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APPROVED

ENVIRONMENTAL REMEDIATION
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ENVIRONMENTAL REMEDIATION

October 22, 2015

Daniel Newman
Kansas Department of Health and Environment
Bureau of Environmental Remediation, Site Restoration Unit
Charles Curtis State Office Building
1000 SW Jackson Street
Topeka, Kansas 66612-1367

Re: Interim Groundwater Pilot Test Implementation Report, NuStar Pipeline Release Site,
Quail Crossing Neighborhood
Response to KDHE Comments
Consent Agreement and Final Order 12-E-36 BER
Andover, Kansas
1641-08

Dear Mr. Newman:

On behalf of NuStar Pipeline Operating Partnership L.P. (NuStar), Apex Companies, LLC (Apex) prepared this letter in response to the Kansas Department of Health and Environment (KDHE) comments provided in a September 11, 2015 letter to NuStar. The comments pertained to the *Interim Groundwater Pilot Test Implementation Report, Quail Crossing Neighborhood* (the Report), prepared by Apex and submitted to KDHE on August 27, 2015. The Report was revised in response to KDHE comments as described herein, and is transmitted with this letter. The Report was prepared as part of a continuing response to the release of gasoline from a pipeline in the Quail Crossing Neighborhood (the Neighborhood) in Andover, Kansas. KDHE comments are presented below in *Italics*, followed by NuStar's response to each comment.

1. ***Section 4.5 ORC Advanced® Injection, page 9**: The paragraph states that "consistent with KDHE policy, the injection pressure was less than 50 pounds per square inch (psi)." The field notes and injection logs for IB-7 indicate that the injection was at 100 psi. The field notes and injection logs indicate that the psi for other injection locations was reduced to be in accordance with KDHE policy. Please revise the paragraph accordingly.*

   Response: Section 4.5 of the Report was revised as follows: KDHE policy stipulates a maximum injection pressure of 50 pounds per square inch (psi); however, at the first injection point (IB-7), the ORC Advanced® slurry was inadvertently injected at a higher pressure (100 psi). Apex staff advised the subcontractor that the maximum injection pressure specified in the Work Plan was 50 psi. Consequently, the ORC Advanced® slurry injection pressure was 50 psi at the remaining injection points.

2. ***Section 5.3.2 Groundwater Analytical Data, Dissolved-Phase Petroleum Concentrations, page 11:** The paragraph states that "during the limited period between March and June, gasoline constituent concentrations ... (3) increased in monitoring wells MW-17 and MW-1." Upon review of the data for MW-3, concentrations increased to 21 mg/L. Please revise accordingly.*

   Response: In accordance with the Groundwater Pilot Test Work Plan, groundwater quality in the pilot test area was characterized using data collected from monitoring wells MW-1, MW-4, MW-5, and MW-17 through MW-19 only; those wells were gauged and groundwater samples were collected in March, April and

June 2015. Monitoring well MW-3, which is located approximately 125 feet to the southeast of the pilot test area. As such, the well is too distant to be affected by the pilot testing during the reporting period and was not included as part of the pilot test; groundwater data collected from this well are included in quarterly groundwater monitoring reports. Accordingly, no revisions were made the Report.

Figures: *As stated on page 12 of the report, NuStar continues to monitor groundwater in the pilot test area and elsewhere at the site. Please provide a figure including all of the June 2015 data in order to assess overall groundwater quality.*

Response: As noted on page 11 of the Report, Site-wide groundwater data and trends are presented in quarterly groundwater monitoring reports. For your reference, figures from the Second Quarter 2015 Groundwater Monitoring Report present the requested data, and are provided as an attachment to this letter.

Please do not hesitate to contact me at sjackson@apexcos.com or 503-924-4704 x1924 or Renee Robinson at renee.robinson@nustarenergy.com or 210-918-2975 with questions regarding these responses.

Sincerely,

Sam Jackson
Associate Engineer

ATTACHMENTS

A Revised Interim Groundwater Pilot Test Implementation Report
B Figures, Second Quarter 2015 Groundwater Monitoring Report

cc: Renee Robinson, NuStar Energy L.P. (electronic deliverable)

Attachment A

Revised Interim Groundwater Pilot Test Implementation Report

APEX

Revised Interim Groundwater Pilot Test Implementation Report March Through June 2015 Quail Crossing Neighborhood Andover, Kansas

Prepared for:
NuStar Pipeline Operating Partnership L.P.

October 22, 2015
1641-08

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Associate Engineer

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1.0 Introduction

This *Interim Groundwater Pilot Test Implementation Report* (Report) was prepared on behalf of NuStar Pipeline Operating Partnership L.P. (NuStar) as part of a continuing response to the release of gasoline from a pipeline in the Quail Crossing Neighborhood (the Neighborhood) in Andover, Kansas. The area in the vicinity of the release, the Site, is shown on Figures 1 and 2. This Report was prepared in accordance with the Consent Agreement and Final Order (CAFO) dated May 10, 2013 and joint NuStar and Kansas Department of Health and Environment (KDHE) project discussions.

The purpose of the groundwater pilot test is to evaluate a groundwater remedial technology that may be appropriate for treating groundwater at the Site as part of NuStar's continuing response. Activities presented in this Report were performed in general accordance with the *Revised Groundwater Pilot Test Work Plan* (Work Plan; Apex, 2015a); the Work Plan was submitted to KDHE on January 16, 2015 and approved by KDHE on January 26, 2015.

This Report documents the initial phase of the groundwater pilot test, which was performed during the period March – June 2015. Work performed during this period includes: (1) installation and development of three monitoring wells (MW-17 through MW-19); (2) injection of an oxygen releasing compound (ORC) through nine temporary injection borings; and (3) collection and analysis of groundwater samples from monitoring wells in the vicinity of the release in March, April, and June 2015.

1.1 Work Plan Organization

This Work Plan is organized as follows:

Background (Section 2) – A summary of previous investigations and remedial measures implemented at the Site.

Site Description (Section 3) – A description of the physical setting of the Site, local geology and hydrogeology, and a discussion of the nature and extent of gasoline in soil and groundwater.

Pilot Test Implementation (Section 4) – A presentation of the monitoring well installation, ORC injection activities, and groundwater sampling activities.

Pilot Test Preliminary Results (Section 5) – A presentation of soil and groundwater analytical results collected during the pilot test implementation during the period March through June 2015.

Reporting and Schedule (Section 6) – A timeline for continued implementation of the pilot test and associated reporting.

2.0 Background

The pipeline release was discovered in June 2012 after separate-phase hydrocarbons (SPH) were detected in the irrigation well at 2006 N Colt Court, Andover, Kansas. The NuStar pipeline release location is approximately 80 feet north of the affected irrigation well. Upon notification of the discovery of SPH in the irrigation well, NuStar immediately mobilized to the Site and implemented several initial response and abatement activities, including repairs to the pipeline, deactivation of the irrigation well at 2006 N Colt Court, and removal of SPH from the irrigation well.

Following the initial response activities, NuStar: (1) performed a number of interim remedial measures (IRMs); (2) planned and implemented a Comprehensive Investigation [CI]); (3) performed additional investigation to refine the understanding of petroleum constituents in vadose-zone soil; (4) designed and implemented a soil vapor extraction pilot test; and (5) implemented an ongoing groundwater monitoring program. These activities are described in detail in reports previously prepared by Apex (2013; 2014a; 2014b; 2014c; 2014d; 2014e; and 2015b).

During the CI, 16 groundwater monitoring were installed at the Site, at the locations shown on Figure 2. Since installation through December 2014, the monitoring wells were gauged for the presence of SPH and to measure depth to water on a weekly basis; in 2015, this activity was performed monthly. In March 2015, monitoring wells MW-17 through MW-19 were installed as part of the groundwater pilot test. On a quarterly frequency, groundwater samples have been collected from the 19 monitoring wells and approximately 17 Neighborhood irrigation wells and analyzed for dissolved-phase petroleum constituents. Based upon the data obtained during the CI, gasoline constituents remain in soil and groundwater in a limited area near the pipeline release location at concentrations that exceed KDHE drinking water screening criteria.

Concurrent with preparation of this document, NuStar is developing a soil excavation work plan to address residual petroleum constituents in soil. The soil excavation work plan is scheduled for submittal to KDHE in August 2015.

3.0 Site Description

The Site is located in the northern portion of the City of Andover, in Butler County, Kansas (Figure 1), approximately 1/3 mile southeast of the intersection of North 159th Street East and West 21st Street. Land use at and surrounding the Site is residential. A stormwater pond is located approximately 250 feet south of the pipeline. The stormwater pond has not been affected by the release.

Residents in the Neighborhood use municipal water for domestic purposes. In addition to the municipal water supply, some residents in the Neighborhood have irrigation water wells that are used for outdoor irrigation and landscape purposes. The irrigation wells range in total depth from approximately 80 to 116 feet below the

ground surface (bgs). In most irrigation wells, the screened interval extends from total well depth to approximately 40 feet bgs; gravel filter packs typically extend from the total well depth to approximately 20 feet bgs. As part of NuStar's response, nine irrigation systems have been converted to municipal service; these converted wells/irrigation systems are shown on Figure 2 and 3.

3.1 Geology

The regional geology in Butler County consists of unconsolidated sediments, including Tertiary and Quaternary alluvium and Quaternary loess at the ground surface, overlying lower Permian limestone and shale of the Council Grove and Chase Groups (Aber, 1991). O'Connor et al. (1982) report that the uppermost bedrock unit at the Site is the Permian Wellington Formation, which reportedly consists of up to 100 feet of light gray and green silty shale, with some thin limestone and gypsum beds. The Wellington Formation is underlain by the Nolans Limestone formation, which is approximately 20 to 30 feet thick, and consists of a light-buff limestone and dolomite in the upper part.

Geological conditions at the Site are generally consistent with regional conditions, based on information presented in irrigation well construction logs (surface to 116 feet bgs) and monitoring well and soil boring logs (surface to 65 feet bgs). At the Site, yellowish brown clay (loess) is generally encountered from the surface to depths of approximately 10 to 15 feet bgs. The clay is underlain by gray, yellow, and olive brown shale of the Wellington Formation. Based on observations in borings, shale of the Wellington formation is weathered at the surface, and underlying materials exhibit widely viable competency.

3.2 Groundwater / Aquifer Characteristics

This Section describes the regional and local groundwater conditions.

3.2.1 Regional Groundwater Conditions

The Site and surrounding area are generally flat, although regional topography slopes gently to the east, toward the Whitewater River, which is approximately 4 miles east of the Site. O'Connor et al. (1982) report that the uppermost water-bearing unit at the Site is the Wellington Formation. The productivity and quality of water from the Wellington Formation are limited. A regional groundwater elevation map prepared by O'Connor et al. (1982) indicates that groundwater in the Wellington formation exhibits an easterly gradient (0.005 foot per foot [ft/ft]) near the Site.

O'Connor et al. also report that the shale units in southwest Butler County inhibit vertical groundwater flow below approximately 50 feet.

3.2.2 Groundwater Conditions at the Site

During the most recent monitoring events, depths to groundwater in monitoring wells at the Site ranged from approximately 15 to 53 feet bgs (equivalent to approximately 1298 to 1334 feet above mean sea level [MSL]). Groundwater elevation data are presented in Table 1. Groundwater elevations are generally highest in the vicinity of the stormwater retention pond, resulting in radial groundwater flow away from the pond. Further from the pond, in the vicinity of groundwater monitoring wells MW-4, MW-11, MW-12, MW-14, MW-15, and MW-16, groundwater exhibits a more easterly flow component and shallower gradient, consistent with regional patterns (O'Connor et al., 1982). Figures 4 through 6 show March, April and June 2015 groundwater elevations and the inferred groundwater flow directions.

3.3 Nature and Extent of Gasoline in Soil and Groundwater

3.3.1 Soil

Data obtained from samples collected between 2012 and 2015 demonstrate that residual gasoline constituents are present in the vadose zone at depths of 7 to 18 feet bgs in the vicinity of the pipeline release location. A detailed description of the nature and extent of gasoline constituents in the vadose zone is provided in the *Soil Investigation Report and Proposed Soil Excavation Work Plan* (Apex, 2014e), which was approved by KDHE on August 8, 2014. The *Soil Excavation Work Plan* (Apex, 2015c), detailing the implementation aspects, was submitted to KDHE on August 19, 2015. On August 26, 2015, KDHE approved the *Soil Excavation Work Plan*; those excavation activities are currently being performed.

Gasoline constituents have also been detected in material below the vadose zone; however, those observations are attributed to constituents in groundwater.

3.3.2 Groundwater

The nature and extent of gasoline constituents in groundwater at the Site have been characterized based on samples collected from a network of 19 groundwater monitoring wells and 17 Neighborhood irrigation wells. During the most recent monitoring event (June 2015), five groundwater monitoring wells (MW-1, MW-3, MW-17 through MW-19) exhibited gasoline constituents (gasoline-range organics [GRO], 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, benzene, naphthalene, and/or toluene) at concentrations that exceeded the corresponding KDHE Tier 2 Risk-Based Screening Values (RBSVs) for drinking water. All of these wells are located near the release location, as shown on Figure 2. The highest concentrations were detected in monitoring well MW-1, which is approximately 50 feet from the pipeline release location.

3.3.3 Separate-Phase Hydrocarbons

Groundwater data collected to date indicate that mobile SPH are limited to the area in the vicinity of the irrigation well at 2006 N Colt Court. SPH have not been observed on the water in any other irrigation wells

or monitoring wells at the Site, including several wells in the immediate vicinity of the release location (i.e. well MW-1, which is located 30 feet from the irrigation well at 2006 N Colt Court; and wells MW-17 through MW-19, which are located within 60 feet of the release location).

3.4 Groundwater Constituents of Interest

Between 2012 and June 2015, the following constituents have been detected in one or more groundwater samples at concentrations that exceed KDHE Tier 2 RBSVs:

- GRO;
- 1,2,4-trimethylbenzene;
- 1,3,5-trimethylbenzene;
- Benzene;
- Ethylbenzene;
- Isopropylbenzene;
- Naphthalene; and
- Toluene.

During the most recent groundwater monitoring event in June 2015, constituents of interest were not detected or were detected at concentrations below the corresponding KDHE Tier 2 RBSVs in 14 of the 19 monitoring wells on the Site.

4.0 Groundwater Pilot Test Implementation - March 2015

The groundwater pilot test was performed in accordance with the *Revised Groundwater Pilot Test Work Plan* (Apex, 2015a), which was approved by KDHE on January 26, 2015. A variety of oxygen releasing compounds were considered for pilot testing (e.g., Oxygen Release Compound [ORC®], Advanced Formula Oxygen Release Compound [ORC Advanced®], PermeOx Plus®, and O-SOX™). ORC Advanced®, a calcium oxy-hydroxide, which produces a controlled release of molecular oxygen into groundwater, was selected for the Site because it is a safe food-grade compound that has a long track record of success at sites throughout the U.S. and it is available in a number of forms (slurry, pellets, or "socks" that are deployed in wells), allowing flexibility in pilot test and remediation design. ORC Advanced®, like most substances intended to enhance aerobic bioremediation, normally must be injected two or more times to sufficiently stimulate aerobic biodegradation at a target location. ORC Advanced® specifications are included in Appendix A. The following sections describe the pilot test in detail.

4.1 Pilot Test Location

The pilot test was performed in the vicinity of and hydraulically downgradient from the pipeline release location and planned soil excavation, as shown on Figure 3. The pilot test location was selected because: (1) the test area is representative of Site-wide geological conditions; (2) dissolved-phase gasoline constituents in groundwater are generally highest in the portion of test area in the immediate vicinity of the release location; (3) groundwater levels and gradient in the test area are relatively stable; (4) dissolved oxygen concentrations in the test area (e.g., well MW-1) are below the aerobic threshold; and (5) the pilot test boring locations are in the NuStar pipeline easement.

4.2 Pilot Injection Boring and Monitoring Well Locations and Purpose

The pilot test consisted of advancement of borings at 12 locations. ORC Advanced® was introduced in nine temporary borings (IB-1 through IB-9), and three of the borings were completed as monitoring wells (MW-17 through MW-19).

4.2.1 Injection Wells

Nine temporary injection borings (IB-1 through IB-9) were advanced at the locations shown on Figure 2, and depicted in detail on Figure 3. The injection boring location and spacing are intended to introduce a sufficient quantity of ORC Advanced® into the target area to stimulate aerobic biodegradation of petroleum constituents in groundwater. The borings were used to inject ORC Advanced® into the saturated zone. Injection details are presented in Section 4.5.

4.2.2 Monitoring Wells

Monitoring wells MW-17 through MW-19 were installed at locations north and east of the injection wells to monitor groundwater quality and assess the effectiveness of ORC Advanced® for stimulating biodegradation of petroleum constituents. The wells are in positions inferred to be hydraulically downgradient and possibly crossgradient of the injection area. Other, previously installed monitoring wells in the vicinity of the injection area (e.g., monitoring wells MW-1, MW-4, and MW-5) were also used to monitor groundwater conditions.

4.3 Pilot Test Injection Boring and Monitoring Well Installation Procedures

Using sonic drilling equipment, soil borings were advanced to approximately 40 feet bgs at injection boring locations (IB-1 through IB-9) and approximately 45 feet bgs at monitoring well locations MW-17 through MW-19. The following sections briefly describe the methods used for drilling, soil logging, injection of ORC Advanced®, and monitoring well construction.

4.3.1 Drilling

The borings were completed using rotosonic drilling equipment. Sonic drilling equipment was used because it has the capability to penetrate the dense soil and bedrock at the Site and tooling is capable of pressurized injection of ORC Advanced®. Dual wall casing (4-inch inner casing and 6-inch outer casing) were used to obtain continuous soil cores and inject ORC Advanced®.

4.3.2 Soil Screening and Logging

Continuous soil samples were collected from the borings to evaluate hydrogeological conditions. Soil cores were extracted and soil lithology was logged in general accordance with ASTM 2487/2488. Soil samples were field screened at 2.5-foot intervals for VOCs and SPH using a photoionization detector (PID) and sheen tests. Soil lithology and field screening observations are discussed in Sections 5.1 and 5.2. Field notes are included in Appendix B and soil boring logs are included in Appendix C.

4.3.3 Pilot Test Well Construction

Pilot test monitoring wells MW-17 through MW-19 were installed in accordance with KDHE SOP BER-06 – Installation of Monitoring Wells. A 2-inch-diameter pilot test well, constructed using Schedule 40 polyvinyl chloride (PVC) casing and screen, was installed in each boring. The pilot test monitoring wells include 15-foot screen intervals that intersect the water table (27 – 42 feet bgs). Silica sand was placed in the screen interval annular space and two feet above the screen. Bentonite grout was emplaced in the annular space from the top of the sand pack to approximately one foot bgs. The pilot test wells were completed at the ground surface in flush-mount traffic-rated monuments. A well completion record (WWC-5) was completed for each well and submitted to KDHE (Appendix D).

4.3.4 Pilot Test Well Development

The pilot test wells were allowed to set for at least 24 hours prior to initiating well development. Wells were developed by over-pumping and surging to remove excess turbidity and improve hydraulic communication with the adjacent water-bearing zone.

4.3.5 Well and Borehole Well Location Control

The horizontal locations of the monitoring wells MW-17 through MW-19 were surveyed by Garber Land Surveying Service, P.A., a Kansas-licensed land surveyor. The top-of-well casing and cap elevations for monitoring wells were measured to the nearest hundredth of a foot, relative to mean sea level. The survey report in included in Appendix E. The location of each boring was recorded using a sub-meter grade Global Positioning System (GPS) instrument.

4.3.6 Investigation-Derived Waste

Investigation-derived waste (IDW) consisted of soil cuttings, excavated soil from well monument construction, decontamination water, purge water, and personal protection equipment (PPE). Soil IDW containers were labeled with the project name, general contents, and date. Soil IDW was transported to the NuStar El Dorado landfarm in accordance with KDHE authorization. Water IDW was temporarily stored on-site in 55-gallon drums, prior to being removed via vacuum truck and disposed of appropriately. PPE was disposed of as unregulated solid waste.

4.4 Groundwater Sampling and Analytical Program

In March, April, and June 2015, groundwater samples were collected from wells MW-1, MW-4, MW-5, and MW-17 through MW-19. Groundwater samples were collected from monitoring wells using low-flow sampling techniques. Prior to sampling, each monitoring well was purged using a peristaltic pump while water quality parameters (pH, temperature, specific conductance, dissolved oxygen, and oxidation-reduction potential [ORP]) were recorded. The baseline sampling data (March 2015) were obtained to evaluate aquifer conditions prior to implementation of the pilot test, and to provide a basis for subsequent evaluation of pilot test data.

Groundwater samples were submitted to an accredited analytical laboratory for the following analyses:

- GRO by Iowa Method OA-1;
- VOCs by EPA Method 8260B;
- Methane by method RSK-175;
- Potassium and iron by EPA Method SW6020;
- Nitrogen as nitrate, sulfate, and dissolved orthophosphate by EPA Method E300.0;
- Alkalinity by EPA Method 310.1;
- Carbon dioxide by Standard Method (SM) 9060A; and
- Ammonia by SM 4500.

The GRO and VOC analyses are intended to assess constituent concentrations in groundwater. The other analyses are used to evaluate for aerobic and anaerobic biodegradation of petroleum constituents.

4.5 ORC Advanced® Injection

Following baseline sampling, ORC Advanced® was injected at locations IB-1 through IB-9 using direct-injection techniques. Application specifications for ORC Advanced® were developed based on site-specific conditions (i.e. concentrations of dissolved-phase petroleum constituents and hydrological

conditions), and manufacturer recommendations. The specifications were provided in a Design Summary Report prepared by Regenesis, the manufacturer of ORC Advanced® (Appendix A). ORC Advanced® was mixed with water to form an injectable slurry which was then pressure injected (using an above-ground pump) into the saturated zone, within 30 minutes after preparing the slurry. KDHE policy stipulates a maximum injection pressure of 50 pounds per square inch (psi); however, at the first injection point (IB-7), the ORC Advanced® slurry was inadvertently injected at a higher pressure (100 psi). Apex staff advised the subcontractor that the maximum injection pressure specified in the Work Plan was 50 psi. Consequently, the ORC Advanced® slurry injection pressure was 50 psi at the remaining injection points. At each injection point, approximately 80 gallons of 20 percent ORC Advanced® slurry was injected from ten feet above to ten feet below the approximate groundwater surface elevation; this vertical profile was selected to accommodate seasonal groundwater fluctuations at the Site.

The injection radius at each location is dependent on the overall permeability of the surrounding formation and the effects of zones of higher and lower permeability. ORC Advanced® produces a controlled release of oxygen to groundwater; therefore, the radius of influence at each injection point is expected to significantly exceed the area affected by the initial injection.

5.0 Interim Results – March to June 2015

This section presents the analytical results for soil and groundwater collected during the Pilot Test implementation in the period March – June 2015. Laboratory data are listed in Tables 1 through 5. Laboratory reports and a laboratory data quality assurance/quality control (QA/QC) review are included in Appendix F.

5.1 Lithology

As previously discussed, borings completed during the groundwater pilot test were advanced using rotosonic drilling equipment. This technology allows the recovery of continuous soil cores under a range of challenging drilling conditions. Previous borings at the Site have been completed using direct-push, air rotary, hollow-stem auger, and solid stem auger drilling equipment, which provide less detail regarding subsurface conditions.

Yellowish brown silt was encountered between the ground surface and approximately 13 to 17 feet bgs. The silt was underlain by shale that exhibited a range of weathering and competency. In most borings, the uppermost shale was light brown to greenish-brown, dry, and hard, and the uppermost shale was underlain by interbedded shale, clay, and limestone. Calcite and gypsum were observed in some borings. Overall, geological conditions observed during the pilot test were consistent with the regional conditions described by O'Connor et al. (1982), and with conditions observed during previous phases of the investigation.

5.2 Soil Analytical Data

Petroleum constituents in soil in the Pilot Test area were evaluated during the groundwater pilot test using field screening methods and laboratory analytical data. Field screening was performed on continuous cores collected from each boring. Field indications of petroleum constituents in soil were generally absent in soil borings in the interval between from the ground surface to approximately 20 feet bgs. Field screening data (PID measurements) from some borings indicated the presence of petroleum constituents in the interval from approximately 20 to 32 feet bgs. Sheen tests indicated the presence of SPH in boring MW-17 at 22 feet bgs and boring IB-4 at 31 feet bgs. Field screening data are shown on boring logs included in Appendix C.

Based upon field screening observations, 15 soil samples were collected in the interval from 6 to 45 feet bgs from borings at locations IB-1, IB-4, IB-7, MW-17, and MW-19 and submitted for laboratory analysis. Soil data are presented in Table 2 and shown on Figure 7.

Petroleum constituents were detected at concentrations that exceed KDHE Tier 2 RBSVs in five of the 15 soil samples submitted for analysis: (1) boring IB-4 at 19.5 and 31 feet bgs; (2) boring IB-7 at 24 feet bgs; (3) boring MW-17 at 22 feet bgs; and (4) boring MW-19 at 32 feet bgs. The highest GRO concentrations (1,600 milligrams per kilogram [mg/kg]) and benzene (4.0 mg/kg) were detected in boring IB-4 in soil collected at approximately 31 feet bgs, which is located within the seasonally saturated zone and is indicative of groundwater conditions. At each boring, the gasoline affected soil intervals were overlain and underlain by unaffected soil, indicating that gasoline impacts to soil are limited to a relatively limited interval (19.5 to 32 feet bgs) that approximately corresponds to the depth of the groundwater interface. Soil analytical data are listed in Table 2 and shown on Figure 7.

5.3 Groundwater Elevations and Analytical Data

Groundwater quality in the pilot test area was characterized using data collected from monitoring wells MW-1, MW-4, MW-5, and MW-17 through MW-19; those wells were gauged and groundwater samples were collected in March, April and June. Table 2 lists groundwater elevations, Table 3 lists groundwater quality parameters, Table 4 and Figure 8 present dissolved-phase petroleum analytical data, and Table 5 and Figure 9 present monitored natural attenuation (MNA) parameters. Laboratory analytical reports and the QA/QC review are included in Appendix F.

5.3.1 Groundwater Elevations

As shown in Table 1 and Figures 4 through 6, groundwater measurements indicate that the groundwater levels in the pilot test area (wells MW-1, MW-4, MW-5, and MW-17 through MW-19) ranged between approximately 19 and 34 feet bgs (equivalent to approximately 1,317 to 1,333 feet MSL). In March 2015, groundwater elevations in wells MW-18 and MW-19 were significantly different compared to one another and nearby wells,

which is likely because groundwater in the newly installed wells had not reached an equilibrium state. In April and June, groundwater elevations in wells MW-18 and MW-19 were similar to groundwater elevations in surrounding wells.

Water level measurements indicate that groundwater gradients at the Site are controlled by local and regional systems. Locally, leakage from the stormwater retention pond leads to groundwater recharge and elevated groundwater levels near the pond. As shown on Figures 4 through 6, this recharge effect results in radial outward flow of groundwater from the pond and relatively steep groundwater gradients near the retention pond. During the March – June 2015 monitoring events, for example, groundwater near the northeast corner of the pond exhibited a steep northerly gradient of approximately 0.1 ft/ft (represented by wells MW-6 and MW-9). In contrast, during the same monitoring events, wells further from the pilot test area (north of West Mountain) exhibited a gradient in the range of 0.01 to 0.001 ft/ft.

5.3.2 Groundwater Analytical Data

Groundwater samples were collected from monitoring wells in the pilot test area (wells MW-1, MW-4, MW-5, and MW-17 through MW-19) in March, April, and June 2015. Groundwater quality parameters, including dissolved oxygen and ORP, are listed in Table 3; dissolved-phase petroleum constituent concentrations are listed in Table 4; and MNA parameters are listed in Table 5. Figures 8 and 9 depict the groundwater dissolved-phase petroleum constituents and MNA parameters, respectively.

Dissolved-Phase Petroleum Concentrations. During the March, April and June groundwater monitoring events, gasoline constituents were detected in pilot test area monitoring wells. In general, the observed concentrations of GRO, 1,2,4 trimethylbenzene, benzene, and naphthalene were above corresponding KDHE Tier 2 RBSVs. During the limited period between March and June, gasoline constituent concentrations: (1) were generally stable in monitoring well MW-19; (2) decreased in wells MW-4, MW-18 and MW-5; and (3) increased in monitoring wells MW-17 and MW-1. The highest concentrations of GRO (140 ppm) and benzene (5.2 mg/L) were detected in monitoring well MW-1, which is approximately 50 feet from the release location. This well has consistently exhibited the highest GRO concentrations at the Site, since it was installed in 2013. Dissolved-phase petroleum constituent concentrations were within the historical and expected ranges in pilot test area monitoring wells.

Outside the pilot test area, dissolved-phase constituent concentrations are significantly lower and exhibit a longer-term decreasing trend. Site-wide groundwater concentrations and trends are discussed in detail in quarterly groundwater monitoring reports (Apex, 2015b).

MNA Parameters. The MNA data, presented in Table 5 and on Figure 9, demonstrate that both aerobic and anaerobic microbial degradation of petroleum hydrocarbons are occurring in groundwater beneath the Site. The MNA data are interpreted below.

- Aerobic microbial degradation of petroleum hydrocarbons is a process during which available dissolved oxygen is consumed, resulting in negative ORP measurements. The source area wells (MW-17 through MW-19 and MW-1) show consistently low ORP measurements as compared to wells farther from the release location (MW-5 and MW-4), indicating that aerobic processes are occurring within the source area.
- Aerobic microbial degradation of petroleum hydrocarbons is a process during which carbon dioxide is produced. In general, the carbon dioxide concentrations in source area wells MW-1 and MW-17 are elevated compared to other wells, which suggests aerobic activity.
- After the oxygen is depleted as a result of aerobic processes, subsequent microbial activity occurs under anaerobic conditions. The anaerobic microbial degradation of petroleum hydrocarbons consumes sulfate and generates methane as a degradation byproduct.
    - Sulfate concentrations in source area wells (MW-17 through MW-19 and MW-1) are generally lower compared to wells farther from the release location (MW-5 and MW-4), indicating that anaerobic processes are occurring within the source area.
    - In general, the source area wells (MW-17 through MW-19, and MW-1) show higher methane concentrations compared to wells farther from the release location (MW-5 and MW-4), indicating that aerobic processes are occurring within the source area.
- Indications of oxygen rich environment (positive ORP values or lower methane concentrations) were not observed in wells near the ORC Advanced® injection locations.

While analytical data indicate that aerobic and anaerobic biodegradation of petroleum hydrocarbons in ongoing at the Site, the data set is currently insufficient to quantify the effects of the injection of ORC Advanced® on groundwater quality. The timeframe and area that are affected by ORC Advanced® are dependent on multiple factors, including the mass of ORC Advanced® injected into the subsurface, groundwater gradients, hydraulic conductivity, geological variability, and soil and groundwater geochemistry. Based upon the data collected through June 2015, it is likely that insufficient time has elapsed for oxygen amended groundwater to affect constituent concentrations at monitoring points. Accordingly, NuStar will continue to monitor the MNA parameters for the duration of the pilot test (through February 2016).

In summary, based on data collected during the three groundwater sampling events in March, April and June 2015, both aerobic and anaerobic microbial degradation of petroleum hydrocarbons are occurring in groundwater beneath the Site. These processes reduce the mass of petroleum hydrocarbons in the subsurface. The effects of the March 2015 injections of ORC Advanced® are currently not distinguishable from ongoing biodegradation processes. It is likely that insufficient time has elapsed for ORC Advanced® to significantly affect the biogeochemical system at monitoring points. In accordance with the Pilot Test Work Plan, NuStar will continue to monitoring groundwater in the pilot test area and elsewhere at the Site to measure the effectiveness of the pilot test and to assess overall groundwater quality.

6.0 Reporting and Schedule

In accordance with the *Groundwater Pilot Test Work Plan*, groundwater monitoring is schedule for August, October, December 2015 and February 2016. Groundwater data collected during these events will be used to further evaluate the effectiveness of ORC Advanced® as a groundwater remediation technology.

The final *Groundwater Pilot Test Implementation Report* will be submitted to KDHE approximately 60 days after receipt of final analytical data from the February 2016 monitoring event. The final report will include a compilation and evaluation of analytical data, including levels of dissolved oxygen in groundwater, indications of microbial activity, and gasoline constituent concentration trends. These data will be used to draw conclusions about the effectiveness of ORC Advanced® at the Site. If ORC Advanced® is determined to be effective and suitable for full-scale application, the report will include general design criteria for full-scale application as an interim remedial measure, including ORC Advanced® introduction methodology, injection point locations and spacing, ORC Advanced® replacement interval, a proposed monitoring program, and schedule. In the event that full-scale implementation is proposed, NuStar will coordinate with KDHE regarding design, implementation, and schedule. If results of the pilot test are inconclusive, NuStar will coordinate with KDHE regarding alternative remediation approaches.

7.0 References

Aber, J.S., 1991. *Surficial Geology of Butler County, Kansas, Final Report*. Earth Science Department, Emporia State University, KGS Open-File Report 1991-48. April 26, 1991.

Apex, 2013. *Soil Vapor Extraction Pilot Test Work Plan. Quail Crossing Neighborhood, Andover, Kansas.* November 15, 2013.

Apex, 2014a. *Soil Vapor Extraction Evaluation and Soil Investigation Report. Quail Crossing Neighborhood, Andover, Kansas.* March 28, 2014.

Apex, 2014b. *Comprehensive Investigation Report. Quail Crossing Neighborhood, Andover, Kansas.* April 30, 2014.

Apex, 2014c. *First Quarter 2014 Groundwater Monitoring Report. Quail Crossing Neighborhood, Andover, Kansas.* May 2, 2014.

Apex, 2014d. *Second Quarter 2014 Groundwater Monitoring Report. Quail Crossing Neighborhood, Andover, Kansas.* July 9, 2014.

Apex, 2014e. *Soil Investigation Report and Proposed Soil Excavation Work Plan. Quail Crossing Neighborhood, Andover, Kansas.* July 17, 2014.

Apex, 2015a. *Revised Groundwater Pilot Test Work Plan. Quail Crossing Neighborhood, Andover, Kansas.* January 16, 2015.

Apex, 2015b. *First Quarter 2015 Groundwater Monitoring Report. Quail Crossing Neighborhood, Andover, Kansas.* April 15, 2015.

Apex, 2015c. *Soil Excavation Work Plan. Quail Crossing Neighborhood, Andover, Kansas.* August 19, 2015.

O'Connor, Howard G., Chaffee, Pamela, and Link, Martha, 1982. *Geohydrology of Southwestern Butler County, Kansas: A Preliminary Report*. Kansas Geological Survey Open File Report 82-2. May 1982.

Table 1
Groundwater Gauging Data
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Measurement Date	Casing Diameter (inches)	Top of Casing Elevation (feet)[1]	Total Depth (feet bgs)	Screen Interval (feet bgs)	Depth to Groundwater (feet bgs)	Depth to SPH (feet)	SPH Thickness (feet)	Groundwater Elevation (feet MSL)
MW-1	1/7/2015	4.0	1352.13	35.0	20-35	31.75	--	--	1320.38
	1/14/2015					31.44	--	--	1320.69
	1/20/2015					31.45	--	--	1320.68
	1/28/2015					31.42	--	--	1320.71
	2/4/2015					31.44	--	--	1320.69
	2/9/2015					31.62	--	--	1320.51
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/20/2015					31.38	--	--	1320.75
	3/25/2015					NM	--	--	NM
	4/20/2015					31.39	--	--	1320.74
	6/10/2015					31.23	--	--	1320.90
	6/15/2015					31.31	--	--	1320.82
MW-2	1/7/2015	2.0	1353.17	44.0	29-44	NM	--	--	NM
	1/14/2015					32.90	--	--	1320.27
	1/20/2015					32.93	--	--	1320.24
	1/28/2015					32.89	--	--	1320.28
	2/4/2015					32.92	--	--	1320.25
	2/9/2015					33.15	--	--	1320.02
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					32.87	--	--	1320.30
	3/25/2015					NM	--	--	NM
	4/20/2015					36.43	--	--	1316.74
	6/10/2015					NM	--	--	NM
	6/15/2015					34.83	--	--	1318.34
MW-3	1/7/2015	2.0	1350.47	60.0	40-60	NM	--	--	NM
	1/14/2015					41.35	--	--	1309.12
	1/20/2015					41.36	--	--	1309.11
	1/28/2015					42.22	--	--	1308.25
	2/4/2015					41.12	--	--	1309.35
	2/9/2015					40.60	--	--	1309.87
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					41.02	--	--	1309.45
	3/25/2015					NM	--	--	NM
	4/20/2015					45.61	--	--	1304.86
	6/10/2015					NM	--	--	NM
	6/15/2015					38.21	--	--	1312.26

Please refer to notes at end of table.

Table 1
Groundwater Gauging Data
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Measurement Date	Casing Diameter (inches)	Top of Casing Elevation (feet)[1]	Total Depth (feet bgs)	Screen Interval (feet bgs)	Depth to Groundwater (feet bgs)	Depth to SPH (feet)	SPH Thickness (feet)	Groundwater Elevation (feet MSL)
MW-4	1/7/2015	2.0	1350.73	41.0	26-41	NM	--	--	NM
	1/14/2015					31.52	--	--	1319.21
	1/20/2015					31.55	--	--	1319.18
	1/28/2015					31.66	--	--	1319.07
	2/4/2015					31.70	--	--	1319.03
	2/9/2015					31.75	--	--	1318.98
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					31.22	--	--	1319.51
	3/25/2015					NM	--	--	NM
	4/20/2015					34.10	--	--	1316.63
	6/10/2015					29.28	--	--	1321.45
	6/15/2015					29.02	--	--	1321.71
MW-5	1/7/2015	2.0	1352.77	30.0	15-30	NM	--	--	NM
	1/14/2015					20.56	--	--	1332.21
	1/20/2015					20.55	--	--	1332.22
	1/28/2015					20.58	--	--	1332.19
	2/4/2015					20.69	--	--	1332.08
	2/9/2015					20.58	--	--	1332.19
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					20.80	--	--	1331.97
	3/25/2015					NM	--	--	NM
	4/20/2015					21.01	--	--	1331.76
	6/10/2015					19.44	--	--	1333.33
	6/15/2015					19.60	--	--	1333.17
MW-6	1/7/2015	2.0	1349.76	41.0	26-41	NM	--	--	NM
	1/14/2015					22.59	--	--	1327.17
	1/20/2015					22.45	--	--	1327.31
	1/28/2015					22.54	--	--	1327.22
	2/4/2015					22.59	--	--	1327.17
	2/9/2015					22.77	--	--	1326.99
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					22.62	--	--	1327.14
	3/25/2015					NM	--	--	NM
	4/20/2015					23.05	--	--	1326.71
	6/10/2015					NM	--	--	NM
	6/15/2015					20.45	--	--	1329.31

Please refer to notes at end of table.

Table 1
Groundwater Gauging Data
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Measurement Date	Casing Diameter (inches)	Top of Casing Elevation (feet)[1]	Total Depth (feet bgs)	Screen Interval (feet bgs)	Depth to Groundwater (feet bgs)	Depth to SPH (feet)	SPH Thickness (feet)	Groundwater Elevation (feet MSL)
MW-7	1/7/2015	2.0	1348.98	24.0	9-24	NM	--	--	NM
	1/14/2015					16.49	--	--	1332.49
	1/20/2015					16.55	--	--	1332.43
	1/28/2015					16.56	--	--	1332.42
	2/4/2015					16.56	--	--	1332.42
	2/9/2015					16.58	--	--	1332.40
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					16.63	--	--	1332.35
	3/25/2015					NM	--	--	NM
	4/20/2015					16.10	--	--	1332.88
	6/10/2015					NM	--	--	NM
	6/15/2015					14.91	--	--	1334.07
MW-8	1/7/2015	2.0	1353.38	30.0	15-30	NM	--	--	NM
	1/14/2015					21.64	--	--	1331.74
	1/20/2015					21.70	--	--	1331.68
	1/28/2015					21.72	--	--	1331.66
	2/4/2015					21.92	--	--	1331.46
	2/9/2015					21.88	--	--	1331.50
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					21.96	--	--	1331.42
	3/25/2015					NM	--	--	NM
	4/20/2015					22.25	--	--	1331.13
	6/10/2015					NM	--	--	NM
	6/15/2015					19.93	--	--	1333.45
MW-9	1/7/2015	2.0	1349.48	34.0	19-34	NM	--	--	NM
	1/14/2015					NM	--	--	NM
	1/20/2015					NM	--	--	NM
	1/28/2015					31.81	--	--	1317.67
	2/4/2015					31.90	--	--	1317.58
	2/9/2015					31.78	--	--	1317.70
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					31.59	--	--	1317.89
	3/25/2015					NM	--	--	NM
	4/20/2015					33.25	--	--	1316.23
	6/10/2015					NM	--	--	NM
	6/15/2015					29.83	--	--	1319.65

Please refer to notes at end of table.

Table 1
Groundwater Gauging Data
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Measurement Date	Casing Diameter (inches)	Top of Casing Elevation (feet)[1]	Total Depth (feet bgs)	Screen Interval (feet bgs)	Depth to Groundwater (feet bgs)	Depth to SPH (feet)	SPH Thickness (feet)	Groundwater Elevation (feet MSL)
MW-10	1/7/2015	2.0	1348.79	34.0	19-34	NM	--	--	NM
	1/14/2015					28.45	--	--	1320.34
	1/20/2015					28.42	--	--	1320.37
	1/28/2015					28.44	--	--	1320.35
	2/4/2015					28.49	--	--	1320.30
	2/9/2015					28.54	--	--	1320.25
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					28.42	--	--	1320.37
	3/25/2015					NM	--	--	NM
	4/20/2015					28.53	--	--	1320.26
	6/10/2015					NM	--	--	NM
	6/15/2015					28.30	--	--	1320.49
MW-11	1/7/2015	2.0	1351.34	42.0	22-42	NM	--	--	NM
	1/14/2015					28.88	--	--	1322.46
	1/20/2015					28.88	--	--	1322.46
	1/28/2015					28.97	--	--	1322.37
	2/4/2015					28.94	--	--	1322.40
	2/9/2015					29.26	--	--	1322.08
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/19/2015					29.84	--	--	1321.50
	3/25/2015					NM	--	--	NM
	4/20/2015					30.39	--	--	1320.95
	6/10/2015					NM	--	--	NM
	6/15/2015					28.31	--	--	1323.03
MW-12	1/7/2015	2.0	1349.74	43.0	23-43	NM	--	--	NM
	1/14/2015					NM	--	--	NM
	1/20/2015					31.04	--	--	1318.70
	1/28/2015					31.05	--	--	1318.69
	2/4/2015					31.07	--	--	1318.67
	2/9/2015					31.06	--	--	1318.68
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					30.95	--	--	1318.79
	3/25/2015					NM	--	--	NM
	4/20/2015					31.09	--	--	1318.65
	6/10/2015					NM	--	--	'NM
	6/15/2015					30.86	--	--	1318.88

Please refer to notes at end of table.

Table 1
Groundwater Gauging Data
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Measurement Date	Casing Diameter (inches)	Top of Casing Elevation (feet)[1]	Total Depth (feet bgs)	Screen Interval (feet bgs)	Depth to Groundwater (feet bgs)	Depth to SPH (feet)	SPH Thickness (feet)	Groundwater Elevation (feet MSL)
MW-13	1/7/2015	2.0	1354.58	45.0	25-45	NM	--	--	NM
	1/14/2015					33.06	--	--	1321.52
	1/20/2015					32.93	--	--	1321.65
	1/28/2015					32.85	--	--	1321.73
	2/4/2015					33.07	--	--	1321.51
	2/9/2015					32.81	--	--	1321.77
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					33.16	--	--	1321.42
	3/25/2015					NM	--	--	NM
	4/20/2015					33.34	--	--	1321.24
	6/10/2015					NM	--	--	NM
	6/15/2015					31.94	--	--	1322.64
MW-14	1/7/2015	2.0	1354.99	45.0	25-45	NM	--	--	NM
	1/14/2015					33.51	--	--	1321.48
	1/20/2015					33.59	--	--	1321.40
	1/28/2015					33.65	--	--	1321.34
	2/4/2015					33.88	--	--	1321.11
	2/9/2015					34.00	--	--	1320.99
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					33.94	--	--	1321.05
	3/25/2015					NM	--	--	NM
	4/20/2015					34.93	--	--	1320.06
	6/10/2015					NM	--	--	NM
	6/15/2015					31.70	--	--	1323.29
MW-15	1/7/2015	2.0	1351.79	45.0	25-45	NM	--	--	NM
	1/14/2015					NM	--	--	NM
	1/20/2015					34.93	--	--	1316.86
	1/28/2015					34.98	--	--	1316.81
	2/4/2015					35.12	--	--	1316.67
	2/9/2015					35.02	--	--	1316.77
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					35.04	--	--	1316.75
	3/25/2015					NM	--	--	NM
	4/20/2015					36.50	--	--	1315.29
	6/10/2015					NM	--	--	'NM
	6/15/2015					32.34	--	--	1319.45

Please refer to notes at end of table.

Table 1
Groundwater Gauging Data
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Measurement Date	Casing Diameter (inches)	Top of Casing Elevation (feet)[1]	Total Depth (feet bgs)	Screen Interval (feet bgs)	Depth to Groundwater (feet bgs)	Depth to SPH (feet)	SPH Thickness (feet)	Groundwater Elevation (feet MSL)
MW-16	1/7/2015	2.0	1352.13	45.0	25-45	NM	--	--	NM
	1/14/2015					NM	--	--	NM
	1/20/2015					30.71	--	--	1321.42
	1/28/2015					20.13	--	--	1332.00
	2/4/2015					30.76	--	--	1321.37
	2/9/2015					31.09	--	--	1321.04
	2/18/2015					NM	--	--	NM
	2/25/2015					NM	--	--	NM
	3/4/2015					NM	--	--	NM
	3/11/2015					NM	--	--	NM
	3/18/2015					31.80	--	--	1320.33
	3/25/2015					NM	--	--	NM
	4/20/2015					33.03	--	--	1319.10
	6/10/2015					NM	--	--	NM
	6/15/2015					29.48	--	--	1322.65
MW-17	3/18/2015	2.0	1351.69	43	27-43	NM	--	--	NM
	4/20/2015					33.91	--	--	1317.78
	6/10/2015					31.15	--	--	1320.54
	6/15/2015					31.28	--	--	1320.41
MW-18	3/18/2015	2.0	1351.11	43	27-43	27.93	--	--	1323.18
	4/20/2015					33.51	--	--	1317.60
	6/10/2015					30.50	--	--	1320.61
	6/15/2015					30.64	--	--	1320.47
MW-19	3/18/2015	2.0	1351.13	43	27-43	35.19	--	--	1315.94
	4/20/2015					33.70	--	--	1317.43
	6/10/2015					30.24	--	--	1320.89
	6/15/2015					30.60	--	--	1320.53
Stormwater Pond (Pond Stage [feet MSL])	1/7/2015	NA	NA	NA	NA	NA	NA	NA	NM
	1/14/2015								NM
	1/20/2015								1344.00
	1/28/2015								1343.80
	2/4/2015								1344.15
	2/9/2015								1344.10
	2/18/2015								NM
	2/25/2015								NM
	3/4/2015								NM
	3/11/2015								NM
	3/18/2015								1343.60
	3/25/2015								NM
	4/20/2015								1344.75
	6/10/2015								1344.50
	6/15/2015								1344.75

Notes:

1. feet MSL = Feet above mean sea level (NAVD88).
2. -- = No SPH
3. NM = Not measured.
4. Pond elevation is measured directly from a staff gauge in the pond (in 0.25-foot increments). The top of the staff gauge is 1347.59 feet above mean sea level.
5. NA = Not applicable.

Table 2
Soil Analytical Data - Borings
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Depth (feet bgs)	Sample Date	GRO	1,2,4 Trimethylbenzene	1,2 Dichloroethane	1,3,5-Trimethylbenzene	2-Butanone	Benzene	Cyclohexane	Ethylbenzene	Isopropylbenzene	m,p-Xylene	Methylcyclohexane	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	Toluene	Total Xylenes
			Concentrations in mg/kg (ppm)																
IB-1	16.5	3/14/2015	<0.05	0.0053	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.010
	24.0	3/14/2015	5.4	0.16	<0.005	0.056	0.056	0.11	0.077	0.059	0.013	--	0.034	0.037	0.013	0.036	--	0.18	0.21
IB-4	6.0	3/18/2015	<0.05	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.010
	19.5	3/18/2015	**100**	**5.7**	<0.05	1.4	<0.1	0.065	1.0	0.83	0.16	--	0.80	**0.56**	0.38	0.87	--	0.59	3.3
	31.0	3/18/2015	**1600**	**30**	<0.5	**17**	<0.99	**4.0**	11	21	2.3	--	10	**4.7**	4.1	11	--	40	81
	39.0	3/18/2015	0.29	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.010
IB-7	19.0	3/18/2015	<0.05	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.010
	24.0	3/18/2015	**590**	**8.6**	<0.05	3.1	0.33	**1.2**	5.6	5.7	0.35	--	0.96	**1.1**	0.42	1.5	--	11	21
	39.0	3/18/2015	<0.05	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.010
MW-17	19.0	3/12/2015	<0.05	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.01
	22.0	3/12/2015	30	**2.1**	<0.05	0.75	<0.1	0.16	0.51	1.3	0.11	--	0.26	0.23	0.13	0.38	--	0.48	5.2
	37.0	3/12/2015	<0.05	0.0065	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.01
MW-19	28.0	3/11/2015	<0.05	<0.005	<0.005	<0.005	<0.01	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.010
	32.0	3/11/2015	3.4	0.02	<0.005	0.16	0.021	**0.17**	0.076	0.081	0.025	--	0.052	0.073	0.053	0.089	--	0.17	0.48
	45.0	3/11/2015	<0.05	<0.005	<0.005	<0.005	<0.01	0.081	<0.005	<0.005	<0.005	--	<0.005	<0.005	<0.005	<0.005	--	<0.005	<0.01
KDHE Tier 2 Screening Value (soil to groundwater pathway)			**79.3**	**1.07**	**0.060**	**5.51**	**24.15**	**0.168**	**--**	**65.6**	**65.14**	**--**	**--**	**0.349**	**10.2**	**110**	**--**	**51.2**	**809**

Notes:

1. GRO = Gasoline-range organics quantified by IOWA OA-1.
2. Volatile organic compounds by U.S. Environmental Protection Agency (EPA) Method 8260B.
3. mg/kg (ppm) = Milligrams per kilogram (parts per million).
4. **Bold** indicates detected concentration above the KDHE screening value.
5. < = Not detected above the method reporting limit (MRL).
6. KDHE Tier 2 Screening Values from the *Risk-Based Standards for Kansas, 5th Edition* , October 2010.

Table 3
Groundwater Quality Parameters
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH	ORP
MW-1	1/30/2014	15.79	0.00	1,060	7.25	-52
	4/9/2014	19.22	5.52	979	6.98	-130
	7/23/2014	19.98	5.35	1,251	7.49	-110
	10/29/2014	15.81	3.21	1,369	6.97	-60
	2/12/2015	11.33	1.43	1,250	6.77	-57
	3/20/2015	16.71	1.16	1,388	6.75	-46
	4/20/2015	16.67	1.16	1,203	6.67	-46
	6/16/2015	16.50	0.95	1,311	7.01	-52
MW-2	1/30/2014	15.50	0.00	843	6.22	99
	4/8/2014	15.29	4.05	752	6.77	7
	7/22/2014	21.74	4.79	852	4.79	55
	10/30/2014	19.07	4.87	813	7.21	130
	2/10/2015	14.90	3.16	816	5.77	129
	6/16/2015	18.89	2.75	805	7.28	40
MW-3	1/30/2014	11.91	0.00	853	4.05	18
	4/8/2014	17.25	8.41	740	6.96	-11
	7/24/2014	25.79	2.89	971	7.18	-95
	10/30/2014	18.47	0.96	901	7.07	-236
	2/10/2015	16.27	0.93	940	6.68	-85
	6/17/2015	18.87	0.46	947	7.04	-83
MW-4	1/30/2014	14.01	2.78	1,130	5.46	158
	4/9/2014	14.99	2.54	968	6.95	132
	7/24/2014	20.53	0.57	1,135	7.24	-9
	10/30/2014	16.98	0.54	1,083	7.03	-146
	2/10/2015	16.62	1.07	1,044	6.54	-48
	3/20/2015	15.77	0.86	1,050	6.52	-30
	4/20/2015	17.43	0.86	719	7.02	-30
	6/16/2015	19.74	3.82	1,101	7.24	26
MW-5	1/30/2014	15.57	0.00	1,300	6.96	57
	4/8/2014	15.99	1.09	1,190	6.92	189
	7/23/2014	20.70	2.28	1,458	7.17	64
	10/29/2014	19.39	0.49	1,453	6.98	127
	2/10/2015	15.98	1.38	1,444	6.47	93
	3/20/2015	16.44	1.07	1,451	6.73	35
	4/20/2015	16.80	1.10	1,360	6.80	20
	6/16/2015	17.90	1.49	1,429	6.96	149
MW-6	1/30/2014	15.54	0.63	986	7.11	146
	4/9/2014	16.58	9.16	797	7.00	201
	7/24/2014	19.56	5.64	1,303	7.27	17
	10/29/2014	18.08	4.29	1,137	7.09	160
	2/11/2015	13.07	4.06	893	6.91	100
	6/17/2015	17.60	3.88	1,280	7.15	15
MW-7	1/30/2014	16.13	0.00	667	7.21	-37
	4/9/2014	15.78	9.43	566	7.08	23
	7/24/2014	18.24	0.66	740	7.38	-11
	10/29/2014	17.47	0.22	754	7.25	-33
	2/11/2015	15.25	0.80	662	6.93	18
	6/17/2015	17.16	0.60	868	7.27	-31

Please refer to notes at end of table.

Table 3
Groundwater Quality Parameters
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH	ORP
MW-8	1/30/2014	16.94	1.56	1,120	7.00	109
	4/8/2014	16.42	9.18	976	6.80	170
	7/22/2014	19.71	4.88	1,156	7.27	70
	10/29/2014	20.01	3.92	1,051	7.19	138
	2/10/2015	16.90	2.66	1,178	6.44	100
	6/17/2015	1926.00	3.16	1,209	7.18	110
MW-9	1/30/2014	12.13	0.00	760	4.50	8
	4/8/2014	16.65	4.05	725	7.07	192
	7/24/2014	23.24	3.59	1,080	7.11	48
	10/30/2014	16.72	5.61	977	7.08	98
	2/11/2015	15.06	3.13	884	7.05	91
	6/16/2015	19.40	0.67	1,247	7.16	61
MW-10	1/30/2014	14.31	0.00	1,340	4.90	-44
	4/8/2014	17.01	0.18	982	6.79	-105
	8/1/2014	21.23	9.61	1,236	7.59	77
	10/29/2014	19.71	1.80	1,302	6.90	88
	2/11/2015	13.84	1.67	984	6.88	99
	6/16/2015	19.13	0.55	1,439	7.28	47
MW-11	1/30/2014	16.22	6.91	1,320	6.54	185
	4/8/2014	16.61	6.09	1,140	7.05	199
	7/23/2014	20.17	2.45	1,438	7.24	100
	10/30/2014	18.55	4.02	1,404	7.11	91
	2/10/2015	16.66	4.01	1,314	6.61	72
	6/17/2015	18.94	1.78	1,463	7.12	120
MW-12	1/30/2014	14.13	0.00	927	5.44	66
	4/9/2014	19.96	8.58	774	7.01	30
	7/22/2014	24.34	0.85	1,067	7.11	-5
	10/29/2014	18.73	0.63	967	7.13	-67
	2/12/2015	15.09	1.11	906	6.78	45
	6/16/2015	20.24	2.43	1,014	7.15	50
MW-13	1/30/2014	15.00	6.53	774	7.04	158
	4/8/2014	15.35	7.03	674	6.93	109
	7/22/2014	23.53	8.10	790	7.31	76
	10/29/2014	19.97	6.70	767	7.19	135
	2/10/2015	15.74	4.85	759	6.25	110
	6/17/2015	1895.00	5.22	673	7.27	102
MW-14	1/30/2014	15.31	3.53	724	7.00	183
	4/9/2014	18.75	5.62	608	7.06	181
	7/22/2014	22.63	4.81	683	7.32	66
	10/29/2014	17.09	5.49	703	7.29	101
	2/12/2015	14.50	4.17	687	6.73	94
	6/17/2015	18.90	3.42	698	7.20	97

Please refer to notes at end of table.

Table 3
Groundwater Quality Parameters
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	Temperature (°C)	Dissolved Oxygen (mg/L)	Specific Conductivity (µS/cm)	pH	ORP
MW-15	1/30/2014	12.24	0.00	732	5.65	218
	4/8/2014	15.84	9.96	653	6.93	180
	7/23/2014	18.11	4.78	734	7.31	92
	10/29/2014	20.21	4.49	728	7.16	147
	2/10/2015	16.94	3.79	732	6.56	75
	6/17/2015	18.85	3.58	744	7.08	113
MW-16	1/30/2014	12.34	2.39	929	5.79	191
	4/8/2014	15.65	8.32	713	6.91	181
	7/23/2014	21.58	4.60	981	7.28	87
	10/29/2014	20.13	4.36	972	7.09	156
	2/10/2015	16.70	3.25	924	6.73	97
	6/17/2015	20.30	3.66	889	7.16	120
MW-17	3/20/2015	18.15	0.61	1057	6.81	42
	4/20/2015	16.87	0.83	1,012	6.70	-46
	6/16/2015	17.43	0.92	1,047	7.00	-10
MW-18	3/20/2015	17.43	0.68	990	6.89	-13
	4/20/2015	17.38	0.79	880	6.17	62
	6/16/2015	18.90	0.93	899	7.12	-18
MW-19	3/20/2015	17.83	1.57	905	7.09	50
	4/20/2015	17.11	1.36	841	6.62	-61
	6/16/2015	18.83	0.49	827	7.25	-82

Notes:

1. °C = Degrees Celsius.
2. mg/L = Milligrams per liter.
3. ORP = Oxidation-reduction potential.
4. Specific Conductivity was documented as mS/cm (millisiemens per centimeter) on the field sampling sheets. The value is reported in this table as millisiemens/centimeter (mS/cm).

Table 4
Groundwater Analytical Results – Monitoring and Pilot Test Wells
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	GRO	1,2,4 Trimethylbenzene	1,2 Dichloroethane	1,3,5- Trimethylbenzene	2-Butanone	Benzene	Cyclohexane	Ethylbenzene	Isopropylbenzene	m,p-Xylene	Methylcyclohexane	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	Toluene	Total Xylenes
		Concentrations in mg/L (ppm)																
MW-1	8/9/2013	**120**	**0.86**	<0.05	**0.22**	<0.1	**9.1**	0.37	**1.9**	<0.05	6.3	0.1	**0.23**	<0.05	0.068	2.8	**26**	9.1
	10/24/2013	**39**	**0.69**	<0.010	**0.19**	0.050	**7.8**	0.26	**2.0**	0.031	4.9	0.043	**0.14**	0.011	0.084	2.2	**18**	7.1
	1/30/2014	**44**	**1.0**	<0.025	**0.30**	<0.05	**3.1**	0.45	**1.4**	0.045	3.5	0.076	**0.29**	0.030	0.14	1.6	**9.3**	5.2
	4/9/2014	**20**	**0.49**	<0.010	**0.18**	<0.020	**1.1**	<0.01	0.2	0.011	--	0.023	**0.069**	0.018	0.016	--	**3.1**	2.5
	7/23/2014	**49**	**0.39**	<0.001	**0.11**	0.023	**3.1**	0.059	0.61	0.011	2.2	<0.010	**0.044**	<0.010	0.019	1.2	**6.4**	3.4
	10/29/2014	**45**	**0.47**	<0.010	**0.19**	<0.020	**5.0**	0.051	0.50	<0.010	3.4	0.015	**0.043**	<0.010	<0.010	2.2	**12**	5.5
	2/12/2015	**5.8**	<0.010	<0.010	<0.010	<0.020	**0.26**	<0.010	0.077	<0.010	0.64	0.016	**0.022**	<0.010	<0.010	0.36	0.99	0.99
	3/20/2015	**2.5**	**0.11**	0.0014	**0.044**	<0.0020	**0.052**	0.035	0.045	0.0029	0.16	0.01	**0.014**	0.008	0.0075	0.11	0.11	0.27
	4/20/2015	**7.0**	**0.074**	<0.001	**0.093**	<0.0020	**0.077**	0.072	0.11	0.15	0.39	0.023	**0.027**	0.019	0.025	0.21	0.25	0.60
	6/16/2015	**140**	**0.32**	<0.010	**0.30**	<0.020	**5.2**	0.12	0.47	0.011	5.3	<0.010	**0.11**	<0.010	0.012	2.8	**11**	8.1
MW-2	8/8/2013	**2.3**	<0.005	<0.005	<0.005	0.13	**0.12**	0.099	<0.005	<0.005	0.017	0.02	<0.005	<0.005	<0.005	<0.005	0.027	0.021
DUP	8/8/2013	**2.2**	<0.005	<0.005	<0.005	0.13	**0.15**	0.11	<0.005	<0.005	0.021	0.021	<0.005	<0.005	<0.005	<0.005	0.031	0.026
	10/23/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/22/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/30/2014	0.11	**0.0085**	<0.001	0.0030	<0.002	0.0034	0.0038	0.018	<0.001	0.010	0.0013	**0.0024**	<0.001	0.0014	0.0097	0.0095	0.020
	2/10/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
DUP	2/10/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/16/2015	0.089	<0.001	<0.001	<0.001	<0.002	0.0013	<0.001	<0.001	<0.001	0.0052	<0.001	<0.001	<0.001	<0.001	0.0026	0.0089	0.0078
MW-3	8/9/2013	**6**	**0.054**	<0.005	0.010	0.016	**1.2**	0.070	0.12	<0.005	0.086	0.014	**0.011**	<0.005	0.0074	0.12	0.4	0.21
	10/24/2013	**1.7**	**0.075**	<0.001	0.012	0.0057	**1.1**	0.082	0.12	0.0061	0.065	0.011	**0.017**	0.010	0.010	0.011	0.051	0.077
DUP	10/24/2013	**2.0**	**0.073**	<0.001	0.012	0.0059	**1.1**	0.077	0.11	0.0058	0.063	0.011	**0.018**	0.001	0.010	0.011	0.051	0.075
	1/28/2014	**2.8**	**0.038**	<0.001	<0.001	0.0069	**0.76**	0.072	0.07	0.0062	0.0098	0.0061	**0.0081**	<0.001	0.0079	<0.001	0.0081	0.011
	4/8/2014	**3.0**	**0.048**	<0.005	0.010	<0.01	**0.64**	<0.005	0.058	0.0061	--	0.0075	**0.014**	<0.005	0.011	--	0.1	0.053
	7/24/2014	**9.8**	**0.16**	<0.010	0.037	<0.020	**1.8**	0.081	0.51	<0.010	0.32	<0.010	**0.028**	<0.010	0.023	0.51	**1.6**	0.83
	10/30/2014	**6.1**	**0.12**	<0.010	0.025	<0.020	**1.1**	0.085	0.36	<0.010	0.17	0.019	**0.029**	<0.010	0.018	0.18	0.15	0.35
	2/10/2015	**7.9**	**0.19**	<0.010	**0.047**	<0.020	**1.4**	0.15	0.52	0.014	0.41	0.034	**0.054**	<0.010	0.032	0.32	0.93	0.73
	6/17/2015	**21**	**0.46**	<0.005	**0.11**	<0.01	**1.6**	0.016	**0.95**	0.030	0.92	0.029	**0.10**	0.031	0.078	0.57	**1.5**	1.5

Please refer to notes at end of table.

Table 4
Groundwater Analytical Results – Monitoring and Pilot Test Wells
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	GRO	1,2,4 Trimethylbenzene	1,2 Dichloroethane	1,3,5- Trimethylbenzene	2-Butanone	Benzene	Cyclohexane	Ethylbenzene	Isopropylbenzene	m,p-Xylene	Methylcyclohexane	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	Toluene	Total Xylenes
		Concentrations in mg/L (ppm)																
MW-4	8/8/2013	0.48	0.0013	<0.001	0.0013	<0.002	**0.035**	0.012	0.0075	0.0013	0.027	0.0027	**0.0027**	<0.001	0.0022	0.011	0.056	0.038
	10/23/2013	**1.0**	**0.0096**	<0.001	0.016	0.0046	**0.083**	0.050	0.017	<0.0010	0.0071	0.0085	**0.0036**	<0.001	0.0013	0.034	0.034	0.041
	1/28/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	**2.5**	**0.054**	<0.001	0.027	0.0043	**0.23**	0.070	0.15	0.0039	--	0.0071	**0.016**	0.0022	0.0084	--	0.2	0.14
	7/24/2014	**0.75**	**0.047**	<0.001	0.017	<0.002	**0.11**	0.022	0.049	0.0029	0.043	0.0027	**0.0092**	<0.001	0.0070	0.028	0.015	0.070
DUP	7/24/2014	**0.79**	**0.054**	<0.001	0.019	<0.002	**0.11**	0.025	0.057	0.0033	0.050	0.0031	**0.0098**	0.0017	0.0080	0.032	0.017	0.083
	10/30/2014	**4.8**	**0.20**	<0.001	**0.089**	<0.002	**0.49**	0.097	0.40	0.014	0.20	0.017	**0.062**	0.0078	0.039	0.24	0.33	0.44
	2/10/2015	**1.6**	**0.12**	<0.001	**0.058**	<0.002	**0.17**	0.052	0.12	0.0042	0.022	0.0092	**0.019**	0.0058	0.0077	0.081	0.042	0.10
	3/20/2015	**4.6**	**0.19**	<0.001	**0.088**	<0.002	**0.26**	0.094	0.20	0.012	0.099	0.014	**0.044**	0.0095	0.0220	0.13	0.18	0.23
	4/20/2015	0.083	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	0.0013	<0.001	0.0032	<0.001	**0.0017**	<0.001	<0.001	0.0015	0.0018	0.0047
	6/16/2015	0.14	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	0.0013	<0.001	0.0046	<0.001	<0.001	<0.001	<0.001	0.003	0.0059	0.0077
MW-5	8/8/2013	**0.94**	**0.015**	<0.001	**0.15**	<0.002	**0.038**	0.24	0.002	0.0018	0.11	0.0046	**0.0084**	<0.001	0.0023	0.0068	0.05	0.17
	10/24/2013	**2.1**	**0.098**	<0.001	0.028	<0.002	**0.081**	0.039	0.063	0.0051	0.20	0.0075	**0.023**	0.0026	0.011	0.12	0.10	0.32
	1/30/2014	**0.61**	**0.038**	0.0012	0.011	<0.002	**0.05**	0.018	0.034	0.0022	0.041	0.0017	**0.0086**	<0.001	0.0046	0.033	0.009	0.075
	4/8/2014	0.35 J	0.0051 J	<0.001	0.0013 J	0.0021 J	**0.025 J**	<0.001	0.0018 J	0.0021 J	--	0.0015 J	**0.0085 J**	<0.001	<0.001	--	0.0024 J	0.041 J
DUP	4/8/2014	**0.52 J**	**0.012 J**	<0.001	0.0035 J	0.0033 J	**0.037 J**	<0.001	0.0058 J	0.003 J	--	0.0019 J	**0.013 J**	0.001	0.0014 J	--	0.0061 J	0.06 J
	7/23/2014	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	**0.0014**	<0.001	<0.001	<0.001	<0.001	<0.003
DUP	7/23/2014	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	**0.0013**	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	<0.050	<0.001	<0.001	<0.001	<0.002	0.0018	<0.001	<0.001	<0.001	0.0048	<0.001	<0.001	<0.001	<0.001	0.0027	0.010	0.0075
	2/10/2015	0.27	**0.0092**	<0.001	0.0024	<0.002	**0.040**	0.016	0.0071	0.0020	0.0068	0.0030	**0.0069**	0.0016	0.0021	0.011	0.0092	0.018
	3/20/2015	0.2	<0.001	<0.001	<0.001	<0.002	**0.023**	<0.001	0.0015	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0010	<0.003
	4/20/2015	**1.5**	0.0015	<0.001	0.0062	<0.002	**0.057**	0.052	0.039	0.0052	0.024	0.0042	**0.022**	0.0019	0.0096	0.0072	0.012	0.031
	6/16/2015	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
MW-6	8/9/2013	<0.05	<0.001	<0.001	<0.001	0.0029	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	**0.0026**	<0.001	<0.001	<0.001	<0.001	<0.003
	10/24/2013	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
DUP	10/24/2013	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/30/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/24/2014	<0.05	<0.001	<0.001	<0.001	<0.002	0.0031	<0.001	0.0032	<0.001	0.0027	<0.001	<0.001	<0.001	<0.001	0.0031	0.0083	0.0059
	10/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	0.0028	<0.001	<0.001	<0.001	<0.001	0.0014	0.0052	0.0042
	2/11/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
DUP	2/11/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003

Please refer to notes at end of table.

Table 4
Groundwater Analytical Results – Monitoring and Pilot Test Wells
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	GRO	1,2,4 Trimethylbenzene	1,2 Dichloroethane	1,3,5- Trimethylbenzene	2-Butanone	Benzene	Cyclohexane	Ethylbenzene	Isopropylbenzene	m,p-Xylene	Methylcyclohexane	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	Toluene	Total Xylenes
		Concentrations in mg/L (ppm)																
MW-7	8/9/2013	<0.05	<0.001	<0.001	<0.001	<0.002	0.0012	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0014	<0.003
	10/24/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/30/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/24/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0016	<0.003
	10/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0024	<0.003
	2/11/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	0.089	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
MW-8	8/8/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/24/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/30/2014	0.16	0.0026	<0.001	0.001	<0.002	0.0030	<0.001	0.0049	<0.001	0.013	<0.001	**0.0041**	<0.001	<0.001	0.0056	0.02	0.018
DUP	1/30/2014	0.15	0.0031	<0.001	0.001	<0.002	0.0038	<0.001	0.0056	0.0011	0.014	<0.001	**0.0040**	<0.001	<0.001	0.0064	0.025	0.021
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/22/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	0.0014	<0.001	<0.001	<0.001	0.0041	<0.001	<0.001	<0.001	<0.001	0.0024	0.0082	0.0065
DUP	10/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	0.0013	<0.001	<0.001	<0.001	0.0041	<0.001	<0.001	<0.001	<0.001	0.0021	0.0081	0.0063
	2/10/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0017	<0.003
MW-9	8/9/2013	**36**	**0.82**	<0.001	**0.23**	0.23	**0.99**	0.21	0.65	0.025	2.8	0.048	**0.17**	0.014	0.068	1.3	**4.4**	4.1
	10/23/2013	0.054	<0.001	<0.001	<0.001	<0.002	0.0026	0.0011	<0.001	<0.001	<0.002	0.0025	**0.001**	<0.001	<0.001	<0.001	<0.001	<0.003
	11/25/2013	**0.57**	**0.022**	<0.010	0.013	0.004	**0.058**	0.017	0.0019	<0.001	0.019	0.0028	**0.0084**	<0.001	<0.001	0.018	0.005	0.037
	1/28/2014	0.058	<0.001	<0.001	<0.001	<0.002	0.0046	0.0015	<0.001	<0.001	<0.002	<0.001	**0.0033**	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
DUP	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/24/2014	<0.05	<0.001	<0.001	<0.001	<0.002	0.0017	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0034	<0.003
	10/30/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0026	<0.003
DUP	10/30/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0023	<0.003
	2/11/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/16/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0053	<0.003
MW-10	8/9/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/23/2013	**2.6**	**0.033**	<0.001	0.029	0.014	**0.051**	0.069	0.0034	<0.001	0.27	0.021	**0.0013**	0.0014	<0.001	0.15	0.14	0.42
	11/25/2013	**3.7**	**0.22**	<0.001	**0.072**	0.019	**0.016**	0.081	0.027	0.0065	0.26	0.016	**0.023**	<0.001	0.025	0.12	0.048	0.38
	1/28/2014	**1.1**	**0.12**	<0.001	0.039	0.0023	**0.026**	0.0081	0.036	0.0049	0.073	0.0036	**0.014**	0.0064	0.015	0.05	0.048	0.12
	4/8/2014	**8.8**	**0.56**	<0.005	**0.23**	<0.01	**0.12**	<0.005	0.11	0.011	--	0.026	**0.035**	<0.005	<0.005	--	0.3	1.1
	8/1/2014	0.091	<0.001	<0.001	<0.001	0.0066	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	0.066	<0.001	<0.001	<0.001	<0.002	0.0021	<0.001	<0.001	<0.001	0.0058	<0.001	<0.001	<0.001	<0.001	0.0034	0.013	0.0092
	2/11/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/16/2015	0.35	<0.001	<0.001	<0.001	0.0029	0.0024	0.0032	<0.001	<0.001	0.0040	0.0045	<0.001	<0.001	<0.001	0.0021	0.0068	0.0062

Please refer to notes at end of table.

Table 4
Groundwater Analytical Results – Monitoring and Pilot Test Wells
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	GRO	1,2,4 Trimethylbenzene	1,2 Dichloroethane	1,3,5- Trimethylbenzene	2-Butanone	Benzene	Cyclohexane	Ethylbenzene	Isopropylbenzene	m,p-Xylene	Methylcyclohexane	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	Toluene	Total Xylenes
		Concentrations in mg/L (ppm)																
MW-11	10/23/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	0.0024	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	0.0024	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/23/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/30/2014	0.25	0.016	<0.001	0.0058	<0.02	**0.012**	0.0078	0.038	0.0011	0.021	0.0014	**0.0059**	<0.001	0.0024	0.023	0.023	0.044
	2/10/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	0.0010	<0.001	<0.002	<0.001	**0.0034**	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0032	<0.003
DUP	6/17/2015	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0035	<0.003
MW-12	10/23/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	0.0026	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/28/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/9/2014	0.081	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/22/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	0.12	0.0011	<0.001	<0.001	<0.002	**0.0050**	<0.001	0.0017	<0.001	0.010	<0.001	<0.001	<0.001	<0.001	0.0063	0.027	0.016
	2/12/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	0.0054	<0.001	<0.001	<0.001	<0.001	0.0029	0.0064	0.0083
	6/16/2015	0.061	<0.001	<0.001	<0.001	<0.002	0.0014	<0.001	0.0013	<0.001	0.0058	<0.001	<0.001	<0.001	<0.001	0.0028	0.011	0.0086
MW-13	10/23/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	0.0032	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/30/2014	0.072	0.0014	<0.001	<0.001	<0.002	0.0011	<0.001	0.0024	<0.001	0.0063	<0.001	**0.0038**	<0.001	<0.001	0.0026	0.0083	0.0089
	4/8/2014	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/22/2014	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	0.056	<0.001	<0.001	<0.001	<0.002	0.0028	<0.001	0.0011	<0.001	0.0065	<0.001	<0.001	<0.001	<0.001	0.0040	0.015	0.011
	2/10/2015	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	<0.050	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0019	<0.003
MW-14	10/23/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/30/2014	<0.05	0.0011	<0.001	<0.001	<0.002	<0.001	<0.001	0.0016	<0.001	0.0043	<0.001	<0.001	<0.001	<0.001	0.0017	0.0059	0.0061
	4/9/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/22/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	**0.54**	0.0029	<0.001	0.0013	<0.002	**0.021**	<0.001	0.0049	<0.001	0.036	<0.001	<0.001	<0.001	<0.001	0.022	0.10	0.058
	2/12/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0016	<0.003
MW-15	10/24/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	0.0026	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/28/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	0.0026	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/23/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	0.0012	<0.001	<0.001	<0.001	0.0030	<0.001	<0.001	<0.001	<0.001	0.0018	0.0072	0.0048
	2/10/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0043	<0.003

Please refer to notes at end of table.

Table 4
Groundwater Analytical Results – Monitoring and Pilot Test Wells
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Sample Location	Sample Date	GRO	1,2,4 Trimethylbenzene	1,2 Dichloroethane	1,3,5- Trimethylbenzene	2-Butanone	Benzene	Cyclohexane	Ethylbenzene	Isopropylbenzene	m,p-Xylene	Methylcyclohexane	Naphthalene	n-Butylbenzene	n-Propylbenzene	o-Xylene	Toluene	Total Xylenes
		Concentrations in mg/L (ppm)																
MW-16	10/23/2013	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	0.0027	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	1/28/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
DUP	1/28/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	4/8/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.001	<0.001	<0.001	--	<0.001	<0.003
	7/23/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	10/29/2014	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	0.0026	<0.001	<0.001	<0.001	<0.001	0.0014	0.0050	0.0040
	2/10/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.003
	6/17/2015	<0.05	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.002	<0.001	<0.001	<0.001	<0.001	<0.001	0.0029	<0.003
MW-17	3/20/2015	**8.9**	**0.14**	<0.001	0.043	<0.002	**0.80**	0.11	0.14	0.006	0.5	0.0099	**0.020**	0.0022	0.007	0.30	0.79	0.80
	4/20/2015	**5.1**	**0.020**	<0.001	0.022	<0.002	**0.36**	0.075	0.084	0.098	0.23	0.0087	**0.0072**	<0.001	0.0052	0.13	0.29	0.36
	6/16/2015	**95**	**0.19**	<0.001	**0.31**	0.04400	**2.0**	0.37	**1.5**	0.044	3.4	0.038	**0.14**	0.015	0.10	1.8	**6.8**	5.2
MW-18	3/20/2015	**40**	**0.45**	<0.001	0.13	<0.002	**2.0**	0.23	0.56	0.02	2.3	0.031	**0.097**	0.0077	0.027	1.2	**6.2**	3.4
	4/20/2015	**4.4**	**0.016**	<0.001	0.016	<0.002	**0.20**	0.032	0.091	0.094	0.24	0.0039	**0.0087**	<0.001	0.0061	0.13	0.52	0.37
	6/16/2015	**6.3**	**0.021**	<0.001	0.021	<0.002	**0.26**	0.036	0.12	0.0041	0.24	0.0035	**0.015**	0.0016	0.0089	0.17	0.59	0.41
MW-19	3/20/2015	**2.2**	**0.039**	<0.001	0.011	0.0098	**0.14**	0.033	0.0057	<0.001	0.17	0.0021	**0.0037**	<0.001	<0.001	0.098	0.16	0.27
	4/20/2015	**1.5**	0.0054	<0.001	0.0053	<0.002	**0.096**	0.018	0.027	0.027	0.060	0.0020	**0.0038**	<0.001	0.0022	0.037	0.088	0.098
	6/16/2015	**0.99**	**0.024**	<0.001	0.0074	<0.002	**0.11**	0.013	0.045	0.0015	0.160	<0.0010	**0.0029**	<0.001	0.0031	0.068	0.30	0.23
DUP	6/16/2015	**2.5**	0.0071	<0.001	0.0062	<0.002	**0.11**	0.012	0.046	0.0016	0.130	<0.0010	**0.0051**	<0.001	0.0027	0.067	0.30	0.19
KDHE Tier 2 Values		**0.5**	**0.00844**	**0.005**	**0.044**	**4.92**	**0.005**	**7.02**	**0.7**	**0.45**	**--**	**--**	**0.00111**	**0.169**	**0.66**	**--**	**1**	**10**

Notes:

1. GRO = Gasoline-range organics quantified by IOWA OA-1.
2. Volatile organic compounds by U.S. Environmental Protection Agency (EPA) Method 8260B.
3. mg/L (ppm) = Milligrams per liter (parts per million).
4. **Bold** indicates detected concentration above the KDHE screening value.
5. < = Not detected above the method reporting limit (MRL).
6. -- = Not analyzed or not established.
7. KDHE Tier 2 Screening Values from the *Risk-Based Standards for Kansas, 5th Edition*, October 2010.
8. J = Estimated concentration. See Appendix C for more information.

Table 5
Monitored Natural Attenuation Parameters
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Sample Date	Results (mg/L)										
		Total Alkalinity (As CaCO3)	Dissolved Iron	Methane	Potassium	Nitrogen as Nitrate	Sulfate	Orthophosphate	Nitrogen/ Ammonia	Carbon Dioxide	Dissolved Oxygen	ORP (mV)
MW-1	3/20/2015	537.00	<0.20	0.097	1.57	0.161	8.08	0.16	<0.20	86	1.16	-46
	4/20/2015	465.00	<0.20	0.132	5.87	0.288	6.17	0.48	<0.20	81	0.75	-78
	6/16/2015	503.00	<0.20	0.008	0.935	0.257	36	<0.10	<0.20	81	0.95	-52
MW-4	3/20/2015	467.00	<0.20	0.039	1.30	0.468	41.4	<0.10	<0.20	62	0.86	-30
	4/20/2015	319.00	<0.20	0.042	2.44	1.12	45.1	<0.10	<0.20	20	2.71	-25
	6/16/2015	419.00	<0.20	<0.0005	1.72	1.96	117	<0.10	<0.20	30	3.82	26
MW-5	3/20/2015	446.00	<0.20	0.002	0.67	5.78	167	<0.10	<0.20	48	1.07	35
	4/20/2015	434.00	<0.20	0.003	0.66	3.55	176	<0.10	<0.20	23	1.10	20
	6/16/2015	491.00	<0.20	0.002	0.68	5.18	162	<0.10	<0.20	60	1.49	149
MW-17	3/20/2015	430.00	<0.20	0.005	18.40	0.175	39.5	<0.10	<0.20	63	0.61	42
	4/20/2015	455.00	<0.20	0.003	15.70	0.280	36.0	<0.10	<0.20	40	0.83	-46
	6/16/2015	471.00	<0.20	0.011	2.21	0.258	32.8	<0.10	<0.20	72	0.92	-10
MW-18	3/20/2015	394.00	<0.20	0.006	7.63	0.175	27.8	<0.10	<0.20	44	0.68	-13
	4/20/2015	343.00	<0.20	0.008	21.60	0.415	38.0	<0.10	<0.20	35	0.79	62
	6/16/2015	406.00	<0.20	0.004	9.15	0.387	27.0	<0.10	<0.20	42	0.93	-18
MW-19	3/20/2015	361.00	<0.20	0.002	8.95	0.466	60.7	<0.10	<0.20	23	1.57	50
	4/20/2015	332.00	<0.20	0.003	10.70	0.258	53.5	<0.10	<0.20	18	1.36	-61
	6/16/2015	349.00	<0.20	0.005	7.75	0.222	40.6	<0.10	<0.20	22	0.49	-82
DUP	6/16/2015	351.00	<0.20	0.007	8.17	0.216	40.0	<0.10	<0.20	21	NM	NM

Notes:

1. mg/L = Milligrams per liter.
2. mV = Millivolts.
3. < = Analyte not detected at the reporting limit shown.
4. NM = Not measured.

Table 5
Monitored Natural Attenuation Parameters
Groundwater Pilot Test
Andover Quail Crossing Release Site
Andover, Kansas

Well ID	Sample Date	Results (mg/L)										
		Total Alkalinity (As CaCO3)	Dissolved Iron	Methane	Potassium	Nitrogen as Nitrate	Sulfate	Orthophosphate	Nitrogen/ Ammonia	Carbon Dioxide	Dissolved Oxygen	ORP (mV)
MW-1	3/20/2015	537.00	<0.20	0.097	1.57	0.161	8.08	0.16	<0.20	86	1.16	-46
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	6/16/2015	503.00	<0.20	0.008	0.935	0.257	36	<0.10	<0.20	81	0.95	-52
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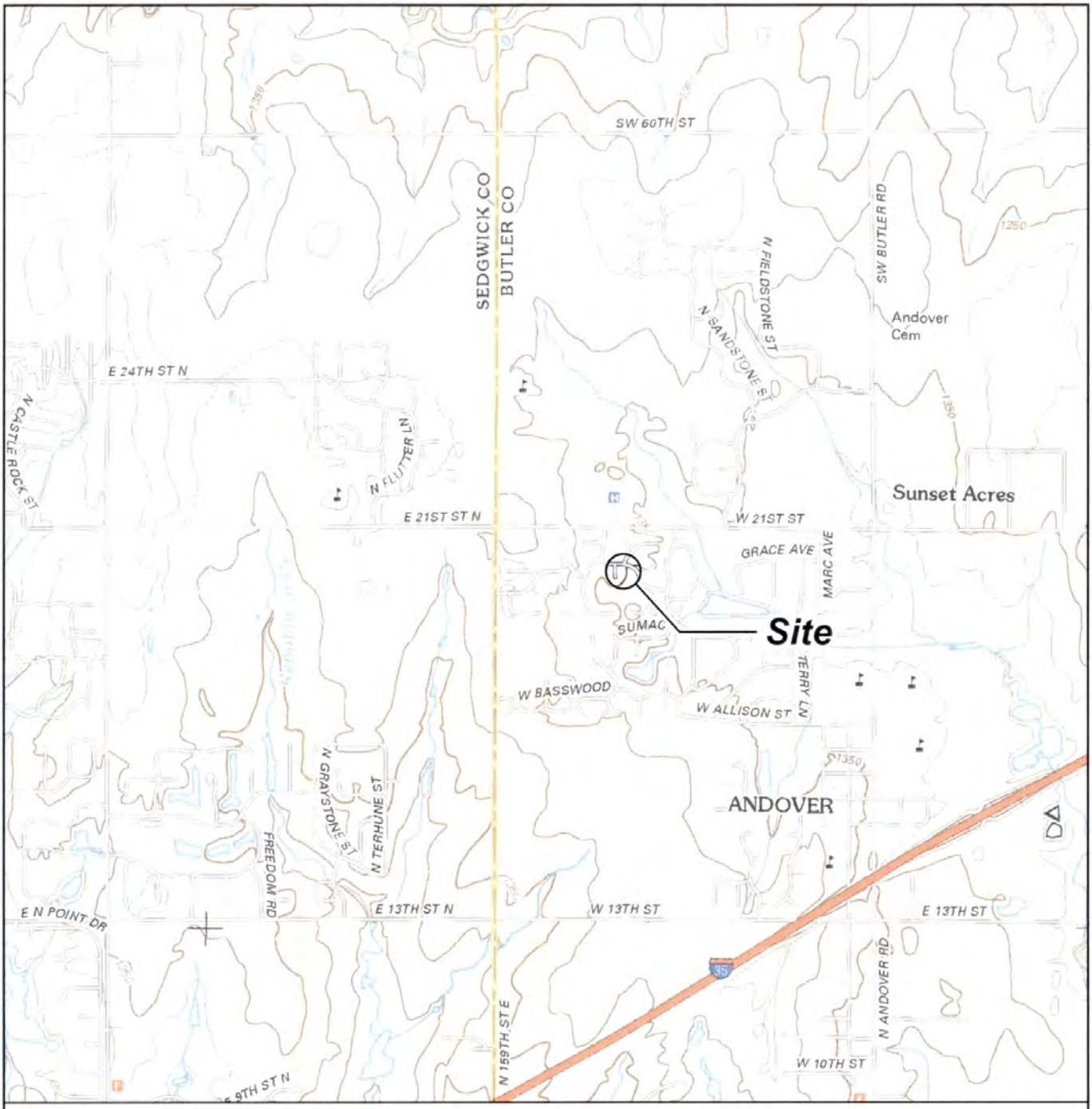
	6/16/2015	419.00	<0.20	<0.0005	1.72	1.96	117	<0.10	<0.20	30	3.82	26
MW-5	3/20/2015	446.00	<0.20	0.002	0.67	5.78	167	<0.10	<0.20	48	1.07	35
	4/20/2015	434.00	<0.20	0.003	0.66	3.55	176	<0.10	<0.20	23	1.10	20
	6/16/2015	491.00	<0.20	0.002	0.68	5.18	162	<0.10	<0.20	60	1.49	149
MW-17	3/20/2015	430.00	<0.20	0.005	18.40	0.175	39.5	<0.10	<0.20	63	0.61	42
	4/20/2015	455.00	<0.20	0.003	15.70	0.280	36.0	<0.10	<0.20	40	0.83	-46
	6/16/2015	471.00	<0.20	0.011	2.21	0.258	32.8	<0.10	<0.20	72	0.92	-10
MW-18	3/20/2015	394.00	<0.20	0.006	7.63	0.175	27.8	<0.10	<0.20	44	0.68	-13
	4/20/2015	343.00	<0.20	0.008	21.60	0.415	38.0	<0.10	<0.20	35	0.79	62
	6/16/2015	406.00	<0.20	0.004	9.15	0.387	27.0	<0.10	<0.20	42	0.93	-18
MW-19	3/20/2015	361.00	<0.20	0.002	8.95	0.466	60.7	<0.10	<0.20	23	1.57	50
	4/20/2015	332.00	<0.20	0.003	10.70	0.258	53.5	<0.10	<0.20	18	1.36	-61
	6/16/2015	349.00	<0.20	0.005	7.75	0.222	40.6	<0.10	<0.20	22	0.49	-82
DUP	6/16/2015	351.00	<0.20	0.007	8.17	0.216	40.0	<0.10	<0.20	21	NM	NM

Notes:

1. mg/L = Milligrams per liter.
2. mV = Millivolts.
3. < = Analyte not detected at the reporting limit shown.
4. NM = Not measured.



Note: Base map prepared from USGS 7.5-minute quadrangles of Andover, KS, dated 2012 as provided by USGS.gov.

0 2,000 4,000

Approximate Scale in Feet

N

Site Location Map

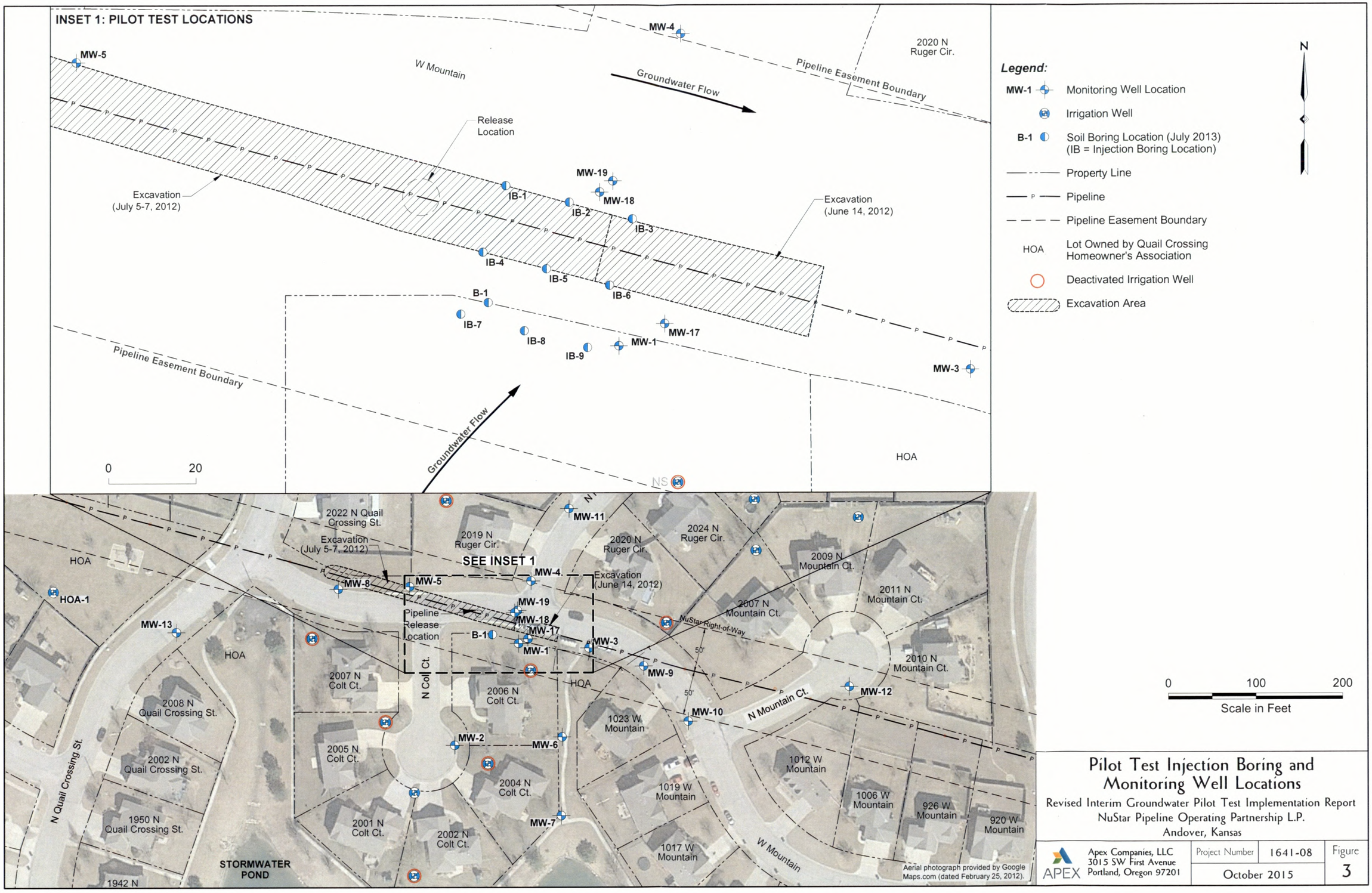
Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

APEX Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201	Project Number	1641-08	Figure
	October 2015		1

Site Plan and Pilot Test Location Map

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

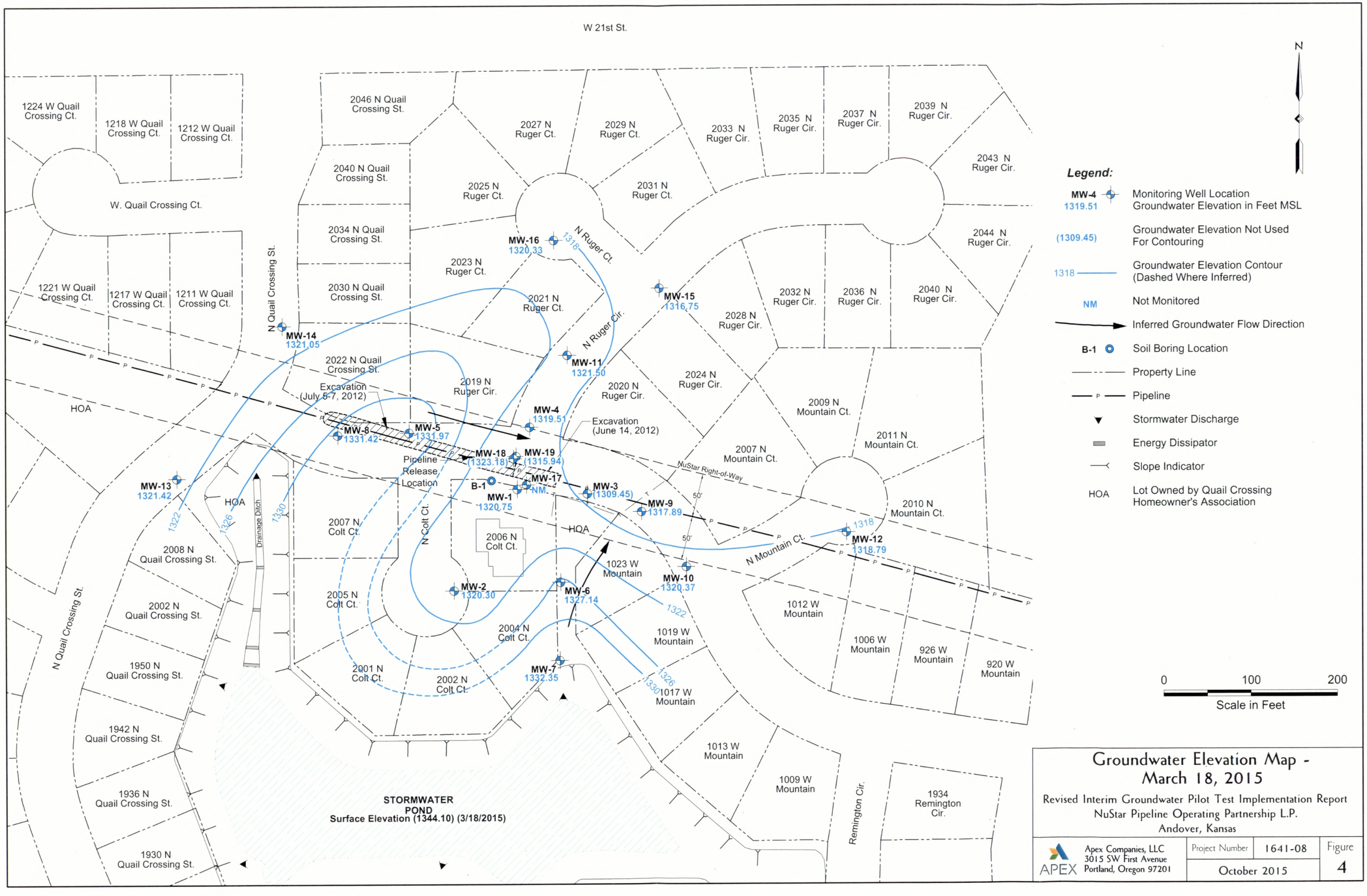
APEX Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201	Project Number	1641-08	Figure
	October 2015		2



Pilot Test Injection Boring and Monitoring Well Locations

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

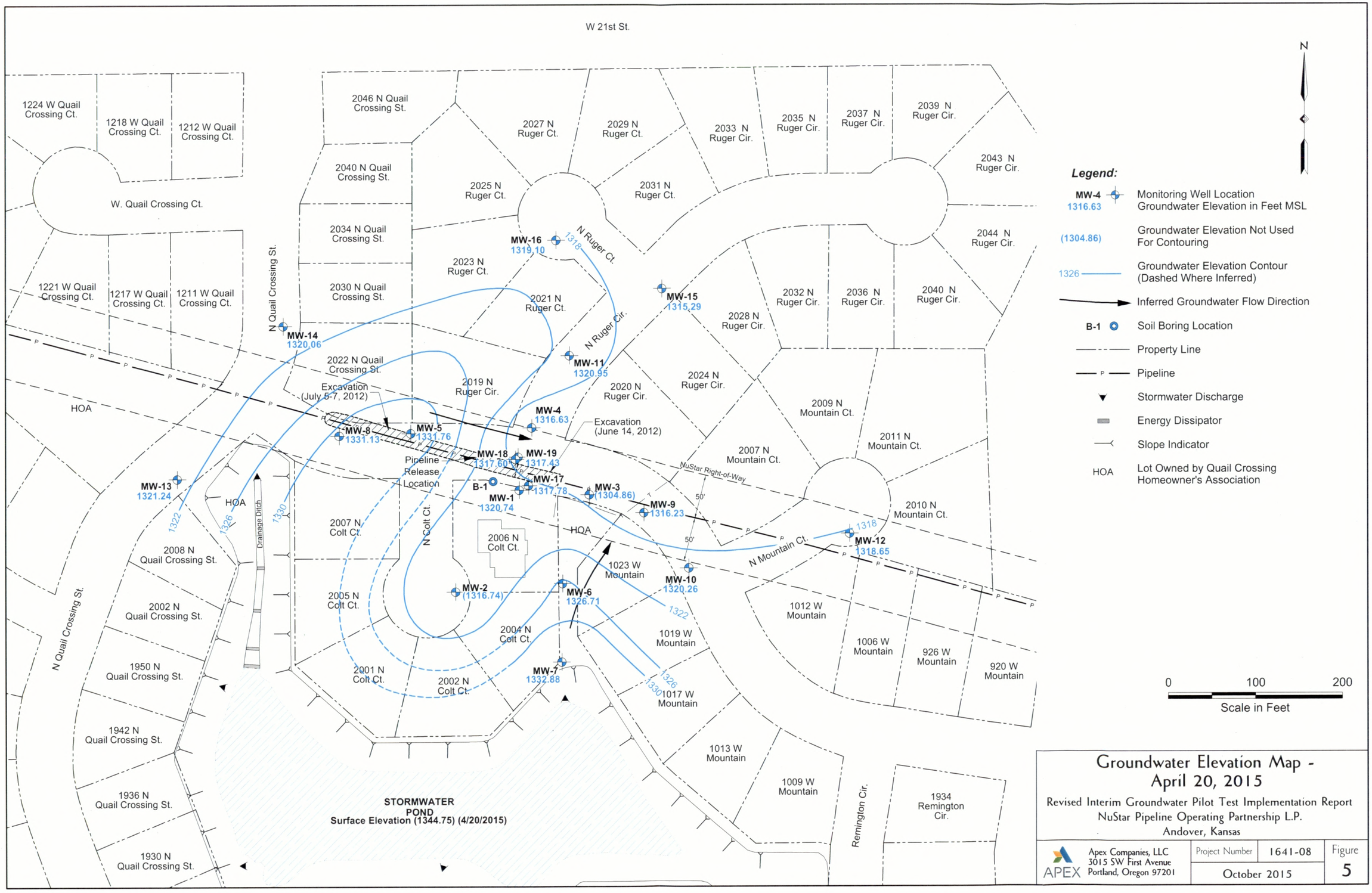
APEX	Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201	Project Number 1641-08 October 2015	Figure 3



Groundwater Elevation Map - March 18, 2015

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

APEX Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201	Project Number	1641-08	Figure
	October 2015		4

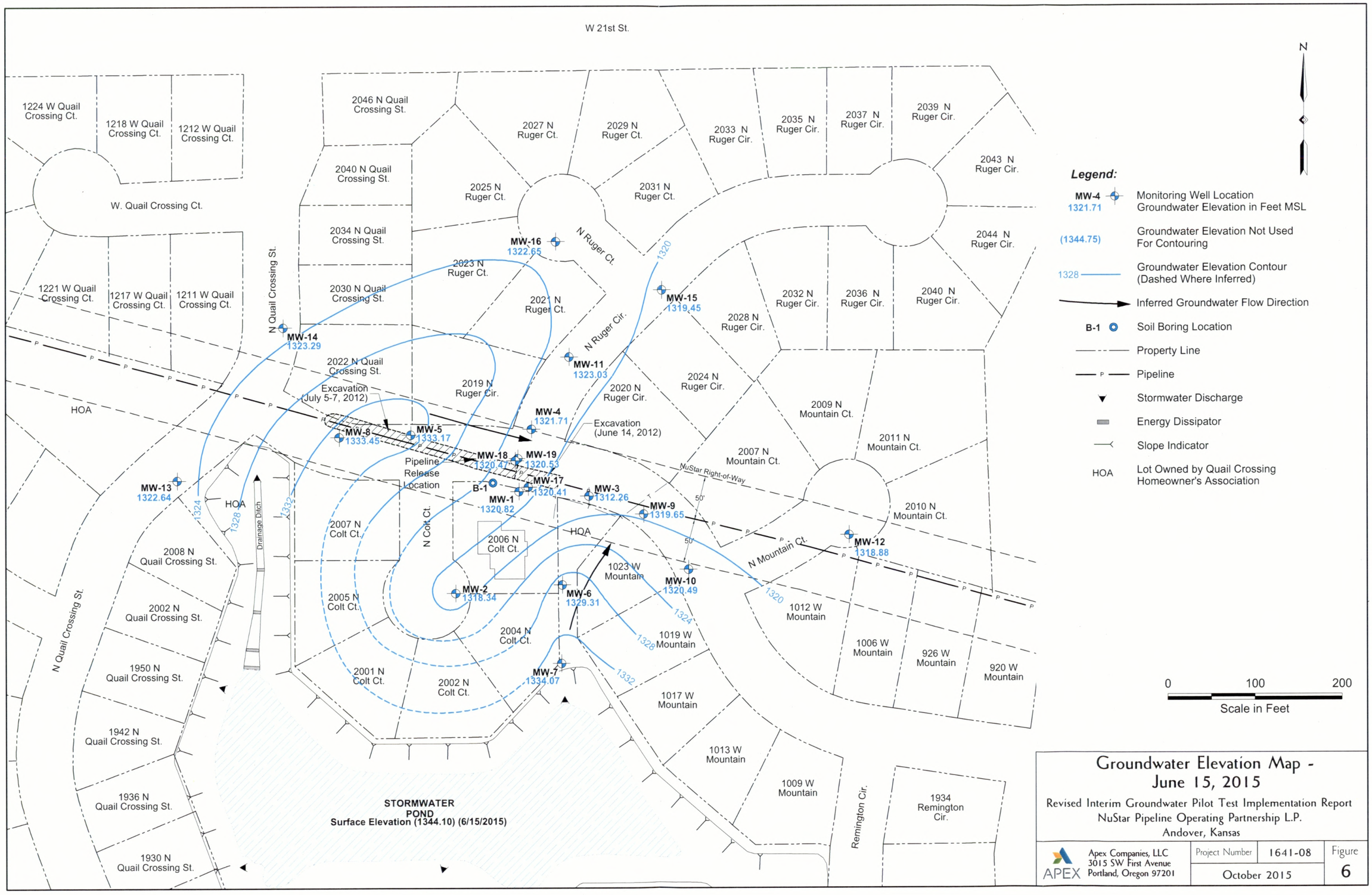


Groundwater Elevation Map - April 20, 2015

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

APEX
Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

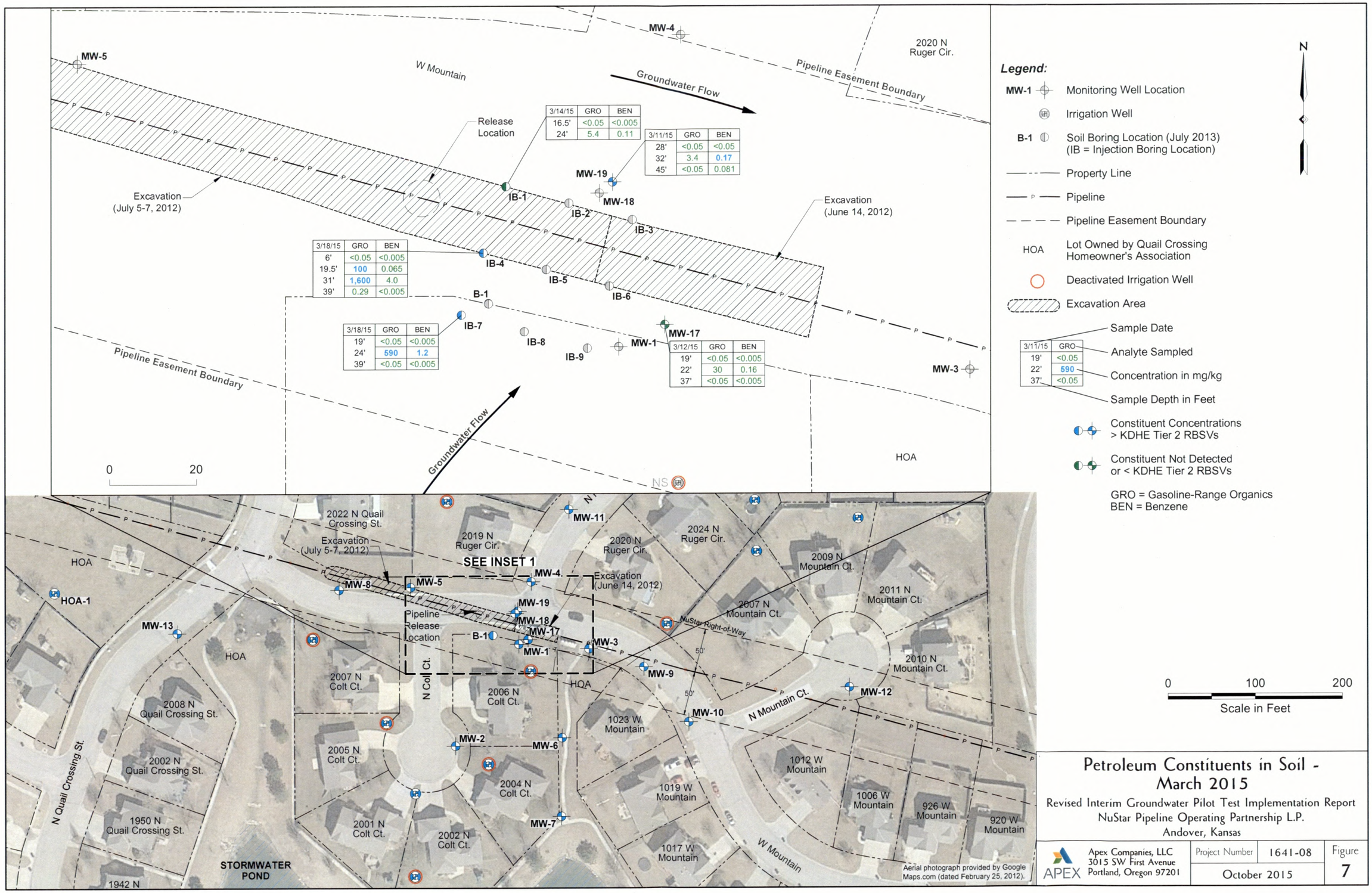
Project Number	1641-08	Figure
October 2015		5



Groundwater Elevation Map - June 15, 2015

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

APEX Apex Companies, LLC 3015 SW First Avenue Portland, Oregon 97201	Project Number	1641-08	Figure
	October 2015		6



3/14/15	GRO	BEN
16.5'	<0.05	<0.005
24'	5.4	0.11

3/11/15	GRO	BEN
28'	<0.05	<0.05
32'	3.4	0.17
45'	<0.05	0.081

3/18/15	GRO	BEN
6'	<0.05	<0.005
19.5'	100	0.065
31'	1,600	4.0
39'	0.29	<0.005

3/18/15	GRO	BEN
19'	<0.05	<0.005
24'	590	1.2
39'	<0.05	<0.005

3/12/15	GRO	BEN
19'	<0.05	<0.005
22'	30	0.16
37'	<0.05	<0.005

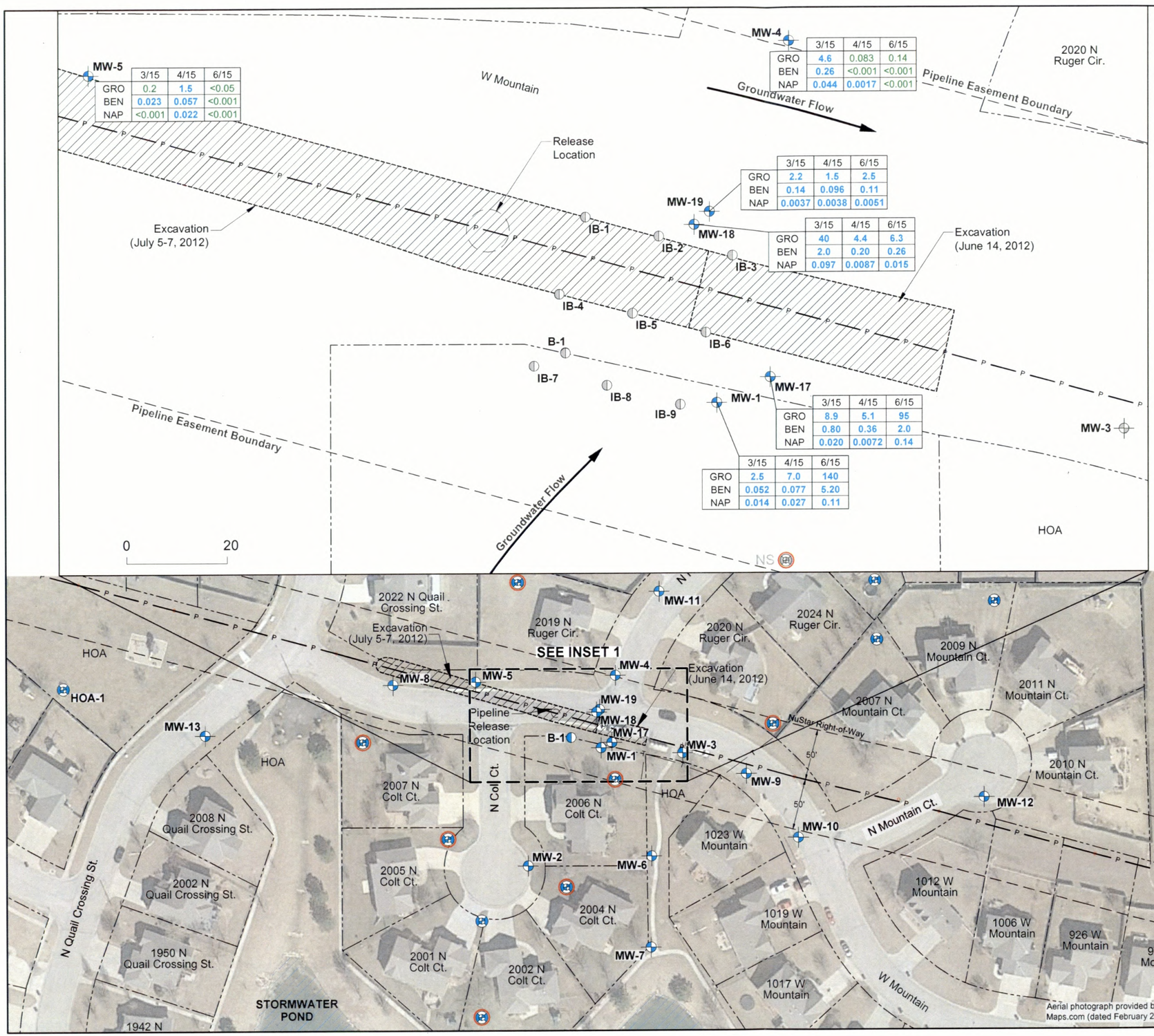
3/11/15	GRO
19'	<0.05
22'	590
37'	<0.05

Petroleum Constituents in Soil - March 2015

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

APEX
Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	1641-08	Figure
October 2015		7



Aerial photograph provided by Google Maps.com (dated February 25, 2012).

Legend:

- MW-1 — Monitoring Well Location
- Irrigation Well
- B-1 — Soil Boring Location (July 2013) (IB = Injection Boring Location)
- Property Line
- Pipeline
- Pipeline Easement Boundary
- HOA — Lot Owned by Quail Crossing Homeowner's Association
- Deactivated Irrigation Well
- Excavation Area

	3/15
GRO	2.5
BEN	0.052
NAP	0.014

Date Sampled
Concentration in mg/L
Analyte Sampled

- Dissolved-Phase Constituent Concentrations > KDHE Tier 2 RBSVs
- Dissolved-Phase Constituent Not Detected or < KDHE Tier 2 RBSVs

GRO = Gasoline-Range Organics
BEN = Benzene
NAP = Naphthalene

N

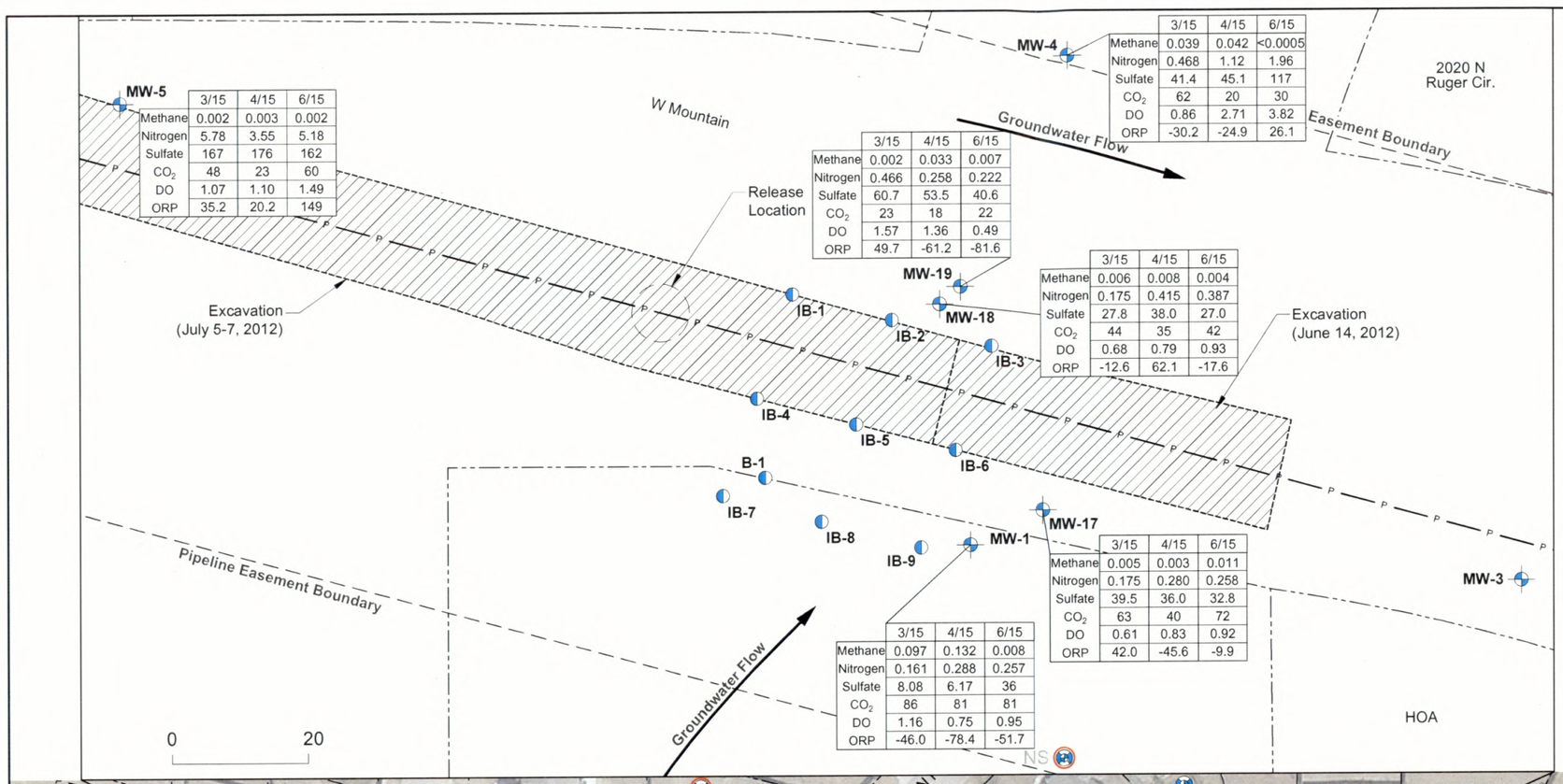
0 100 200
Scale in Feet

Dissolved-Phase Constituents in Groundwater - March/April/June 2015

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

APEX
Apex Companies, LLC
3015 SW First Avenue
Portland, Oregon 97201

Project Number	1641-08	Figure
October 2015		8



	3/15	4/15	6/15
Methane	0.002	0.003	0.002
Nitrogen	5.78	3.55	5.18
Sulfate	167	176	162
CO_2	48	23	60
DO	1.07	1.10	1.49
ORP	35.2	20.2	149

	3/15	4/15	6/15
Methane	0.039	0.042	<0.0005
Nitrogen	0.468	1.12	1.96
Sulfate	41.4	45.1	117
CO_2	62	20	30
DO	0.86	2.71	3.82
ORP	-30.2	-24.9	26.1

	3/15	4/15	6/15
Methane	0.002	0.033	0.007
Nitrogen	0.466	0.258	0.222
Sulfate	60.7	53.5	40.6
CO_2	23	18	22
DO	1.57	1.36	0.49
ORP	49.7	-61.2	-81.6

	3/15	4/15	6/15
Methane	0.006	0.008	0.004
Nitrogen	0.175	0.415	0.387
Sulfate	27.8	38.0	27.0
CO_2	44	35	42
DO	0.68	0.79	0.93
ORP	-12.6	62.1	-17.6

	3/15	4/15	6/15
Methane	0.005	0.003	0.011
Nitrogen	0.175	0.280	0.258
Sulfate	39.5	36.0	32.8
CO_2	63	40	72
DO	0.61	0.83	0.92
ORP	42.0	-45.6	-9.9

	3/15	4/15	6/15
Methane	0.097	0.132	0.008
Nitrogen	0.161	0.288	0.257
Sulfate	8.08	6.17	36
CO_2	86	81	81
DO	1.16	0.75	0.95
ORP	-46.0	-78.4	-51.7

Legend:

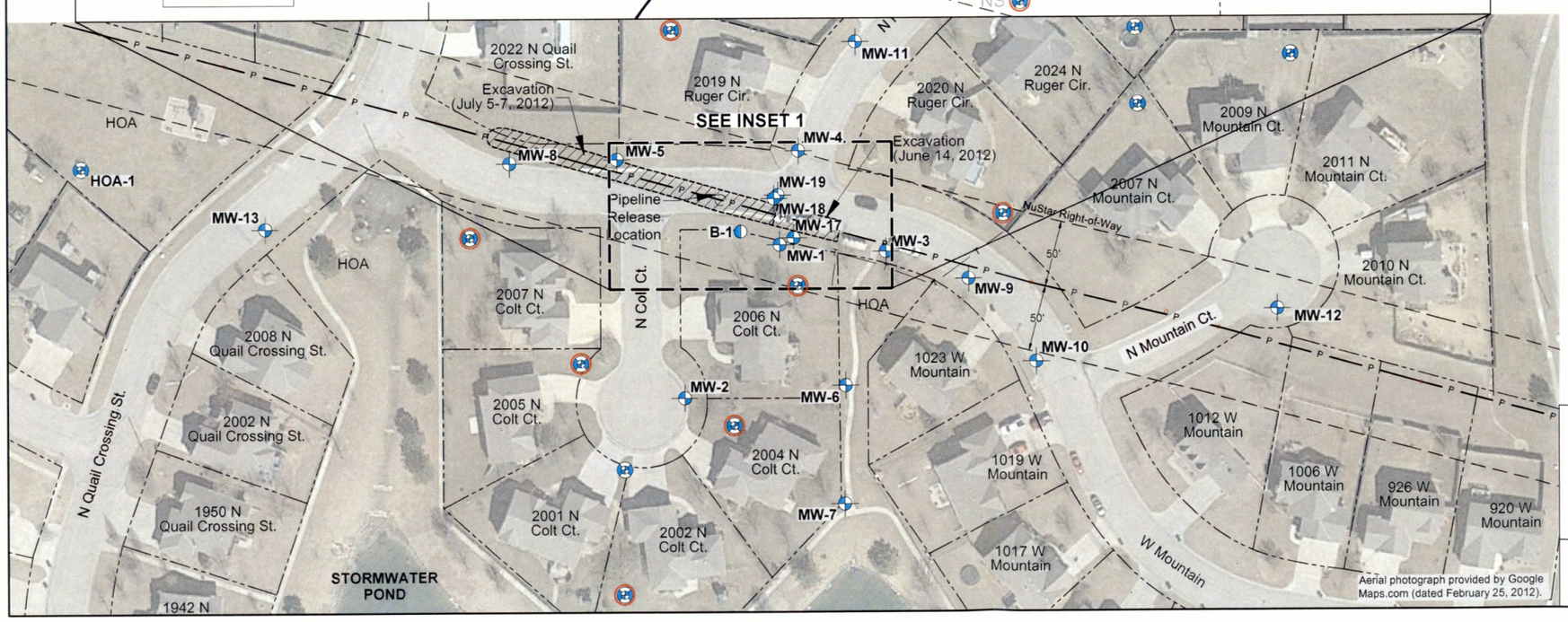
- MW-1 — Monitoring Well Location
- Irrigation Well
- B-1 — Soil Boring Location (July 2013) (IB = Injection Boring Location)
- Property Line
- Pipeline
- Pipeline Easement Boundary
- HOA — Lot Owned by Quail Crossing Homeowner's Association
- Deactivated Irrigation Well
- Excavation Area

	3/15
Methane	0.097
Nitrogen	0.161
Sulfate	8.08
CO_2	86
DO	1.16
ORP	-46.0

Date Sampled
Concentration in mg/L
Analyte Sampled

N

0 100 200
Scale in Feet



Aerial photograph provided by Google Maps.com (dated February 25, 2012).

Monitored Natural Attenuation Parameters - March/April/June 2015

Revised Interim Groundwater Pilot Test Implementation Report
NuStar Pipeline Operating Partnership L.P.
Andover, Kansas

APEX — Apex Companies, LLC, 3015 SW First Avenue, Portland, Oregon 97201

Project Number	1641-08	Figure
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Appendix A

ORC Advanced® Specifications and Design Report

REGENESIS

ORC ADVANCED
OXYGEN RELEASE COMPOUND

Design Summary Output

Regenesis Technical Support: USA (949) 366-8000

www.regenesis.com

Date:	3/4/2015
Site Name:	NuStar Andover Quail Crossing
Location:	Dissolved Plume
Consultant (Firm/Name):	Apex Companies, LLC

ORC Advanced Grid Design Specifications

NuStar Andover Quail Crossing

Dissolved Plume

Design Specifications	**Quantity**	**Units**
Treatment Area Size	900	ft^2
Depth to Top Treatment Interval	20	ft
Depth to Bottom Treatment Interval	40	ft
Vertical Treatment Thickness	20	ft
Number of Injection Points	9	---
Injection Point Spacing (within rows)	10	ft on center
Injection Point Spacing (between rows)	10	ft on center
Total Linear Drilling	360	ft
Product Quantities	**Quantity**	**Units**
ORC Advanced per Foot	7.555555556	lbs
ORC Advanced per Point	151	lbs
Total ORC Advanced	1,360	lbs
Product Cost		
ORC Advanced Cost	**$12,172**	**not including tax/freight**
Field Mixing/Injection Ratios		**Units**
ORC Advanced Slurry %	20%	%
Mixing Water per Foot	3.6	gallons
Mixing Water per Point	72	gallons
Total Water for Mixing	652	gallons
Injection Slurry (Water + ORC-A) per Foot	4.0	gallons
Injection Slurry (Water + ORC-A) per Point	79	gallons
Total Injection Slurry (all Points)	713	gallons

REGENESIS

ORC ADVANCED
OXYGEN RELEASE COMPOUND

Design Summary Output

SITE DATA - INPUT PARAMETERS		
Hydraulic Parameters	**Value**	**Units**
Soil Type (sand, silt, gravel, clay, etc.)	shale	---
Porosity	0.33	cm^3/cm^3
Effective Porosity	0.2	cm^3/cm^3
Hydraulic Conductivity	25	ft/day
Hydraulic Gradient	0.005	ft/ft
Seepage Velocity	228.3	ft/yr
Saturated Soil Concentrations (sorbed mass)	**Concentration**	**Units**
Benzene	0.2	mg/kg
Toluene	1.6	mg/kg
Ethylbenzene	0.1	mg/kg
Xylenes	1.5	mg/kg
MTBE	0.0	mg/kg
cis-1,2-DCE	0.0	mg/kg
Vinyl Chloride	0.0	mg/kg
Naphthalenes	0.1	mg/kg
TMBs	0.2	mg/kg
Groundwater Concentrations (dissolved mass)	**Concentration**	**Units**
Benzene	1.0	mg/L
Toluene	3.0	mg/L
Ethylbenzene	0.2	mg/L
Xylenes	2.5	mg/L
MTBE	0.0	mg/L
cis-1,2-DCE	0.0	mg/L
Vinyl Chloride	0.0	mg/L
Naphthalenes	0.0	mg/L
TMBs	0.1	mg/L
Reduced metals: Fe+2 and Mn+2	10.0	mg/L
Alternative Measures of Oxidant Demand	**Concentration**	**Units**
Total Petroleum Hydrocarbons (see pull-down for Kc	20.0	mg/L
Dissolved Phase Contaminant Mass	***21.1***	***lbs***

Additional Assumptions/Qualifications

1) Data Used for Modeling - GW - MW-1 (sample #)

2)

3)

REGENESIS

Oxygen Release Compound (ORC®) Installation Instructions

(Direct-Injection Slurry Application)

SAFETY:

Pure ORC is shipped to you as a fine powder rated at -325 mesh (passes through a 44 micron screen). It is considered to be a mild oxidizer and as such should be handled with care while in the field. Field personnel should take precautions while applying the pure ORC. Typically, the operator should work upwind of the product as well as use appropriate safety equipment. These would include eye and respiratory protection, and gloves as deemed appropriate by exposure duration and field conditions.

Personnel operating the field equipment utilized during the installation process should have appropriate training, supervision and experience.

GENERAL GUIDELINES:

ORC may be installed in the contaminated saturated zone in the ground utilizing hand augered holes, Geoprobe® type hydraulic punch equipment, or hollow stem augers. This set of instructions is specific for Geoprobe equipment. Alternate instructions may be obtained from the Regenesis Technical Support Department.

For optimum results the ORC slurry installation should span the entire vertical contaminated saturated thickness, including the capillary fringe and "smear zone".

Two general installation approaches are available. The first is to backfill only the probe hole with slurry. This is a simple approach, in that it is easy, straightforward, and the location of the ORC slurry is precisely known after installation. However, this method requires significantly more probe holes than the alternative, and may take more time for the completion of the remediation process. A separate set of instructions for this method utilizing Geoprobe equipment is available from Regenesis.

The second method is to inject the slurry through the probe holes into the contaminated saturated zone. This method requires fewer probe holes, is less disruptive to the site, and aids the spread of oxygen by spreading the ORC source material. However, it may be difficult to know the exact, final disposition of the ORC installed with this method. This is the method described in these instructions.

Note: It is important that the installation method and specific ORC slurry point location be established prior to field installation. It is also important that the ORC slurry volume and solids content for each drive point be predetermined. The Regenesis Technical Service Department is available to discuss these issues, and Helpful Hints at the end of these instructions offers relevant information. Regenesis also has available Technical Bulletins covering source treatments with ORC.

SPECIFIC INSTALLATION PROCEDURES

1. Identify the location of all underground structures, including utilities, tanks, distribution piping, sewers, drains, and landscape irrigation systems.
2. Identify surface and aerial impediments.
3. Adjust planned installation locations for all impediments and obstacles.
4. Pre-mark the installation grid point locations, noting any that have special depth requirements.
5. Set up the Geoprobe unit over each specific point, following manufacturer recommended procedures. Care should be taken to assure approximate vertical probe holes.
6. Penetrate surface pavement, if necessary, following standard Geoprobe procedures.
7. Drive the 1 1/2" (one-and-one-half inch) pre-probe (part #AT-148B) with the expendable tip (part #AT142B) to the desired maximum depth. Standard 1" (one inch) drive rods (part AT104B) should be used, after the pre-probe. (Hint: Pre-counted drive rods should be positioned prior to the installation driving procedure to assure the desired depth is reached.)
8. Disconnect the drive rods from the expendable tip, following standard Geoprobe procedures.
9. Mix the appropriate quantity of ORC slurry for the current drive point. (See separate "Directions for ORC® Slurry Mixing" and Helpful Hints). **Note: Do not mix more slurry than will be used within a 30 minute period.**
10. Set up and operate an appropriate slurry pump according to manufacturer's directions. Based on our experience, a Geoprobe model GS-1000 pump is recommended. Connect the pump to the probe grout pull cap (GS-1054) via a 1 inch diameter delivery hose. The hose is then attached to the 1" drive rod with its quick connector fitting. Upon confirmation of all connections add the ORC slurry to the pump hopper/tank.
11. Withdraw the pre-probe and drive stem 4' (four feet). (Also note Helpful Hints - Operations at end of instructions.)
12. Optional pretreatment step. (See Helpful Hints - Operations at end of instructions). Pump one to two gallons of tap water into the aquifer to enhance dispersion pathways from the probe hole.
13. Pump the predetermined quantity of ORC slurry for the depth interval being injected. Observe pump pressure levels for indications of slurry dispersion or refusal into the aquifer. (Increasing pressure indicates reduced acceptance of material by the aquifer).
14. Remove one 4' section of the 1" drive rod. The drive rod will contain slurry. This slurry should be returned to the ORC bucket for reuse.
15. Repeat steps 11, 13, and 14 until treatment of the entire affected thickness has been achieved. It is generally recommended that the procedure extend to the top of the capillary fringe/smear zone.
16. Install an appropriate seal, such as bentonite, above the ORC slurry through the entire vadose zone. This helps assure that the slurry stays in place and prevents contaminant migration from the surface. Depending on soil conditions and local regulations, a bentonite seal can be pumped through the slurry pump or added via chips or pellets after probe removal.
17. Remove and decontaminate the drive rods and pre-probe.

18. Finish the probe hole at surface as appropriate (concrete or asphalt cap, if necessary).
19. Move to the next probe point, repeating steps 5 through 18.

HELPFUL HINTS:

A. Physical characteristics

A1. Slurry

The ORC slurry is made using the dry ORC powder (rated at -325 mesh). It makes a smooth slurry, with a consistency that depends on the amount of water used.

A thick, but pumpable, slurry that approaches a paste can be made by using 65-67% solids. This material would normally be used for back-filling a bore or probe hole. It is especially useful where maximum density is desired such as where ground water is present in the hole or there are heaving sands.

Thinner slurries can be made by using more water. Typical solids for the thinner slurries content will range from 35% to 62%. Such slurries are useful for injecting through a probe or bore hole into the saturated aquifer.

As a rule, it is best to mix the first batch of slurry at the maximum solids content one would expect to use. It can then be thinned by adding additional water in small increments. By monitoring this process, the appropriate quantities of water for subsequent batches can be determined.

The slurry should be mixed at about the time it is expected to be used. It is best to not hold it for more than 30 minutes. Thinner slurries, especially, can experience a separation upon standing. All ORC slurries have a tendency to form cements when left standing. If a slurry begins to thicken too much, it should be mixed again and additional water added if necessary.

Care should be taken with slurry that may be left standing in a grout pump or hose. Problems can generally be avoided by periodically re-circulating the slurry through the pump and hose back into the pump's mixing or holding tank.

A2. Equipment

Most geotechnical grout pumping equipment has a holding tank with a capacity sufficient for injection.

When applying measured volumes of ORC slurry to probe holes, it is sometimes useful to know the volumes and content of the delivery system lines. The following information may be useful in this regard.

Geoprobe pump: At the end of a pump stroke virtually no deliverable slurry remains in the pump.

5/8" O.D. connecting hose (10 feet long):	0.2 gallons (26 fluid ounces).
Four foot (4') length of 1" drive rod:	.04 gallons (5 fluid ounces).
Three foot (3') length of 1 1/2" pre-probe:	.03 gallons (4 fluid ounces).

Cleaning and maintenance:

Pumping equipment and drive rods can be lightly cleaned by circulating clear water through them. Further cleaning and decontamination (if necessary due to subsurface conditions) should be performed according to the equipment supplier's standard procedures and local regulatory requirements.

B. Operating characteristics

B1. Operations - General

Judgment will be needed in the field when injecting ORC slurries. In general, it is relatively easy to inject ORC slurries into sandy soils, and this can usually be accomplished at very moderate pressures. Silts and clays require more pressure, and may accept less slurry.

Careful observation of pressure during slurry pumping is the best indication of the effectiveness of the slurry injection. To test the soil's ability to accept the slurry and to "precondition" the injection point for the slurry, it is sometimes useful to inject a small volume of plain water prior to the slurry. Normally, one-half (0.5) gallons to two (2) gallons would be appropriate.

During injection, increasing pressure and decreasing flow rate are signs of refusal by the soil matrix to accept the slurry. The site geologist should determine whether to increase pressure, and possibly fracture ("frac") the soil matrix to achieve ORC slurry installation in a tight site that has refused the slurry at lower pressures.

B2. Fill Volumes

Probe hole back-filling

Probe hole capacities:

Per 10' (Ten Foot) Length			
Theoretical		**Operating Volume**	
(Gallons/Fluid Ounces/Cubic Inches)		**(Gallons/Fluid Ounces)**	
Sand, Silts & Clay		**Sand**	**Silts & Clay**
1" Diameter	.41 gal/52 fl. oz./94.2 cu. in.	.61 gal/78 fl. oz.	.51 gal/65 fl. oz.
1 1/2" Diameter	.92 gal/117 fl. oz./212.0 cu. in.	1.38 gal/176 fl. oz.	1.15 gal/146 fl. oz.
2" Diameter	1.63 gal/209 fl. oz./376.8 cu. in.	2.44 gal/313 fl. oz.	2.04 gal/261 fl. oz.
2 1/4" Diameter	2.06 gal/264 fl. oz./476.9 cu. in	3.09 gal/396 fl. oz.	2.57 gal/330 fl. oz.

Note that the operating volumes include a 50% excess above the theoretical volume in sands and 25% in clays and silts. This is important to successful treatment. The additional material allows for a small degree of infiltration of the slurry into the surrounding soil and fractures, as well as hole diameter variability. It is important to assure that the entire contaminated saturated zone is treated (including the capillary fringe), since this is often the area of highest pollution concentration. Failure to treat this area due to improper installation can undermine an otherwise successful remediation effort.

For direct assistance or answers to any questions you may have regarding these instructions, contact Regenesis Technical Services at 949-366-8000.

REGENESIS, 2002
www.regenesis.com

Oxygen Release Compound – Advanced Pellets (ORC Advanced® Pellets)
MATERIAL SAFETY DATA SHEET (MSDS)

Last Revised: March 22, 2012

Section 1 - Material Identification

Supplier:

REGENESIS

1011 Calle Sombra
San Clemente, CA 92673

Phone:	**949.366.8000**
Fax:	**949.366.8090**
E-mail:	info@regenesis.com

Chemical Description:	A mixture of Calcium Hydroxide Oxide [$CaO(OH)_2$] and Calcium Hydroxide [$Ca(OH)_2$].
Chemical Family:	Inorganic Chemical
Trade Name:	Advanced Formula Oxygen Release Compound (ORC Advanced® Pellets)
Chemical Synonyms	Calcium OxyHydroxide; Calcium Oxide Peroxide
Product Use:	Used to remediate contaminated soil and groundwater (environmental applications)

Section 2 – Composition

CAS No.	Chemical
682334-66-3	**Calcium Hydroxide Oxide [$CaO(OH)_2$]**
1305-62-0	**Calcium Hydroxide [$Ca(OH)_2$]**
7758-11-4	**Dipotassium Phosphate (HK_2O_4P)**
7783-28-0	**Ammonium Phosphate Dibasic [$(NH4)_2HPO_4$]**

Section 3 – Physical Data

Form:	tablets
Color:	White to Pale Yellow
Odor:	Odorless
Melting Point:	527 °F (275 °C) – Decomposes
Boiling Point:	Not Applicable (NA)
Flammability/Flash Point:	NA
Auto-Flammability:	NA
Vapor Pressure:	NA
Self-Ignition Temperature:	NA
Thermal Decomposition:	527 °F (275 °C) – Decomposes
Bulk Density:	0.5 – 0.65 g/ml (Loose Method)
Solubility:	1.65 g/L @ 68° F (20° C) for calcium hydroxide.
Viscosity:	NA
pH:	11-13 (saturated solution)
Explosion Limits % by Volume:	Non-explosive
Hazardous Decomposition Products:	Oxygen, Hydrogen Peroxide, Steam, and Heat
Hazardous Reactions:	None

Section 4 – Reactivity Data

Stability:	Stable under certain conditions (see below).
Conditions to Avoid:	Heat and moisture.
Incompatibility:	Acids, bases, salts of heavy metals, reducing agents, and flammable substances.
Hazardous Polymerization:	Does not occur.

Section 5 – Regulations

TSCA Inventory List:	Listed

CERCLA Hazardous Substance (40 CFR Part 302)

Listed Substance:	No
Unlisted Substance:	Yes
Reportable Quantity (RQ):	100 pounds
Characteristic(s):	Ignitibility
RCRA Waste Number:	D001

SARA, Title III, Sections 302/303 (40 CFR Part 355 – Emergency Planning and Notification)

Extremely Hazardous Substance:	No

SARA, Title III, Sections 311/312 (40 CFR Part 370 – Hazardous Chemical Reporting: Community Right-To-Know

Hazard Category:	Immediate Health Hazard Fire Hazard

Threshold Planning Quantity:	10,000 pounds

Section 5 – Regulations (cont)

SARA, Title III, Section 313 (40 CFR Part 372 – Toxic Chemical Release Reporting: Community Right-To-Know

Extremely Hazardous Substance:	No	
WHMIS Classification:	C	Oxidizing Material Poisonous and Infectious Material
	D	Material Causing Other Toxic Effects – Eye and Skin Irritant
Canadian Domestic Substance List:	Not Listed	

Section 6 – Protective Measures, Storage and Handling

Technical Protective Measures

Storage:	Keep in tightly closed container. Store in dry area, protected from heat sources and direct sunlight.
Handling:	Clean and dry processing pipes and equipment before operation. Never return unused product to the storage container. Keep away from incompatible products. Containers and equipment used to handle this product should be used exclusively for this material. Avoid contact with water or humidity.

Section 6 – Protective Measures, Storage and Handling (cont)

Personal Protective Equipment (PPE)

Engineering Controls:	Calcium Hydroxide ACGIH® TLV® (2000) 5 mg/m^3 TWA OSHA PEL Total dust–15 mg/m^3 TWA Respirable fraction– 5 mg/m^3 TWA NIOSH REL (1994) 5 mg/m^3
Respiratory Protection:	For many conditions, no respiratory protection may be needed; however, in dusty or unknown atmospheres use a NIOSH approved dust respirator.
Hand Protection:	Impervious protective gloves made of nitrile, natural rubbber or neoprene.
Eye Protection:	Use chemical safety goggles (dust proof).
Skin Protection:	For brief contact, few precautions other than clean clothing are needed. Full body clothing impervious to this material should be used during prolonged exposure.
Other:	Safety shower and eyewash stations should be present. Consultation with an industrial hygienist or safety manager for the selection of PPE suitable for working conditions is suggested.
Industrial Hygiene:	Avoid contact with skin and eyes.
Protection Against Fire & Explosion:	NA

Section 7 – Hazards Identification

Emergency Overview:	Oxidizer – Contact with combustibles may cause a fire. This material decomposes and releases oxygen in a fire. The additional oxygen may intensify the fire.

Potential Health Effects:	Irritating to the mucous membrane and eyes. If the product splashes in ones face and eyes, treat the eyes first. Do not dry soiled clothing close to an open flame or heat source. Any clothing that has been contaminated with this product should be submerged in water prior to drying.
Inhalation:	High concentrations may cause slight nose and throat irritation with a cough. There is risk of sore throat and nose bleeds if one is exposed to this material for an extended period of time.
Eye Contact:	Severe eye irritation with watering and redness. There is also the risk of serious and/or permanent eye lesions.
Skin Contact:	Irritation may occur if one is exposed to this material for extended periods.
Ingestion:	Irritation of the mouth and throat with nausea and vomiting.

Section 8 – Measures in Case of Accidents and Fire

After Spillage/Leakage/Gas Leakage:	Collect in suitable containers. Wash remainder with copious quantities of water.
Extinguishing Media:	See next.
Suitable:	Large quantities of water or water spray. In case of fire in close proximity, all means of extinguishing are acceptable.
Further Information:	Self contained breathing apparatus or approved gas mask should be worn due to small particle size. Use extinguishing media appropriate for surrounding fire. Apply cooling water to sides of transport or storage vessels that are exposed to flames until the fire is extinguished. Do not approach hot vessels that contain this product.
First Aid:	After contact with skin, wash immediately with plenty of water and soap. In case of contact with eyes, rinse immediately with plenty of water and seek medical attention. Consult an opthalmologist in all cases.

Section 8 – Measures in Case of Accidents and Fire

Eye Contact:	Flush eyes with running water for 15 minutes, while keeping the eyelids wide open. Consult with an ophthalmologist in all cases.
Inhalation:	Remove subject from dusty environment. Consult with a physician in case of respiratory symptoms.
Ingestion:	If the victim is conscious, rinse mouth and admnister fresh water. DO NOT induce vomiting. Consult a physician in all cases.
Skin Contact:	Wash affected skin with running water. Remove and clean clothing. Consult with a physician in case of persistent pain or redness.
Special Precautions:	Evacuate all non-essential personnel. Intervention should only be done by capable personnel that are trained and aware of the hazards associated with this product. When it is safe, unaffected product should be moved to safe area.
Specific Hazards:	Oxidizing substance. Oxygen released on exothermic decomposition may support combustion. Confined spaces and/or containers may be subject to increased pressure. If product comes into contact with flammables, fire or explosion may occur.

Section 9 – Accidental Release Measures

Precautions:	Observe the protection methods cited in Section 3. Avoid materials and products that are incompatible with product. Immediately notify the appropriate authorities in case of reportable discharge (> 100 lbs).
Cleanup Methods:	Collect the product with a suitable means of avoiding dust formation. All receiving equipment should be clean, vented, dry, labeled and made of material that this product is compatible with. Because of the contamination risk, the collected material should be kept in a safe isolated place. Use large quantities of water to clean the impacted area. See Section 12 for disposal methods.

Section 10 – Information on Toxicology

Toxicity Data

Acute Toxicity:	Oral Route, LD_{50}, rat, > 2,000 mg/kg (powder 50%) Dermal Route, LD_{50}, rat, > 2,000 mg/kg (powder 50%) Inhalation, LD_{50}, rat, > 5,000 mg/m^3 (powder 35%)
Irritation:	Rabbit (eyes), severe irritant
Sensitization:	No data
Chronic Toxicity:	In vitro, no mutagenic effect (Powder 50%)
Target Organ Effects:	Eyes and respiratory passages.

Section 11 – Information on Ecology

Ecology Data

Acute Exotoxicity:	10 mg $Ca(OH)_2$/L: pH = 9.0 100 mg $Ca(OH)_2$/L: pH = 10.6 Fishes, Cyprinus carpio, LC_{50}, 48 hrs, 160 mg/L Crustaceans, Daphnia sp., EC_{50}, 24 hours, 25.6 mg/L (Powder 16%)
Mobility:	Low Solubility and Mobility
Abiotic Degradation:	Water – Slow Hydrolysis. Degradation Products: Calcium Hydroxide Water/soil – complexation/precipitation. Carbonates/sulfates present at environmental concentrations. Degradation products: carbonates/sulfates sparingly soluble
Biotic Degradation:	NA (inorganic compound)
Potential for Bioaccumulation:	NA (ionizable inorganic compound)

Section 11 – Information on Ecology (cont)

Comments:	Observed effects are related to alkaline properties of the product. Hazard for the environment is limited due to the product properties of: • No bioaccumulation • Weak solubility and precipitation as carbonate or sulfate in an aquatic environment. Diluted product is rapidly neutralized at environmental pH.
Further Information:	NA

Section 12 – Disposal Considerations

Waste Disposal Method:	Consult current federal, state and local regulations regarding the proper disposal of this material and its emptied containers.

Section 13 – Shipping/Transport Information

D.O.T Shipping Name:	Oxidizing Solid, N.O.S [A mixture of Calcium Hydroxide Oxide [$CaO(OH)_2$] and Calcium Hydroxide [$Ca(OH)_2$].
UN Number:	1479
Hazard Class:	5.1
Label(s):	5.1 (Oxidizer)
Packaging Group:	II
STCC Number:	4918717

Section 14 – Other Information

HMIS® Rating	Health – 2 Flammability – 0	Reactivity – 1 PPE - Required

HMIS® is a registered trademark of the National Painting and Coating Association.

NFPA® Rating	Health – 2 Flammability – 0	Reactivity – 1 OX

NFPA® is a registered trademark of the National Fire Protection Association.

Reason for Issue:	Update toxicological and ecological data

Section 15 – Further Information

The information contained in this document is the best available to the supplier at the time of writing, but is provided without warranty of any kind. Some possible hazards have been determined by analogy to similar classes of material. The items in this document are subject to change and clarification as more information become available.

ORC ADVANCED®
OXYGEN RELEASE COMPOUND

Highest amount of active oxygen in a controlled-release, oxygen producing compound

PRODUCT OVERVIEW

ORC Advanced® is the state-of-the-art technology for stimulating aerobic bioremediation. It offers unparalleled, maximum oxygen release for periods up to 12 months on a single injection and is specifically designed to minimize oxygen waste while maximizing contaminated site remediation.

ORC Advanced is a formulation of calcium oxyhydroxide which, upon hydration, releases oxygen and forms simple calcium hydroxide and water.

$$CaO(OH)_2 + H_2O \rightarrow \tfrac{1}{2}O_2 + Ca(OH)_2 + H_2O$$

PRODUCT BENEFITS

PRODUCT BENEFITS

HIGHEST AVAILABLE OXYGEN CONTENT

More active oxygen (17%) plus Regenesis' patented controlled-release technology (CRT™) saves time and money by increasing degradation rates and improving remediation performance by providing more oxygen on a single injection. It is particularly effective at higher demand sites where oxygen may be limited and scavenged by competing carbon sources.

PATENTED CONTROLLED-RELEASE TECHNOLOGY (CRT™)

Based on the same proven technology employed in the industry standard Oxygen Release Compound (ORC®), CRT allows for an efficient, long-term release of oxygen providing the optimal conditions for sustained aerobic biodegradation. This can save time and money by reducing the potential need for multiple applications. Also, oxygen release "lock-up" is avoided – an unfortunate problem experienced with commodity chemicals.

IN SITU APPLICATION

Remediation with ORC Advanced is typically more cost-effective than *ex situ* treatments. With the use of ORC Advanced there is minimal site disturbance with no above-ground piping or mechanical equipment, no operations and maintenance costs and no hazardous materials handling or disposal.

CRT

DEFINING THE SCIENCE BEHIND CONTROLLED-RELEASE TECHNOLOGY (CRT™)

Early on, Regenesis researchers noted that in order to optimally stimulate the natural attenuation of aerobically degradable contaminants, biologically usable oxygen was best supplied in low but constant concentrations. Big bursts of oxygen are wasteful and simply "bubble off", often generating undesirable foaming and producing unwanted preferential flow paths in the subsurface. Regenesis sought to solve this problem by controlling the rate of oxygen release from solid oxygen sources.

The answer was provided by the development of CRT. The CRT process involves intercalating (embedding) phosphates into the crystal structure of solid peroxygen molecules. This patented feature, now available in the ORC Advanced® formulation, slows the reaction that yields oxygen within the crystal, minimizing "bubble off" which can waste the majority of oxygen available in common solid peroxygen chemicals.

FIGURE 1:
FILLING A PUMP WITH
ORC ADVANCED SLURRY

CRT provides "balance" – it slows down the rate of oxygen release while at the same time preventing "lock-up". Commodity solid peroxygen chemicals, when in contact with water, will produce an initial rapid and uncontrolled-release of oxygen. Then, as hydroxides form, a significant portion of the oxygen deeper in the crystal is made unavailable or becomes"locked-up." This undesirable effect is inefficient and costly. CRT prevents lock up and controls the rate of oxygen release, representing the state-of-the-art technology in passive oxygen delivery.

1011 Calle Sombra San Clemente California 92673-6244 Telephone: 949.366.8000 Fax: 949.366.8090 www.regenesis.com

The original controlled-release oxygen compound, since 1994

ORC® OXYGEN RELEASE COMPOUND

PRODUCT OVERVIEW

The original Oxygen Release Compound (ORC®) is a fine, powdery material comprised of a patented formulation of phosphate-intercalated magnesium peroxide. The intercalation or embedding of phosphates within the magnesium peroxide is Regenesis' patented, controlled-release mechanism.

Upon hydration, ORC is designed to produce a controlled-release of oxygen (10% by weight) into the subsurface in accordance with the following reaction:

$$MgO_2 + H_2O \rightarrow \tfrac{1}{2} O_2 + Mg(OH)_2$$

This process can proceed for periods of up to one year depending on site conditions. In the presence of this long-lasting oxygen source, aerobic microbes flourish - accelerating the naturally slow rates of aerobic biodegradation.

BENEFITS

PRODUCT BENEFITS

By enhancing bioremediation using ORC, in situ treatment of contaminants can result in an efficient, simple and cost-effective alternative to traditional technologies. With low capital costs, no operations and maintenance, minimal site disturbance and proven effectiveness, ORC can restore water quality and property values at a reasonable cost.

PRODUCT APPLICATION

MATERIAL APPLICATION

Most contaminated sites are treated using ORC slurry which is a prescribed and easily injectable water and ORC mixture (Figure 2). The direct - injection of ORC slurry maximizes ORC and oxygen distribution in the subsurface increasing the range of enhanced biodegradation. ORC is dosed in pounds per vertical foot of material treated. The amount of ORC recommended depends greatly on various factors such as contaminant concentrations, oxygen sinks, groundwater flow rates and subsurface geology. It is recommended that a Regenesis Technical Services Representative be contacted for detailed design information.

ORC treatment approaches or designs may consist of one, or combinations of the following: Source Area Grids, Plume Area Grids or Barriers, Excavations and Biopiles.

SUBSURFACE EMPLACEMENT

- Direct – Push Injection
- Hollow Stem Augers
- Existing Wells
- Recirculating Wells
- Replaceable Filter Socks (existing wells)
- Excavations
- Trenches

CONTAMINANTS

TREATABLE CONTAMINANTS

ORC can treat a wide range of contaminants and most any aerobically degradable compound including: gasoline and fuel additives (BTEX and MTBE), diesel, kerosene, jet fuel, gas condensates, fuel oils, lubricants, bunker oil, PAHs, certain metals (arsenic), certain pesticides/herbicides and certain industrial solvents (alcohols and ketones).

FIGURE 2: ORC SLURRY

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REGENESIS

Oxygen Release Compound (ORC®) Installation Instructions

(Slurry Mixing)

1. OPEN 5 GALLON BUCKET, AND REMOVE PRE-MEASURED BAG OF ORC.
2. MEASURE AND POUR WATER INTO THE 5-GALLON BUCKET ACCORDING TO THE FOLLOWING DESIRED CONSISTENCY:

65% Solids Slurry	Mix .63 gallons of water per 10 pounds of ORC powder.	
	Example:	Mix 20 pounds of ORC with 1.26 gallons of water.
		Mix 30 pounds of ORC with 1.89 gallons of water.
60% Solids Slurry	Mix .79 gallons of water per 10 pounds of ORC powder.	
	Example:	Mix 20 pounds of ORC with 1.58 gallons of water.
		Mix 30 pounds of ORC with 2.37 gallons of water.
50% Solids Slurry	Mix 1.19 gallons of water per 10 pounds of ORC powder.	
	Example:	Mix 20 pounds of ORC with 2.38 gallons of water.
		Mix 30 pounds of ORC with 3.57 gallons of water.
25% Solids Slurry	Mix 3.57 gallons of water per 10 pounds of ORC powder.	
	Example:	Mix 10 pounds of ORC with 3.57gallons of water.

3. ADD THE APPROPRIATE ORC QUANTITY TO THE WATER. Check weight of each bucket (see label). The 5 gallon shipping bucket weighs 2 pounds. An additional 4 pounds of ORC would require one additional quart of water, at the 65% solids level.
4. USE AN APPROPRIATE MIXING DEVICE TO THOROUGHLY MIX ORC AND WATER. A hand held drill with a "jiffy mixer" or a stucco mixer on it may be used in conjunction with a small paddle to scrape the bottom and sides of the container. Standard environmental slurry mixers may also be used, following the equipment instructions for operation. For small quantities a usable slurry can be mixed by hand, if care is taken to blend all lumps into the mixture thoroughly.

CAUTION: ORC MAY SETTLE OUT OF SLURRY IF LEFT STANDING. ALSO, ORC EVENTUALLY HARDENS INTO A CEMENT-LIKE COMPOUND, AND CANNOT BE RE-MIXED AFTER THAT HAS HAPPENED. THEREFORE:

Mix immediately before using. Do not let stand more than 30 minutes, and re-mix immediately before use, to be sure the mixture has not settled out. If a mechanical slurry mixer attached to a pump is being used, the material may be cycled back through the mixer to maintain slurry suspension and consistency.

5. CHECK SLURRY CONSISTENCY FOR POURABILITY. ADD WATER IF NECESSARY (IN 1 CUP INCREMENTS) TO ACHIEVE THE CORRECT CONSISTENCY.

For direct assistance or answers to any questions you may have regarding these instructions, contact Regenesis Technical Services at 949-366-8000.

REGENESIS, 2002
www.regenesis.com

Appendix B

Field Notes

APEX

3015 SW First Avenue
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(503) 924-4704 Phone
(503) 943-6357 Fax

PROJECT NUMBER 320001641-07/08
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-10-2015

PROJECT	QUAIL CROSSING PILOT TEST	ARRIVAL TIME	0845
LOCATION	ANDOVER, KANSAS	DEPARTURE TIME	1630
CLIENT	NUSTAR	WEATHER	FOG (40'S) AM / CLEAR (70'S) PM
PURPOSE OF OBSERVATIONS	WELL INSTALLATION / PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE DRILLING	PERMIT NO.	–
CONTRACTOR REP.	CHAD AND MARK	H&S REVIEW	✓

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0845 APEX (M. WHITSON) ARRIVES ON SITE, DRILLERS (CHAD AND MARK; LAYNE) HAVE STAGED EQUIPMENT AND LEFT TO OBTAIN WATER USE PERMIT AND TOTALIZER FROM CITY.
WELL LOCATIONS HAVE BEEN CLEARED, UTILITY LOCATES APPEAR TO HAVE BEEN COMPLETED.
PID AND INTERFACE PROBE SHIPMENT WAS DELAYED, WILL ARRIVE AT FEDEX FACILITY BY NOON TODAY.
0945 LAYNE ON SITE, MOVE PORTA POTTY INSIDE OF DELINEATION ZONE
WALK SITE WITH LAYNE, GO OVER SCOPE OF WORK
1015 START MOVING EQUIPMENT, JACE AND JASON (APEX) ARRIVE ON SITE.
APEX FINISHES CLEARING MW-17 LOC.
LAYNE SETUP ON MW-18 LOC.
H+S REVIEW
1100 JACE AND JASON HEAD TO EASTER ADDITION TO CLEAR LOCATIONS
LAYNE EXPERIENCING RIG DIFFICULTIES / TROUBLESHOOT
APEX MOBS TO FEDEX TO PICKUP PID / INTERFACE PROBE AND SAMPLE JARS / COOLERS
RETURN TO SITE, FEDEX WILL DELIVER TOMORROW MORNING
MOB TO EASTER ADDITION
1515 START ABANDONING WELLS AT EASTER ADDITION, AS-1 - AS-3, MC-1 - MC-3, MW-1, MW-F.
1600 SURFACE MONUMENTS REMOVED, PROTECT HOLES
CLEAN UP
1630 DEPART SITE

BY

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REVIEWED BY

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PROJECT NUMBER 32000164 1-08
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-11-2015

PROJECT	QUAIL CROSSING PILOT TEST	ARRIVAL TIME	1010
LOCATION	ANDOVER, KS	DEPARTURE TIME	1830
CLIENT	NUSTAR	WEATHER	CLEAR (60's-70's) CALM
PURPOSE OF OBSERVATIONS	WELL INSTALLATION / PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE DRILLING	PERMIT NO.	–
CONTRACTOR REP.	CHAD AND MARK	H&S REVIEW	✓

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1010 APEX ARRIVES ON SITE AFTER PICKING UP EQUIP/BOTTLES AT FEDEX, LAYNE ON SITE
1015 H+S PLAN REVIEW WITH CHAD AND MARK, LAYNE DOES NOT HAVE FR, OKAY (PM)
1030 START CORING MW-18 LOCATION (SEE LOG), PAMELA (KDHE) ON SITE
1130 KDHE DEPARTS, PHOTOGRAPH MW-6 AND MW-7 MON.S FOR FIX
1345 FINISH WITH MW-18 (CASED TO 19' BGS)
MOVE TO MW-19 LOCATION AND SET UP
1500 START CORING MW-19 (SEE LOG), DRILLERS ASK ABOUT LANDFARM
1800 DOWN TO 45' BGS IN MW-19 (CASED TO 19' BGS)
CLEAN UP, TALK TO DRILLERS ABOUT LANDFARM HOURS (8-5 PM)
1830 DEPART SITE

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PROJECT NUMBER 320001641-08/07
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-12-2015

PROJECT	QUAIL CROSSING PILOT TEST	ARRIVAL TIME	0800
LOCATION	ANDOVER, KS	DEPARTURE TIME	1815
CLIENT	NUSTAR	WEATHER	CLEAR (40's-70's) CALM
PURPOSE OF OBSERVATIONS	WELL INSTALLATION/PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE DRILLING	PERMIT NO.	–
CONTRACTOR REP.	CHAD AND MARK	H&S REVIEW	✓

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0800 APEX ARRIVES ON SITE, LAYNE ON SITE, H+S REVIEW
LAYNE SETS UP ON MW-17 LOCATION USING MUD MATS FOR TRACK RIG
0830 GAUGE WATER IN MW-18 AND MW-19
0830 START CORING MW-17 LOCATION (SEE LOG)
1115 FINISH CORING MW-17 (CASED TO 19' BGS)
1200 GAUGE OPEN BOREHOLE
LAYNE CLEANS UP AND MOBS TO EASTER ADDITION
SETUP ON MW-1R LOCATION
1430 START CORING MW-1R (SEE LOG)
1640 FINISH CORING MW-1R LOCATION
INSTALL MW-1R WELL FROM 25-40' (SCREENED) (SEE INSTALLATION LOG)
MOVE RIG OFF MW-1R
CLEAN UP
1815 DEPART SITE

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PROJECT NUMBER 320001641-07
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-13-2015

PROJECT	EASTER ADDITION	ARRIVAL TIME	0845
LOCATION	ANDOVER, KS	DEPARTURE TIME	1915
CLIENT	NUSTAR	WEATHER	CLEAR (40'S-70'S) CALM
PURPOSE OF OBSERVATIONS	WELL INSTALLATION / PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE DRILLING	PERMIT NO.	–
CONTRACTOR REP.	MARK AND CHAD	H&S REVIEW	✓

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0845 APEX ARRIVES ON SITE, H+S REVIEW
0915 LAYNE SAYS RIG IS NOT STARTING UP, THEY ARE TROUBLESHOOTING AND, MAKING PHONE CALLS TO FIX IT. CALL S. JACKSON
LAYNE CALLS JOHN DEERE MECHANIC
1015 GAUGE WELLS AT QUAIL CROSSING
LAYNE TROUBLESHOOTING RIG
CLEAN UP SITE, LOAD UP SOIL
1120 LAYNE TAKES LOAD TO EL DORADO
1300 LAYNE RETURNS FROM EL DORADO
MECHANIC ON SITE
WORK ON RIG
1445 RIG UP AND RUNNING MECHANIC DEPARTS
SENSOR, FUEL FILTER, COMBINATION OF OTHER ISSUES
WITH RIG IN VICINITY OF WELLS TO BE ABANDONED, SET UP TREMIE AND INJECT GROUT IN WELLS TO ABANDON, MOVE RIG TO F-1R LOC.
1550 SETUP ON F-1R LOC.
1615 START CORING F-1R LOCATION (SEE LOG)
1900 FINISH CORING F-1R
1915 CLEAN UP, DEPART SITE

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PROJECT NUMBER 320001641-07/08
FIELD REPORT NUMBER
PAGE 1 OF
DATE 03-14-15

PROJECT	EASTER ADDITION / QUAIL CROSSING	ARRIVAL TIME	0800
LOCATION	ANDOVER, KS	DEPARTURE TIME	1730
CLIENT	NUSTAR	WEATHER	CLEAR (70'S) CALM
PURPOSE OF OBSERVATIONS	WELL REPLACEMENT / INSTALLATION / PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE DRILLING	PERMIT NO.	–
CONTRACTOR REP.	MARK AND CHAD	H&S REVIEW	✓

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0800 APEX ARRIVES ON SITE, H+S REVIEW
RUN CASING IN F-1R LOCATION, START INSTALLING WELL (25-40')
0915 WELL INSTALLED, START CLEANUP DEMOB OFF WELL LOCATION
SETUP OVER F-1 TO ABANDON, MOVE EQUIPMENT
0930 START ABANDONMENT OF F-1
CHIP MONUMENT
0945 PLUG WELL WITH GROUT THROUGH TREMIE
CUT CASING 3' BGS, TALK WITH OWNER ABOUT RUTS IN DRIVEWAY, THEY SUGGEST GRAVEL FILL
1020 LAYNE TO MENARDS FOR TOP SOIL
PLACE TOP SOIL, COMPLETE SURFACE ON F-1R AND MW-1R
1300 ALL ABANDONMENTS COMPLETE
CLEAN UP AND MOVE TO QUAIL CROSSING
1330 GAUGE WELLS AT QUAIL CROSSING
MOVE EQUIPMENT
1430 START SETTING UP ON INJECTION LOCATION IB-1
1515 START CORING IB-1 LOC. (SEE LOG)
1700 GET TO 29' BGS, STOP FOR DAY
CLEAN UP
1730 DEPART SITE

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PROJECT NUMBER 320001641-08
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-15-2015

PROJECT	QUAIL CROSSING	ARRIVAL TIME	0930
LOCATION	ANDOVER, KS	DEPARTURE TIME	1800
CLIENT	NUSTAR	WEATHER	CLEAR (40'S/60'S) CALM
PURPOSE OF OBSERVATIONS	WELL INSTALL/PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE	PERMIT NO.	–
CONTRACTOR REP.	MARK/CHAD	H&S REVIEW	✓

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0930 APEX ARRIVES ON SITE, LAYNE ON SITE, H+S REVIEW
SETUP ON IB-1 LOCATION
1015 RESUME CORING IB-1 (SEE LOG)
1115 COMPLETE IB-1 (CASED TO 20' BGS)
MOVE TO IB-2 AND SETUP
1115 CORE IB-2 (SEE LOG)
1330 IB-2 COMPLETE (CASED TO 20' BGS)
MOVE TO IB-3 AND SETUP
1330 CORE IB-3 (SEE LOG)
1600 COMPLETE IB-3 (CASED TO 20' BGS
1600 GAUGE WELLS ON SITE (SEE GAUGING SHEET)
CLEAN UP
SETUP ON IB WELLS FOR INJECTION, DISCUSS WITH S. JACKSON
WILL START WITH WELL INSTALLATIONS TOMORROW
CLEAN UP
1800 DEPART SITE

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PROJECT NUMBER 32000164I-08
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-16-15

PROJECT	NUSTAR QUAIL CROSSING	ARRIVAL TIME	0830
LOCATION	ANDOVER, KS	DEPARTURE TIME	~~1630~~ MW 03-16-15 1700
CLIENT	NUSTAR	WEATHER	CLEAR
PURPOSE OF OBSERVATIONS	WELL INSTALLATION / PILOT STUDY / TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE DRILLING	PERMIT NO.	–
CONTRACTOR REP.	MARK AND CHAD	H&S REVIEW	✓

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0830 APEX ARRIVES ON SITE, LAYNE ON SITE, H+S REVIEW
MOVE RIG TO SETUP ON MW-17 FOR INSTALLATION
RIG SETUP OVER MW-17
RUN CASING DOWN TO 42'
CASING DOWN TO DEPTH
START INSTALLING WELL MW-17 FROM 27-42' (SCREENED)
1310 WELL INSTALLED (MW-17)
MOVE RIG, SETUP ON MW-19 TO CONSTRUCT WELL
RIG SETUP, POSITION CASING
1340 START SENDING CASING DOWN TO 42'
CASING DOWN TO DEPTH
1510 INSTALL WELL COMPONENTS ON MW-19 FROM 27-42' (SCREENED)
1550 FINISH INSTALL ON MW-19
PULL CASING
PULL RIG OFF OF MW-19 LOCATION
(620)245-7847 - JAY HAWK LANDSCAPING
SETUP ON MW-18 LOCATION
CLEAN UP
1700 DEPART SITE

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PROJECT NUMBER 320001641-08
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-17-2015

PROJECT	QUAIL CROSSING	ARRIVAL TIME	0815
LOCATION	ANDOVER, KS	DEPARTURE TIME	1745
CLIENT	NUSTAR	WEATHER	M. CLEAR (40'S) WINDY
PURPOSE OF OBSERVATIONS	WELL INSTALLATION/PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE	PERMIT NO.	-
CONTRACTOR REP.	MARK AND CHAD	H&S REVIEW	✓

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0815 APEX ARRIVES ON SITE, LAYNE ON SITE, RIG IS DOWN
HYDRAULIC CYLINDER/ACTUATOR ON DRILL HEAD BROKE THIS MORNING
CALL S. JACKSON, LAYNE HAS SOMEONE FROM TEXAS DRIVING UP REPLACEMENT
COMPLETE SURFACE OF MW-17 MONITORING WELL
EXTEND PAD ON MW-7 LOC. (PER S. JACKSON)
PART COMES IN FOR DRILL RIG, INSTALL ON DRILL HEAD
1515 SAMPLES SHIPPED TO LABORATORY
WORK ON DRILL RIG
RIG BACK UP AND RUNNING, START PUSHING CASING TO 42' BGS
CASING DOWN TO DEPTH
1625 START INSTALLING MONITORING WELL MW-18
WELL MW-18 INSTALL, SCREEN FROM 27-42' BGS
1645 APEX (PAUL AND RYAN) DEPART SITE
1700 WELL INSTALLED, PULL RIG OFF HOLE.
BENTONITE IN SURFACE
MOVE EQUIPMENT AROUND
CLEAN UP SITE
1745 DEPART

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PROJECT NUMBER 320001641-08
FIELD REPORT NUMBER
PAGE 1 OF 2
DATE 03-18-2015

PROJECT	QUAIL CROSSING	ARRIVAL TIME	0800
LOCATION	ANDOVER, KS	DEPARTURE TIME	1700
CLIENT	NVSTAR	WEATHER	OVERCAST, LIGHT RAIN (40's)
PURPOSE OF OBSERVATIONS	WELL INSTALL / PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE	PERMIT NO.	—
CONTRACTOR REP.	MARK/CHAD	H&S REVIEW	✓

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0800 APEX ARRIVES ON SITE, LAYNE ON SITE, H+S REVIEW
SETUP ON IB-7 LOCATION WITH MUD MATS FOR TRACKS
0815 CORE IB-7 LOCATION (SEE LOG)
0940 COMPLETE IB-7 LOCATION
SETUP EQUIPMENT FOR INJECTION
0950 MIX FIRST 40-GALLON BATCH OF ORC ADVANCED, 2 x 40 LB BAGS ORC, 36 GALLONS OF WATER, 40-GALLON SLURRY, PLAN TO INJECT THROUGH 4-4.5" CASING (CORE BARREL) (4-INCH OD CORE BARREL AND 3.5" OD TOOLING/RODS) (SEE INJECTION LOG
MIX SECOND BATCH OF ORC, INJECT
1030 INJECTION IB-7 COMPLETE 80-GALLONS OF SLURRY INJECTED
PULL RIG OFF IB-7 LOCATION, CALL S. JACKSON, ALF DRILLER TO REDUCE INJECTION PRESSURE TO 50 PSI, PER INJECTION PERMIT (VIC PERMIT DOES NOT ALLOW GREATER THAN 50 PSI FOR INJECTIONS)
SETUP ON IB-8 LOCATION
1045 CORE IB-8
1155 IB-8 COMPLETED TO 40' BGS
1200 INJECT AT IB-8 LOCATION (SEE INJECTION LOG)
SETUP ON IB-4 LOCATION
1300 CORE IB-4
1415 IB-4 COMPLETED TO 40' BGS
1418 INJECT AT IB-4 LOCATION (SEE INJECTION LOG)
SETUP ON IB-5 LOCATION
1435 CORE IB-5

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APEX

3015 SW First Avenue
Portland, Oregon 97201-4707
(503) 924-4704 Phone
(503) 943-6357 Fax

PROJECT NUMBER 320001641-08
FIELD REPORT NUMBER
PAGE 2 OF 2
DATE 03-18-2015

1545 IB-5 CORED TO 40' BGS
1~~55~~5 INJECT AT IB-5 LOC. (SEE INJECTION LOG)
1610 COMPLETE INJECTION
CLEAN UP
1700 DEPART SITE

BY

APEX REPRESENTATIVE

REVIEWED BY

APEX PROJECT MANAGER

APEX

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Portland, Oregon 97201-4707
(503) 924-4704 Phone
(503) 943-6357 Fax

PROJECT NUMBER 320001641-08
FIELD REPORT NUMBER
PAGE 1 OF 1
DATE 03-19-2015

PROJECT	QUAIL CROSSING	ARRIVAL TIME	0815
LOCATION	ANDOVER, KS	DEPARTURE TIME	1215
CLIENT	NUSTAR	WEATHER	LT RAIN (40'S-50'S)
PURPOSE OF OBSERVATIONS	WELL INSTALLATION / PILOT TEST		
APEX REPRESENTATIVE	M. WHITSON	APEX PROJECT MANAGER	S. JACKSON
CONTRACTOR	LAYNE	PERMIT NO.	–
CONTRACTOR REP.	(MARK AND CHAD)	H&S REVIEW	✓

Our firm's professionals are represented on site solely to observe operations of the contractor identified, to form opinions about the adequacy of those operations, and to report those opinions to our client. The presence and activities of our field representative do not relieve any contractor from its obligation to meet contractual requirements. The contractor retains sole responsibility for site safety and the methods, operations, send sequence of construction. Unless signed by the Ash Creek Associates Project Manager, this report is preliminary. A preliminary report is provided solely as evidence that field observation was performed. Observations and/or conclusions and/or recommendations conveyed in the final report may vary from and shall take precedence over those included in a preliminary report.

0815 APEX ON SITE, LAYNE ON SITE, H+S REVIEW
CORE IB-9 LOCATION TO 40' BGS
0910 INJECT AT IB-9 LOCATION (SEE INJECTION LOG)
MOVE TO IB-6
CORE IB-6 LOCATION TO 40' BGS
1120 INJECT AT IB-6 LOCATION (SEE INJECTION LOG)
CLEAN UP
LEAVE APEX TULSA WITH INJECTION LOG AND INSTRUCTIONS
1215 DEPART SITE FOR FEDEX AND KANSAS CITY AIRPORT

BY

APEX REPRESENTATIVE

REVIEWED BY

APEX PROJECT MANAGER

WELL GAGING DATA SHEET

APEX

		Job Number:	1641
Client:	NUSTAR	Date:	03-12-2015
Project:	QUAIL CROSSING	Sampler:	M. WHITSON
Weather:	CLEAR (70'S) CALM	Time In/Out:	

WATER LEVEL DATA

Well I.D.	Time	Depth to Free Product (feet)	Depth to Water (feet)	Depth to Well Bottom (feet)	Product Thickness (feet)	Water Column Height (feet)	Notes/Other Remarks
MW-19	0835	–	45.0	45.7'	–	0.7'	
MW-18	0845	–	43.2'	44'	–	0.8'	
MW-17	1200	–	–	45.0'	–	–	
	03-13						
MW-19	1030	–	42.6'	44.8'	–	2.2'	
MW-18	1035	–	40.0'	43.3'	–	3.3'	
MW-17	1040	–	42.8	44.0'	–	1.2'	
	03-14						
MW-19	1335	–	40.1'	44.6	–	4.5'	
MW-18	1340	–	36.3'	41.5	–	5.2'	
MW-17	1345	–	38.7'	41.3	–	2.6'	
	03-15						
MW-17	1600	–	35.4	39.4	–	4.0'	
MW-19	1605	–	38.5	41.1	–	2.6'	
MW-18	1610	–	33.5	39.8	–	6.3'	

WELL GAGING DATA SHEET

APEX

		Job Number:	
Client:	NUSTAR	Date:	03-18-15
Project:	QUAIL CROSSING	Sampler:	M. WHITSON
Weather:	CLOUDY (40'S)	Time In/Out:	

WATER LEVEL DATA

Well I.D.	Time	~~Depth to Free Product (feet)~~	~~Depth to Water (feet)~~	~~Depth to Well Bottom (feet)~~	~~Product Thickness (feet)~~	~~Water Column Height (feet)~~	Notes/Other Remarks		
WELL ID	TIME START	SLURRY GALLONS	BOTTOM DEPTH	TOP DEPTH	TIME FINISH	PRESSURE	SLURRY MIX TIME	ORE LBS	WATER GALLONS
IB-7	~~09~~ 1000	~~40~~	40	30	1015	100	0950	80	36
	1015	~~40~~	30	20	1030	100	1015	80	36
IB-8	1200	~40	40	30	1207	40	1155	~75	36
	1209	~40	30	20	1215	40	1208	~75	36
IB-4	1418	~40	40	30	1421	35	1415	~75	36
	1424	~40	30	20	1430	35	1422	~75	36
IB-5	1555	~40	40	30	1600	40	1550	~75	36
	1605	~40	30	20	1610	40	1601	~75	36

WELL GAGING DATA SHEET

APEX

		Job Number:	
Client:		Date:	03-19-15
Project:		Sampler:	M. WHITSON
Weather:		Time In/Out:	

WATER LEVEL DATA

Well I.D.	Time	~~Depth to Free Product (feet)~~	~~Depth to Water (feet)~~	~~Depth to Well Bottom (feet)~~	~~Product Thickness (feet)~~	~~Water Column Height (feet)~~	Notes/Other Remarks		
WELL ID	TIME START	SLURRY GALS	BOTTOM DEPTH	TOP DEPTH	TIME FINISH	PRESS	SLURRY MIX TIME	ORC	WATER
18-4	0910	40	40	30	0915	35	0907	75	36
	0918	40	30	20	0925	35	0916	75	36
18-6	1120	40	40	30	1125	40	1116	75	36
	1130	40	30	20	1135	40	1128	75	36

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Chain of Custody Form

Page 1 of 2

COC ID: 118554

ALS Project Manager: | ALS Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	Andover Release Site	A	VOCs (8260) 14 compound Select List
Work Order		Project Number	E3CE-0065	B	GRO - VPH OA-1
Company Name	Apex Companies	Bill To Company	Apex Companies	C	
Send Report To	Samuel Jackson	Invoice Attn	Samuel Jackson	D	
Address	3015 SW First Avenue	Address	3015 SW First Avenue	E	H = HOLD FOR INSTRUCTIONS FROM PM
				F	(NOT ALL SAMPLES WILL BE RUN FOR ANALYSIS)
City/State/Zip	Portland, OR 97201	City/State/Zip	Portland, OR 97201	G	
Phone	(503) 924-4704	Phone	(503) 924-4704	H	
Fax		Fax		I	
e-Mail Address	sjackson@apexcos.com	e-Mail Address		J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	MW-19 (28)	03-11	1710	S	–	2	H	H									
2	MW-19 (32)	03-11	1720	S	–	2	H	H									
3	MW-19 (45)	03-11	1800	S	–	2	H	H									
4	MW-18 (26.5)	03-11	1315	S	–	2	H	H									
5	MW-18 (31.5)	03-11	1325	S	–	2	H	H									
6	MW-17 (19)	03-12	1005	S	–	2	H	H									
7	MW-17 (22)	03-12	1015	S	–	2	H	H									
8	MW-17 (37)	03-12	1100	S	–	2	H	H									
9	IB-1 (18.0)	03-14	1650	S	–	2	H	H									
10	IB-1 (24.0)	03-14	1700	S	–	2	H	H									

Sampler(s) Please Print & Sign: MICHAEL WHITSON

Shipment Method: FEDEX

Required Turnaround Time: (Check Box) [X] Std 10 Wk days [ ] 5 Wk Days [ ] 2 Wk Days [ ] 24 Hour [ ] Other

Results Due Date:

Relinquished by:	Date:	Time:	Received by:
	03-17	1530	
Relinquished by:	Date:	Time:	Received by (Laboratory):
Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):

Notes: Andover Quail Crossing Soil Investigation

Cooler ID	Cooler Temp.

QC Package: (Check One Box Below)
[X] Level 2 Std QC
[ ] Level 3 Std QC/Row da
[ ] Level 4 SW846/CLP
[ ] Other/EDD
[ ] TRRP Chk List
[ ] TRRP Level 4

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

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COC ID: 118555

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ALS Project Manager: | ALS Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	Andover Release Site	A	VOCs (8260) 14 compound Select List
Work Order		Project Number	E3CE-0065	B	GRO - VPH OA-1
Company Name	Apex Companies	Bill To Company	Apex Companies	C	
Send Report To	Samuel Jackson	Invoice Attn	Samuel Jackson	D	
Address	3015 SW First Avenue	Address	3015 SW First Avenue	E	H = HOLD FOR INSTRUCTIONS FROM PM
				F	(NOT ALL SAMPLES RUN FOR ANALYSIS)
City/State/Zip	Portland, OR 97201	City/State/Zip	Portland, OR 97201	G	
Phone	(503) 924-4704	Phone	(503) 924-4704	H	
Fax		Fax		I	
e-Mail Address	sjackson@apexcos.com	e-Mail Address		J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	IB-2 (32)	03-15	1320	S	–	2	H	H									
2	IB-2 (38)	03-15	1330	S	–	2	H	H									
3	IB-3 (24)	03-15	1530	S	–	2	H	H									
4	IB-3 (30)	03-15	1540	S	–	2	H	H									
5	IB-3 (36)	03-15	1600	S	–	2	H	H									
6																	
7																	
8																	
9																	
10																	

Sampler(s) Please Print & Sign: MICHAEL WHITSON

Shipment Method: FEDEX

Required Turnaround Time: (Check Box): ☒ Std 10 Wk days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour ☐ Other

Results Due Date:

Relinquished by: | Date: 03-17 | Time: 1530 | Received by:

Relinquished by: | Date: | Time: | Received by (Laboratory):

Logged by (Laboratory): | Date: | Time: | Checked by (Laboratory):

Notes: Andover Quad Crossing Gw Investigation

Cooler ID	Cooler Temp.

QC Package: (Check One Box Below)

☒ Level 2 Std QC ☐ TRRP ChkList
☐ Level 3 Std QC/Row da ☐ TRRP Level 4
☐ Level 4 SW846/CLP
☐ Other/ECD

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

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Apex Companies, LLC- Portland, OR

3015 SW First Avenue
Portland, OR 97201-4707

Billing Information:
Accounts Payable- Rachelle Vanderzanden
3015 SW First Avenue
Portland, OR 97201-4707

Report to: Ian Maguire-/ Sam Jackson

Email To: IMaguire@apexcos.com; SJackson@apexcos.com

Project Description: Andover Release Site

City/State Collected: ANDOVER, KS

Phone: 503-924-4704
Fax: 503-943-6357

Client Project # E3CE-0065

Lab Project # ASHCREPOR-NUSTAR

Collected by (print): MICHAEL WHITSON

Site/Facility ID # EASTER ADDITION

P.O. #

Collected by (signature): [signature]

Immediately Packed on Ice N ____ Y ✓

Rush? (Lab MUST Be Notified)
___ Same Day 200%
___ Next Day 100%
___ Two Day 50%
___ Three Day 25%

Date Results Needed

Email? ___No X__Yes
FAX? ___No ___Yes

Analysis / Container / Preservative

Chain of Custody Page ___ of ___

ESC LAB SCIENCES
YOUR LAB OF CHOICE
12065 Lebanon Rd
Mount Juliet, TN 37122
Phone: 615-758-5858
Phone: 800-767-5859
Fax: 615-758-5859

L #

Table #

Acctnum: ASHCREPOR
Template: T100693
Prelogin: P500936
TSR: 358 - Jarred Willis
PB: 2/7/15 MW
Shipped Via: FedEX Ground

Sample ID	Comp/Grab	Matrix *	Depth	Date	Time	No. of Cntrs	OA1(GRO) / V8260 2ozClr-NoPres	OA2 4ozClr-NoPres	V8260-Trip Blank 40mlAmb-HCl-Blk							Rem./Contaminant	Sample # (lab only)
MW-1R (19.5)	G	SS	19.5	03-12	1550	2	H	H									
MW-1R (22)	G	SS	22	03-12	1600	2	H	H									
MW-1R (33)	G	SS	33	03-12	1630	2	H	H									
F-1R (26)	G	SS	26	03-13	1750	2	H	H									
F-1R (30)	G	SS	30	03-13	1830	2	H	H									
F-1R (36)	G	SS	36	03-13	1845	2	H	H									
TRIP BLANK	–	~~SS~~	–	–	–	~~2~~	~~X~~	~~X~~	X MW	03-17-15							
		SS				~~2~~	~~X~~	~~X~~	MW	03-17-15							
		SS				~~2~~	~~X~~	~~X~~	MW	03-17-15							
		SS				~~2~~	~~X~~	~~X~~	MW	03-17-15							

* Matrix: SS - Soil GW - Groundwater WW - WasteWater DW - Drinking Water OT - Other_____

Remarks: H = HOLD FOR INSTRUCTIONS FROM PM
(NOT ALL SAMPLES WILL BE RUN FOR ANALYSIS)

pH _____ Temp _____
Flow _____ Other _____

Hold #

Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Samples returned via: ☐ UPS ☑ FedEx ☐ Courier ☐ _____	Condition: (lab use only)
[signature]					
Relinquished by : (Signature)	Date:	Time:	Received by: (Signature)	Temp: °C Bottles Received:	COC Seal Intact: ___Y ___N ___NA
Relinquished by : (Signature)	Date:	Time:	Received for lab by: (Signature)	Date: Time:	pH Checked: NCF:

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ALS Project Manager: | ALS Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	Andover Release Site	A	VOCs (8260) 14 compound Select List
Work Order		Project Number	E3CE-0065	B	GRO - VPH OA-1
Company Name	Apex Companies	Bill To Company	Apex Companies	C	
Send Report To	Samuel Jackson	Invoice Attn	Samuel Jackson	D	
Address	3015 SW First Avenue	Address	3015 SW First Avenue	E	
				F	H = HOLD FOR INSTRUCTIONS FROM PM
City/State/Zip	Portland, OR 97201	City/State/Zip	Portland, OR 97201	G	(NOT ALL SAMPLES WILL BE RUN FOR
Phone	(503) 924-4704	Phone	(503) 924-4704	H	ANALYSIS)
Fax		Fax		I	
e-Mail Address	sjackson@apexcos.com	e-Mail Address		J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	IB-7 (19)	03-18-15	0900	S	–	2	H	H									
2	IB-7 (24)	03-18-15	0915	S	–	2	H	H									
3	IB-7 (39)	03-18-15	0930	S	–	2	H	H									
4	IB-8 (18)	03-18-15	1130	S	–	2	H	H									
5	IB-8 (32.5)	03-18-15	1200	S	–	2	H	H									
6	IB-8 (39)	03-18-15	1205	S	–	2	H	H									
7	IB-4 (6)	03-18-15	1330	S	–	2	H	H									
8	IB-4 (19.5)	03-18-15	1345	S	–	2	H	H									
9	IB-4 (31)	03-18-15	1400	S	–	2	H	H									
10	IB-4 (39)	03-18-15	1415	S	–	2	H	H									

Sampler(s) Please Print & Sign: MIKE WHITSON

Shipment Method: FEDEX OVERNIGHT

Required Turnaround Time: (Check Box) ☒ Std 10 Wk days ☐ 5 Wk Days ☐ 2 Wk Days ☐ 24 Hour ☐ Other

Results Due Date:

Relinquished by: | Date: 03-19 | Time: 1700 | Received by:

Relinquished by: | Date: | Time: | Received by (Laboratory):

Logged by (Laboratory): | Date: | Time: | Checked by (Laboratory):

Notes: Andover Road Crossing Soil Investigation

Cooler ID	Cooler Temp.

QC Package: (Check One Box Below)

- ☒ Level 2 Std QC
- ☐ Level 3 Std QC/Raw da
- ☐ Level 4 SW846/CLP
- ☐ Other/EDD
- ☐ TRRP ChkList
- ☐ TRRP Level 4

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

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Chain of Custody Form

Page 2 of 2

COC ID: 118556

ALS Project Manager: | ALS Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	Andover Release Site	A	VOCs (8260) 14 compound Select List
Work Order		Project Number	E3CE-0065	B	GRO - VPH OA-1
Company Name	Apex Companies	Bill To Company	Apex Companies	C	
Send Report To	Samuel Jackson	Invoice Attn	Samuel Jackson	D	
Address	3015 SW First Avenue	Address	3015 SW First Avenue	E	
				F	
City/State/Zip	Portland, OR 97201	City/State/Zip	Portland, OR 97201	G	
Phone	(503) 924-4704	Phone	(503) 924-4704	H	
Fax		Fax		I	
e-Mail Address	sjackson@apexcos.com	e-Mail Address		J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	TRIP BLANK	(—	—	W	1	2	X										
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	

Sampler(s) Please Print & Sign: MIKE WHITSON / [signature]

Shipment Method: FEDEX OVERNIGHT

Required Turnaround Time: (Check Box) [X] Std 10 Wk days [ ] 5 Wk Days [ ] 3 Wk Days [ ] 24 Hour [ ] Other

Results Due Date:

Relinquished by: [signature] Date: Time: 1700 Received by:

Relinquished by: Date: Time: Received by (Laboratory):

Logged by (Laboratory): Date: Time: Checked by (Laboratory):

Notes: Andover Quail Crossing Soil Investigation

Cooler ID	Cooler Temp.

QC Package: (Check One Box Below)
- [X] Level 2 Std QC
- [ ] Level 3 Std QC/Row da
- [ ] Level 4 SW846/CLP
- [ ] Other/EDD
- [ ] TRRP ChkList
- [ ] TRRP Level 4

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

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WELL GAGING DATA SHEET

APEX

		Job Number:	32000441-08.003
Client:	Nissan	Date:	20150218
Project:	Anchorage / colHart	Sampler:	
Weather:	Cloudy	Time In/Out:	

WATER LEVEL DATA

	Well I.D.	Time	Depth to Free Product (feet)	Depth to Water (feet)	Depth to Well Bottom (feet)	Product Thickness (feet)	Water Column Height (feet)	Notes/Other Remarks
	2006	15:49	—	45.55	—	—	—	
	MW-18	16:05	—	27.93	41.09	—	—	16:09 began development
	MW-18	16:20	—	—	—	—	—	16:20 Dry
	MW-19	16:30	—	35.14	42.85	—	—	16:32 Began development
	MW-19	16:33	water	clear.	16:34 back to		cloudy	dry at 16:35
03-19	MW-11	13:56	—	29.84	—	—	—	
	MW-14	14:07	—	33.94	—	—	—	
	MW-13	14:14	—	33.16	—	—	—	
	MW-8	14:17	—	21.96	—	—	—	
	MW-5	14:19	—	20.80	—	—	—	
	MW-2	14:22	—	32.87	—	—	—	
	MW3	14:25	—	41.02	—	—	—	
	MW-6	14:28	—	22.62	—	—	—	
	MW-7	14:31	—	16.63	—	—	—	
	Pond	14:33	—	—	—	—	—	1343.6
	MW9	14:36	—	31.59	—	—	—	
	MW-10	14:39	—	28.42	—	—	—	
	MW-12	14:42	—	30.95	—	—	—	
	MW-4	14:45	—	31.22	—	—	—	
16	MW-16	14:48	—	31.80	—	—	—	
	MW-15	1454	—	35.04	—	—	—	
3-20	MW-1	1055	—	31.38	—	—	—	

WELL MONITORING DATA SHEET

APEX

Well I.D.	MW-4	Job Number:	32000164108-003
Client:	NUSTAR	Date:	3-20-2015
Project:	Anderson / Colt Creek	Sampler:	PN
Weather:	cool, sunny	Time In/Out:	0930 / 1015

WELL DATA

Well Depth:	—	Well Diameter:	2	Water Height	—
Depth to Water:	31.22	Screened Interval:	—	x Multiplier	—
Water Column Length:	—	Depth to Free Product:	—	x Casing Volumes	—
Purge Volume:	—	Free Product Thickness:	—	= Purge Volume	—
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	—

PURGING DATA

Purge Method:	PN	Pump Intake Depth:	35
Sampling Method:	PN	Tubing Type:	poly

Comments

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.1	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
0945	0.3	0.3	31.28	0.3	6.45	14.83	1.047	11.48	5.2	—	CL
0948	0.9	1.2	31.58	0.3	6.49	15.46	1.051	1.69	-16.7	—	CL
0951	0.9	2.1	31.85	0.3	6.50	15.51	1.050	1.24	-24.3	—	SC
0954	0.9	3.0	32.07	0.3	6.51	15.49	1.050	0.99	-28.3	—	AC
0957	0.9	3.9	32.33	0.3	6.52	15.77	1.050	0.86	-30.2	—	C

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-4	Sampling Flow Rate	0.3	Analytical Laboratory:	ALS
Sample Time:	0959	Final Depth to Water:	33.46	Did Well Dewater?	NO

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			

COMMENTS

WELL MONITORING DATA SHEET

APEX

Well I.D.	MW-5	Job Number:	32001641 08-004
Client:	NUSTAR	Date:	3-20-2015
Project:	Ambrose Colt Court	Sampler:	PN
Weather:	cool, sunny	Time In/Out:	1020/1050

WELL DATA

Well Depth:	—	Well Diameter:	2"	Water Height	—
Depth to Water:	20.80	Screened Interval:	—	x Multiplier	—
Water Column Length:	—	Depth to Free Product:	—	x Casing Volumes	—
Purge Volume:	—	Free Product Thickness:	—	= Purge Volume	—
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	—

PURGING DATA

Purge Method:	PN	Pump Intake Depth:	23
Sampling Method:	PN	Tubing Type:	poly

Comments

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.1	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
1026	0.3	0.3	21.06	0.3	6.85	16.37	1.444	2.42	28.9	—	C
1029	0.9	1.2	21.29	0.3	6.78	16.45	1.457	1.07	[illegible]	—	C
1032	0.9	2.1	21.43	0.3	6.75	16.45	1.452	1.13	31.3	—	C
1035	0.9	3.0	21.53	0.3	6.73	16.44	1.451	1.07	35.2	—	C

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-5	Sampling Flow Rate	0.3	Analytical Laboratory:	ALS
Sample Time:	1037	Final Depth to Water:	21.59	Did Well Dewater?	NO

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			

COMMENTS

WELL MONITORING DATA SHEET

APEX

Well I.D.	MW-1	Job Number:	32022164.1-08.003
Client:	NV STAT	Date:	3-20-2015
Project:	Ardmore Lott Court	Sampler:	PN
Weather:	NICE, sunny	Time In/Out:	11:10

WELL DATA

Well Depth:	—	Well Diameter:	4"	Water Height	—
Depth to Water:	31.38	Screened Interval:	—	x Multiplier	—
Water Column Length:	—	Depth to Free Product:	—	x Casing Volumes	—
Purge Volume:	—	Free Product Thickness:	—	= Purge Volume	—
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	—

PURGING DATA

Purge Method:	PN	Pump Intake Depth:	34	Comments	
Sampling Method:	PN	Tubing Type:	Poly		

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.1	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
1116	0.3	0.3	31.52	0.3	7.00	16.87	1.391	6.07	-71.9	—	CL
1119	0.9	1.2	31.64	0.3	6.84	16.80	1.391	2.08	-67.9	—	CL
1122	0.9	2.1	31.77	0.3	6.78	16.87	1.389	1.41	-63.7	—	CL
1125	0.9	3.0	31.81	0.3	6.76	16.70	1.388	1.21	-54.0	—	CL
1128	0.9	3.9	32.02	0.3	6.75	16.77	1.388	1.16	-46.0	—	CL

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-1	Sampling Flow Rate	0.3	Analytical Laboratory:	ALS
Sample Time:	1130	Final Depth to Water:	32.55	Did Well Dewater?	NO

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			

COMMENTS

WELL MONITORING DATA SHEET

APEX

Well I.D.	MW-17	Job Number:	32012/641-08004
Client:	NW STAT	Date:	3-20-2015
Project:	Andover Volt Court	Sampler:	PW
Weather:	Nice/sunny	Time In/Out:	1150

WELL DATA

Well Depth:	—	Well Diameter:	2"	Water Height	—
Depth to Water:	31.45	Screened Interval:	—	x Multiplier	—
Water Column Length:	—	Depth to Free Product:	—	x Casing Volumes	—
Purge Volume:	—	Free Product Thickness:	—	= Purge Volume	—
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	—

PURGING DATA

Purge Method:	PW	Pump Intake Depth:	42	Comments	
Sampling Method:	PW	Tubing Type:	Poly		

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.1	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
1155	0.3	0.3	35.95	0.3	6.45	18.01	1,051	3.03	30.1		VC
1158	0.9	1.2	36.35	0.3	6.88	16.28	1056	1.28	38.8		VC
1201	0.9	2.1	36.81	0.3	6.84	18.18	1,053	0.87	43.3		VC
1204	0.9	3.0	37.30	0.3	6.82	18.07	1,055	0.70	43.2		VC
1207	0.9	3.9	37.85	0.3	6.81	18.15	1,057	0.61	42.0		VC

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-17	Sampling Flow Rate	0.3	Analytical Laboratory:	ALS
Sample Time:	1209	Final Depth to Water:	40.32	Did Well Dewater?	NO

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			

COMMENTS

WELL MONITORING DATA SHEET

APEX

Well I.D.	MW-18	Job Number:	32000641-08.003
Client:	NUSTAR	Date:	3-20-2015
Project:	Anchor/Salt Cont	Sampler:	PN
Weather:	nice, sunny	Time In/Out:	12:45

WELL DATA

Well Depth:	—	Well Diameter:	2"	Water Height	—
Depth to Water:	~~21.68~~ 27.93	Screened Interval:	—	x Multiplier	—
Water Column Length:	—	Depth to Free Product:	—	x Casing Volumes	—
Purge Volume:	—	Free Product Thickness:	—	= Purge Volume	—
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	—

PURGING DATA

Purge Method:	PN	Pump Intake Depth:	36	Comments	
Sampling Method:	PN	Tubing Type:	poly		

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.1	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
1248	0.3	0.3	31.00	0.3	7.05	17.89	0.993	2.03	~~-6~~ -3.5	/	VC
1251	0.9	1.2	31.52	0.3	6.97	17.78	1.009	1.03	-18.8	/	VC
1254	0.9	2.1	31.92	0.3	6.90	17.52	0.999	0.78	-19.2	/	VC
1257	0.9	3.0	32.19	0.3	6.89	17.43	0.990	0.68	-12.6	/	VC

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-18	Sampling Flow Rate	0.3	Analytical Laboratory:	ALS
Sample Time:	1259	Final Depth to Water:	33.17	Did Well Dewater?	NO

# Containers/Type	Preservative	Analysis/Method	Field Filtered		Filter Size	MS/MSD	Duplicate ID
			yes	no			
			yes	no			
			yes	no			
			yes	no			
			yes	no			
			yes	no			

COMMENTS

WELL MONITORING DATA SHEET

APEX

Well I.D.	MW-19	Job Number:	32020/241-08.023
Client:	NVSTAT	Date:	3-20-2025
Project:	Andorra / Lot Lout	Sampler:	PN
Weather:	nice, sunny	Time In/Out:	13:14

WELL DATA

Well Depth:	—	Well Diameter:	2"	Water Height	—
Depth to Water:	35.19	Screened Interval:	—	x Multiplier	—
Water Column Length:	—	Depth to Free Product:	—	x Casing Volumes	—
Purge Volume:	—	Free Product Thickness:	—	= Purge Volume	—

Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters

PURGING DATA

Purge Method:	PN	Pump Intake Depth:	39	Comments
Sampling Method:	PN	Tubing Type:	poly	

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.1	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
1318	0.3	0.3	34.26	0.3	7.24	18.18	0.909	6.54	53.9	/	CL
1321	0.9	1.2	34.55	0.3	7.13	17.99	0.906	1.90	43.8	/	CL
1324	0.9	2.1	34.89	0.3	7.09	17.91	0.906	1.55	43.7	/	CL
1327	0.9	3.0	35.22	0.3	7.09	17.83	0.905	1.57	49.7	/	CL

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-19	Sampling Flow Rate	0.3	Analytical Laboratory:	ALS
Sample Time:	1329	Final Depth to Water:	~~36.3~~ 35.36	Did Well Dewater?	NO

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			
			yes no			

COMMENTS

ALS Environmental

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Chain of Custody Form

Page 1 of 1

COC ID: 118685

Houston, TX +1 281 530 5656 | Spring City, PA +1 610 948 4903 | South Charleston, WV +1 304 356 3168 | Middletown, PA +1 717 944 5541 | Salt Lake City, UT +1 801 266 7700 | York, PA +1 717 505 5280

ALS Project Manager: | ALS Work Order #:

Customer Information		Project Information		Parameter/Method Request for Analysis	
Purchase Order		Project Name	E3CE-0065 Andover Release Site	A	300_W (Sulfate, nitrate, O-Phos)
Work Order		Project Number		B	8260_LL_W (Colt Court GW List)
Company Name	Apex Companies	Bill To Company	Apex Companies	C	ALK_W 2320B
Send Report To	Samuel Jackson	Invoice Attn	Samuel Jackson	D	ICP_DISS (Dissolved Iron)
Address	3015 SW First Avenue	Address	3015 SW First Avenue	E	ICP_TW (Potassium only)
				F	NIT_AMM_W_ISE
City/State/Zip	Portland, OR 97201	City/State/Zip	Portland, OR 97201	G	RSK175 (Methane)
Phone	(503) 924-4704	Phone	(503) 924-4704	H	VPH OA-1_W (HYD-5)
Fax		Fax		I	XXX SUB (SUB CO2 (Simi Valley))
e-Mail Address		e-Mail Address		J	

No.	Sample Description	Date	Time	Matrix	Pres.	# Bottles	A	B	C	D	E	F	G	H	I	J	Hold
1	MW-4	3-20-2015	0959	GW	VAPOS	15	X	X	X	X	X	X	X	X	X		
2	MW-5		1037	GW	VAPOS	15	X	X	X	X	X	X	X	X	X		
3	MW-1		1130	GW	VAPOS	15	X	X	X	X	X	X	X	X	X		
4	MW-17		1209	GW	VAPOS	15	X	X	X	X	X	X	X	X	X		
5	MW-18	1259	~~1329~~	GW	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
6	MW-19		1329	GW	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓	↓		
7																	
8																	
9																	
10																	

Sampler(s) Please Print & Sign: Paul Ward

Shipment Method: FEDEX

Required Turnaround Time: (Check Box) TAT 7 days Other

Results Due Date:

Relinquished by:	Date:	Time:	Received by:	Notes: (E3CE-0065 Andover Release Site)
	3-20-15	14:20		
Relinquished by:	Date:	Time:	Received by (Laboratory):	Cooler ID / Cooler Temp.
Logged by (Laboratory):	Date:	Time:	Checked by (Laboratory):	QC Package: (Check One Box Below) QC Level STD Other

Preservative Key: 1-HCl 2-HNO_3 3-H_2SO_4 4-NaOH 5-$Na_2S_2O_3$ 6-$NaHSO_4$ 7-Other 8-4°C 9-5035

Note: 1. Any changes must be made in writing once samples and COC Form have been submitted to ALS Environmental.
2. Unless otherwise agreed in a formal contract, services provided by ALS Environmental are expressly limited to the terms and conditions stated on the reverse.
3. The Chain of Custody is a legal document. All information must be completed accurately.

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FIELD OBSERVATION FORM

SITE: Andover Quail Crossing	DATE: 4/20/15
WEATHER: wind 55°F	ESTIMATED DURATION OF EVENT: 1 day
EVENT TYPE: Gauge + Sample 6 wells	PTW #:
FIELD STAFF / COMPANY NAME: Jace Harris Ted Alfred	

OBJECTIVE OF FIELD WORK: Gauge all wells + Sample 6 new wells for MNA parameters

LIST APPLICABLE SOPs: Gauge wells + Sample

WERE SOPs FOLLOWED?	YES	NO	N/A
ARE THE WELLS IN GOOD CONDITION?	YES	NO	N/A
WERE WATER LEVELS CONSISTENT WITH PREVIOUS EVENTS?	YES	NO	N/A
WERE NAPL LEVELS CONSISTENT WITH PREVIOUS EVENTS (if applicable)?	YES	NO	N/A
ARE OFF-SITE ACTIVITIES/RECEPTORS NEAR SITE THE SAME AS DURING PREVIOUS EVENTS?	YES	NO	N/A
NUMBER OF DRUMS ONSITE UPON ARRIVAL: ___ ARE DRUMS LABELED:	YES	NO	N/A

(PROVIDE EXPLANATION BELOW FOR ALL "NO" ANSWERS. ATTACH ADDITIONAL DOCUMENTATION TO FORM IF NECESSARY)

NOTES/COMMENTS:

WELL GAGING DATA SHEET

APEX

		Job Number:	N/A
Client:	NuStar	Date:	4/20/15
Project:	Andover Quarl Xing	Sampler:	JH + TA
Weather:	Wind 55°F	Time In/Out:	

WATER LEVEL DATA

Well I.D.	Time	Depth to Free Product (feet)	Depth to Water (feet)	Depth to Well Bottom (feet)	Product Thickness (feet)	Water Column Height (feet)	Notes/Other Remarks
MW-1	10:41	—	31.39				
MW-2	10:44	—	36.43				
MW-3	10:29	—	45.61				
MW-4	11:13	—	34.10				
MW-5	10:51	—	21.01				
MW-6	10:34	—	23.05				
MW-7	10:32	—	16.10				
MW-8	10:50	—	22.25				
MW-9	10:27	—	33.25				
MW-10	10:24	—	28.53				
MW-11	11:11	—	30.39				
MW-12	10:20	—	31.09				
MW-13	10:48	—	33.34				
MW-14	10:46	—	34.93				
MW-15	11:06	—	36.50				
MW-16	11:02	—	33.03				
MW-17	10:39	—	~~34.91~~ 33.91				
MW-18	11:18	—	33.51				
MW-19	11:19	—	33.70				
Pond	10:31	—	1344.75'				

WELL MONITORING DATA SHEET

Ash Creek Associates, Inc.

Well I.D.	MW-1	Job Number:	
Client:	Nu Star	Date:	4/20/15
Project:	Andrews Quail Crossing	Sampler:	EA, JH
Weather:	Sunny / cloudy	Time In/Out:	1455 / 1535

WELL DATA

Well Depth:		Well Diameter:	4"	Water Height	
Depth to Water:	31.39	Screened Interval:		x Multiplier	
Water Column Length:		Depth to Free Product:		x Casing Volumes	
Purge Volume:		Free Product Thickness:		= Purge Volume	
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	

PURGING DATA

Purge Method:	bladder	Pump Intake Depth:	0.5' ft from bottom	Comments	
Sampling Method:	bladder	Tubing Type:	poly		

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.2	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
15:06			31.45	.2	6.81	16.72	1.186	1.03	-72.2		SC
15:09			31.49	.2	6.73	17.42	1.208	0.59	-75.6		SC
15:12			31.53	.2	6.71	16.94	1.214	0.89	-77.7		SC
15:15			31.60	.2	6.67	16.67	1.203	0.75	-78.4		SC

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-1	Sampling Flow Rate	.2	Analytical Laboratory:	ALS	
Sample Time:	1522	Final Depth to Water:	31.82	Did Well Dewater?	No	
# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
12 VOAs	9 HCl / 3 Neat	See	yes (no)			
1 250 Plastic	H_2SO_4		yes no			
1 250 Plastic	HNO_3	COC	yes no			
3 250 Plastic	Neat		yes no			
			yes no			
			yes no			

COMMENTS

Variations in cloud cover causing large swings in temp readings due to sun exposure (YSI vessel + tubing)

WELL MONITORING DATA SHEET

Ash Creek Associates, Inc.

Well I.D.	MW-4	Job Number:	
Client:	Nu Star	Date:	4/20/15
Project:	Andover Quail Crossing	Sampler:	TA, JH
Weather:	Sunny / cloudy	Time In/Out:	1540 / 1615

WELL DATA

Well Depth:		Well Diameter:	2"	Water Height	
Depth to Water:	34.10	Screened Interval:		x Multiplier	
Water Column Length:		Depth to Free Product:		x Casing Volumes	
Purge Volume:		Free Product Thickness:		= Purge Volume	
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	

PURGING DATA

Purge Method:	bladder	Pump Intake Depth:	4' from bottom
Sampling Method:	bladder	Tubing Type:	poly

Comments

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.2	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
15:45			34.19	.15	7.09	18.01	0.722	3.10	-25.3		SC
15:48			34.34	.15	7.04	17.41	0.724	2.83	-29.0		SC
15:51			34.57	.15	6.99	17.07	0.722	2.69	-27.9		SC
15:53			34.64	.125	7.00	17.31	0.719	2.54	-25.3		SC
15:56			34.69	.125	7.02	17.43	0.719	2.71	-24.9		SC

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-4	Sampling Flow Rate	.125	Analytical Laboratory:	ALS
Sample Time:	16:04	Final Depth to Water:	34.80	Did Well Dewater?	No

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
12 VOAs	9 HCl / 3 heat	See	yes (no)			
1 250 PL	H_2SO_4	C.O.C.	yes no			
1 250 PL	HNO_3		yes no			
3 250 PL	Neat		yes no			
			yes no			
			yes no			

COMMENTS

fluctuations in cloud cover causing temperature variances due to sun exposure to vessel / tubing

WELL MONITORING DATA SHEET

Ash Creek Associates, Inc.

Well I.D.	MW-5	Job Number:	
Client:	NuStar	Date:	4/20/15
Project:	Andrews Quail Crossing	Sampler:	TA, JH
Weather:	Sunny / Cloudy	Time In/Out:	16 /

WELL DATA

Well Depth:		Well Diameter:	2"	Water Height	
Depth to Water:	21.01	Screened Interval:		x Multiplier	
Water Column Length:		Depth to Free Product:		x Casing Volumes	
Purge Volume:		Free Product Thickness:		= Purge Volume	
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	

PURGING DATA

Purge Method:	bladder	Pump Intake Depth:			Comments
Sampling Method:	bladder	Tubing Type:	poly		

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.2	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
1624			21.12	.2	6.99	17.63	1.337	1.71	1.6		AC
1627			21.25	.2	6.85	17.12	1.358	1.27	10.5		AC
1630			21.34	.2	6.84	17.04	1.356	1.27	14.2		C
1633			21.56	.2	6.82	17.01	1.357	1.30	20.1		C
1636			21.71	.2	6.80	16.80	1.360	1.10	20.2		

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-5	Sampling Flow Rate	.2	Analytical Laboratory:	ALS
Sample Time:	1647	Final Depth to Water:	27.87	Did Well Dewater?	No

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
12 Vocs	4 HCl / 3 Neat		yes (no)			
1 250 Pl	H_2SO_4	See	yes no			
1 250 Pl	HNO_3	C.O.C	yes no			
3 250 Pl	Neat		yes no			
			yes no			
			yes no			

COMMENTS

WELL MONITORING DATA SHEET

Ash Creek Associates, Inc.

Well I.D.	MW-17	Job Number:	
Client:	NuStar	Date:	4/20/15
Project:	Andrews Quail Crossing	Sampler:	TA, JH
Weather:	Sunny / cloudy	Time In/Out:	1416

WELL DATA

Well Depth:		Well Diameter:	2"	Water Height	
Depth to Water:	~~34.91~~ 33.91	Screened Interval:		x Multiplier	
Water Column Length:		Depth to Free Product:		x Casing Volumes	
Purge Volume:		Free Product Thickness:		= Purge Volume	
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	

PURGING DATA

Purge Method:	bladder	Pump Intake Depth:	2.5' from bottom
Sampling Method:	bladder	Tubing Type:	poly

Comments

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond mS/cm	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.2	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
1421			34.10	.2	7.08	17.40	1.020	2.60	-44.8		SC
1424			34.31	.2	6.81	17.16	1.014	1.04	-42.9		SC
1427			34.47	.15	6.74	16.89	1.014	1.15	-44.3		SC
1430			34.69	.15	6.68	16.63	1.004	0.87	-44.1		SC
1433			34.83	.15	6.70	16.87	1.012	0.83	-45.6		SC

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-17	Sampling Flow Rate	.15	Analytical Laboratory:	ALS
Sample Time:	14:40	Final Depth to Water:	35.31	Did Well Dewater?	No

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
12 VOAs	9 HCl / 3 neat	See CoC	yes (no)			
1 250ml Plastic	H_2SO_4		yes no			
1 250ml Plastic	HNO_3		yes no			
3 250ml Plastic	Neat		yes no			
			yes no			
			yes no			

COMMENTS

WELL MONITORING DATA SHEET

Ash Creek Associates, Inc.

Well I.D.	MW-18	Job Number:	
Client:	NuStar	Date:	4/20/15
Project:	Andover Release	Sampler:	TA, JH
Weather:	Sunny	Time In/Out:	1205/1235

WELL DATA

Well Depth:		Well Diameter:	2"	Water Height	
Depth to Water:	33.51	Screened Interval:		x Multiplier	
Water Column Length:		Depth to Free Product:		x Casing Volumes	
Purge Volume:		Free Product Thickness:		= Purge Volume	
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	

PURGING DATA

Purge Method:	Bladder	Pump Intake Depth:	5' from bottom		Comments
Sampling Method:	Bladder	Tubing Type:	poly		

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (mS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.2	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
12:13			33.71	.15	5.93	17.07	.951	1.03	62.4	—	Cl
12:16			34.07	.15	6.03	17.18	.885	0.89	64.0	—	Cl
12:19			34.36	.15	6.10	17.17	.880	0.84	62.4	—	Cl
12:22			34.45	.10	6.17	17.38	.880	0.79	62.1	—	Cl

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-18	Sampling Flow Rate	.100	Analytical Laboratory:	ALS	
Sample Time:	12:27	Final Depth to Water:	34.97	Did Well Dewater?	No	
# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
12 voas	HCl	See C.o.C.	yes (no)			
2 Sulf 1 Pl, H_2SO_4			yes no			
" 1 Pl, HNO_3			yes no			
" 3 Neat			yes no			
			yes no			
			yes no			

COMMENTS

WELL MONITORING DATA SHEET

Ash Creek Associates, Inc.

Well I.D.	MW-19	Job Number:	
Client:	NuStar	Date:	4/20/15
Project:	Andrews Quail Xing	Sampler:	TA/JH
Weather:	Sunny	Time In/Out:	12:40/1325

WELL DATA

Well Depth:		Well Diameter:	2"	Water Height	
Depth to Water:	33.70	Screened Interval:		x Multiplier	
Water Column Length:		Depth to Free Product:		x Casing Volumes	
Purge Volume:		Free Product Thickness:		= Purge Volume	
Water Height Multipliers (gal)	1-inch = 0.041	2-inch = 0.162	4-inch = 0.653	1 gallon = 3.785 liters	

PURGING DATA

Purge Method:	Bladder	Pump Intake Depth:			Comments
Sampling Method:	Bladder	Tubing Type:	Poly		

Time	Volume Purged (liters)	Cumulative Volume Purged (liters)	DTW (btc)	Purge Rate (L/min)	pH	Temp (°C)	Cond (µS/cm)	DO (ppm)	ORP (mV)	Turbidity (NTUs)	Clarity/Color Other Remarks
					+/-0.2	+/-0.5° C	+/-5%	+/- 0.5 ppm	+/-20mV	+/-10%	<-- Stabilization Criteria
12:53			33.90	.15	6.91	17.74	.896	7.44	-14.3		SC
12:56			33.99	.15	6.74	17.34	.863	3.01	-45.9		SC
12:59			34.04	.15	6.63	17.16	.851	1.61	-59.5		SC
13:02			34.17	.15	6.62	17.10	.845	1.40	-61.6		SC
13:05			34.28	.15	6.62	17.11	.841	1.36	-61.2		SC

Clarity: VC = very cloudy, Cl = Cloudy, SC = slightly cloudy, AC = almost clear, C = clear

SAMPLING DATA

Sample ID:	MW-19	Sampling Flow Rate	.15	Analytical Laboratory:	ALS
Sample Time:	13:15	Final Depth to Water:	35.03	Did Well Dewater?	NO

# Containers/Type	Preservative	Analysis/Method	Field Filtered	Filter Size	MS/MSD	Duplicate ID
12 VOA's	9 HCl / 3 Neat	See COC	yes (no)			
250 mL Plastic	H_2SO_4		yes no			
250 mL Plastic	HNO_3		yes no			
250 mL Plastic	Neat		yes no			
			yes no			
			yes no			

COMMENTS