

APPENDIX B
DRILLING PHOTOGRAPHS AND PHOTOGRAPH LOG



Technical Memorandum

To:	Toby Wright	From:	Jason Andrews, P.E.
Company:	Wright Environmental Services, Inc.	Date:	January 26, 2012
EA No.:	110231		
Re:	RAP 15.2.3 – Cotter Corporation, Lincoln Park Drilling, Well Installation, and Well Development		
CC:			

1.0 INTRODUCTION

Engineering Analytics, Inc. (EA) supervised the drilling, installation, and development of 11 monitoring wells in the Lincoln Park area as part of RAP 15.2.3 for the Cotter Corporation in Cañon City, Colorado. Cotter will collect water samples periodically to monitor water quality at the well locations.

2.0 DRILLING

Drilling services were provided by Site Services from Golden, Colorado. Drilling was performed between November 28, 2011 and December 30, 2011. Twelve borings were drilled to depths between 12.5 feet and 125 feet at the approximate locations shown on Figure 1. The borings were advanced to bedrock with a CME 75 drill rig or 15 feet below the groundwater depth encountered during drilling. However, borings LP-06 and LP-07 were not advanced to bedrock. Boring LP-06 was advanced to a depth of 125 feet and no bedrock was encountered. Due to cobbles, boring LP-07 was not able to be advanced beyond a depth of 35 feet and was relocated to LP-07A (Figure 1). Where possible, continuous core samples were collected with a continuous core barrel inside the 8 inch augers. Split spoon samples were also collected at selected depths to confirm the presence of bedrock. EA logged the soil profile during drilling, generally following ASTM D 2488, "Description and Identification of Soils (Visual-Manual Procedure)." Once core sampling and drilling was completed with the 8 inch hollow stem augers, the drillers reamed the borings with 10 inch hollow stem augers. All cuttings generated during drilling were placed in metal drums and taken to the Cotter Mill for disposal. The augers were decontaminated between holes using a steam cleaner. Steam cleaning of the augers was done at Cotter Mill site. Boring logs and core photos are shown in Appendix A. Drilling photos with a photo log are provided in Appendix B.

3.0 WELL INSTALLATION

Eleven wells were installed to depths between 9 feet and 100 feet, and in accordance with Colorado State Well Construction Rules (2 CCR 402-2). The well casing consisted of 4 inch diameter PVC pipe with 0.020 inch machine slotted screens. EA and Site Services backfilled the boreholes around the outside of the casing using 10/20 silica sand, bentonite pellets and/or chips, and a Portland cement grout with approximately 3% bentonite for a surface seal. A concrete pad was placed to protect the well-head from surface infiltration. All the wells had locking metal risers to cover the well casing above the ground surface for protection of the casing, except well LP-03, which was mounted flush with the ground surface. Well installation details are shown in Table 1 and on the boring logs in Appendix A.

All the wells except LP-06 and LP-07 were installed to bedrock. After discussions with Site Services about equipment limitations and Errol Lawrence for groundwater data needs, it was determined that the well LP-06 could be placed to a depth of 100 feet, without having reached bedrock at 125 feet. As requested by Errol Lawrence from Hydrosolutions, a well was installed at LP-06 to a depth of 100 feet. A separate boring was drilled about 12 feet from LP-06 and a well installed to a depth of 50 feet (LP-06A). The two wells were installed to monitor the upper portion and lower portion of the groundwater separately. EA and Site Services did not install a well at LP-07 due to auger refusal in the large cobbles. This well was moved to the southern portion of the property and re-named LP-07A.

The only deviation from Lincoln Park Monitoring Well Installation Plan (Hydrosolutions, 8/23/2011) was for well LP-05. Only one foot of sand was placed above the screen and the seal was 3 feet thick. The bentonite seal and sand pack were less than the prescribed thicknesses of 5 and 2 feet above the top of the screen, respectively, due to the shallow depth to the top of the screen.

4.0 WELL DEVELOPMENT

The wells were developed by Engineering Analytics and Site Services between January 3rd and January 6, 2012. Well development was completed by a combination of bailing, pumping and surging, until the water flowed clear, per the recommendation by Wright Environmental Services, Inc. Bailing was performed with either a large bailer 3' x 3.5" or a small bailer 2' x 2" to protect the pump from becoming clogged with sediment. Pumping was performed with a Geotech SS Geosub pump. Actual development pumping rates were approximately 0.9 gpm. The pumping rate was approximated based on the average flow rates measured during development of LP-04, LP-06, LP-08, and LP-10. The wells were pumped until the water was visibly clear. After the first pumping the wells were swabbed and surged to agitate sediment that had collected on the inside of the casing and sand pack that could then be pumped out of the well. The well was pumped again after surging until the water ran clear. Well LP-09 contained only 2 feet of water at the time of development and was bailed dry. Well development details are provided in Table 2. All well development water was collected in a plastic tank, hauled to the Cotter Mill, and disposed of in the primary impoundment at Cotter Mill.

Table 1 Well Completion Data

Well ID	Northing ¹	Easting ¹	Ground Elevation ³ (ft.)	Total Boring Depth (ft) ³	Water Level During Drilling (ft) ³	Bottom of Well (ft) ³	Well Material ⁴	Inside Diameter (In.)	TOC Elevation ³ (ft.)	Screen Length (ft)	Top of Screen ² (ft.)	Bottom of Sand Filter ⁵ (ft.)	Top of Sand Filter ⁵ (ft.)	Top of Bentonite Seal ¹ (ft.)
LP-01	1215515.46	3080549.62	5404.42	49	29	45.5	PVC	4	5406.11	20	5379.42	5355.92	5382.42	5399.92
LP-02	1212661.29	3084676.49	5385.70	34.5	25.5	34.5	PVC	4	5387.71	20	5371.2	5351.2	5373.2	5381.2
LP-03	1217159.11	3082459.93	5359.15	60	24	60	PVC	4	5358.77	45	5344.15	5299.15	5346.15	5355.15
LP-04	1216603.06	3085237.56	5345.22	51	26	49	PVC	4	5347.30	30	5326.22	5294.22	5328.22	5340.72
LP-05	1214788.16	3088593.27	5283.04	12.5	5.75	9	PVC	4	5284.83	5	5279.04	5270.54	5280.04	5283.04
LP-06	1214269.50	3083156.22	5383.75	125	39	100	PVC	4	5385.36	20	5303.75	5258.75	5310.25	5379.25
LP-06A	1214270.31	3083143.84	5383.59	50	35	49	PVC	4	5385.38	20	5384.59	5333.59	5356.59	5377.59
LP-07	-	-	-	35	23	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
LP-07A	1215844.60	3084818.40	5343.34	47	21.5	47	PVC	4	5345.04	30	5326.34	5296.34	5329.34	5338.84
LP-08	1215607.72	3082374.23	5385.66	89	45	89	PVC	4	5387.68	50	5346.66	5296.16	5348.66	5381.16
LP-09	1211461.62	3083703.22	5425.97	44	None	44	PVC	4	5428.04	20	5401.97	5381.97	5403.97	5421.97
LP-10	1215289.26	3085752.83	5341.38	60	25	59	PVC	4	5343.83	40	5322.38	5281.38	5324.38	5336.88

Notes: ¹ NAD 83 Colorado State Plane, Central

² Above Mean Sea Level

³ Below ground surface

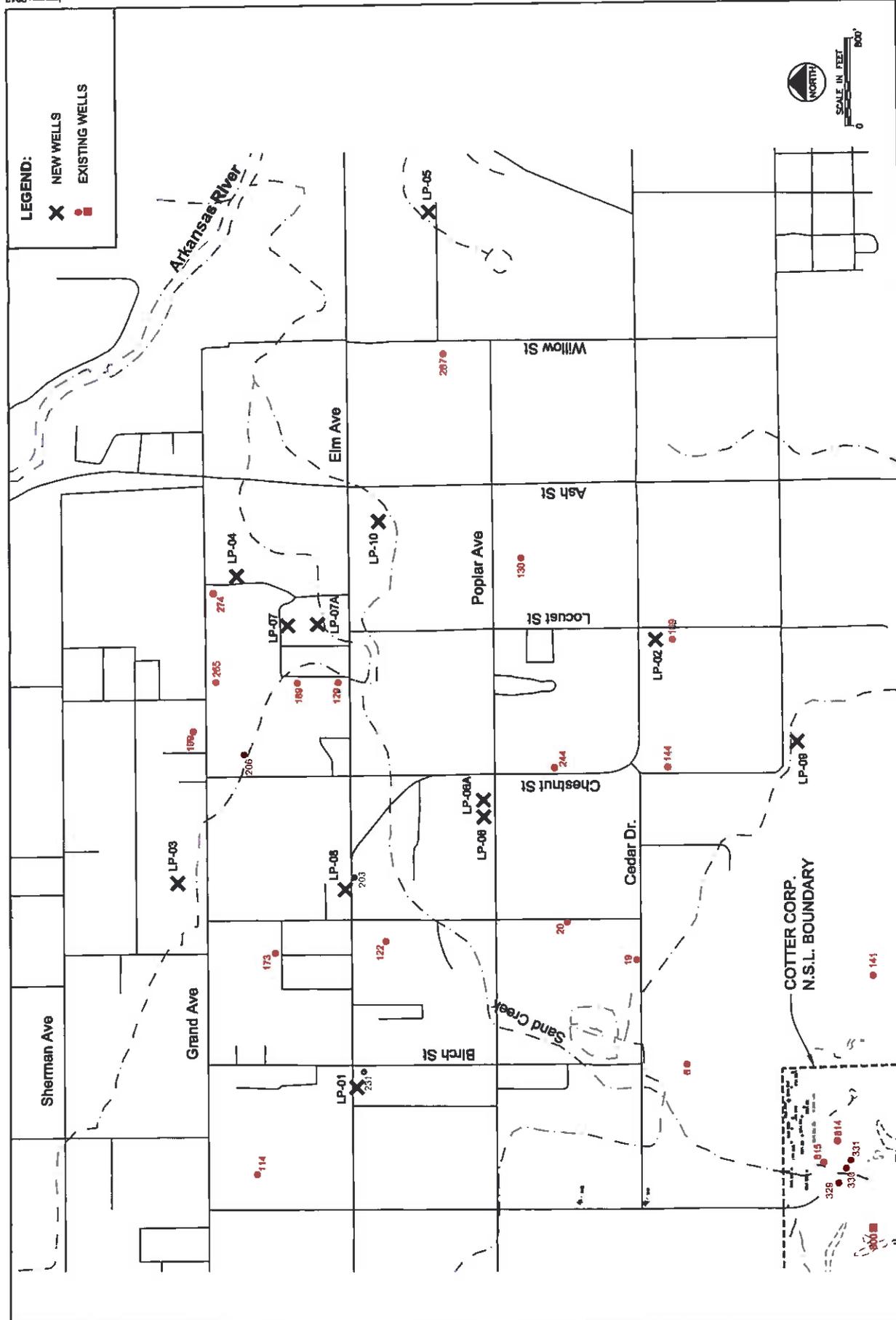
⁴ Threaded schedule 40PVC casing

⁵ Flush mount

Table 2 Well Development Data

Well ID	Water Level Just Prior to Development (ft)	Water Level Just After Development (ft)	Water Level 1 day After Development (ft)	Approximate Amount of Water Bailed (gallons)	Duration of Pumping (minutes)	Approximate Amount of Water Pumped (gallons)
LP-01	30.4	38.4	30.4	-	39	34 ¹
LP-02	26.2	26.2	26.2	-	75	66 ¹
LP-03	22.7	22.6	22.6	-	77	68 ¹
LP-04	24.4	43.0	24.2	-	71	37.5
LP-05	4.9	4.9	4.6	-	25	22 ¹
LP-06	38.9	53.3	39.6	-	158	125
LP-06A	38.2	-	40.0	15	85	75 ¹
LP-07A	20.0	-	20.3	16	90	79 ¹
LP-08	46.6	47.6	-	-	148	150
LP-09	42.0	-	43.5	0.3	Not Pumped	-
LP-10	29.0	-	26.6	-	121	90-100

Note: ¹ Amount of water pumped was approximated based on the average flow rate (gallons per minute) from LP-04, LP-06, LP-08, and LP-10.



Photograph Log

Photos taken by Michaela Varnier, Zach Fox, and Tim Fry.

Photo #	Date Taken	Description
DSC02694	12/30/11	Well LP-10 After pad completion
DSC02695	12/30/11	Well LP-05 After pad completion
DSC02723	01/03/12	Well LP-09 After pad completion
DSC02724	01/03/12	Well LP-09 After pad completion
DSC02725	01/03/12	Well LP-09 After pad completion
DSC02726	01/03/12	Well LP-09 After pad completion
DSC02727	01/03/12	Well LP-06A during well development, facing west
DSC02728	01/03/12	500 Gallon water tank used in development
DSC02729	01/03/12	Well LP-06A during well development, facing north
DSC02730	01/03/12	Well LP-06A during well development, facing northeast
DSC02731	01/03/12	Well LP-06A during well development, facing northeast
DSC02732	01/03/12	Well LP-06A during well development, facing west
DSC02733	01/03/12	Wells LP-06A and LP-06 after development, facing southwest
DSC02734	01/03/12	Wells LP-06A and LP-06 after development, facing southwest
DSC02735	01/03/12	Area around wells LP-06A and LP-06 after field work, facing north
DSC02736	01/03/12	Area around wells LP-06A and LP-06 after field work, facing northwest
DSC02737	01/03/12	Area around wells LP-06A and LP-06 after field work, facing west
DSC02738	01/03/12	Area around wells LP-06A and LP-06 after field work, facing north
DSC02739	01/03/12	Area around wells LP-06A and LP-06 after field work, facing northeast
DSC02740	01/03/12	Area around wells LP-06A and LP-06 after field work, facing northeast
DSC02741	01/03/12	Well LP-07A during well development, facing north
DSC02742	01/03/12	Well LP-07A during well development, facing northeast
DSC02743	01/03/12	Well LP-07A during well development, facing northeast
DSC02744	01/03/12	Well LP-07A during well development, facing north
DSC02745	01/03/12	Well LP-07A during well development, facing north
DSC02746	01/04/12	Well LP-10 during well development, facing southwest
DSC02747	01/04/12	Well LP-10 during well development, facing southwest
DSC02748	01/04/12	Well LP-10 during well development, facing southwest
DSC02749	01/04/12	Well LP-10 during well development, facing southwest
DSC02750	01/04/12	Well LP-10 during well development, facing southwest
DSC02751	01/04/12	Well LP-10 during well development, facing southwest
DSC02752	01/04/12	Area Around well LP-10 during well development, facing west
DSC02753	01/04/12	Well LP-10 during well development, facing southwest
DSC02754	01/04/12	Well LP-10 during well development, facing southwest
DSC02755	01/04/12	Well LP-10 after completion of field activities, facing southwest
DSC02756	01/04/12	Well LP-10 after completion of field activities, facing north
DSC02757	01/04/12	Well LP-10 after completion of field activities, facing south
DSC02758	01/04/12	Well LP-10 after completion of field activities, facing southwest

DSC02759	01/04/12	Well LP-02 during well development, facing south
DSC02760	01/04/12	Well LP-02 during well development, facing south
DSC02761	01/04/12	Well LP-02 during well development, facing southeast
DSC02762	01/04/12	500 gallon water tank during well development of LP-02
DSC02763	01/04/12	Well LP-02 during well development, facing southeast
DSC02764	01/04/12	Well LP-02 after completion of field activities, facing south
DSC02765	01/04/12	Well LP-02 after completion of field activities, facing southwest
DSC02766	01/04/12	Well LP-02 after completion of field activities, facing west
DSC02767	01/04/12	Area around well LP-02 after completion of field activities, facing west
DSC02768	01/04/12	Area around well LP-02 after completion of field activities, facing north
DSC02769	01/04/12	Well LP-02 after completion of field activities, facing east
DSC02770	01/04/12	Area around well LP-02 after completion of field activities
DSC02771	01/04/12	Area around well LP-02 after completion of field activities
DSC02772	01/04/12	Well LP-07A after completion of field activities, facing east
DSC02773	01/04/12	Well LP-07A after completion of field activities, facing west
DSC02774	01/04/12	Well LP-05 during well development, facing north
DSC02775	01/04/12	Well LP-05 during well development, facing northwest
DSC02776	01/04/12	Well LP-05 after completion of field activities, facing northeast
DSC02777	01/04/12	Well LP-05 after completion of field activities, facing northeast
DSC02778	01/04/12	Well LP-05 after completion of field activities, facing southwest
DSC02779	01/04/12	Well LP-05 after completion of field activities, facing southwest
DSC02780	01/04/12	Area around wells LP-06 and LP-06A after completion of field activities, facing north
DSC02781	01/04/12	Area around wells LP-06 and LP-06A after completion of field activities, facing north
DSC02782	01/04/12	Well LP-06 during pad completion, facing northeast
DSC02783	01/04/12	Area around wells LP-06 and LP-06A after completion of field activities, facing north
DSC02784	01/04/12	Well LP-06 during pad completion, facing northeast
DSC02785	01/04/12	Well LP-03 during well development, facing southwest
DSC02786	01/04/12	Well LP-03 during well development, facing southeast
DSC02787	01/04/12	Well LP-03 during well development, facing southeast
DSC02788	01/04/12	Well LP-03 after well development
DSC02789	01/04/12	Well LP-03 after completion of field activities, facing west
DSC02790	01/04/12	Area around well LP-03 after completion of field activities, facing southwest
DSC02791	01/04/12	Well LP-03 after completion of field activities, facing north
DSC02792	01/04/12	Area around well LP-03 after completion of field activities, facing northeast
DSC02793	01/05/12	Well LP-06 during well development, facing north
DSC02794	01/05/12	Well LP-06 during well development, facing north
DSC02795	01/05/12	Well LP-06 during well development, facing north
DSC02796	01/05/12	Well LP-06 after well development, facing north
DSC02797	01/05/12	Area around well LP-06 after well development, facing north
DSC02798	01/05/12	Area around wells LP-06 and LP-06A after well development, facing

		northeast
DSC02799	01/05/12	Area around well LP-06A after completion of field activities, facing northeast
DSC02800	01/05/12	Well LP-04 after completion of field activities, facing east
DSC02801	01/05/12	Well LP-04 after completion of field activities, facing west
DSC02802	01/05/12	Area around well LP-04 after completion of field activities, facing west
DSC02803	01/05/12	Well LP-04 after completion of field activities, facing west
DSC02804	01/05/12	Well LP-01 during well development
DSC02805	01/05/12	Well LP-01 during well development
DSC02806	01/05/12	Well LP-01 during well development
DSC02807	01/05/12	Well LP-01 during well development
DSC02808	01/05/12	Well LP-01 during well development
DSC02809	01/05/12	Well LP-01 during well development
DSC02810	01/05/12	Well LP-01 after well development
DSC02811	01/05/12	Well LP-01 after well development
DSC02812	01/05/12	Well LP-01 after well development
DSC02813	01/06/12	Well LP-08 during well development, facing southwest
DSC02814	01/06/12	Well LP-08 during well development, facing south
DSC02815	01/06/12	Well LP-08 during well development, facing northwest
DSC02816	01/06/12	Well LP-08 during well development, facing west
DSC02817	01/06/12	Well LP-08 after well development, facing southeast
DSC02818	01/06/12	Well LP-08 after well development, facing southwest
DSC02819	01/06/12	Wells LP-06 and LP-06A after completion of field activities, facing northeast
DSC02820	01/06/12	Wells LP-06 and LP-06A after completion of field activities, facing northeast
P1190217	12/19/11	Well LP-07A before drilling, facing east
P1190218	12/19/11	Well LP-07A before drilling, facing southeast
P1190219	12/19/11	Well LP-07A before drilling, facing east
P1190234	12/19/11	Well LP-07A during drilling, facing east
P1190235	12/19/11	Well LP-07A during drilling, facing east
P1190236	12/19/11	Well LP-07A during drilling, facing east
P1190237	12/20/11	Well LP-04 before drilling, facing west
P1190238	12/20/11	Well LP-04 before drilling, facing northeast
P1190239	12/20/11	Well LP-04 during drilling, facing west
P1190249	12/20/11	Well LP-04 after drilling, facing west
P1190250	12/21/11	Well LP-06A during drilling, facing west
P1190251	12/21/11	Well LP-06A during drilling, facing east
P1190252	12/21/11	Well LP-06A during drilling, facing east
P1190253	12/21/11	Well LP-06A during drilling, facing north
P1190254	12/21/11	Well LP-06A during drilling, facing west
P1190255	12/22/11	Well LP-03 before drilling, facing southwest
P1190256	12/22/11	Well LP-03 before drilling, facing west
P1190257	12/22/11	Well LP-03 before drilling, facing southeast
P1190258	12/22/11	Well LP-03 during drilling, facing southwest



DSC02694



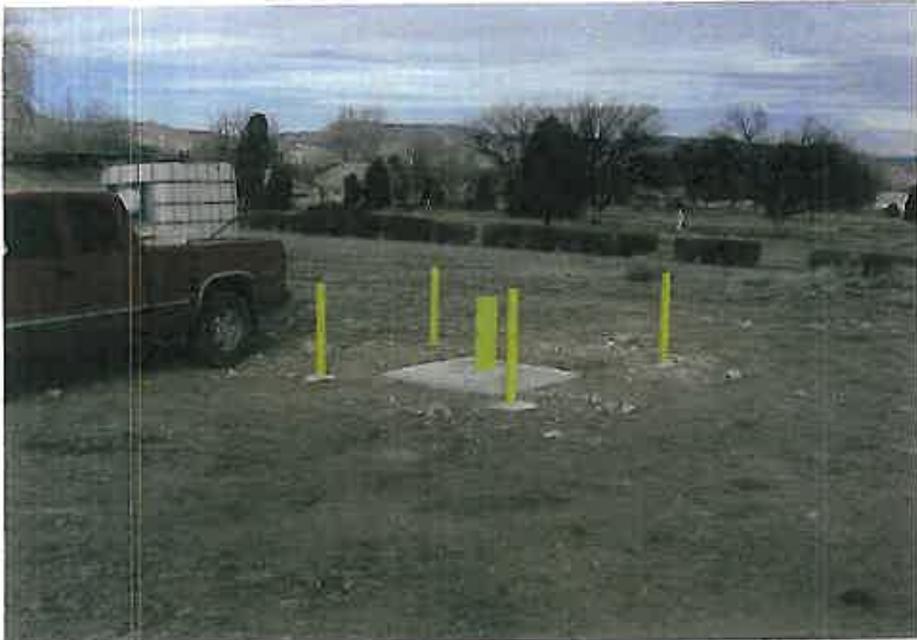
DSC02695



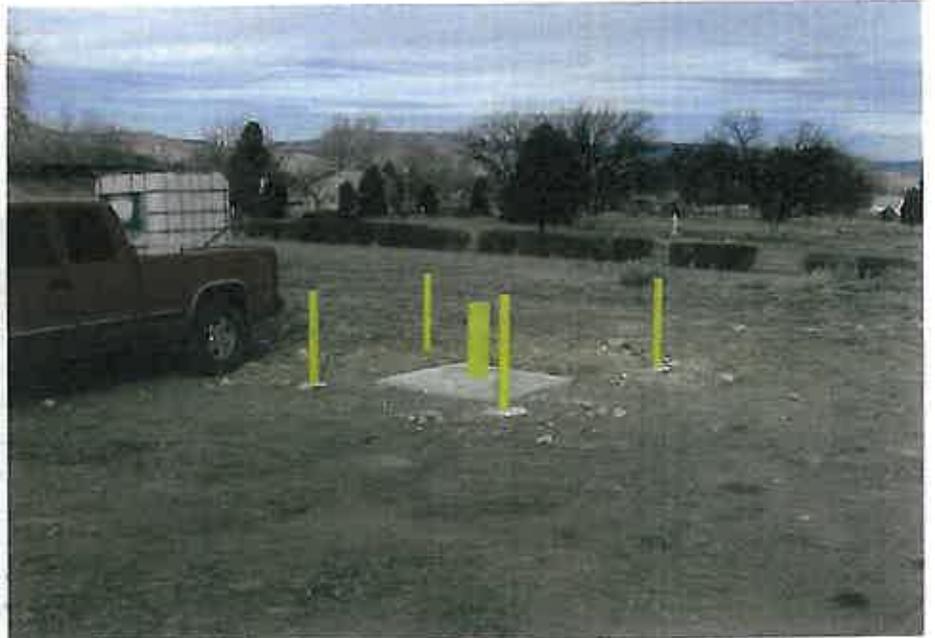
DSC02723



DSC02724



DSC02725



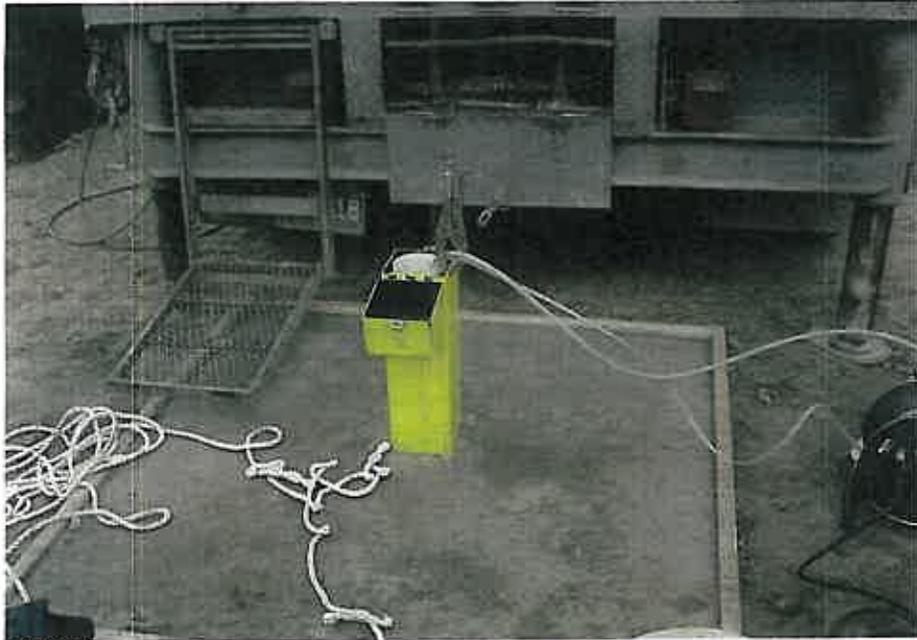
DSC02726



DSC02727



DSC02728



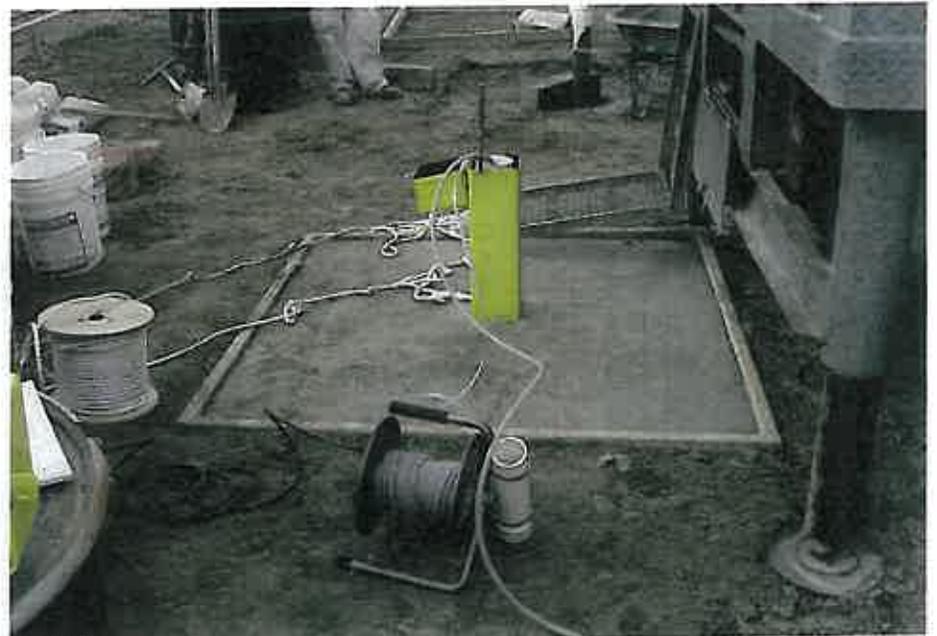
DSC02729



DSC02730



DSC02731



DSC02732



DSC02733



DSC02734



DSC02735



DSC02736



DSC02737



DSC02738



DSC02739



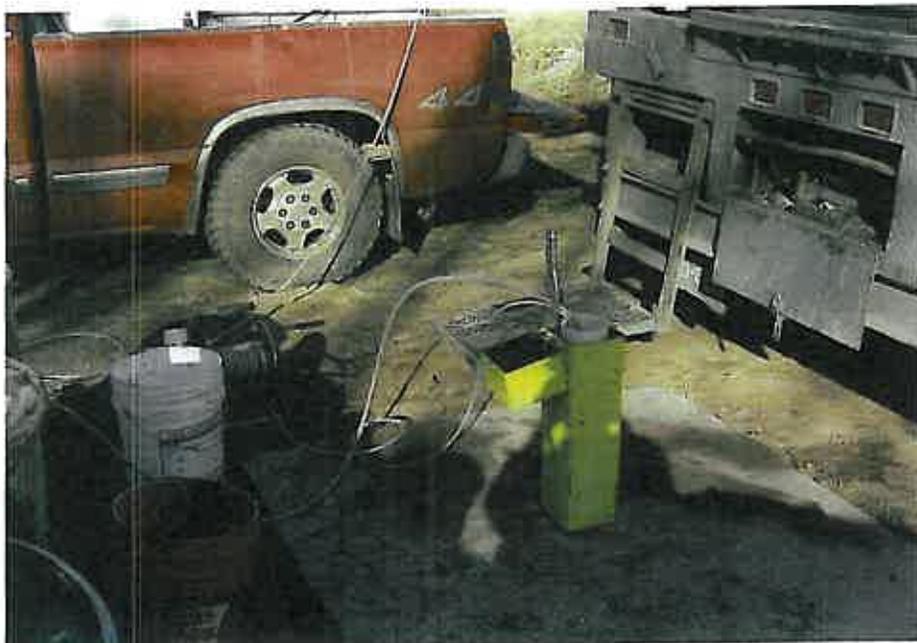
DSC02740



DSC02741



DSC02742



DSC02743



DSC02744



DSC02745



DSC02746



DSC02747



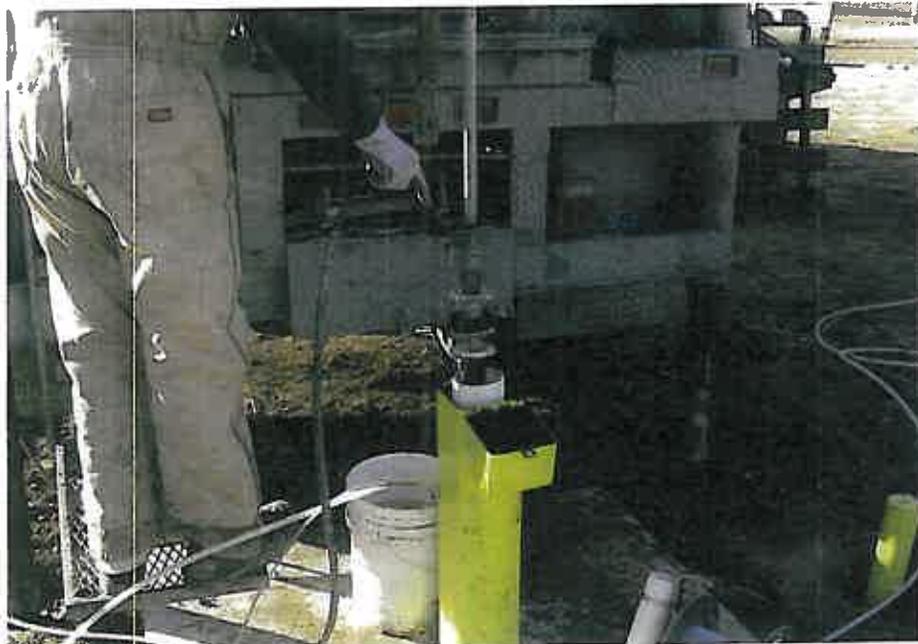
DSC02748



DSC02749



DSC02750



DSC02751



DSC02752



DSC02753



DSC02754



DSC02755



DSC02756



DSC02757



DSC02758



DSC02759



DSC02780



DSC02761



DSC02762



DSC02763



DSC02764



DSC02765



DSC02766



DSC02767



DSC02768



DSC02768



DSC02769



DSC02770



DSC02771



DSC02772



DSC02773



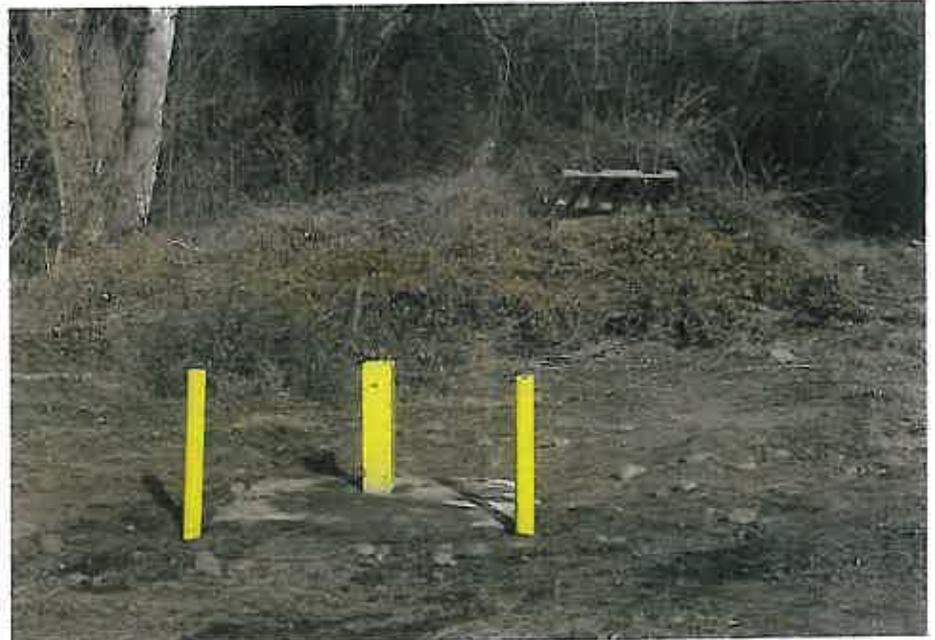
DSC02774



DSC02775



DSC02776



DSC02777



DSC02778



DSC02779



DSC02780



DSC02781



DSC02782



DSC02783



DSC02784



DSC02785



DSC02786



DSC02787



DSC02788



DSC02789



DSC02790



DSC02791



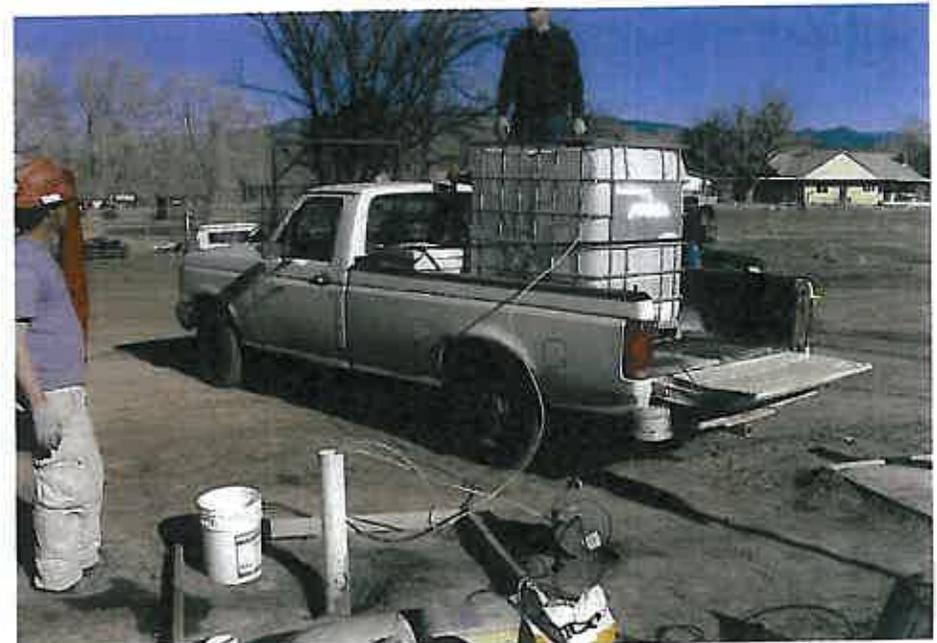
DSC02792



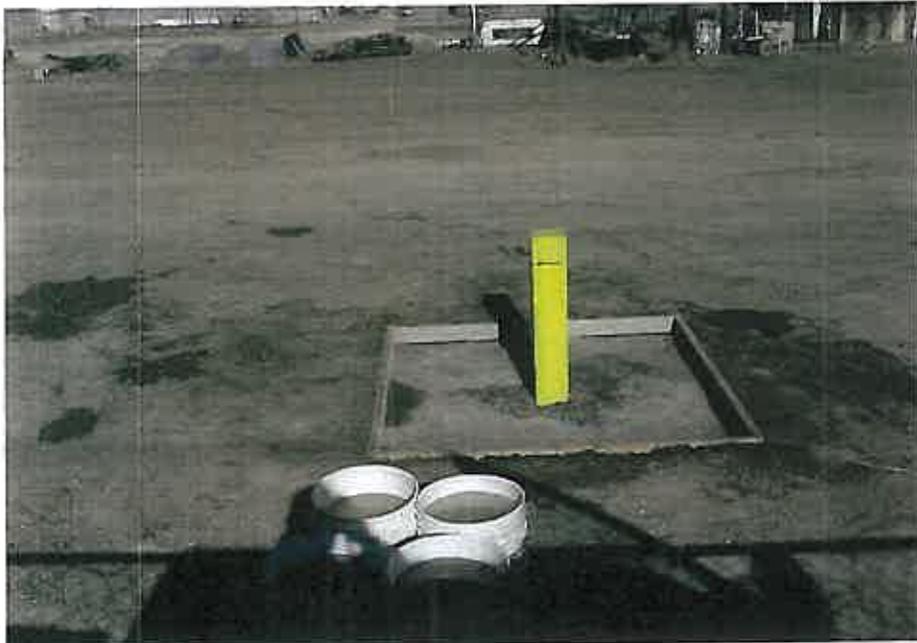
DSC02793



DSC02794



DSC02795



DSC02796



DSC02797



DSC02798



DSC02799



DSC02800



DSC02801



DSC02802



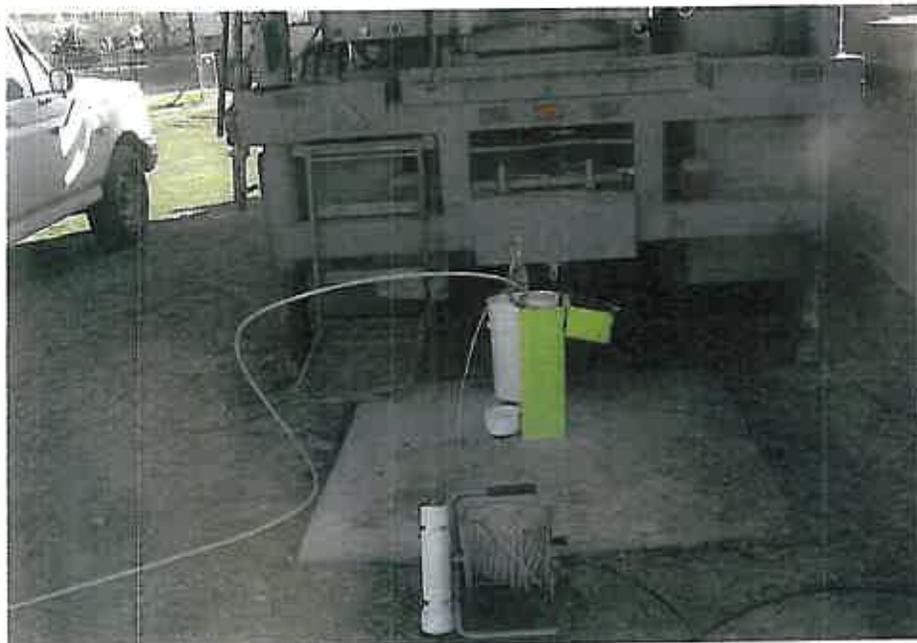
DSC02803



DSC02804



DSC02805



DSC02806



DSC02807



DSC02808



DSC02809



DSC02810



DSC02811



DSC02812



DSC02813



DSC02814



DSC02815



DSC02816



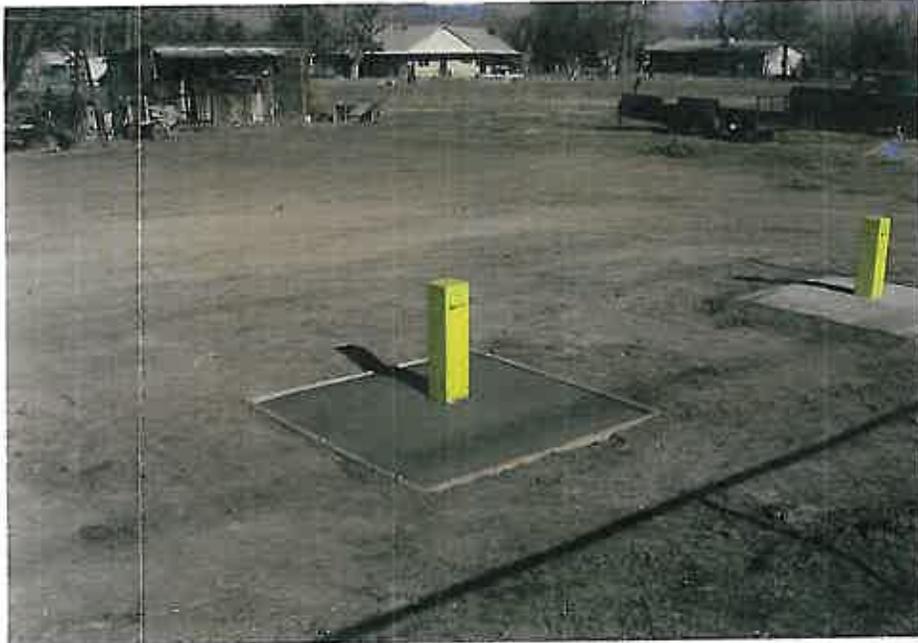
DSC02817



DSC02818



DSC02819



DSC02820



P1190217



P1190218



P1190219



P1190235



P1200237



P1190234



P1190236



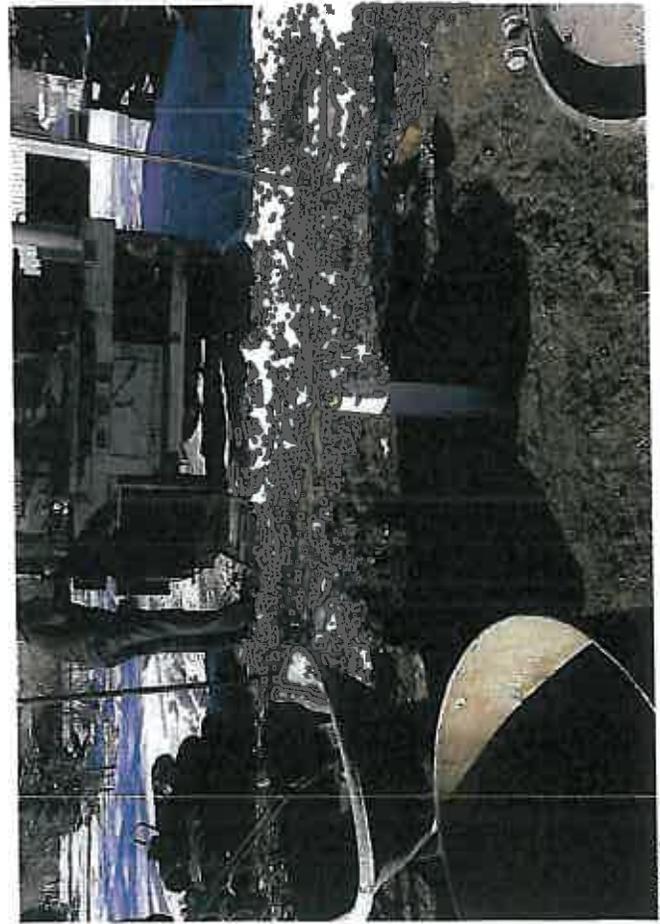
P1200230



P1210250



P1200238



P1210249



P1210252



P1210254



P1210251



P1210253



P1220256



P1220258



P1220255



P1220257