February 11, 2010

Mr. Christopher C. Carey
Remedial Section/Site Remediation Unit
Bureau of Environmental Remediation
Kansas Department of Health and Environment
1000 SW Jackson Street, Suite 410
Topeka, KS 66612-1367

RE: Documentation of Injection Interim Measure Activities
Former Unocal Chemical Distribution Facility
2100 East 37th Street North, Wichita, Kansas 67219

Dear Mr. Carey:

This report documents the implementation of an *in situ* enhanced reductive dechlorination interim measure (IM), as described in the ***Interim Measure (IM) Workplan*** (hereafter referred to as the ***Injection IM Workplan***) (URS Corporation [URS], October 2009). This work was implemented by URS in December 2009 on behalf of the Chevron Environmental Management Company (EMC) at the former Unocal Chemical Distribution Facility (Unocal) in Wichita, Kansas.

To enhance reductive dechlorination, Chevron EMC executed the injection of electron donor material (Hydrogen Release Compound [eXtended release formula] [HRC-X®] mixed with glycerol) in the saturated soil source area of Plumelet A. The objective of this IM was to:

- Lower chlorinated solvent concentrations to below Kansas Department of Health and Environment (KDHE) Risk-Based Standards for Kansas (RSK) residential standards via enhanced and natural attenuation in the P-5 source area; and
- Reduce potential off-site migration of contaminants in that area.

The ***Injection IM Workplan*** was prepared so that the injection portion of the response action recommended in the ***Final Revision 1 Feasibility Study Report*** (URS, June 2009) could be executed prior to the issuance of the site's Corrective Action Decision (CAD). This CAD is currently being prepared by KDHE and will document all former and proposed response actions at the former Unocal site. The injection plan was revised from what was recommended in the Feasibility Study on the basis of analytical results generated during the 2009 Annual Groundwater Monitoring Event. The ***Injection IM Workplan*** and subsequent comment letters documented these changes.

The ***Injection IM Workplan*** was submitted to KDHE on October 28, 2009. On November 5, 2009, KDHE issued a letter with comments regarding the plan. Chevron EMC prepared a response letter, submitted to KDHE on November 17, 2009, providing clarification of details. Via an additional comment letter dated November 23, 2009, KDHE agreed to proceed with the injection work. The November 23, 2009 letter also provided comments on the monitoring plan for the Plumelet A injection. These comments are addressed by the monitoring plan that is proposed in this letter.

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Implementation Overview

The implementation plan was performed in accordance with the ***Injection IM Workplan*** (with minor field deviations). Equipment and material deliveries were coordinated the week prior to subcontractor mobilization. Once all personnel were on-site, the Workplan was reviewed and the following injection process was established:

- Marking/flagging of specific injection locations;
- Monitoring well gauging to determine general depth of groundwater for each transect;
- Drilling of pilot hole for injection equipment installation;
- Heating and mixing of injectants;
- Installing injection equipment (injection lance) into pilot hole;
- Injecting the electron donor mixture; and
- Decontaminating equipment and grouting of boreholes.

A mixture of HRC-X® and glycerol was used to enhance reduction of chlorinated solvent concentrations, providing both longevity (HRC-X®) and a relatively rapid response (glycerol). HRC-X® is an electron donor material that is specifically designed to produce an extended, controlled release of lactic acid when hydrated, while glycerol is an electron donor that produces a short term response and has a much lower viscocity than HRC-X®. Both Remington Technologies (Remington) from Loveland, Colorado and URS implementation staff were experienced in the injection of substrates.

A detailed description of the HRC-X® and glycerol products and their use at the site was presented in the ***Injection IM Workplan***. The following subsection provides implementation details for pertinent steps in the injection process.

Monitoring Well Gauging and Pilot Drilling

Two steps were performed to determine the injection interval: monitoring well gauging and pilot hole drilling. To determine the upper depth for each injection, water levels in the monitoring wells near the proposed injection rows were gauged before initiating the injection work. This gauging was performed to determine the approximate depth to the top of the water column from the ground surface. The results of the water level gauging are presented in **Table 1**.

Table 1. Water Depths Prior to Injection (December 10, 2009)

Monitoring Well ID	TOC DTW (ft bgs)	GS DTW (ft bgs)
P-5	9.64	8.99
P-6	9.55	8.90
P-7	9.61	9.01
P-8	9.65	8.93
P-9	9.91	9.26
P-10	9.73	9.08
P-11	11.52	8.60
P-12	11.67	9.89

DTW - Depth to water.
ft bgs - Feet below ground surface.
GS - Ground surface.
ID - Identification.
TOC - Top of casing.

To establish the bottom depth for the injections, pilot holes were drilled at each location. At each injection point, Remington used a 3-inch solid stem auger (SSA) to create a borehole. During drilling, the depth to shale was observed by the driller, recorded, and then the borehole was extended an additional three feet into the shale. The injections were then performed from the top of the shale to above the top of the water column.

Injection Details

The HRC-X®/glycerol mixture was procured from material vendors and then heated, mixed, and injected by Remington. The material was injected into the subsurface in a "bottom up" manner from the lower confining unit to 8 or 9 feet below ground surface (ft bgs).

In historical Plumelet A, four rows of injections (Transects A through D) were performed as shown in **Figure 1**. These four rows of injections will serve to reduce the source contaminant mass and serve as barriers that will prevent migration of target constituents. Transects A through C were approximately 60 feet long and contained 13 injection points, while Transect D was approximately 100 feet long and contained 21 injection points. For each injection row, the injection points were laid out in two lines with a five-foot offset between the two lines and ten-foot spacing between injection points along the lines.

The injections extended across the saturated zone from 8 ft bgs to the depth associated with shale for Transects A through C and from 9 ft bgs to the depth associated with the shale for Transect D. The injections were performed to depths ranging from 22 to 47 ft bgs, as presented in **Table 2.** For each injection, the final depth of the injection corresponds with the depth of shale. **Figure 2** shows the location of each injection point per transect.

A "lance" was used to inject products into the subsurface. The lance consisted of solid stainless steel pipe with a 2-foot perforated section three feet above the bottom of the lance. Pneumatic packers (approximately 2.5 feet each) were affixed above and below the perforated section.

Table 2. IM Injection Results

Former Unocal - IM Injection Results													
Injection Point	Bottom Depth (ft bgs)	Treatment Thickness (ft)	Volume of HRC-X® Injected (gal)	Volume of Glycerol Injected (gal)	Dosing Rate [1,2] (gal/ft)	HRC-X® Dosing Rate [2] (lbs/ft)	Injection Point	Bottom Depth (ft bgs)	Treatment Thickness (ft)	Volume of HRC-X® Injected (gal)	Volume of Glycerol Injected (gal)	Dosing Rate [1,2] (gal/ft)	HRC-X® Dosing Rate [2] (lbs/ft)
A1	37	29	16	9	0.74	5.11	C5	27	19	16	6	0.92	5.43
A2	37	29	16	9	0.74	5.11	C6	27	19	16	6	0.92	5.43
A3	37	29	16	1	0.50	5.11	C7	26	18	15	0	0.65	5.25
A4	22	14	12	2	0.74	6.85	C8	26	18	16	0	0.70	5.60
A5	34	26	16	9	0.81	5.60	C9	29	21	16	0	0.62	5.11
A6	32	24	16	9	0.86	5.99	C10	27	19	16	0	0.67	5.43
A7	34	26	16	3	0.61	5.60	C11	27	19	16	0	0.67	5.43
A8	40	32	16	9	0.68	4.69	C12	27	19	16	0	0.67	5.43
A9	37	29	16	9	0.74	5.11	C13	29	21	16	0	0.62	5.11
A10	34	26	16	9	0.81	5.60	D1	47	39	21	13	0.77	4.38
A11	34	26	16	9	0.81	5.60	D2	44	36	21	13.5	0.84	4.65
A12	34	26	16	3	0.61	5.60	D3	44	36	20	13	0.80	4.43
A13	30	22	16	3	0.70	6.43	D4	37	29	18	13	0.91	4.65
B1	27	19	15	0	0.63	6.78	D5	42	34	18	13	0.79	4.16
B2	28	20	15	0	0.60	6.51	D6	42	34	18	13	0.79	4.16
B3	30	22	15	0	0.56	6.03	D7	47	39	18	13	0.70	3.76
B4	30	22	15	0	0.56	6.03	D8	37	29	19	13	0.94	4.91
B5	36	28	15	0	0.45	4.93	D9	37	29	18	13	0.91	4.65
B6	30	22	15	0	0.56	6.03	D10	37	29	16	13	0.85	4.13
B7	28	20	15	6	0.84	6.51	D11	27	19	16	13	1.21	5.43
B8	27	19	15	6	0.88	6.78	D12	45	37	21	13	0.81	4.56
B9	28	20	15	6	0.84	6.51	D13	42	34	20	13	0.85	4.62
B10	30	22	15	6	0.78	6.03	D14	44	36	20	13	0.80	4.43
B11	30	22	15	6	0.78	6.03	D15	42	34	18	13	0.79	4.16
B12	30	22	15	6	0.78	6.03	D16	42	34	18	13	0.79	4.16
B13	30	22	15	6	0.78	6.03	D17	39	31	18	13.5	0.88	4.44
C1	26	18	15	6	0.91	7.08	D18	37	29	19	13	0.94	4.91
C2	27	19	16	6	0.92	7.23	D19	37	29	19	13.5	0.96	4.91
C3	29	21	16	6	0.85	6.68	D20	37	29	18	13	0.91	4.65
C4	27	19	16	6	0.92	7.23	D21	31	23	16	13	1.04	4.82

[1] Densities of HRC-X® and Glycerol are assumed to be equal.
[2] Dosing rate was doubled in the bottom five feet.
bgs - Below ground surface.
ft - Feet.
gal - Gallon.
lbs - Pounds.

The lance was inserted into the borehole with the packers deflated. The overdrilling that was previously described allowed injection to occur immediately above the shale, as the tip of the lance penetrated into the shale through the pilot hole.

Once the lance was installed to depth, an air compressor was used to inflate the packers. This served to isolate an injection zone and force the electron donor to enter the subsurface laterally. After pumping the desired amount of electron donor through the perforated section of the lance, the packers were deflated and the lance system was raised two feet. The process was then repeated. The pressures observed during the injection ranged from 10 to 80 pounds per square inch (psi).

A dosing rate similar to that applied during the 1999 and 2006 Pilot Tests was used for the IM injection. The dosing rate of the substrate mixture for the injection points ranged from 0.45 gallons per foot (gal/ft) to 1.21 gal/ft; the HRC-X® dosing rate was doubled for the bottom five feet of each injection location. The HRC-X® dosing rate ranged from 3.76 pounds per foot (lbs/ft) to 7.23 lbs/ft, similar to the proposed HRC-X® dosing rate of 5 lbs/ft. Up to 6 lbs/ft of glycerol were added to the HRC-X® to enable a shorter response and to decrease the viscosity HRC-X®. Additionally, the HRC-X® and glycerol were heated to reduce their viscosities, and the mixture remained heated until it was injected into the subsurface. It should be noted that the heating reduced the viscosity of the HRC-X® to the point where it could be injected without the addition of glycerol.

Revised Monitoring Plan

Monitoring will be performed to measure the reduction of volatile organic compound (VOC) concentrations in Plumelet A and, thereby, the overall effectiveness of the injection IM. A system of monitoring wells, including the newly installed wells P-11 and P-12, are located within the treatment area and will be used to monitor both reductive dechlorination and the reduction in contaminant mass.

Based on conversations with KDHE during a site visit on December 11, 2009, six additional monitoring wells are proposed to enhance the current monitoring network. A pair of monitoring wells (one shallow and one deep) will be installed near the location of MIP-9, between Transects A and B, to determine the effectiveness of the most upgradient injection row. Two pairs of monitoring wells will be installed east and west of P-12 to demonstrate that migration of contaminants off-site is not occurring. It is proposed that monitoring wells not be installed upgradient (north) of Transect A, as previous direct push and MIP analyses indicated low levels of contaminants in that area.

Figure 3 shows the current and proposed monitoring wells to be utilized during monitoring of this IM. The well construction information for the current monitoring well network is provided in **Table 3**. All current wells are two inches in diameter and constructed of polyvinyl chloride. The proposed monitoring wells will be constructed in accordance with Standard Operating Procedure (SOP) for Well Installation (**Attachment A**).

Table 3. Well Construction Data

Monitoring Well ID	Installation Date	Northing	Easting	Surface Elevation (ft amsl)	Top of Casing Elevation (ft amsl)	Total Depth (ft bgs)	Screen Length (ft)	Top of Screen (ft bgs)	Bottom of Screen (ft bgs)
P-1	October 1992	1709878.849	1656543.735	1348.58	1348.19	23.2	15.0	8.0	23.0
P-2	October 1992	1709869.571	1656597.403	1348.65	1348.18	23.2	15.0	8.0	23.0
P-5	May 1999	1709895.465	1656595.560	1348.73	1349.69	15.5	10.0	5.0	15.0
P-6	May 1999	1709878.660	1656596.041	1348.72	1349.47	15.5	10.0	5.0	15.0
P-7	May 1999	1709871.977	1656591.961	1348.59	1349.44	15.5	10.0	5.0	15.0
P-8	May 1999	1709866.424	1656591.415	1348.38	1349.42	15.5	10.0	5.0	15.0
P-9	May 1999	1709859.691	1656594.708	1348.68	1349.60	15.5	10.0	5.0	15.0
P-10	May 1999	1709874.343	1656568.520	1348.69	1349.62	15.5	10.0	5.0	15.0
P-11	April 2009	1709902.676	1656598.145	1348.76	1351.45	35	15.0	20.0	35.0
P-12	April 2009	1709850.661	1656594.742	1348.62	1351.23	35	15.0	20.0	35.0
MW-2	August 1991	1709848.240	1656519.213	1349.20	1348.86	24.3	4.6	18.0	22.6

amsl - Above mean sea level.
bgs - Below ground surface.
ft - Feet.
ID - Identification.

The results from the June 2009 Annual Groundwater Monitoring Event will be used as baseline data for the injections. Chevron EMC has agreed to KDHE's request to sample quarterly for the first year and then annually after that. Therefore, the first sampling event is proposed for the existing monitoring wells in early spring (March/April 2010). The second sample collection event will occur in conjunction with the 2010 Annual Groundwater Monitoring Event, which is planned for early summer (June 2010). For this second event and all subsequent monitoring events, samples will be collected from the wells listed in **Table 4** and analyzed for VOCs by U.S. Environmental Protection Agency (EPA) Method SW8260.

Table 4. Injection Interim Measure Groundwater Monitoring Plan

Transect A (Source Zone)	Transect B (Source Zone)	Transect C (Source Zone)	Transect D (Fence Line)
Upgradient None	*Upgradient* P-13 (Shallow) P-14 (Deep)	*Upgradient* P-5 (Shallow) P-11 (Deep)	*Upgradient* P-6 (Shallow) P-2 (Deep)
Sidegradient None	*Sidegradient* None	*Sidegradient* P-1 (Deep)	*Sidegradient* MW-2 (Deep)
Downgradient P-13 (Shallow) P-14 (Deep)	*Downgradient* P-5 (Shallow) P-11 (Deep)	*Downgradient* P-6 (Shallow) P-2 (Deep)	*Downgradient* P-9 (Shallow), P-12 (Deep) P-15 (Shallow), P-16 (Deep) P-17 (Shallow), P-18 (Deep)

The 2010 Annual Groundwater Monitoring Report will include results from the wells associated with the IM. A separate discussion regarding the effects of the HRC-X® injections will be added to the 2010 Annual Groundwater Monitoring Report. If the injection activity is deemed effective, then the monitoring for this IM will continue on an annual basis. If there are questions associated with the effectiveness of this IM, then Chevron EMC will consult with KDHE regarding the need for additional monitoring.

If you have any questions regarding this implementation summary, please do not hesitate to contact me at (512) 419-6180.

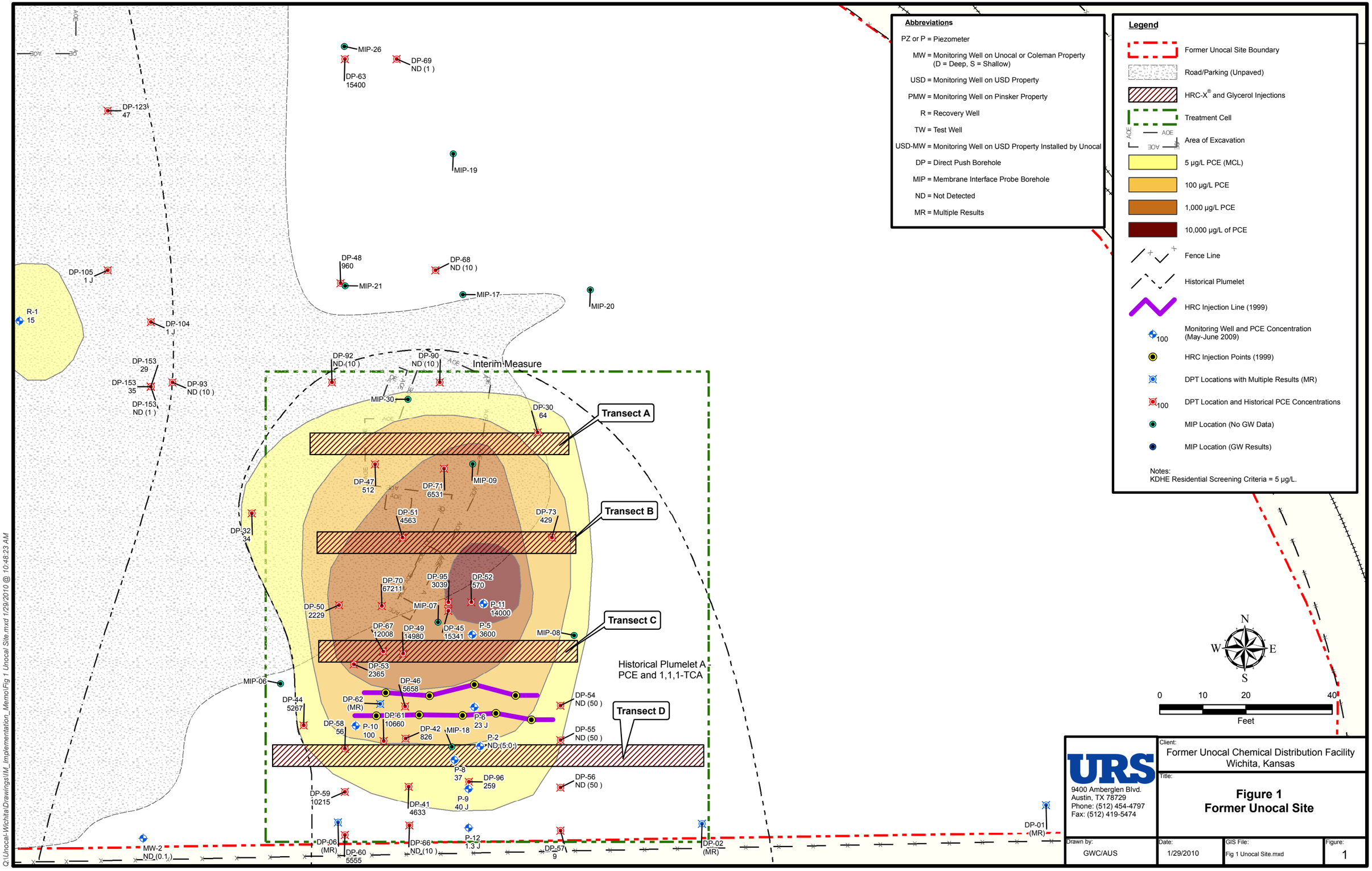
Respectively Submitted,
URS Corporation

Derek R. Peacock, P.E.
Project Manager

cc: Mr. Michael P. Mailloux, Chevron EMC
Urmas Kelmser, Chevron ETC
File

Attachments

Figures



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Client: Former Unocal Chemical Distribution Facility Wichita, Kansas

Title: **Figure 1 Former Unocal Site**

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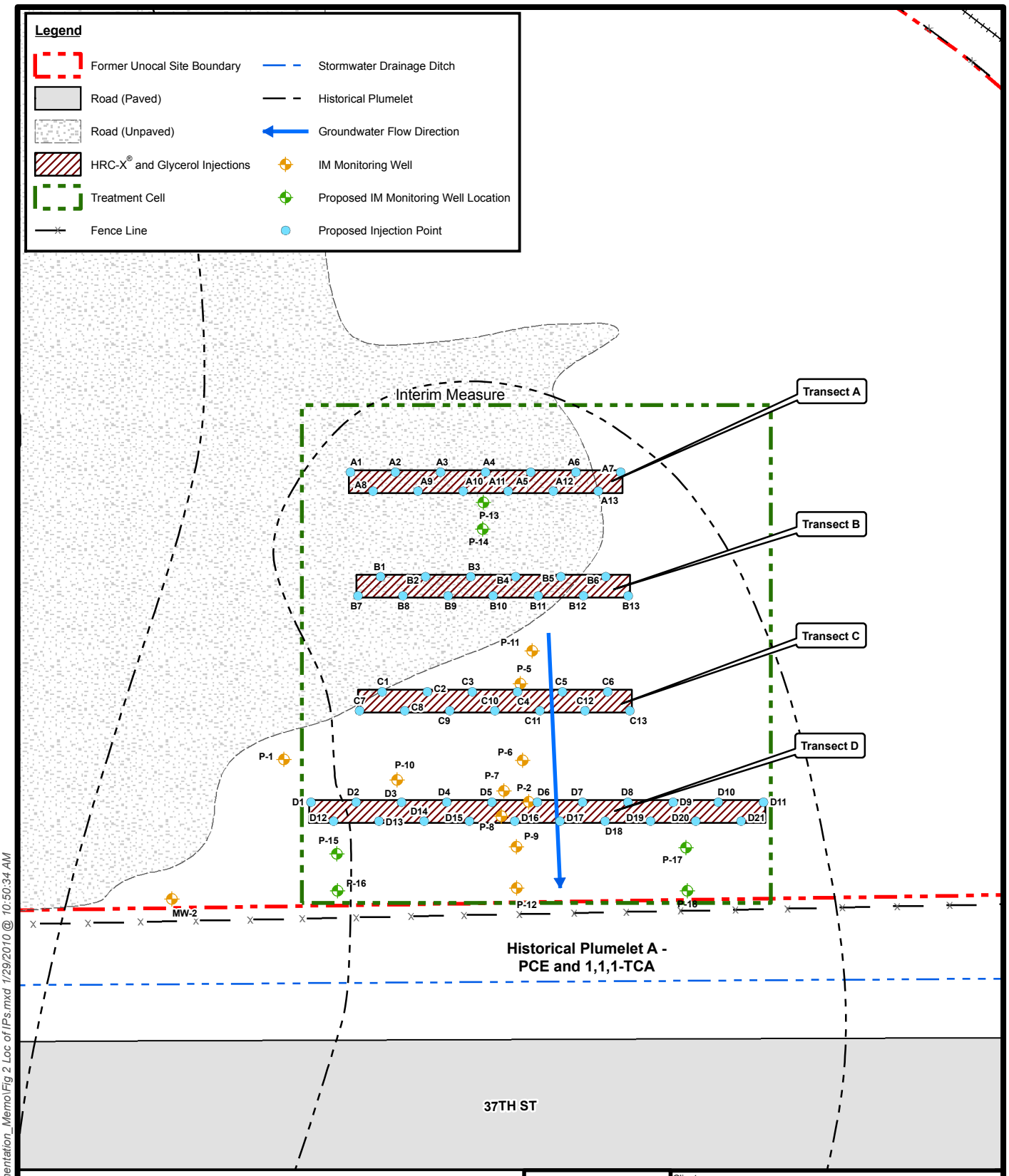

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Figure 2
Location of Injection Points

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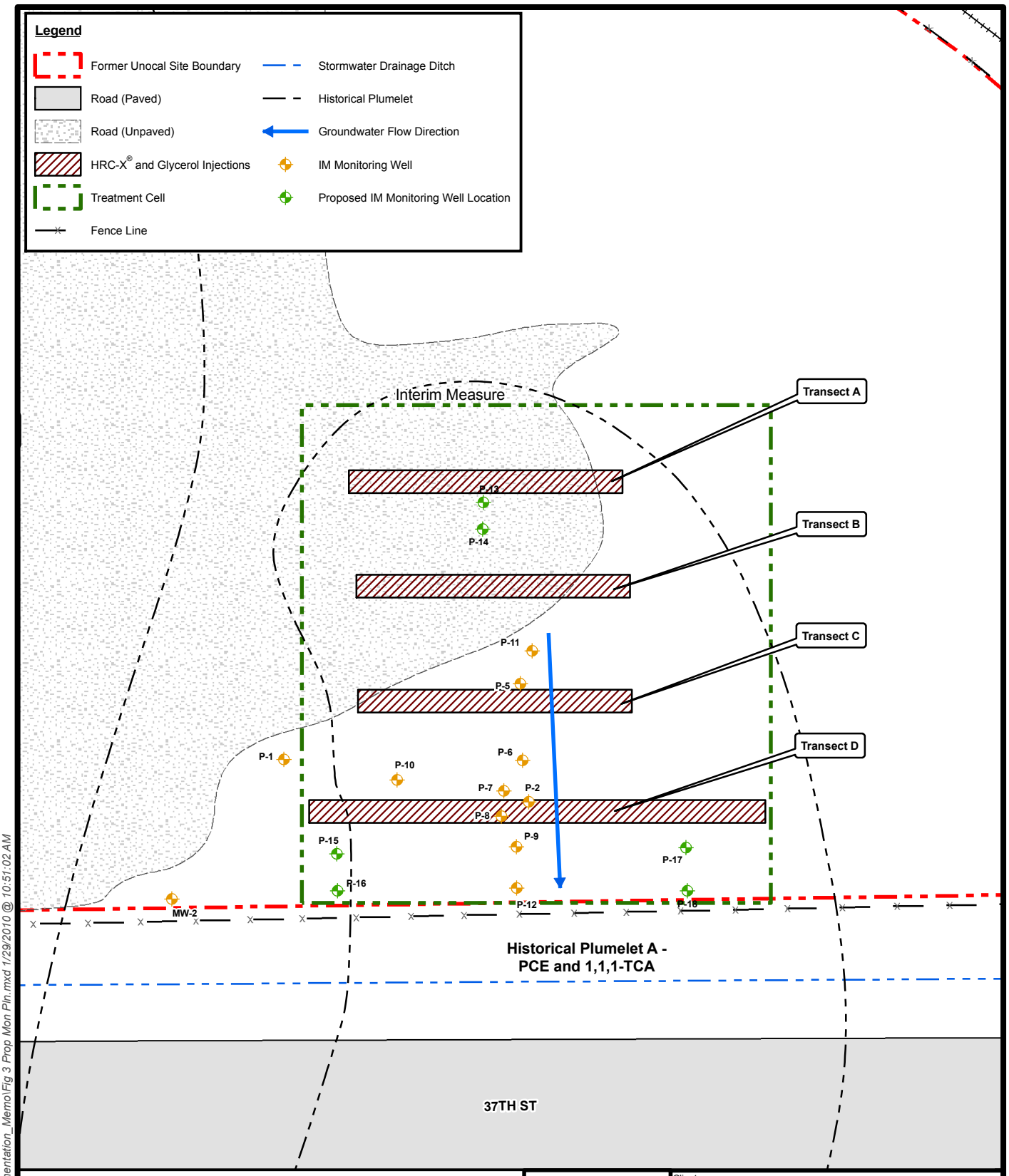

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Figure 3
Proposed Monitoring Plan - Former Unocal Site

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Attachment A

ATTACHMENT A

URS Standard Operating Procedure for Installation of Monitoring Wells at the Former Unocal Distribution Facility

INTRODUCTION

The purpose of this Standard Operating Procedure (SOP) is to establish a basic procedure for installation of auger-advanced monitoring wells by URS Corporation (URS) at the Former Unocal Distribution Facility. This SOP was developed on the basis of Kansas Department of Health and Environment (KDHE) Guidance Documentation.

Monitoring wells installed as part of groundwater investigations are intended to serve several purposes:

- Indicate the presence, if any, of contaminants of interest in groundwater;
- Quantify the concentrations, sources, and vertical distributions of contaminants; and,
- Serve as a means of obtaining basic hydrogeologic information including static water level of the aquifer of concern, type and thickness of subsurface materials, aquifer characteristics at various depths, depth of the bedrock, etc.

METHOD SUMMARY

Wells will be installed with augers, a minimum hollow-stem auger size of 3 3/4" inside diameter or larger) should be used to advance monitoring wells. Placement, depth, and construction of wells will be conducted under the supervision and direction of a URS geologist. Care should be taken to not introduce contamination from the drill rig or surficial area around the well head.

PROCEDURE

Monitoring wells will be constructed of polyvinyl chloride (PVC) casing and screen that are placed at intervals determined by the project geologist. Typical sizes for the casing are nominal inside diameters of 2 inches, 4 inches, 5 inches, or 6 inches. A minimum of Schedule 40 PVC casing and screen should be utilized. Clean pipe and screen must be used in all wells. The screen at the bottom of the well should be sealed with a bottom plug of PVC.

Well screen should be constructed of PVC pipe with factory cut slots. The slot size is typically 0.010 inch, although other slot sizes may be used if appropriate for the formation and approved by the supervising geologist. Screen will be installed at the intervals directed by the supervising geologist, based on the requirements of the project and the site conditions. The casing must not be cleaned or cemented with organic solvents or solvent based cements. Suitable fastening methods are either flush-joint threaded pipe, or slip-joint pipe fastened with stainless steel screws.

A gravel pack is used to fill the annulus between the inside of the borehole and the outside of the casing. A minimum of four (4) inches of annulus plus the well casing (6 inches in diameter minimum for a 2 inch casing) is required. The gravel should be of clean silica sand, having a particle size appropriate for the formations in which it is to be used, and the slot size of the screen. The gravel pack material must be selected or approved by the geologist supervising the drilling. The gravel pack should be installed to two feet above the screened interval to avoid potential grout penetration into the screen. Centralizers may be required to obtain accurate placement of the gravel pack material. Disinfection of the sand or gravel is not required. A grout plug consisting of at least 24 inches of bentonite chips, pellets or similar impervious material must be placed above each aquifer.

From the top of the plug to the surface, the well must be grouted with bentonite, neat cement, or concrete, and the well head must be protected with an apron and locking well cover as described below. Bentonite is preferred as an annular seal and grouting agent. KDHE required 20 feet of grout. In most cases at this site, it will be necessary to install wells, which have less than 20 feet of grout. If less than 20 feet of grout is determined for a well, a waiver must be obtained from Bureau of Water (BOW).

The casing shall extend at least one foot, but not more than three feet above the ground surface, and have a removable PVC cap, unless a flush mount protective cover has been approved by the project manager and a waiver granted by BOW. The well head shall be surrounded by a concrete apron, at least four inches thick and two to three feet square, centered on the well head above normal ground level, and sloped to drain away from the well. A locking well cover, constructed of welded steel, and having a suitable hasp will be installed at each well to prevent unauthorized access to the well. The well cover shall be firmly set in the concrete apron. Flush mount well protectors may be substituted for those described above if approved by the project manager.

GENERAL CONSIDERATIONS

Well construction details and geologic logs should be recorded by the on-site geologist during the well installation. The appropriate BOW WWC-5 water well construction documentation must be completed within 30 days of well completion.

Only Schedule 40 or 80 casing and screen will be permitted for small-diameter monitoring wells. Only threaded casing will be used, with no glues, solvents, joint compounds or adhesives.

Precautions must be taken during all stages of the drilling, installation, and development activities to prevent possible contamination of the well. Grease, fuel, hydraulic fluids, and other foreign materials from the drilling rig and equipment must be isolated from the well. Tools, casing, and drilling fluids must be kept clean and oil free. Clean tap water may be used in situations where heaving conditions are anticipated, however the water source should be sampled for the parameters and constituents of interest to account for water quality of tap water source.

The well head apron and locking well cover is intended to prevent accidental or intentional introduction of foreign materials into the well. The well cap and locking cover should be installed as soon as practical, and must be locked to prevent tampering with the well. Drainage

on the surface in the area of the well should be planned or modified so that there is no standing water in the area of the well, and so that the well will not be subject to runoff or infiltration from known sources of contamination.

Disposal of cuttings and development/purge water should be performed according to the appropriate KDHE SOP (BER-08).

SPECIAL CONSIDERATIONS

The driller must be trained to operate the specific rig in use. All drillers must be licensed through KDHE's BOW to install wells.

SAFETY

Safety issues will be covered under the Loss Prevention System site-specific training and job safety analyses.