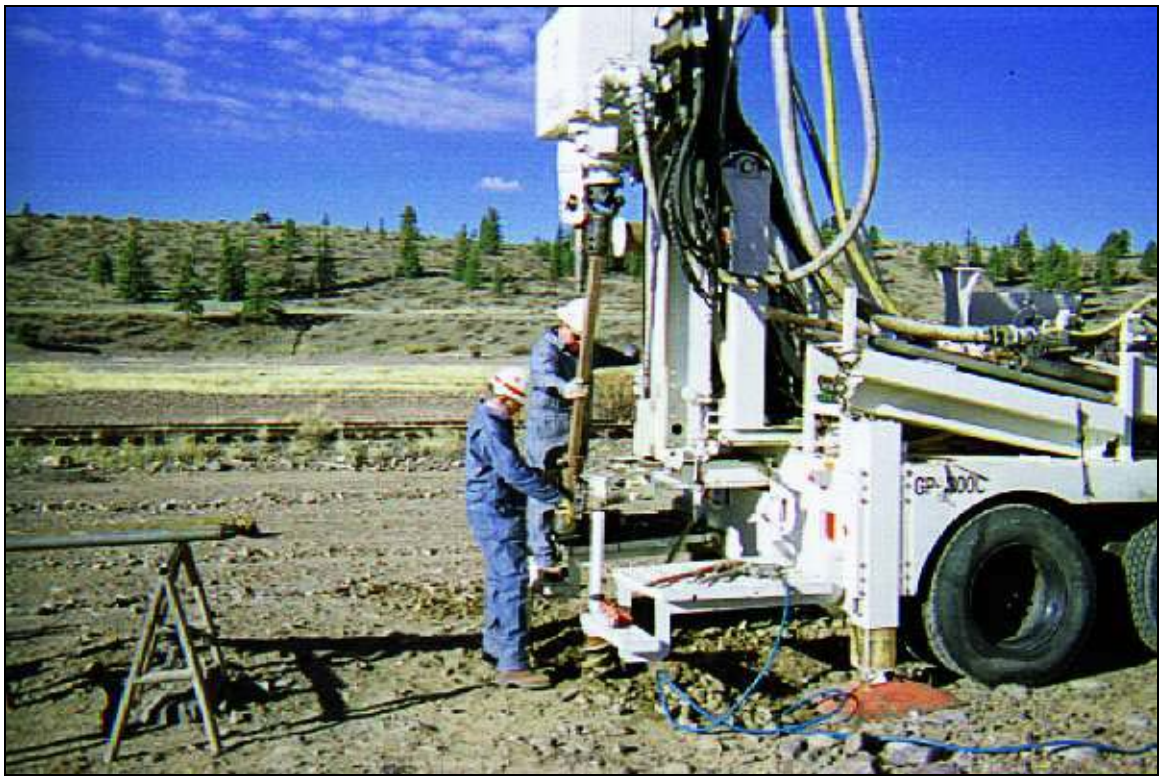
WELL CONSTRUCTION DIAGRAM
MW 16



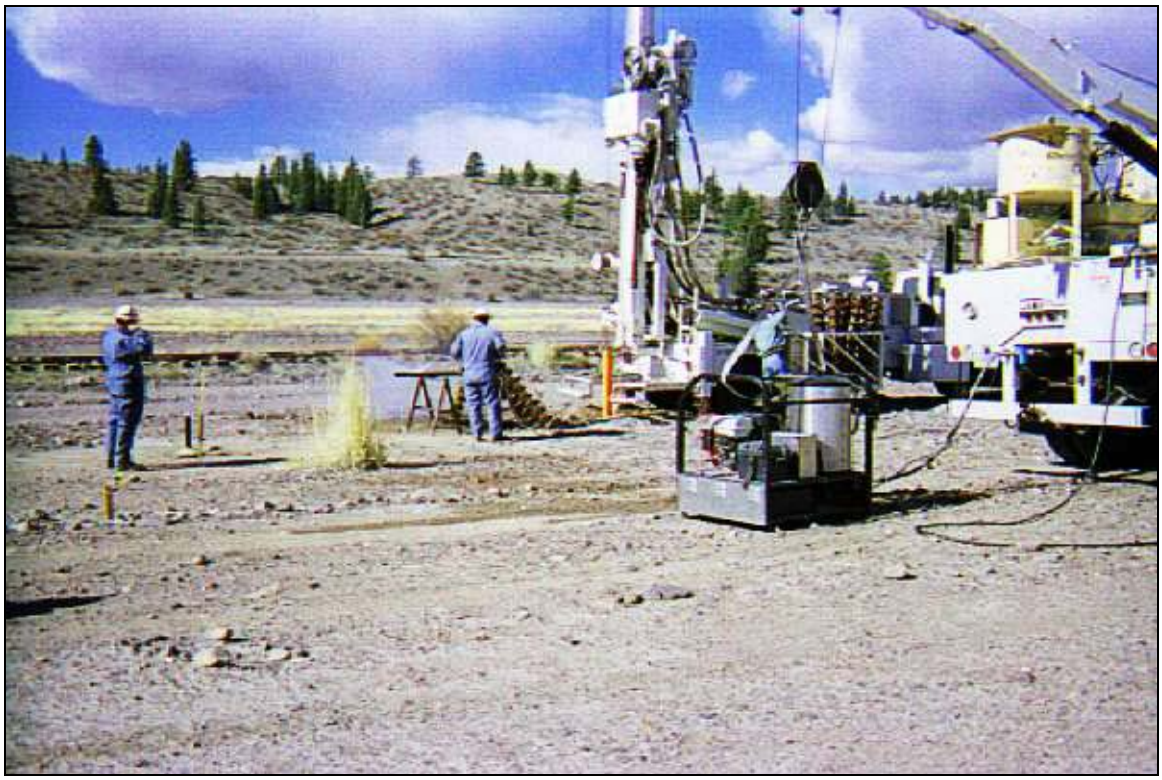
WELL CONSTRUCTION DIAGRAM
MW 20



APPENDIX D: PHOTO LOG



Photograph 1: Setting up at MW20



Photograph 2: Steam Cleaning Equipment

Photograph 3: Setting up at MW19 Original

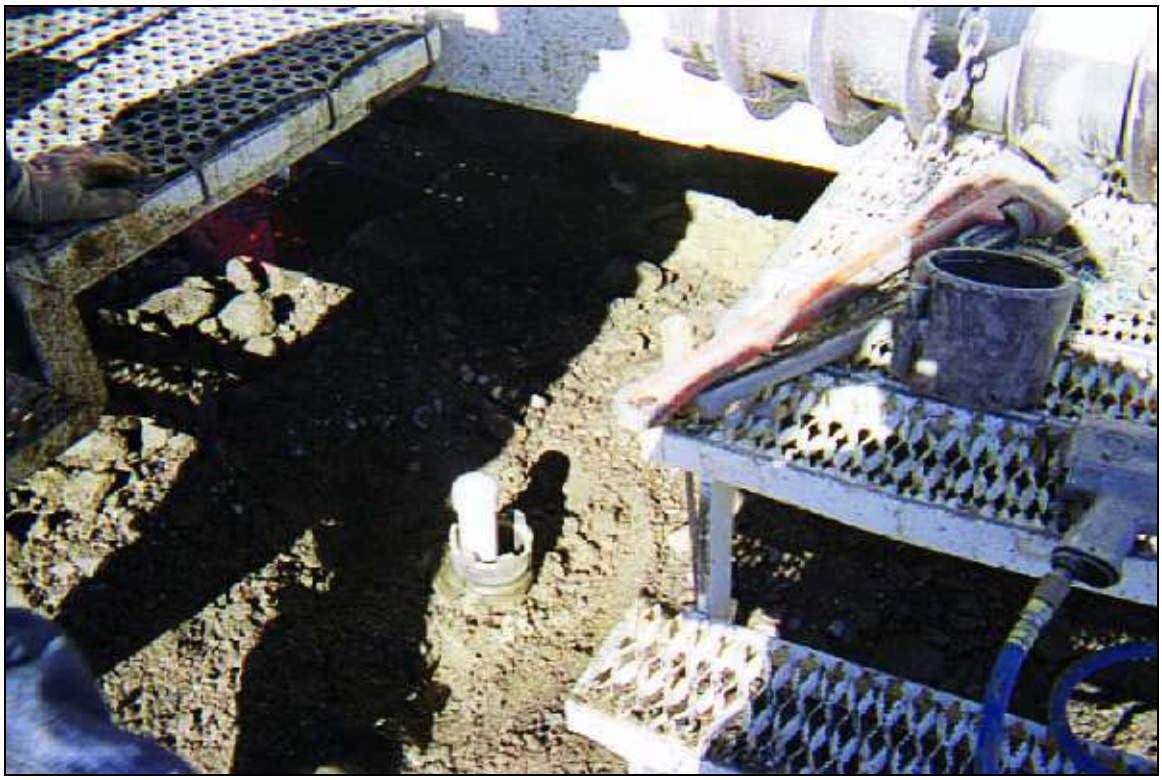
Photograph 4: MW19 Borehole Advancement

Photograph 5: Removal of Casing at MW19

Photograph 6: Removal of Casing at MW19

Photograph 7: Advancement at New Location for MW19

Photograph 8: Damp Cuttings at MW19 Indicating Groundwater



Photograph 9: Casing Set at MW19

Photograph 10: Top Soil in Core Barrel at MW18

Photograph 11: Blowing out MW18 Boring with Air-Rotary

Photograph 12: Blowing out MW18 Boring with Air-Rotary

Photograph 13: Setting up at MW17 Location

Photograph 14: Advancement at MW17

Photograph 15: SB1 from MW11

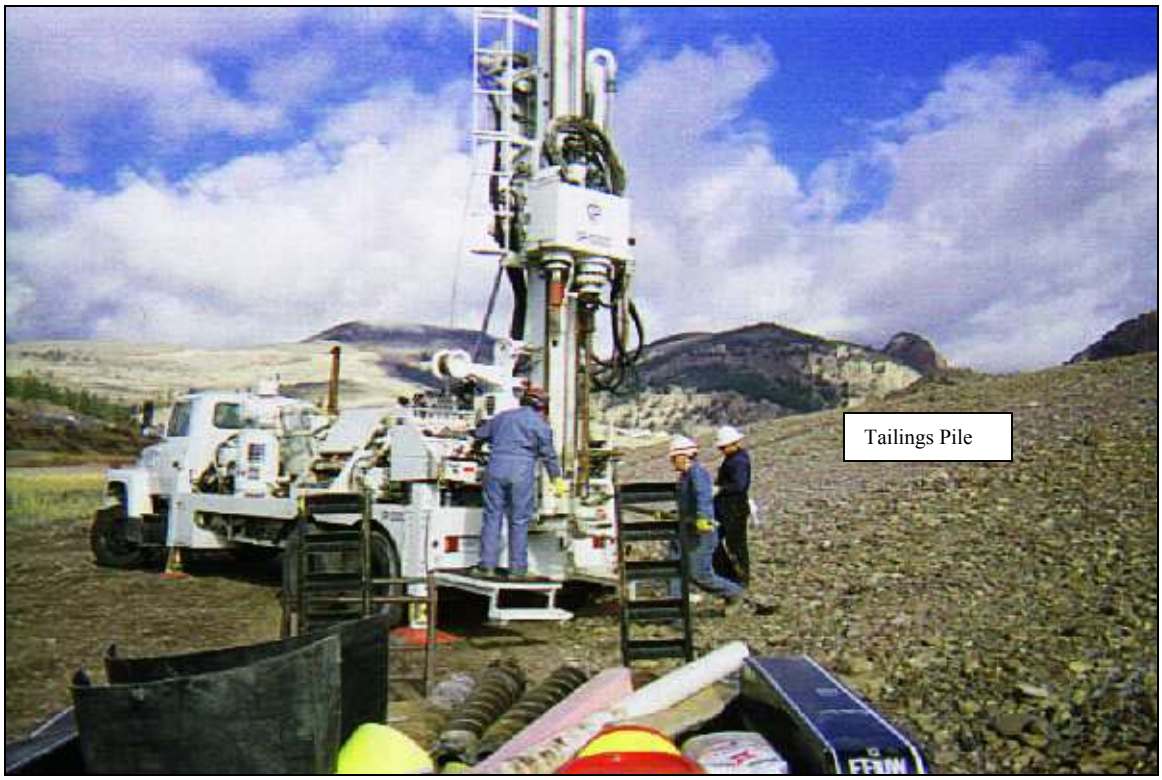
Photograph 16: First Core Barrel from SB1

Photograph 17: Another Core from SB1

Photograph 18: Placing Bentonite Pellets in SB1

Photograph 19: Cap Material at SB1

Photograph 20: Cap Material at SB1 Compacted with the Drilling Rig



Photograph 21: Setting up at MW16

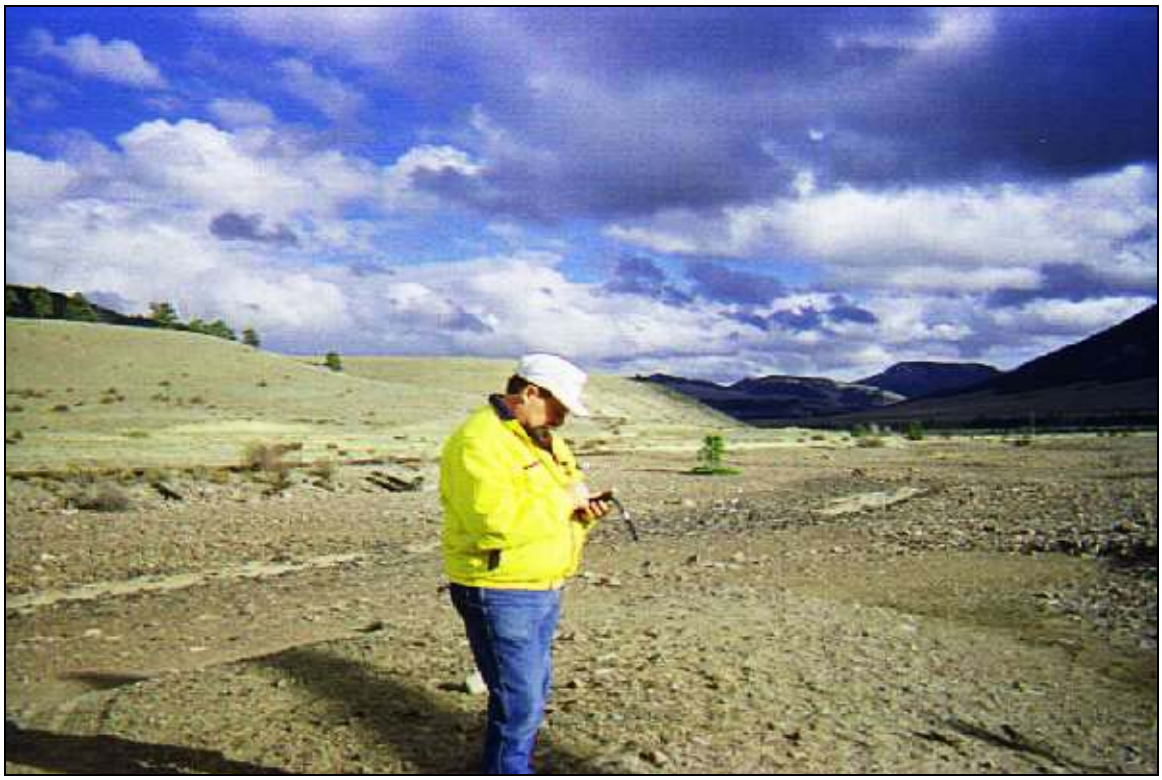
Photograph 22: Well Development at MW19

Photograph 23: Well Development at MW19

Photograph 24: Typical Well Pad

Photograph 25: Cleaning up at MW19

Photograph 26: Cleaning up at MW19



Photograph 27: Creede Resources, Inc (property owner) Representative Bob Tridle, Taking Notes.

APPENDIX E: FIELD LOG BOOKS

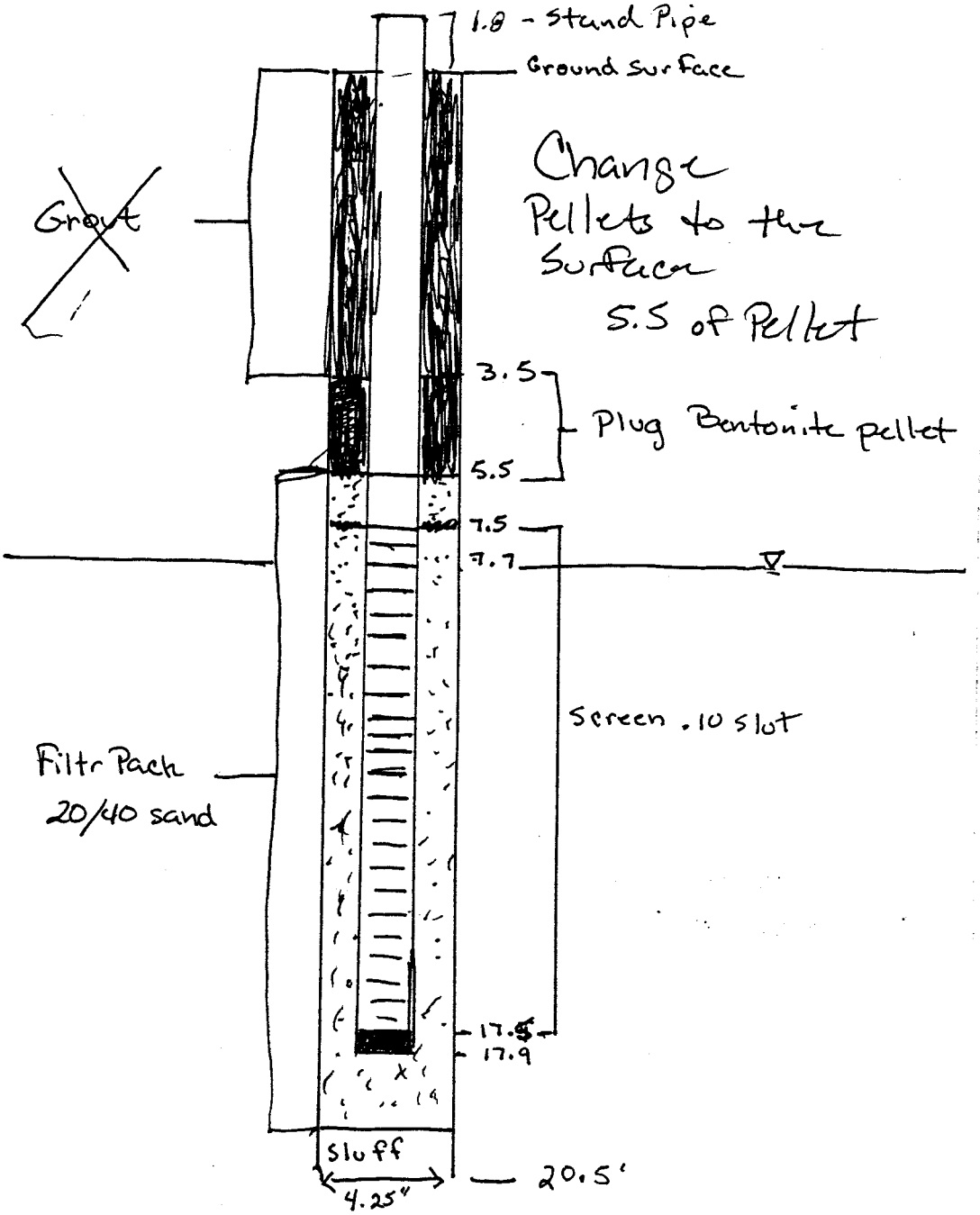
Willow Creek
10-21-02

Photo log

Exposure #	Location	Work
1	MW 20	setting well
2	MW 20	Steam cleaning
3	MW 19 (a)	setting up
4	MW 19 (a)	drilling out casing
5	"	Casing being extracted
6	"	"
7	MW 19(b)	drilling with corebarrel
8	MW 19 (b)	cutting in water bearing zone
9	MW 19 (b)	Casing set
10	MW 18	Core barrel
11	"	Blow out bottom of Auger
12	"	" " " " "
13	MW 17	Setting up on location
14	"	" "
15	~~MW 10~~ SB1	From MW11 Look up at MW 16
16	~~MW 10~~ SB1	Tail First ~~First~~
17	~~MW 10~~ SB1	Tamping Down Gravel
18	~~MW 10~~ SB1	" "
19	MW 16	set up
Remainder	MW19	Development

Willow Creek
10-21-02

MW 20



Willow Creek
10-21-02

Water Table depths on Existing well

~~MW4 - 9' below Top of PVC~~

MW7 - 4.2' below Top of PVC
MW6 - Dry TD = ~9.0 feet
MW8 - 4.2' below Top of PVC
MW20 - 9.15' " " " "
MW9 - 7.96 " " " "
MW11 - 4.18 " " " "

Willow Creek
10-21-02

- Borehole MW 20 was most gravel and it was determined that pulling the Auger out to set grout would cause the borehole to collapse. Rather than try to fill the remaining annular space (above the seal) with grout, we place 3/8 pellets (~~Bad Bentonite~~) to the surface (3' feet below surface). Dug out the slurf at the surface so that grout could be placed for the standpipe

13:40 - started drilling on MW 19
by cutting - Gravel similar to MW20
virtually the same Lithology
TD - 20 ft

16:30 - Could not complete MW19. Gravel heaved into the Auger. Could not get a filter pack in. Will have to abandon the borehole in the morning -. Will probably move over 5-10 feet and drill another borehole

10-22-02

0730 - Arrived at MW19 Borehole location
started drilling out casing to facilitate
Abandonment

-0830 - Retreave 10' foot of casing from
MW19 (a) borehole - As the Augers were
pulled out - The borehole collapsed.
10' foot of screen was not retrievable.

Moved Rig 3 feet to the south of MW19(a)
to drill another borehole for MW19 (MW19(b)
- Cutting are the same as MW19(a) mostly
Large Gravel and sand (~50%)

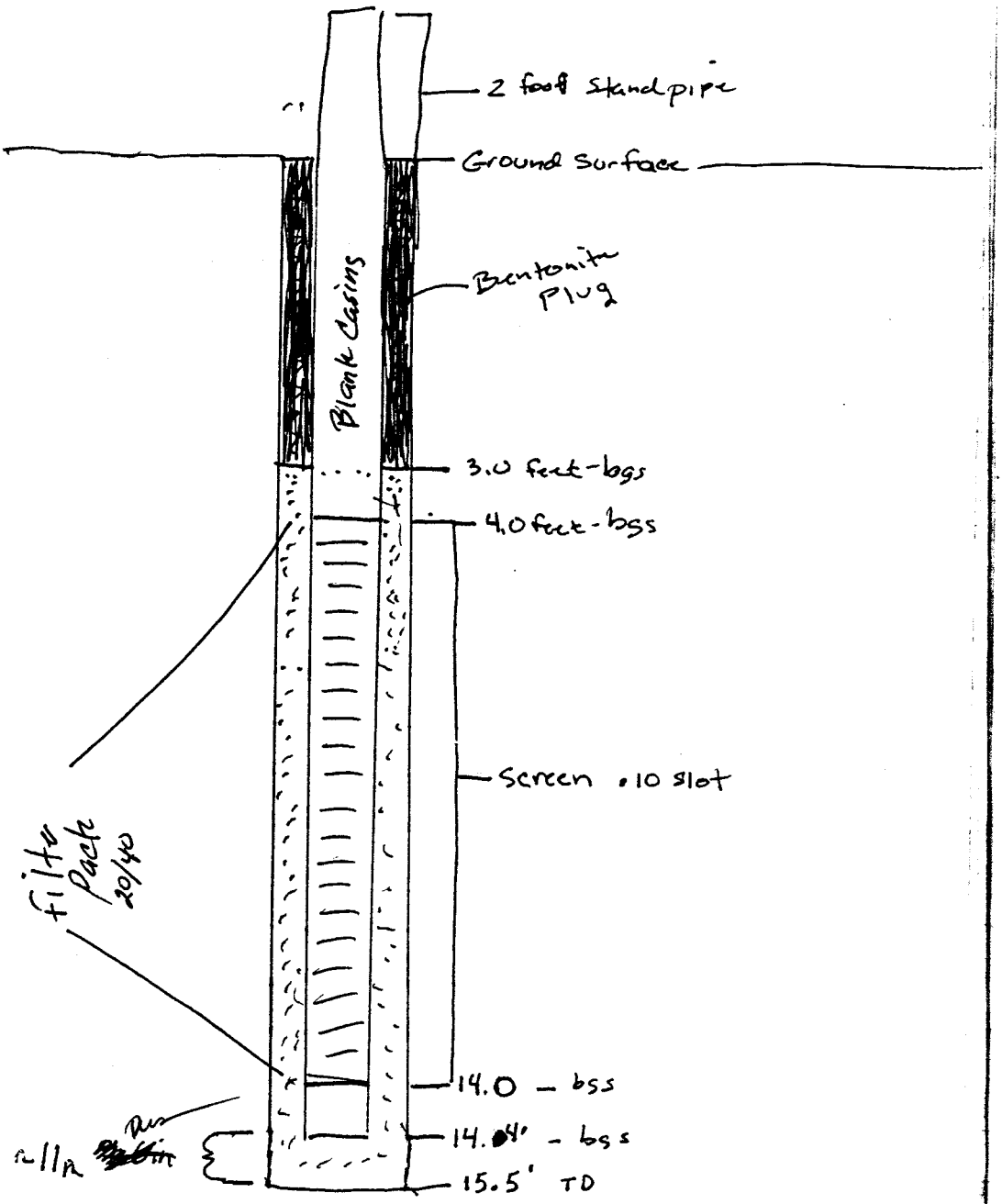
10:20 - TD on MW19(b) is 15.5

1100 - Screen and Casing set

Used 5 bags of 20/40 50lb sand
2 5 gal bucket of Bentonite 3/8" pellets

12:15 Setting up on MW18 Location
- Drilling the first 5' with continuos core
- 1st 1½ is Top soil
- Remainder is gravel/sand (50%)
- Water Table ~ 6.5'
- Continue drilling without core barrel.

Borehole MW19 (b) = ~~MW~~ MW19



Willow Creek

10-22-02

14:30 - MW18: TD 15.5
5 - 50 lb/ bag of 20/40 sand
3 - Bucket (5 gal) of 3/8" pellet

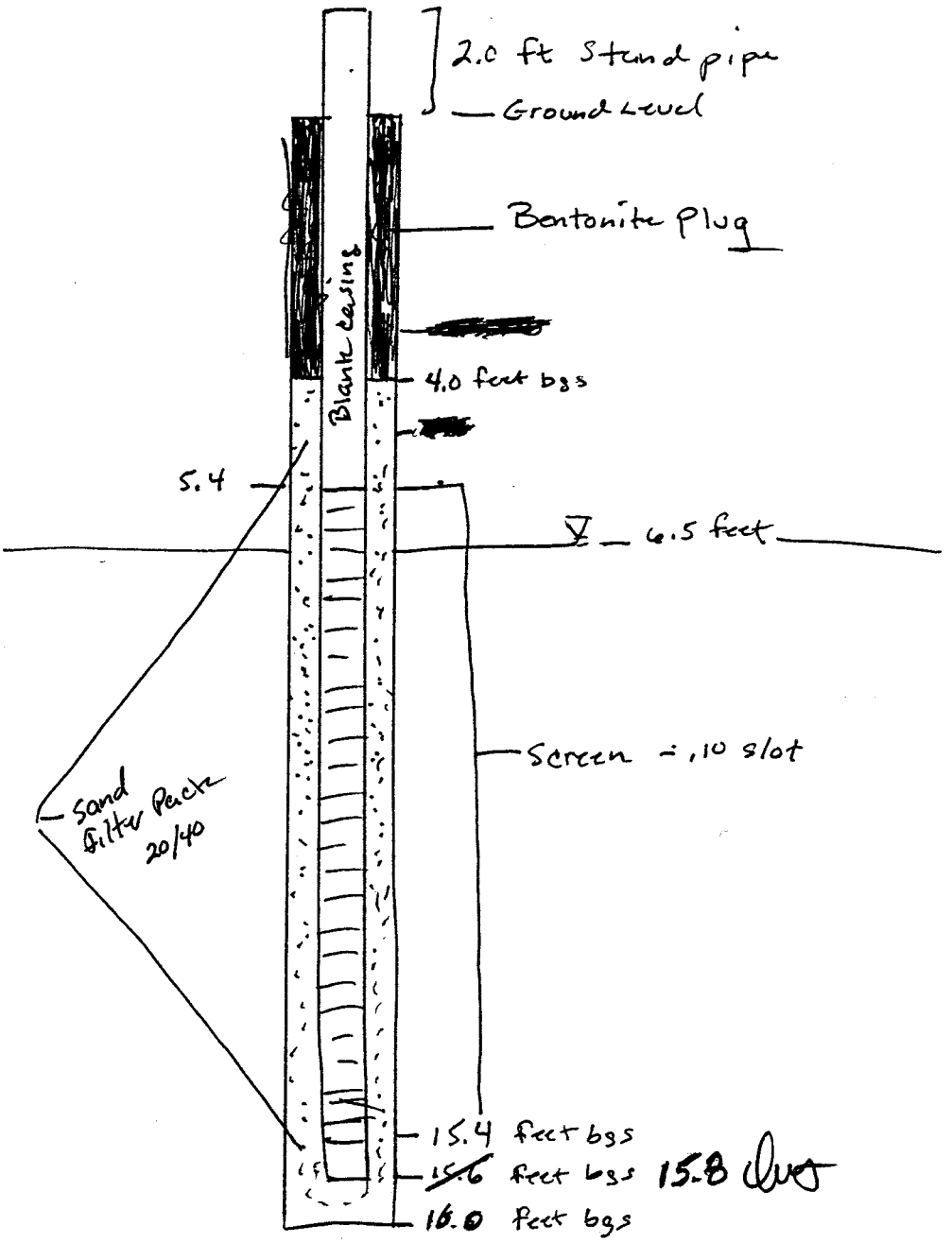
15:00 - Set up on MW17 Location

15:45 - First 5-feet Large Gravel up to 40mm in size, Below 5-feet, Gravel/sand (50%)
Water Table at 12.3 Feet bgs.

17:20 - TD on MW17 = ~~24~~ 23.4 feet bgs
USED 7.5 50lb bags of 20/40 sand
USED 4.0 Buckets of 3/8" Pellets
Well caved in above Filter Pack - Probably did not get a good seal, However a seal was placed above the cave in and should not impact the functionality of the well.

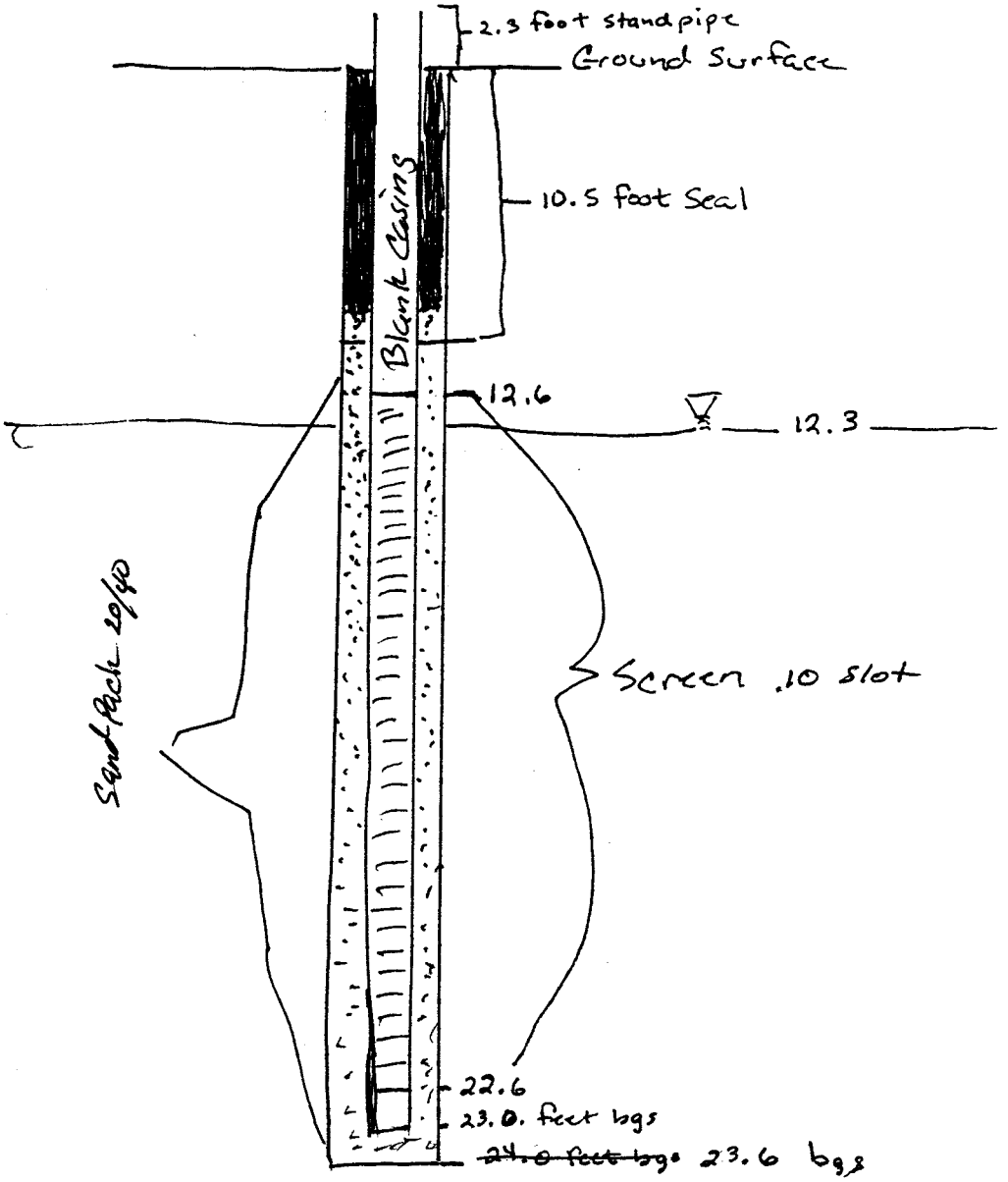
17:45 - Ended work day

MW-18


2.0 ft Stand pipe
Ground Level
Bentonite Plug
Blank casing
4.0 feet bgs
5.4
6.5 feet
Screen - .10 slot
Sand Filter Pack 20/40
15.4 feet bgs
15.6 feet bgs
15.8
16.0 feet bgs

Willow Creek

MW ~~19~~ DW 17 10-22-02



#1 Willow Creek 10-23-02

0800 Arrived at Location MW16, which is the borehole Location on the Tailing pile

Weather condition
- Calm, snowing & partly cloudy
Temp ~ 30°F

Sounded MW11 which is Located approximately 80 feet to the west, at the TOE of the Tailing Pile. water Level is 4.18 feet bgs From the MW11, The west pile is Approximated 6-7 feet to the TOP, from ground surface

First Soil Sample collect at ~5in below surface, just below the cap material The duplicate and ~~MW~~ CO-WC-~~SB16~~SB01-05 were collected at this depth.

Drilled 5 foot of Auger with Core barrel got 50% Recovery - all fine grained Tailing Light Brown - less than 1/10 mm in size CO-WC-~~SB16~~SB01-3 & Duplicate Pair

2nd 5 foot stem of Auger with Core barrel got ~50% Recovery - all fine grained Tailings Light Brown - less than 1/10 mm in size

CO-WC-~~SB16~~SB01-7

Willow creek 10-22-02

3rd Auger flight (15') got 100% recovery

10 - 10.2 feet Tail - same as before

10.2 - 14.4 Silty Clay Gray in color

14.4 - 15 - Native soil organic with Roots and ~~Greenish color spots~~ Red

Soil also had Greenish staining But mostly Black in color

Samples were collected at 10 & 15 feet

CO-WC-~~SB16~~ SB01 -10.

CO-WC-~~SB16~~ SB01 -15.

Placed Bentonite in the bottom of the Borehole to 9.8 feet below ground surface

15 feet to 9.8 feet Bgs

Placed borehole cutting (Tailing) back in borehole for 9.8 feet to 1.5 feet bgs

~~Placed grout from 1.5 feet bgs to surface~~

Placed lose gravel from 1.5 feet to the surface

GPS ~~15m~~ 5mete Accuracy

E 0331002, 4189710 N

10:30 - Borehole Abandoned - Refer to Drawing and Log

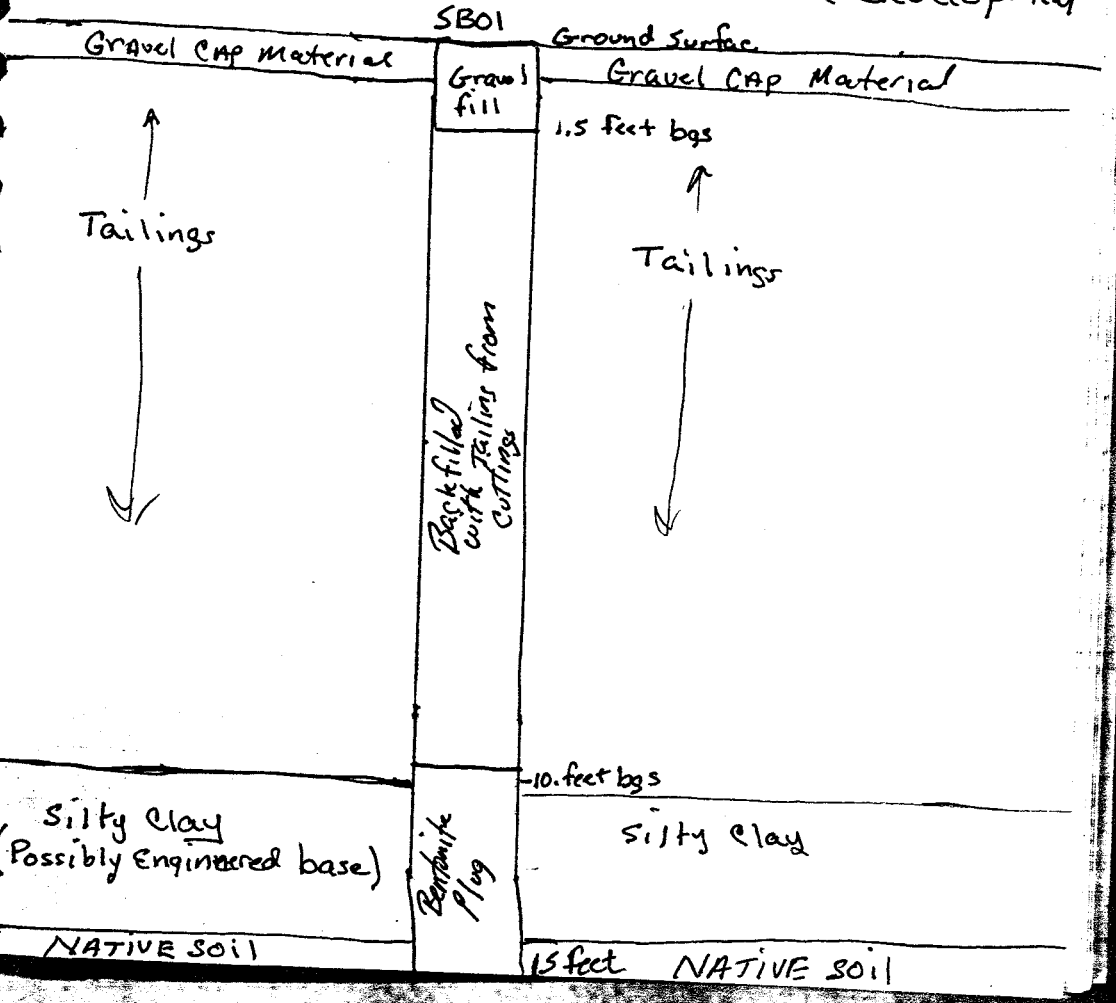
Willow Creek 10-25-02

Samplers are ~~Rapped~~ package. A total of 6 samples, including 1 duplicate are in one cooler, with ICE & Chain-of-Custody form.

Duplicate Sample From SB01 from 3 feet was submitted as CO-WC-SB01-20

14:00 - Dropped samples off at UPS
Tracking # 12 144 2W0 01 1002 0404

Refer to development Logs for Well development



Willow Creek 10-24-02

-0800: MW18 + MW17 are developed (refer to Development log) MW20 does not produce as well as 17 & 18 and has not cleaned up. This morning, we ~~took~~ will surge the well with Air pressure.
- MW19 will be developed today.
- We may drill an additional well - should find out the location this morning. If an additional well is drilled - it shall be called MW-16

-10:00 could not develop MW19 because there is a plug in the casing, keeping the pump from going down the well - Needs Jetting

MW20 was surged with Air + bailed with bailer, still has not cleaned up - will run a pump down later in the afternoon

- Setting up on MW16. Location is directly east of MW12-0 & 56 feet from the centerline of the RR Tracks on the east side

GPS Coordinates

UTM ZONE 13 - 5 meter Accuracy

Well/Boring	EAsting	Northing
MW16	330904	4189823
MW17	331464	4189073
MW18	331398	4189224
MW19	331150	4189336
MW20	331050	4189564
SB1	331002	4189710

MW16 = first 5 foot of Auger
- 1st foot Tailing
- ~~2~~ - 5 feet Gravel
- 2nd 5 foot Auger
~ 1st foot Thick Layer of Clay
6-10 feet gravel/sand (50%) water @ 7.7
3rd 5-foot Auger
10-15 feet Gravel/Sand (50%)
4th 5-foot Auger
~~15-20~~ 15-18 feet Gravel/Sand (50%)
TP ~ 18 feet
~ 1 foot of PAD
Screen bottom @ 17.8 bgs
Bottom of CAP ~~17.6~~ 17.4 feet bgs
Top of Screen ~ 7.0 feet bgs
Filter Pack at ~ 6 feet bgs
Seal from ~6 feet to 2 feet bgs
Bentonite gel to the Surface
12:20: MW16 Completed

2 foot Stand pipe

10-24-02

Willow Creek

1500 - finish developing MW20. IT cleaned up much Nicer After being surged with a baiter Never Pumped dry and the water cleared up. Refer to development log.

1505 - Started developing MW16
Water Depth 8.79
TD 19.3 from TOC

1610 Completed MW16 a TOTAL of 80 gallons of water Removed - still a little milky

16:30 - STARTED Developing MW19
Water Depth 7.70 below TOC
TD from TOC = 15.4

16:55 Completed Development
Water Cleared up
Pumped at a Total of 40 gallons

JOB DONE

1337 READING

PH	COND	°C
5.45	337	11.6

WATER STILL BECOMING LESS TURBID

1338 PUMPED 28 GAL

1339 READING - PUMP-OFF

PH	COND.	°C
5.43	334	10.1

1344 PUMP-ON

1345 READING

PH	COND.	°C
5.17	330	11.6

1347 PUMPED 33 GAL
WATER IS LIGHT TAN SEE-THROUGH

1349 READING

PH	COND.	°C
5.29	329	10.9

1350 PUMPED 38 GAL
1353 PUMPED 43 GAL

1353 READING

PH	COND	°C
5.26	330	10.6

1354 PUMP - OFF (5 MIN REST)

1358 PUMP - ON TURBIDITY STILL COMING DOWN

1400 READING

PH	COND.	°C
5.17	338	11.8

1401 PUMPED ≈ 48 GALS

1404 PUMPED = 53 GALS

1405 READING

PH	COND.	°C
5.30	333	10.6

1406 PUMP - OFF

PUMPED ≈ 56 GALLONS

MW-18

Meas. Conductivity in S/cm

1422 WL 8.05 TOC

TD 17.25 TOC

Cond. measured in MS/cm

1434

STARTED PUMP

VERY TURBID LT. BROWN

1436 READING

PH	COND	°C
5.38	2.23 S/cm	11.0

1436:30 PUMPED 5 GAL

1440:30 " 10 GAL

1441 READING

PH	COND.	°C
5.56	2.86	9.7

1443:30 PUMPED 15 GAL

1444 READING (PUMP REST)

PH	COND.	°C
558	291	9.8

1449 Pump-on

1450 WATER CLEARING - OPAQUE

1451 READING PUMPED 20 GAL

PH	COND.	°C
5.53	2.92	10.5

1551 READING PUMPED 25 GAL

PH	COND.	TEMP.
5.47	2.90	10.4

1552 WATER STILL CLEARING UP NICELY ≈ 50 NTU's

1554 READING PUMP-OFF (30GAL)

PH	COND	°C
5.61	2.94	9.6

MW20

WL 8.38 TOC
TD 18.85 TOC
Meas. cond. in mS/cm

1518 STARTED PUMP

WATER IS TURBID LT BROWN

1520 WATER IS VERY TURBID BROWN
pH 5.20 Cond ~~5.20~~ 5.20 Temp 11.4°C

Turned Pump off 1521
Turned Pump on 1531
Ran for a 1 min 30 sec.
Pumped 5 gal, Stopped at 1532½
ph 5.15 cond. 4.11 Temp. 11.3°C

Turned Pump on 1541 off at 1542
ph: 5.50 cond: 1811 mS/cm Temp 10.C
Pumped 3 gls.
Turned Pump on @ 1546 off at 1546½
Pumped 1 gallon
Turned pump on 1548 Off after 30sec
ph: 5.19 Cond: 4.03 mS/cm Temp 11.0°C

Start pump take sample at 1601
2 gallon.
ph: 5.11 cond: 4.09 mS/cm temp: 10.9°C

Start pump at 1620 for 2. ~~30~~ min 20 sec.

ph: 4.50 cond. 4.10 mS/cm temp: 10.9°C

MW-19 10-24-02

Water Level = 7.70 below TOC

Tagged the bottom at 15.4 bel0 TOC

HAD MUD at the Bottom

10-24-02

MW 19

take sample at 1601

gallon

cond: 4.09 mS/cm temp: 10.9°C

at 1620 for 2 min 20 sec.

cond. 4.10 mS/cm temp: 10.9°C

Time	pH	Cond. (mS/cm)	Temp	Color	Gallons pumped
1630	4.14	1400	11.7	Brown	1
	4.09	1480	12.2	Brown	10
16:40	4.02	1440	11.6	Milky	20
	STOPPED PUMP				
16:45	STARTED PUMP				
	4.03	1480	11.8	Milky	30
16:55	4.02	1480	11.7	Clear	40

STOPPED PUMP

MW-19 10-24-02

evel = 7.70 below TOC

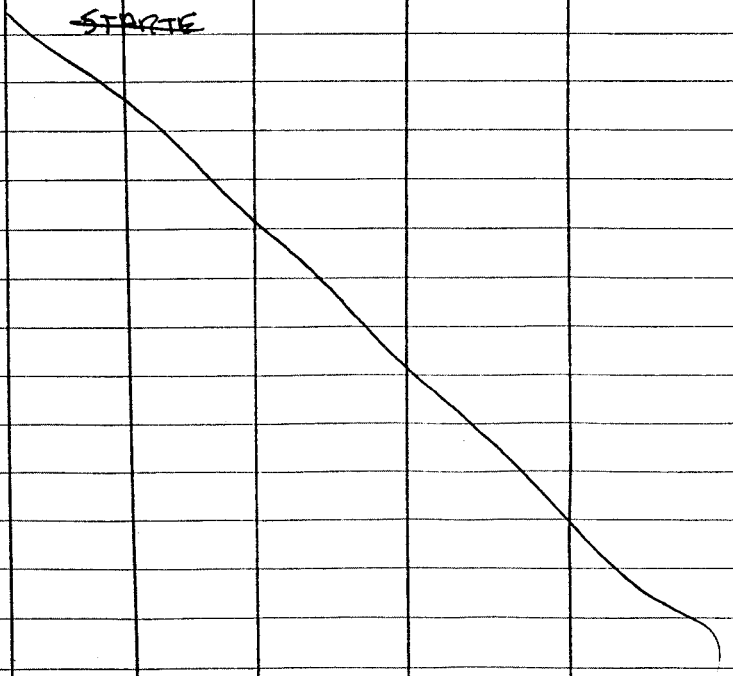
e bottom at 15.4 belo TOC

at the Bottom

10-24-02

MW 20

Time	pH	Cond. us/cm	Temp C°	color	Gallons
14:10	5.22	NM	9.9	Brown	1
	5.00	4880	10.4	milky	15
14:20		Stopped pump			
14:25	4.94	4850	10.2	Milky	20
	4.83	4990	9.9	Milky	30
	4.71	4950	10.1	Clear	40
14:35		STOPPED Pump			
1440	~~4.66~~	STArted Pump		Clear	~~45~~
	4.66	4840	8.8	Clear	45
	4.62	4842	9.9	Clear	60
1450		STOPPED PUMP			
		~~STARTE~~			



10-24-02

MW16

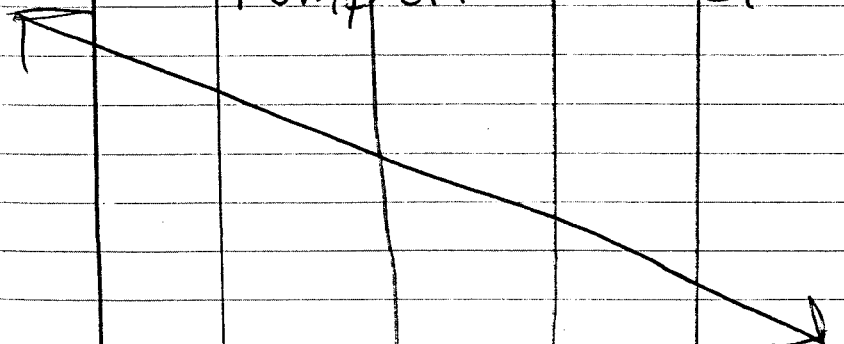
water Depth 8.79 TD ~~18~~ 19.3 from TOC

Time	pH	Cond µs/cm	Temp °C	Color	Gallons
1515		START Pump			
1515	4.15	5380	11.1	Brown	1
	4.06	5810	10.9	Brown	10
	4.03	5880	10.7	Light Brown	20
15:25	STOPPED PUMP				
15:30	STARTED PUMP				
	4.06	5830	10.3	LightBrown	30
	4.06	5900	10.1	Milky	40
15:40	STOPPED Pump				
15,45	START PUMP				
	4.01	5630	10.1	Milky	50
	4.02	5500	9.9	Milky	60
15:50	STOPPED PUMP			*	
16:00	STARTED PUMP				
	3.96	5250	10.0	Milky	70
	4.02	5450	9.9	Milky	80
16:10	STOPPED Pump				

10-23-02

MW 17 — water Level 12.72 TOC, TD 24.95 TOC

Time	pH	Cond µs/cm	Temp °C	Color	Gallons
1314	STARTED PUMP				
1314				Brown	∅
1324	5.04	350	12.5	Brown	12
	PUMP OFF				
1329	STARTED PUMP			Brown	
	5.33	336	11.3	Lt Brown	18
	5.45	337	11.0	Lt Brown	23
	5.43	334	10.1	"	28
1339	PUMP OFF				
1344	STARTED Pump				
	5.17	330	11.6	"	33
	5.29	329	10.9	"	38
	5.24	330	10.6	"	43
1354	PUMP OFF				
1358	START PUMP				
	5.17	338	11.8	Milky	48
	5.30	333	10.6	Milky	
		PUMP OFF			56



10-23-02

MW-18

Water Level 8.05 TOC

TD 17.25 TOC

Time	pH	Cond ~~(mS/cm)~~ µS/cm	Temp	Color	Gallons
1434		STARTED Pump		Brown	∅
	5.38	2.23	11.0	11	5
	5.56	2.86	9.7	11	10
	5.58	2.91	9.8	11	15
1444		Pump off			
1449		STARTED Pump			
~~1454~~	5.53	2.92	10.5	LT Brown	20
~~1454~~	5.47	2.90	10.4	milky	25
~~1554~~	5.61	2.94	9.4	milky	30
		Pump off			

Colville Rivers
Willow Creek

11/17/02

1200 Arrived on site at monitoring well MW-17. Personnel include Rick Grabowski & Brian Jordan, USACE.

W.L. = 13.24' from TOC.

Equipment: geopump 2 peristaltic pump tubing – Silicone entire length
pH, temperature, conductivity probes manufactured by WTW (formerly ORION) with multi-line PH meter
Solinst W.L. meter

Tubing inserted to approximately the mid-point of the submerged screened intervals

1228 Began purging well.

1314 Obtained samples CO-WC-MW17 for dissolved metals, total metals and alkalinity/Chloride/Sulfate

1317 End sampling
Total Metals 1 500ml poly, HNO_3, 4°C

2 Colorado RAMS
Willow Creek 11/17/02

Dissolved Metals, 1 500-ml poly, 4°C.
Alkalinity, Chloride, Sulfate, 1 500-ml poly, 4°C.

Final Readings:

Temp 10.2°C
pH 5.33
Sp. Cond. 380 µS/cm
Turb 2.9
Gallons Removed 6.5

Note that dissolved metals were not filtered in the field. All dissolved metals samples must be filtered and preserved upon receipt at the lab.

1348 Arrived at monitoring well MW 17.
W.L. = 8.07' from TOC.
1355 Began purging well.

ado RAMS 11/17/02
ow Creek

ssolved Metals, 1 500-ml poly
°C.
kalinity, Chloride, Sulfate, 1 500-ml
ly, 4°C.

nal Readings:

mp 10.2°C
H .33
. Cond. 385 ms/cm
ub 2.9
allons Removed 65

ote that dissolved metals were
ot filted in the field. All
issolved metals samples
ust be filted and preserved
pon receipt at the lab.

Arrived at monitoring well MW 18.
W.L. = 8.07' from TOC.
Began purging well.

Colorado RAMS 11/17/02
Walton Creek

1442 Obtained sample CO-WC-MW18;
1 500-ml poly, total metals, HNO_3; 4°C
1 500-ml poly, dissolved metals, 4°C
1 500-ml poly, alkalinity/chloride/sulfate, 4°C

Final Readings:
Temp. 8.6°C
pH 5.06
Sp. Cond. 3.24 ms/cm
Turb. 10
Gallons Removed 7

1458 Arrived at Monitoring well MW 19.
W.L = 7.69' from TOC.
1510 Began Purging well.
1541 Obtained Sample CO-WC-MW19;
1 500ml poly, total metals, HNO_3; 4°C.
1 500 ml poly dissolved metals, 4°C
1 500 ml poly, alk/Sulf/Chlor, 4°C

4 Colorado RAMS 11-17-02
Willow Creek

Final Readings:

Temp: 10.8
pH: 3.93
Sp. Cond: 1116 MS/cm
Turb: 8
Gallons Removed: 5.5

11/17/02

rado RANS 11-17-02
ow Creek

inal Readings:

up: 10.8
H: 3.93
p. Cond: 1116 MS/cm
urb: 8
allow Removed: 5.5

11/17/02

? 27

Colorado RANS 11-17-02 5
Willow Creek

0800 Arrived on site at monitoring well MW20. Personnel include Rich Grabowski, and Brian Worden, USACE. Weather is sunny, cold (20s), with a slight breeze.

WL = 7.27' from TOC.

Same equipment and procedures as documented yesterday.

0838 Began purging well.
0910 Obtained samples CO-WC-MW20 (field sample) and CO-WC-MW21 duplicate.
Total Metals: 2 500-ml polys, HNO_3, 4°C
Dissolved Metals: 2 500-ml polys, 4°C
Nitr/Chlor/Sulfate: 2 500-ml polys, 4°C
NRS collected split samples for the Willow Creek Reclamation Committee for metals, carbon/anion and DOC (dissolved organic carbon).

6 Colorado RAMS 11-18-02
Willow Creek

Final Readings:

Temp: 9.3°C
pH: 4.22
Sp. Cond: 4.23 mS/cm
Turb: 15
Gal. Removed: 6

0942 Arrived at monitoring well MW16. W.L. = 8.96' from TOC.

0949 Began purging.
1022 Obtained Sample Co-WC-MW16; total metals, HNO_3 4°C; dissolved metals, 4°C; Alk/Chlor/Sul, 4°C. 1 500-ml poly each.

Final Readings:

pH: 2.97
Temp: 10.3°C
Sp. Cond: 4.38 mS/cm
Turb: 7
Gal. Removed: 6

do RAMS 11-18-02
w Creek

al Readings:

p: 9.3°C
: 4.22
Cond: 4.23 ms/cm
b-: 15
Removed: 6

Arrived at monitoring well
MW, W.L. = 8.96' from TOC.

egan purging.
btained Sample CC-WC-MW16;
O metals, HNO_3, 4°C; dissolved
tals, 4°C; HCl/Chlor/Std, 4°C.
500-ml poly each.

nal Readings:

: 2.97
p: 10.3°C
Cond: 4.38 ms/cm
ub: 7
l. Removed: 6

Colorado RAMS 11-18-02
Willow Creek

Note: Also collected split samples for the Reclamation Committee - Metals, Cations/Anions, and DOC.