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WORKPLAN

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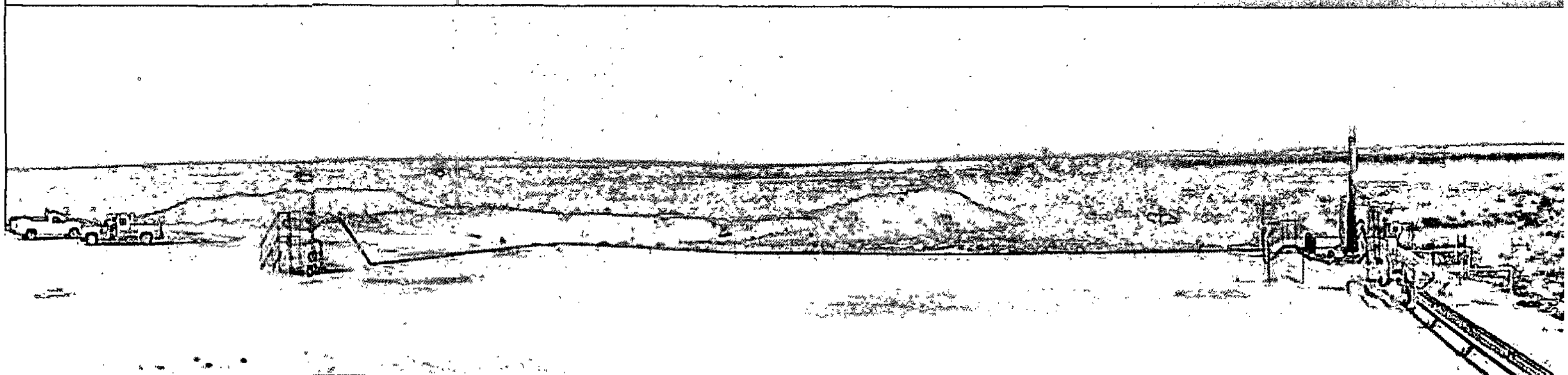
June 2006

Corrective Action Plan



Samson Livestock "30" Reserve Pit
Samson Investment Company

R.T. HICKS CONSULTANTS, LTD.

901 RIO GRANDE BLVD. NW, SUITE F-142, ALBUQUERQUE, NM 87104

June 2006

Corrective Action Plan

SAMSON LIVESTOCK "30" RESERVE PIT

Prepared for:

Samson Investment Company
Two West Second Street
Tulsa, OK 74103

R.T. HICKS CONSULTANTS, LTD.

901 RIO GRANDE, SUITE F-142, ALBUQUERQUE, NM, 87104

1.0 EXECUTIVE SUMMARY

Samson Investment Company (Samson) retained R.T. Hicks Consultants, Ltd. (Hicks Consultants) to address potential environmental concerns at the Samson Livestock "30" Reserve Pit T21S-R35E-Section 30, Unit Letter P (latitude 32° 26′ 41″ N, longitude 103° 24′ 7″ W).

The data and analysis generated by our characterization activities allow us to conclude that, in the absence of a ground water recovery program, a properly designed evapotranspiration infiltration barrier will provide the greatest level of protection of fresh water, public health, and the environment from residual constituents of concern in the vadose zone beneath the former pit. If the work elements recommended herein determine that a ground water recovery effort is necessary, vadose zone flushing that employs precipitation runoff will provide the greatest environmental benefit.

The purpose of an infiltration barrier is not to permanently isolate these constituents in the vadose zone, although that may be the ultimate result. The purpose of an infiltration barrier is to minimize the downward and upward migration of soluble salts such that the rate of vertical migration, down or up, has no material impact on ground water quality or soil productivity. The purpose of a vadose zone flushing is to move salt from the vadose zone to ground water where the salt will be captured by recovery wells.

Current ground water sampling data suggest that one of two hypotheses is correct:

1. Drilling fluid, with high chloride levels, entered ground water

or

2. The ambient quality of shallow ground water beneath the site is higher in TDS than ground water produced from nearby supply wells.

Existing data presented in this report favor a conclusion that hypothesis #1 is correct. This closure plan proposes completing a 6-month ground water pumping and sampling program to determine if hypothesis #1 is true and to provide an estimate of the mass of constituents that may have entered ground water. After evaluation of data from the proposed pumping and monitoring program, we will meet with NMOCD to develop a pathway to closure of the ground water file for this site. The pathway to closure may include one or more of the following elements:

- No action because the data demonstrate the veracity of Hypothesis #2
- Simple aquifer simulation modeling (MODFLOW-3D and MT3D) to estimate the magnitude, extent and fate of any impairment to ground water quality
- Use the results of the modeling to determine which of the following two ground water remedies is appropriate
    - Ground water pumping and removal of a sufficient mass of chloride to allow site closure under a natural attenuation (dilution and dispersion) remedy
    - Natural attentuation
- Installation of one or two 4-inch recovery well(s) down-gradient from the reserve pit to withdraw ground water for use in oil and gas well drilling.

Samson respectfully requests a meeting with NMOCD in August, preferably in Hobbs, to present the results of the 6-month ground water evaluation program and discuss the path forward to closure. If modeling, verified by field data, shows that any on-site impairment will not cause ground water to exceed WQCC Standards at the down gradient edge of the surface lease, Samson will request closure of the ground water file.

2.0 INTRODUCTION

Plate 1 shows the location of the site relative to the junction of the San Simon road (Co. Rd. 32) and State Highway 176, about 15 miles west of Eunice, New Mexico. The photograph below (Figure 1) depicts the site and the nearby environs. In Figure 1, the excavated reserve pit is in the background and the caliche pad associated with the well is in the foreground.

Figure 1 - Samson Livestock "30" Site (view to northwest)

Samson had excavated and exported some material from the site. Ocotillo Environmental conducted several site investigations in 2005. The undated Ocotillo Environmental Report, included as Appendix A to this report, provides a description of previous activities at the site.

Plate 2 is a topographic map of the site and the environs, showing the locations of nearby water supply wells. Plate 3 is an aerial photograph at the same scale as the topographic map showing the surrounding area is used primarily for livestock grazing and oil and gas production.

3.0 SITE ASSESSMENT

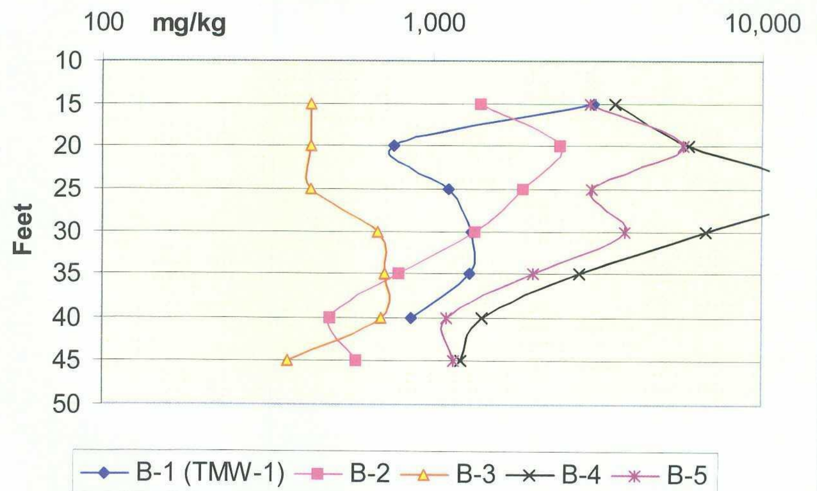
3.1 CONCENTRATIONS OF CONSTITUENTS OF CONCERN IN THE VADOSE ZONE

On May 11, 2005, following the excavation of the reserve pit to a depth of 10 feet, Samson personnel collected soil samples that indicated chloride concentrations from 3,920 to 8,080 mg/kg, with the highest levels located in the center of the excavation. From September 16 to 22, 2005 Ocotillo Environmental collected soil samples from nine hollow-stem auger borings within and surrounding the pit excavation area. The results of these sampling programs identified elevated chloride concentrations (>1,000 mg/kg) in the south and east corners of the pit excavation that extended to the ground water depth (45 feet below ground surface). Elevated chloride concentrations were also present in the center and west corner of the pit excavation that extended to a depth of 35 feet. A soil boring installed in the north corner of the pit excavation did not encounter chloride concentrations above 1,000 mg/kg. Plate 4 shows the location of the borings, surface samples were taken in the same locations as soil borings. Note that Plate 4 shows the former reserve pit as well as an outline of excavation associated with the exportation of material from the site.

The results of the soil sampling are summarized in Table 1 (attached). In all of the four borings located outside of the excavation area (B-6 through B-9) chloride concentrations in soil were less than 250 mg/kg. Twelve of 39 samples showed chloride concentrations less than the 1,000 mg/kg ground water protection limit suggested by highly-conservative simulation modeling conducted by NMOCD as being protective of ground water (see NMOCD Exhibits to the Surface Waste Management Rule Hearing).

Figure 2 shows the chloride concentrations v. depth for the boreholes within the excavation associated with the former reserve pit. The maximum field chloride concentration of 14,080 mg/kg is from B-4 at a depth of 25 feet bgs. The deepest samples above the capillary fringe (about 35 feet bgs) suggest that chloride did not

Figure 2 - Chloride v. Depth Livestock 30



materially impact the lower vadose zone in the north of the former pit (note that borings 2 and 3 were not drilled within the former reserve pit). In the central and southern portion of the excavation (within the area of the former reserve pit), chloride concentrations above the capillary fringe are 1,298 mg/kg (B-1), 2,799 mg/kg (B-4) and 2,031 mg/kg (B-5).

Laboratory analyses of hydrocarbons from the five samples collected on May 11, 2005 from the bottom of the pit (10 feet bgs), taken at approximately the same location as the borings, did not detect benzene, ethylbenzene, toluene, total xylenes or gasoline-range hydrocarbons. Three of these five samples detected diesel-range organic hydrocarbons at 549 mg/kg (SE Corner), 262 mg/kg (Center), and 70.6 mg/kg (NE Corner). The Ocotillo Environmental report from which we base this characterization is included in Appendix A. Please note that a figure in the Ocotillo report mistakenly plots chloride values as TPH.

From chloride data we conclude that the maximum vertical extent of the release penetrates the vadose zone to the capillary fringe and probably to ground water. The lateral extent of the subsurface impact is limited to the area of the former pit.

3.2 GROUND WATER CONDITIONS

The Livestock "30" site is located in the Grama Ridge geographic area, between the San Simon Swale to the south and the Laguna Valley to the north. All of southern Lea County is part of the Pecos Valley section of the Great Plains physiographic province. Drainage is discontinuous and generally occurs to the southeast, across the Eunice plains toward the Monument Draw. There is no natural surface water located in the vicinity of the site although small stock tanks supplied by water wells are present across the area.

Grama Ridge area is characterized by northwest-southeast trending ridges and valleys with up to fifty feet of topographic relief. Similarly trending playa lakes are generally present along the floor of the inter-ridge valleys. The Samson Livestock "30" reserve pit is located within a ½-mile wide valley; the nearest playa lakes are located approximately 1,000 feet to the southeast and 1,200 feet to the northwest. Plate 2 shows the topography of the area.

Rocks exposed at the surface along the ridges are alluvial deposits and petrocalcic soils of the Tertiary Ogallala formation (see Plate 5). They are covered by Quaternary age eolian deposits in the valleys, which consist of less than 10 feet of brown to reddish brown silt and very fine grain sand. The contact between the Quaternary and Tertiary formations is shown in Figure 3.

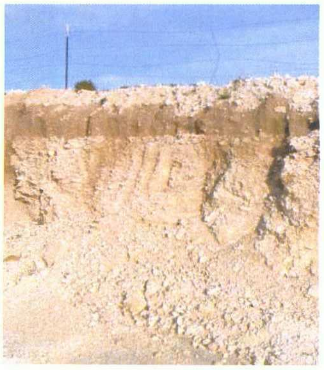


Figure 3. Contact between formations.

Based on state well records from water wells CP-667, CP-917, CP-866, and CP-916, the Ogallala formation is approximately 125 feet thick at the site. From the base of the Quaternary to approximately 40 feet the formation consist of caliche and very fine grain sand that is light brown to tan in color. From 40 to 130 feet it consists of red to white fine grain, sub rounded sand with inter-bedded small gravel. The Ogallala unconformably overlies the Triassic red clays. The on-site monitoring well log shows that the vadose zone consists of caliche and fine sand. Appendix B provides the well logs from the Office of the State Engineer for these nearby wells.

Many reports discuss the hydrogeologic characteristics of the Ogallala Aquifer. Most of these studies and reports do not provide information on the area near the Livestock 30 site. However, Masharrafieh and Chudnoff (Numerical Simulation of Groundwater Flow for Water Rights in the Lea County Underground Water Basin New Mexico, New Mexico Office of the State Engineer Technical Report 99-1, 1999) provides an estimate of the hydraulic conductivity and other parameters near the site (Figure 4). The area of the Livestock 30 well lies about 14 miles southeast of Monument - about 6 miles southeast of the model boundary. In this general area, the 1999 report suggests a hydraulic conductivity for the underlying aquifer of between 81 and 100 feet/day. Based upon our experience, the lithology of the saturated zone is very similar to that encountered south of Monument. In our opinion, the saturated hydraulic conductivity near the Livestock site is within the range of 50-100 ft/day.

Figure 4. Map showing estimated hydraulic conductivity near the site.

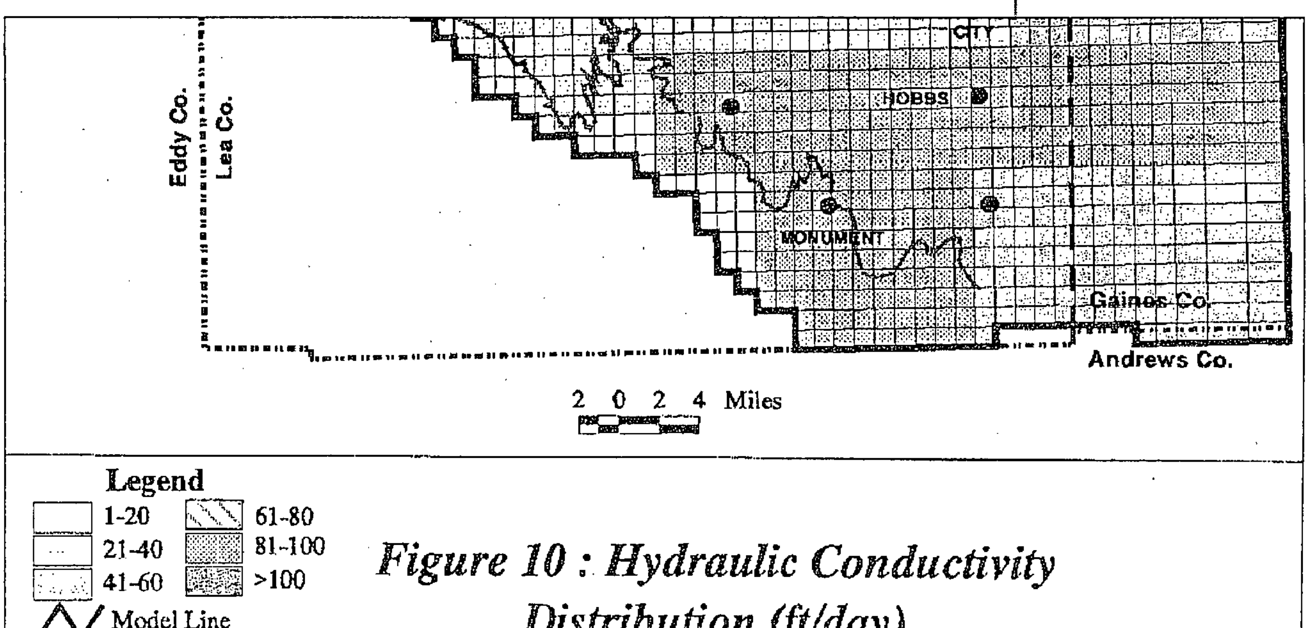


Figure 10 : Hydraulic Conductivity Distribution (ft/day)

According to the state well records, most of the area water wells encountered fresh water in the Ogallala between 40 and 130 feet, however these wells could not be accessed (or located) to verify fluid levels and depths. Fresh water can also be produced from the Triassic Santa Rosa formation in the area at approximately 250 to 350 feet. Plate 6 shows the potentiometric surface of the underlying aquifer based upon available data.

The chemical quality of the Ogallala ground water is reasonably good. Based on published data and a ground water sample recovered from a well located approximately 1,900 feet northwest of the site, the background water contains less than 1,000 mg/L total dissolved solids (TDS) and chloride concentrations of less than 50 mg/L.

A temporary 2-inch monitoring well was installed in the center of the reserve pit excavation on September 16, 2005. Elevated chloride concentrations were observed in the soil above the ground water (encountered at approximately 39 feet below the surface), but the concentrations were generally less than what was observed in samples recovered from borings placed in the south and east corners of the excavation. The initial water sample from the monitoring well recovered on September 19, 2005 contained 3,999 mg/L chloride. On March 30, 2006 the monitoring well was purged of approximately 30 gallons of water and a sample was recovered that contained 2,240 mg/L chloride and 4,520 mg/L TDS. Table 2 presents ground water data collected to date.

Because the reduction in the chloride concentration was so great between the September 2005 and the March 2006 sampling events, a third sampling event was conducted on May 10, 2006. On that date approximately 420 gallons of water were pumped over a 5-hour period (1.5 gpm) prior to sampling the well. The water sample contained 2,580 mg/L chloride and 3,900 mg/L TDS. The decrease in the chloride and TDS concentrations observed from the first to second sampling events indicates that the ground water impact may be limited to a relatively small area, however the proposed pumping and sampling program will test this conclusion.

3.3 CHLORIDE FLUX FROM THE VADOSE ZONE TO GROUND WATER

We employed all of the site-specific data available in a simplified version of the HYDRUS-1D computer model. This simplified model evaluated the potential of the 2-foot interval that represented the largest residual chloride mass in the vadose zone (25-27 feet below ground) to materially impair ground water quality at the site. The average chloride concentration of this interval is 4,370 mg/kg.

HYDRUS-1D simulates one-dimensional water flow, heat transport, and the movement of solutes involved in consecutive first-order decay reactions in variably-saturated soils. The HYDRUS-1D simulations employ highly conservative input parameters that can materially over-predict the chloride flux to ground water. A detailed explanation of the procedures employed in our evaluation of unsaturated flow using the HYDRUS-1D code may be found in Hendrickx and others (Modeling Study of Produced Water Release Scenarios, API Publication Number 4734, 2005).

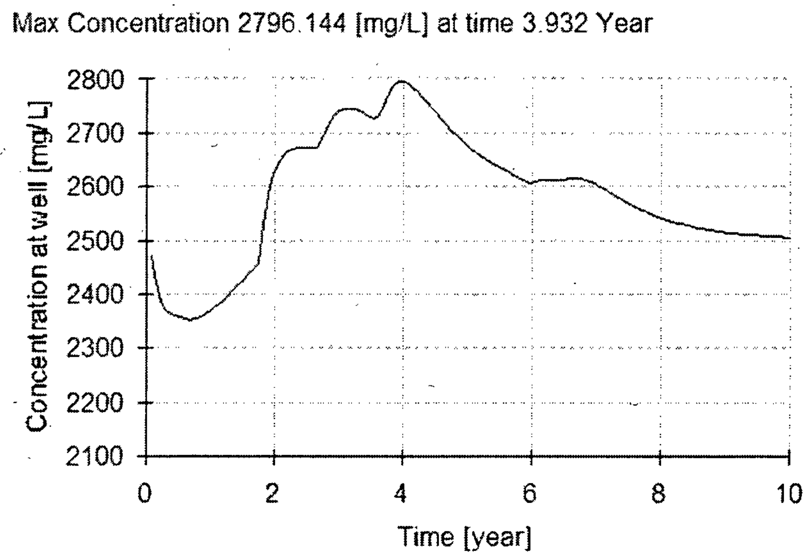


Figure 5. Predicted impact on ground water given a "background" concentration of 2,500 mg/L.

In the absence of any action on the part of Samson and with re-vegetation at the site occurring over several years, a HYDRUS-1D simulation shows residual vadose zone chloride will enter the ground water zone but cause only slight exacerbation of the existing ground water impairment. Figure 5 shows the predicted impact on ground water, given a "background" concentration of 2,500 mg/L chloride.

In the simplified simulation presented in Figures 5, we assume:

- the maximum chloride mass (about 4,300 mg/kg) lies 10 feet (3 meters) above the ground water table
- the chloride mass is 150 feet long, parallel to ground water flow, and resides in caliche
- the hydraulic gradient in the area is 0.002
- the 10-foot thick ground water zone exhibits a hydraulic conductivity of 75 ft/day
- the resultant ground water flux through the 10-foot thick mixing zone is 1.5 ft/day

Note that the initial decline in chloride concentration (between t = 0 and t = 2 years) is a result of the model simplification. In the simplified model, the pore water in the 8 feet between the 2-foot thick chloride-rich zone and ground water contains zero ppm chloride - which results in "dilution" of the ground water as this "pure" water enters the saturated zone. After four years of transport, the entire 2-foot thick chloride mass has entered the aquifer and concentrations begin to decline.

POLLUTION

If we assume that the mass of chloride that entered ground water during the pit operation and drying phase is quite small and will be diluted relatively quickly to the background chloride concentration of about 50 mg/L, then Figure 6 provides the prediction of potential ground water impairment due to migration of the 2-foot thick chloride-rich pore water. This simulation predicts that ground water chloride concentrations will increase by about 500 mg/L before beginning to decline (at year 3.9) as the mass moves from the vadose zone into ground water.

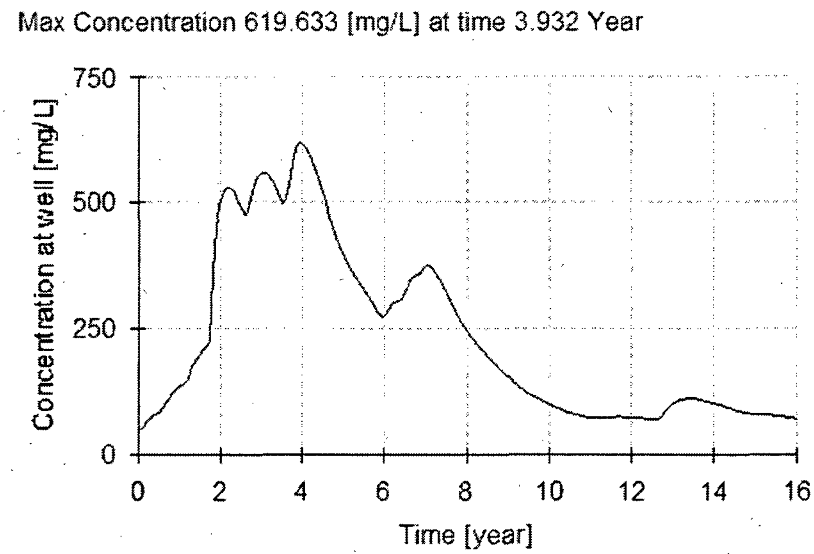


Figure 6. Simplified simulation of vadose zone transport with a background chloride concentration of 50 mg/L.

In Figure 7, the simplified model predicts the impact of a 2-foot layer of chloride-rich material (about 2,300 mg/L chloride) placed 18 feet above the water table. This scenario is a reasonable simulation of the impact caused by the migration of chloride-rich pore water residing near the base of the pit (about 10 feet below ground surface). The simulation predicts an initial "pulse" of chloride from about year 6 to year 9 and a second pulse from year 21 to year 30.

Based upon these simulations, we conclude that natural drainage of the vadose zone could cause ground water to exceed the WQCC chloride standard of 250 mg/L for a period of about 7 years (year 1 to year 8) at an imaginary monitoring well located immediately down gradient from the pit.

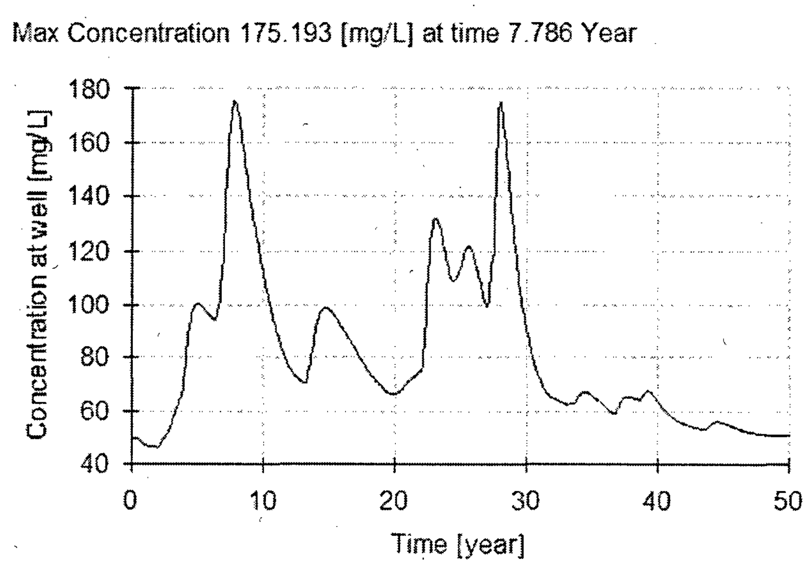


Figure 7. Simplified simulation of a 2-foot thick chloride mass of 2,300 mg/kg placed 18 feet above ground water.

4.0 VADOSE ZONE REMEDY

4.1 EXAMINATION OF ALTERNATIVES

We examined performance criteria of numerous landfill closure designs through a literature search. Specifically we examined the following documents, all of which are available through the internet:

- www.sandia.gov/caps provides a synopsis of landfill liner cover performance for the proposed designs
- www.sandia.gov/caps/designs.htm#landfill1 describes the various landfill cover designs tested by SNL
- cluin.org/products/altcovers/usersearch/lf_list.cfm provides links to performance monitoring of similar sites
- www.sandia.gov/caps/alternative_covers.pdf is the Sandia National Laboratory Report that fully describes the landfill cover evaluation project
- www.epa.gove/superfun/new/evapo.pdf provides useful links and data
- www.beg.utexas.edu/staffinfo/pdf/scanlon_vadosezj.pdf provides more case studies of ET cover performance

From this literature research, we identified several infiltration barriers that we believed could be feasible. These alternatives are:

1. RCRA Subtitle C Barrier - with minor modification
2. Monolithic ET Barrier
3. Capillary ET Barrier

The SNL website gives a brief description of each of these three designs, and Appendix C provides this summary.

4.2 PROOF OF DESIGN

The references described above describe years (and sometimes decades) of field monitoring and simulation modeling that clearly demonstrates the efficacy of these designs. The EPA Fact Sheet identified above provides a recent summary of the monitoring data that includes the three infiltration barrier systems that we considered for the vadose zone remedy. Table 3 shows data from the Fact Sheet that presents the measured infiltration rates below these cover systems.

The systems that performed best during the first year after installation were the Subtitle C Cover (0.04 mm/year), the Monolithic ET barrier (0.08 mm/year) and the Capillary Barrier (0.54 mm/year). All three of

	1997 (May 1 - Dec 31)		1998		1999		2000		2001		2002 (Jan 1 - Jun 25)	
	Precip. (mm)	Perc. (mm)	Precip. (mm)	Perc. (mm)	Precip. (mm)	Perc. (mm)	Precip. (mm)	Perc. (mm)	Precip. (mm)	Perc. (mm)	Precip. (mm)	Perc. (mm)
Monolithic ET	267.00	0.08	291.98	0.22	225.23	0.01	299.92	0.00	254.01	0.00	144.32	0.00
Capillary barrier ET	267.00	0.54	291.98	0.41	225.23	0.00	299.92	0.00	254.01	0.00	144.32	0.00
Anisotropic (layered capillary barrier) ET	267.00	0.05	291.98	0.07	225.23	0.14	299.92	0.00	254.01	0.00	144.32	0.00
Geosynthetic clay liner	267.00	0.51	291.98	0.19	225.23	2.15	299.92	0.00	254.01	0.02	144.32	0.00
Subtitle C	267.00	0.04	291.98	0.15	225.23	0.02	299.92	0.00	254.01	0.00	144.32	0.00
Subtitle D	267.00	3.56	291.98	2.48	225.23	1.56	299.92	0.00	254.01	0.00	144.32	0.74

Table 3. Data from the EPA Fact Sheet

the infiltration barrier systems under consideration performed equally well four years after installation and did not measure any infiltration.

We believe the Capillary Barrier is more difficult to install than other considered systems under oilfield conditions at this site. Because this design performs no better than the Subtitle C or Monolithic design, we eliminated it from consideration due to these logistical concerns.

The Subtitle C barrier performs best during the first year of operation and we strongly considered this design. Because the clay-rich drilling fluids were removed from the site, no nearby clay is available to meet the design criteria of a 60 cm compacted clay layer. Importation of clay to the site would create significant truck traffic, dust and diesel exhaust and gain only a short-term and marginal benefit relative to the Monolithic ET Barrier.

Although we believe the site is well-suited for installation of a Monolithic ET Barrier, we believe we can improve the short-term efficacy of the design through the placement of a 20-mil synthetic liner onto a prepared surface, then covering the liner with at least 4-feet of relatively fine-grained clean fill, then a top dressing of soil. A drawing of the proposed remedy is presented in Figure 8. A more complete description of the proposed remedy is presented in a later section of this plan.

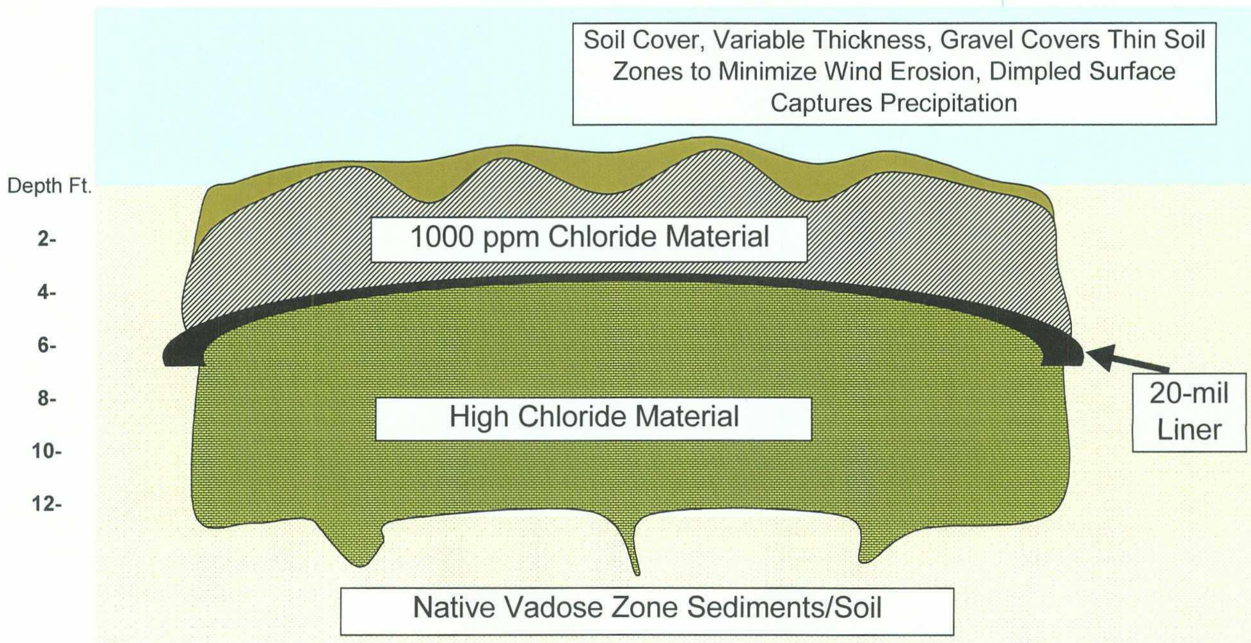


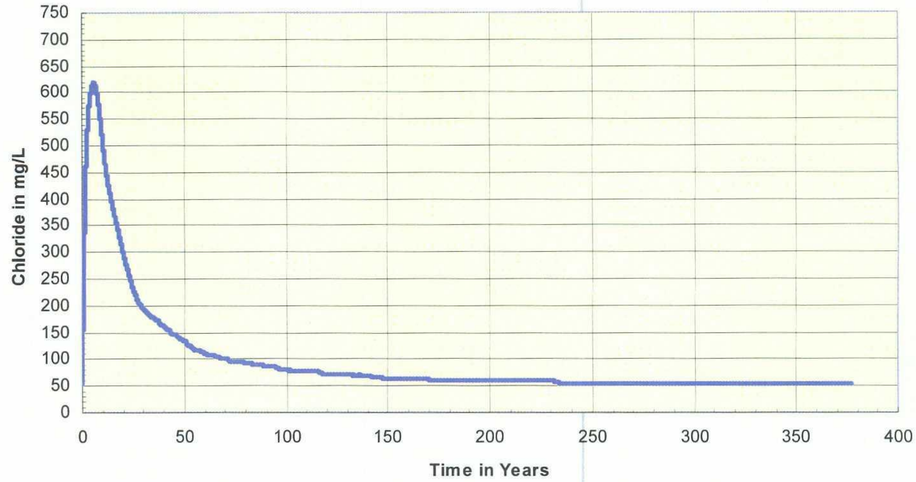
Figure 8. Drawing of proposed remedy.

4.3 SIMULATION MODELING OF MODIFIED MONOLITHIC ET BARRIER

In order to predict the effect of the proposed modified monolithic ET Barrier, we used HYDRUS-1D and a ground water mixing model with site-specific data rather than the simplified vadose zone profile employed for the initial screening exercise discussed earlier in this report. Appendix D describes the input data and our assumptions employed in this site-specific modeling. Although the placement of a synthetic liner over the chloride mass causes the infiltration rate to decline to effectively zero, recharge to the aquifer does occur from year zero to about year 80 due to drainage of existing vadose zone water. After year 80, liner manufacturers state that the liner will probably begin to lose integrity at a rate of about 4% per year. Therefore by year 100, we assume that the liner has lost all integrity and evapotranspiration is the mechanism that controls infiltration and recharge.

Figures 9a and 9b show the results of this simulation experiment. The chloride peak of about 600 mg/L is essentially the same as the simplified modeling experiment (see Figure 6). However, the simplified modeling, which does not attempt to simulate an engineered ET infiltration barrier, suggests that ground water would exceed the WQCC chloride standard for about 8 years. The more accurate HYDRUS-1D simulation of the infiltration barrier slows the migration of the vadose zone chloride mass such that ground water may exceed standards for a period of nearly 25 years. We believe a site-specific simulation of the so-called "no action" alternative would show a peak chloride concentration higher than 600 mg/L but a shorter duration of ground water chloride concentrations exceeding 250 mg/L.

Figure 9a: Chloride Concentration in the Aquifer for the Samson Livestock Site

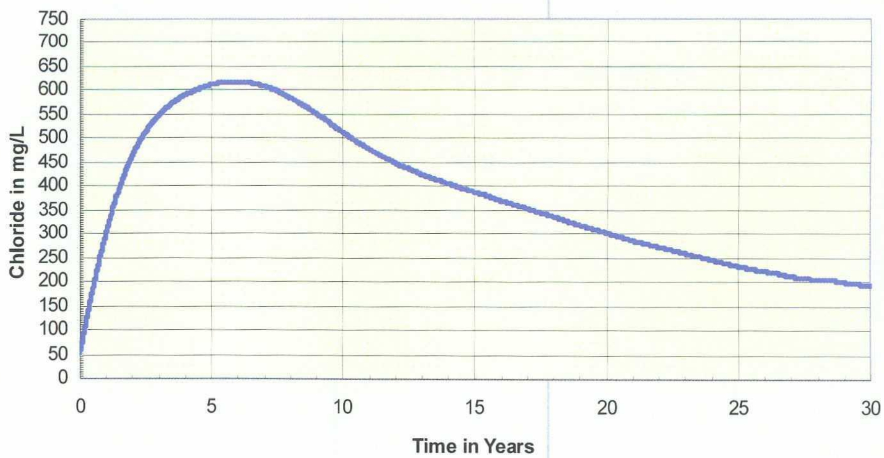


The simulation modeling causes us to recommend the following options for a vadose zone remedy:

1. If the proposed pumping, sampling and simulation modeling demonstrate that pumping and use of recovered water does **not** provide a meaningful environmental benefit, we recommend installation of the modified monolithic infiltration barrier.

2. If the proposed pumping, sampling and modeling demonstrate that pumping and use of recovered water **does** provide a meaningful environmental benefit, we recommend placement of a storm water catchment and infiltration basin over the area of highest subsurface chloride, which will accelerate migration of the vadose chloride into the aquifer, where the recovery well(s) will capture the mass.

Figure 9b: Early Time Chloride Concentration in the Aquifer for the Samson Livestock Site



4.4 PROPOSED INFILTRATION BARRIER DESIGN AND CONSTRUCTION PROTOCOLS

Field conditions will determine the specifics of the design and we will submit "as-built" drawings that confirm compliance with the design concept described above. The design calls for the following elements:

1. A 5% grade at the surface that will prevent excess accumulation of precipitation over the ET barrier and shed excess water away from the former pit area. Because material has been exported from the site, we may elect to grade a larger area and allow excess precipitation to shed downhill to the west.
2. We will attempt to create a topsoil dressing with "dimples" that allow for concentration of small volumes of precipitation in areas of soil that are about 1-foot thick. These dimpled areas, which may be about 20 feet square, will contain a 5-10 foot square area of the 1-foot thick soil area that is planted with warm- and cold-weather grasses and forbs.
3. A very thin (about 1-inch) layer of gravel or coarse-grained caliche will be placed between the dimpled/seeded areas where the topsoil dressing is only 4- to 6-inches thick. The gravel will create a cover/mulch that is more resistant to wind or water erosion and will reduce evaporation of infiltrated precipitation. These thin soil areas will not be seeded except as occurs naturally due to surrounding vegetation.
4. Beneath the topsoil cover is 4-feet of clean fill, most of which would be derived from the original excavation and some that may be borrowed from adjacent areas to create the grade required to shed excess precipitation. If possible, we will cause the upper portion of this clean fill to be finer-grained material, the middle portion of the clean fill coarser-grained, and the lower portion of the clean fill that covers the liner will be consistent with the liner manufacturer's specification.
5. The 12-mil HDPE liner lies below the clean fill. The liner may be placed as overlapping sections, like shingles, because the design does not require complete integrity of the synthetic liner.
6. The liner is placed on a prepared surface that meets the liner manufacturer's specifications, which may consist of material with a chloride concentration greater than 1,000 ppm. The grade of the prepared surface and liner mimics the 5% grade of the topsoil dressing, causing any percolated ground water to migrate away from the impacted material.
7. Below the prepared surface is any material with a chloride concentration greater than 1,000 ppm.

Construction protocols proposed for this remedy consist of the following:

A. A qualified person who is versed in construction earthwork, oilfield activities and environmental protection will supervise all aspects of implementation of the proposed vadose zone remedy and act as a supervisor of completed work.
B. The surface prepared for liner placement will meet manufacturer's specifications for use as a landfill cover. The supervisor will provide photographic documentation of the surface preparation and perform any testing required by the liner manufacturer.
C. The grade of the prepared surface will be surveyed to document a grade of at least 5% and the supervisor will retain the records of this survey.
D. A trained liner installation team will install the liner and the qualified person will oversee and retain documentation of the installation process.
E. Clean fill over the liner will be placed in a manner to minimize any perforations of the liner, in accordance with the liner manufacturer's specifications. The supervisor will retain documentation of this work.
F. The upper surface of the clean fill will be graded and surveyed to meet the design criteria of a 5% grade to shed precipitation away from the former reserve pit and the supervisor will retain the records of this survey.
G. The supervisor will select areas for seeded "dimples" and direct the placement of topsoil and gravel mulch.
H. The supervisor will direct the seeding effort.
I. The supervisor will prepare a report that provides the documentation of appropriate construction of the remedy and submit the report to NMOCD.

Samson will visually monitor the site and, as required, conduct efforts to encourage natural re-vegetation of the site. Such actions could include very limited application of fresh water to the dimpled/seeded areas or fencing the area in to prevent grazing for one or two years after the completion of the restoration project. We recommend that Samson request final closure for this site after the former pit area is re-vegetated to 70% of the ground cover observed in adjacent areas that are not affected by oilfield activities.

4.5 PROPOSED STORMWATER CAPTURE AND INFILTRATION BASIN DESIGN AND CONSTRUCTION PROTOCOLS

Field conditions will determine the specifics of the design and we will submit "as-built" drawings that confirm compliance with the design concept described above. The design calls for the following elements:

1. A 5% grade at the surface that will direct precipitation from the adjacent well pad, the excavation area and selected other portions of the surface lease site to the area of the former pit that exhibit the highest vadose zone chloride (the area near boreholes 4 and 5).
2. A layer of gravel or coarse-grained caliche plus fine-grained material will be placed over the graded area to minimize vegetation and promote direction of excess precipitation to the infiltration basin.
3. The infiltration basin will consist of 3-5 feet of coarse-grained material or caliche gravel.
4. When ground water recovery is no longer necessary, the surface will be reclaimed and re-vegetated in accordance with the surface use contract between Samson and the landowner.

Construction protocols for the proposed stormwater capture and infiltration basin consist of the following:

A. A qualified person who is versed in construction earthwork, oilfield activities and environmental protection will supervise all aspects of implementation of the proposed vadose zone remedy and act as a supervisor of completed work.
B. The ground surface will be graded and surveyed to meet the design criteria of a 5% grade to shed precipitation away from the former reserve pit and the supervisor will retain the records of this survey.

The supervisor will prepare a report that provides the documentation of appropriate construction of the remedy and submit the report to NMOCD.

5.0 RECOMMENDED ACTIONS RELATING TO GROUND WATER

Hicks Consultants recommends that Samson continue to pump and sample the existing 2-inch monitoring well in Early June, Late June, Mid-July and early August. This six-month period (March-August) should provide sufficient data to test the various hypotheses presented in this document. Each pumping and sampling event would remove 200-300 gallons of water prior to sampling and we will monitor the drawdown and recovery to collect data required for the proposed simulation modeling. Samples will be analyzed for major cations and anions as well as TDS. During these sampling events, we will make every effort to collect representative ground water elevations from the nearby supply wells. Gaining access to these wells, owned by the surface landowner, is not simple and may require a pulling unit or other equipment. Obtaining water levels from these wells may not be possible.

If we cannot collect data to provide sufficient certainty of the local hydraulic gradient or we believe that additional data is necessary to calibrate the proposed modeling to field conditions, we will install two 4-inch ground water wells southeast of the pit area to confirm the ground water gradient and conduct additional hydraulic testing. We intend to install these wells, if required, in July. Chemical data from these wells will assist in determining the horizontal extent of the dissolved chloride. After we are relatively certain of the local gradient, we will employ simulation modeling (MODFLOW plus MT3D) to predict the magnitude and extent of any ground water plume caused by any release and the need for a ground water recovery program. If calibrated modeling predicts that ground water quality will not exceed the WQCC Standards at the down gradient edge of the lease, we will <u>not</u> recommend any ground water recovery but allow natural attenuation to effect the remedy.

We hope to have ground water monitoring data and a reasonable ground water gradient for the area by August. We propose a meeting with NMOCD at that time to discuss the results of the monitoring and modeling. At this meeting we will present our recommendations for a Path Forward to closure of the ground water file associated with this site.

TABLES

RT Hicks Consultant Ltd

Table 1A
Laboratory Results Summary - Excavation Soil Samples
Results in mg/kg

Sample Location Sample Depth (ft) Sample Date	Pit Center 10 5/11/05	Pit W/4 10 5/11/05	Pit N/4 10 5/11/05	Pit S/4 10 5/11/05	Pit E/4 10 5/11/05	B-1 40 9/16/05	Applicable Reg. Levels
Benzene	<0.005	<0.005	<0.005	<0.005	<0.005	--	**0.2**
Toluene	<0.005	<0.005	<0.005	<0.005	<0.005	--	**0.347**
Ethyl Benzene	<0.005	<0.005	<0.005	<0.005	<0.005	--	**1.01**
Total Xylenes	<0.015	<0.015	<0.015	<0.015	<0.015	--	**0.167**
GRO (C_6-C_{10})	<10.0	<10.0	<10.0	<10.0	<10.0	--	**200**
DRO (>C_{10}-C_{28})	**262**	<10.0	70.6	<10.0	**549**	--	**200**
Total Alkalinity	--	--	--	--	--	400	**--**
Chloride	**8,080**	**4,160**	**3920**	**5,520**	**6,880**	864	**1,000**
Carbonate	--	--	--	--	--	211	**--**
Bicarbonate	--	--	--	--	--	0	**--**
Sulfate	--	--	--	--	--	77	**--**
Calcium	--	--	--	--	--	64	**--**
Magnesium	--	--	--	--	--	12	**--**
Potassium	--	--	--	--	--	25	**--**
Sodium	--	--	--	--	--	647	**--**

c:\Samson\Livestock 30\Livestock Project Data

Table 1B
Laboratory Results Summary - Soil Samples

Boring Well	Sample Location	Sample Date	Depth (ft)	Cl (mg/kg)
B-1 (TMW-1)	Center of Pit	9/16/2005	15	**3,071**
		9/16/2005	20	768
		9/16/2005	25	**1,120**
		9/16/2005	30	**1,312**
		9/16/2005	35	**1,296**
		9/16/2005	40	864
B-2	West/4 of Pit	9/22/2005	15	**1,400**
		9/22/2005	20	**2,431**
		9/22/2005	25	**1,887**
		9/22/2005	30	**1,344**
		9/22/2005	35	800
		9/22/2005	40	496
		9/22/2005	45	592
B-3	North/4 of Pit	9/20/2005	15	432
		9/20/2005	20	432
		9/20/2005	25	432
		9/20/2005	30	688
		9/20/2005	35	720
		9/20/2005	40	704
		9/20/2005	45	368
B-4	South/4 of Pit	9/22/2005	15	**3,551**
		9/22/2005	20	**5,998**
		9/22/2005	25	**14,080**
		9/22/2005	30	**6,718**
		9/22/2005	35	**2,799**
		9/22/2005	40	**1,424**
		9/22/2005	45	**1,232**
B-5	East/4 of Pit	9/20/2005	15	**3,007**
		9/20/2005	20	**5,726**
		9/20/2005	25	**3,039**
		9/20/2005	30	**3,839**
		9/20/2005	35	**2,031**
		9/20/2005	40	**1,104**
		9/20/2005	45	**1,168**
B-6	20' NW of Pit	9/19/2005	15	16
		9/19/2005	20	16
		9/19/2005	25	32
		9/19/2005	30	32
B-7	20' SW of Pit	9/19/2005	15	112
		9/19/2005	20	80
		9/19/2005	25	32
		9/19/2005	30	16
B-8	20' NE of Pit	9/19/2005	15	16
		9/19/2005	20	128
		9/19/2005	25	128
		9/19/2005	30	112
B-8	20' SE of Pit	9/19/2005	15	224
		9/19/2005	20	64
		9/19/2005	25	240
		9/19/2005	30	48
NMOCD Landfarm Closure Standard				**1,000**

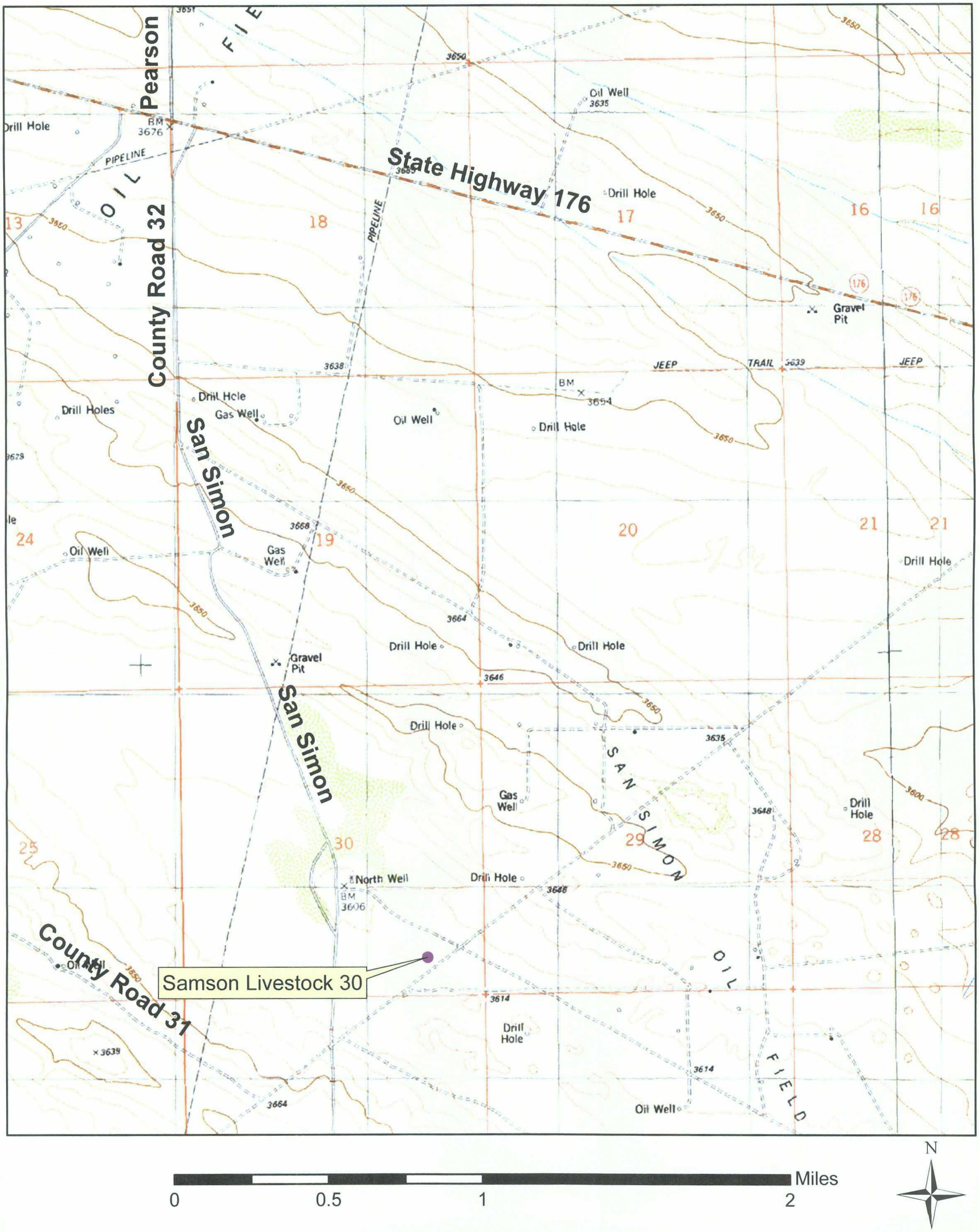
Bold **Text** indicate concentration exceeds Regulatory Standards

Table 2
Laboratory Results Summary - Groundwater Samples
Results in mg/L

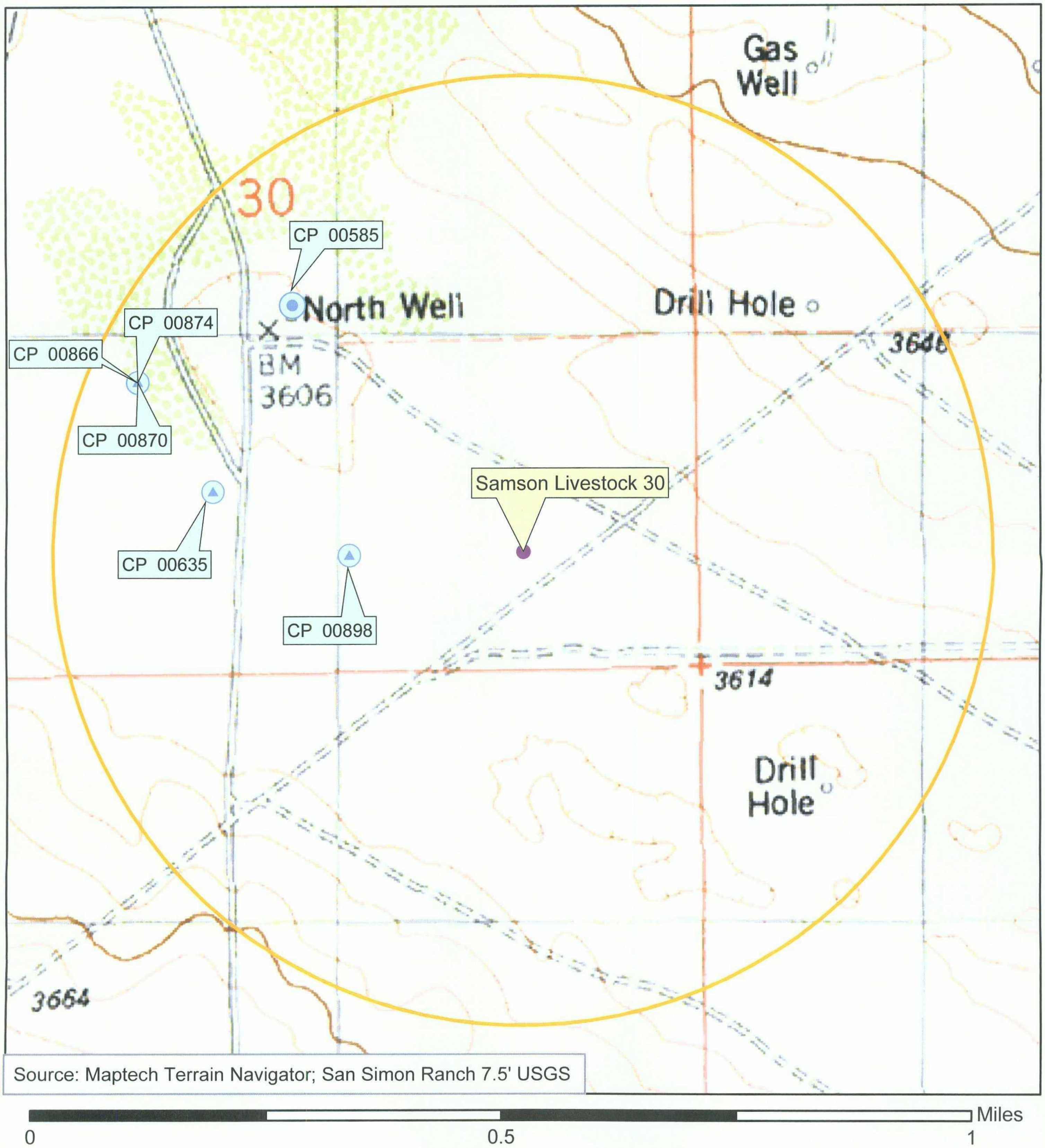
Monitor Well / Sample Date	TMW-1 9/19/05	TMW-1 3/30/06	Windmill 3/30/06	TMW-1 5/10/06	EPA MCLs
Total Alkalinity	--	198	--	--	--
Chloride	**3,999**	**2,240**	34	**2,580**	**250**
Total Dissolved Solids	--	**4,520**	**644**	**3,900**	**500**
Sulfate	--	**258**	--	--	**250**
Calcium	--	30.4	--	--	--
Magnesium	--	5.6	--	--	--
Potassium	--	18.4	--	--	--
Sodium	--	1,530	--	--	--
Bromide	--	--	--	1.5	--

c:\Samson\Livestock 30\Livestock Project Data

PLATES



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Location of Samson Livestock 30 relative to Highway 176 and San Simon Rd	Plate 1
	Samson Livestock "30" Samson Investment Company	June 2006



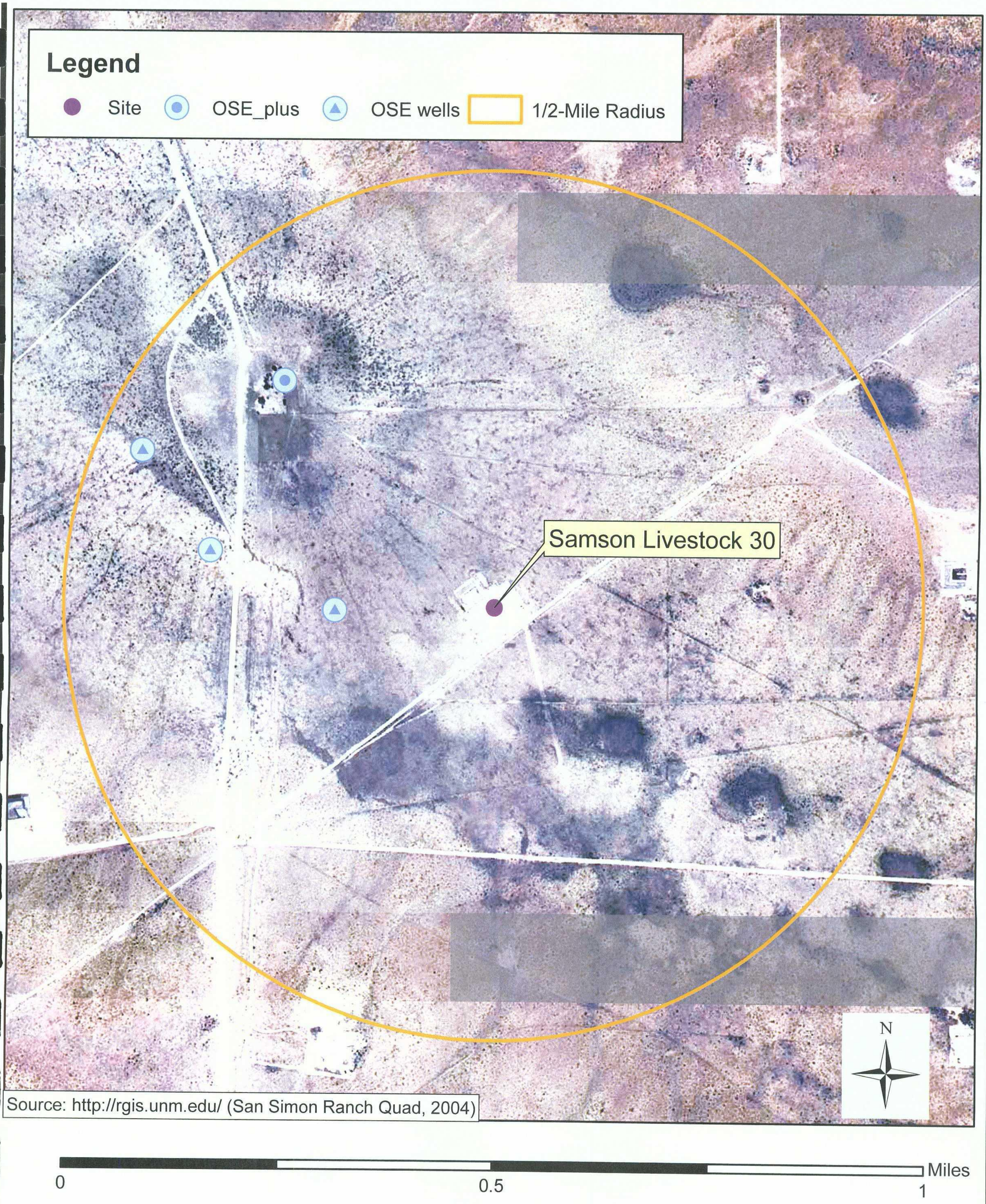
Legend

Site | OSE_plus | OSE wells | 1/2-Mile Radius

N

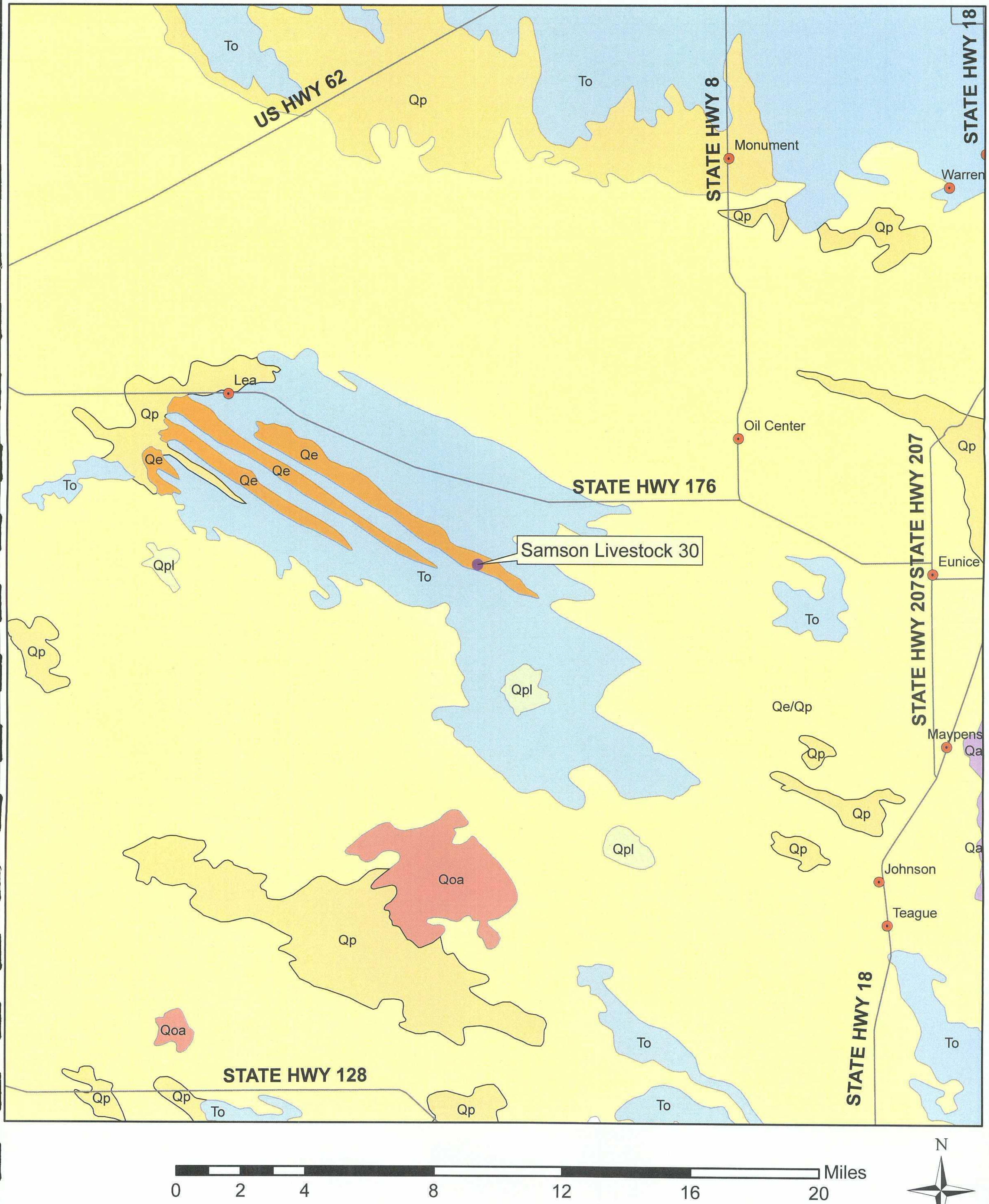
Note: No water wells observed between 1/2-mile and 1-mile

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	7.5' USGS Topo Map showing water wells within a 1/2-mile of the Samson Livestock 30 site	Plate 2
	Samson Livestock "30" Samson Investment Company	June 2006



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	2004 Aerial Photo of Site and environs	Plate 3
	Samson Livestock "30" Samon Investment Company	June 2006

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	2004 Aerial Photo of Site and environs	Plate 4
	Samson Livestock "30" Samon Investment Company	June 2006



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Geologic Map relative to Samson Livestock "30"	Plate 5
	Samson Livestock "30" Samson Investment Company	June 2006

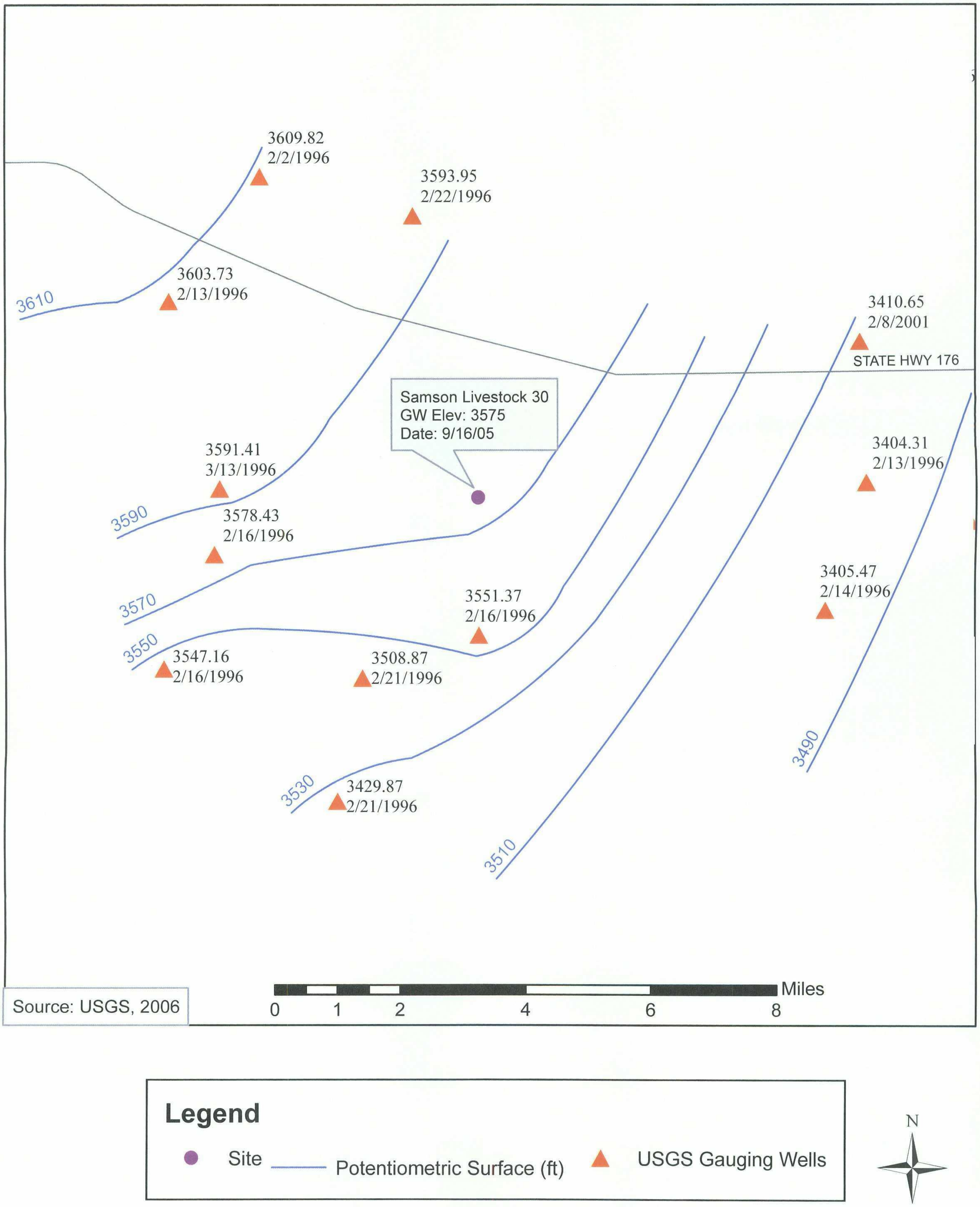
Legend

Geology

Map Unit, Description

- Qa, Quaternary Alluvium
- Qe, Quaternary-Eolian Deposits
- Qe/Qp, Quaternary-Eolian Piedmont Deposits
- Qoa, Quaternary-Older Alluvial Deposits
- Qp, Quaternary-Piedomon Alluvial Deposits
- Qpl, Quaternary-Lacustrine and Playa Deposits
- To, Tertiary-Ogallala Formation

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Geologic Map Legend	Plate 5-Legend
	Samson Livestock "30" Samson Investment Company	June 2006



R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
Ph: 505.266.5004

Regional Potentiometric Surface
USGS gauging wells (2/1996)

Samson Livestock "30"
Samson Investment Company

Plate 6

June 2006

APPENDIX A

TABLE OF CONTENTS

I. **Company Contacts**

Tom Koscelny	Samson Resources	918-591-1386
Jerry Brian	Ocotillo Environmental	505-393-6371

II. **Background**

Ocotillo Environmental was engaged on 7/05/05 to evaluate and conduct a subsurface investigation on the Livestock 30 State #1 Lease, API # 30-025-35200, located in Sec. 30, T21S-R35E in Lea County, NM (see Figures 1 and 2). Subsurface sampling was conducted utilizing a hollow-stem drilling rig to determine the vertical/horizontal extent of chloride impact (see Appendix A). An initial "dig and haul" of impacted soil, in conjunction with sampling and analysis, had already been conducted at the site.

III. **Soils**

The surface soils in the area are of the Simona-Tonuco association and the Midessa series. The Midessa series consists of calcareous, nearly level to gently sloping, well-drained soils that have a loam to clay loam subsoil. These soils formed in wind-deposited and water-deposited, calcareous sediments on plains. Slopes are 0 to 3 percent. The vegetation consists of short and mid grasses and shrubs. The average annual precipitation is 10 to 12 inches.

Typically, the surface layer is dark grayish –brown loam about 4 inches thick. In places it is fine sandy loam. The subsoil is grayish-brown to pale-brown clay loam about 18 inches thick. The substratum, to a depth of 60 inches, is light-gray clay loam that has high lime content. The soul is calcareous throughout.

The soil is used as range and wildlife habitat.

IV. **Groundwater**

Based on the New Mexico State Engineer's Office database, there were not any records found (see Appendix B).

As indicated on the Approved C-144 (see Appendix C) by Mr. Tom Koscelny, personal interview with the landowner indicated that depth to groundwater (dgw) was from 50'-100' below ground surface (bgs).

New Mexico Oil Conservation Division (NMOCD) internal data indicated that the dgw was 40'bgs. Groundwater was actually encountered at 40' bgs.

V. Work Performed

On July 8, 2005, Ocotillo Environmental viewed the site. The site had already undergone an excavation / dig and haul procedure to reduce the source of impacted soils. A sampling event had already been conducted under the supervision of Mr. Tom Koscelny. Soil samples had been transported under chain-of-custody to Cardinal Labs at Hobbs, NM for TPH, BTEX, and chloride analysis (see Appendix F). TPH and total Xylenes were below the accepted maximum contaminant level (MCL).

The Koscelny sampling event consisted of five sampling points at 10' bgs, one in each quadrant and one in the center of the excavated area (see Figure 3) Analytical results for chlorides in the Center, NW quadrant, NE quadrant, SW quadrant, and the SE quadrant were 8,080 ppm, 4160 ppm, 3920 ppm, 5520 ppm, and 6880 ppm respectively. All samples exceeded the accepted MCL for chlorides of 250 ppm.

On the 9/15/05, Ocotillo Environmental returned to the site to delineate the vertical and horizontal extent of chloride impact as per the NMOCD approved Delineation Sampling Plan (see Figure 4 and Appendix D).

Nine bore holes (BH) were drilled and split spoon sampling conducted every 5'(see Figure 4). A total of 51 discrete grab samples were retrieved . A Temporary Monitoring Well (TMW) was completed in BH #1. The well was developed and sampled. The samples were properly packaged, preserved, and transported under Chain-of-Custody (see Appendix F) to Cardinal Laboratories of Hobbs, New Mexico for analysis. All samples were analyzed for Chlorides (EPA Method: 4500-ClB), and Total Ions (EPA Methods: SM3500-Ca-D; 3500-Mg E; SM4500-Cl-B).

BH # 1 (inside the pit area) was sampled at 15', 20', 25', 30', 35', 40', and 50' (TMW) bgs respectively.

Chloride analysis at 15', 20', 25', 30', 35', 40', and 50'(TMW) bgs indicated concentrations at BH #1 were 3071 ppm, 768 ppm, 1121 ppm, 1312 ppm, 1296 ppm, 864 ppm, and 3999 ppm (TMW), respectively (see Figure 5, table, or Appendix E).

BH # 2,3,4, and 5 (inside the pit area) were sampled at 15', 20', 25', 30' , 35', 40', and 45' bgs respectively.

Chloride analysis at 15' bgs indicated concentrations at BH #2, BH #3, BH #4, BH #5 were 1400 ppm, 432 ppm, 3551 ppm, and 3007 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 20' bgs indicated concentrations at BH #2, BH #3, BH #4, BH #5 were 2431 ppm, 432 ppm, 5998 ppm, and 5726 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 25' bgs indicated concentrations at BH #2, BH #3, BH #4, BH #5 were 1887 ppm, 432 ppm, 14080 ppm, and 3039 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 30' bgs indicated concentrations at BH #2, BH #3, BH #4, BH #5 were 1344 ppm, 688 ppm, 6718 ppm, and 3839 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 35' bgs indicated concentrations at BH #2, BH #3, BH #4, BH #5 were 800 ppm, 720 ppm, 2799 ppm, and 2031 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 40' bgs indicated concentrations at BH #2, BH #3, BH #4, BH #5 were 496 ppm, 704 ppm, 1424 ppm, and 1104 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 45' bgs indicated concentrations at BH #2, BH #3, BH #4, BH #5 were 592 ppm, 368 ppm, 1232 ppm, and 1168 ppm respectively (see Figure 5, table, or Appendix E).

BH # 6,7,8,and 9 (outside the pit area) were sampled at 15', 20', 25', and 30' bgs respectively.

Chloride analysis at 15' bgs indicated concentrations at BH #6, BH #7, BH #8, BH #9 were 16 ppm, 112 ppm, 116 ppm, and 224 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 20' bgs indicated concentrations at BH #6, BH #7, BH #8, BH #9 were 16 ppm, 80 ppm, 128 ppm, and 64 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 25' bgs indicated concentrations at BH #6, BH #7, BH #8, BH #9 were 32 ppm, 32 ppm, 128 ppm, and 240 ppm respectively (see Figure 5, table, or Appendix E).

Chloride analysis at 30' bgs indicated concentrations at BH #6, BH #7, BH #8, BH #9 were 32 ppm, 16 ppm, 112 ppm, and 48 ppm respectively (see Figure 5, table, or Appendix E).

DATE	ID		Cl
9/19/2005	BH #1	15' BGS	3071
9/19/2005	BH #1	20' BGS	768
9/19/2005	BH #1	25' BGS	1120
9/19/2005	BH #1	30' BGS	1312
9/19/2005	BH #1	35' BGS	1296
9/19/2005	BH #1	40' BGS	864
9/20/2005	BH #1	50' BGS	3999
9/22//2005	BH #2	15' BGS	1400
9/22//2005	BH #2	20' BGS	2431
9/22//2005	BH #2	25' BGS	1887
9/22//2005	BH #2	30' BGS	1344
9/22//2005	BH #2	35' BGS	800
9/22//2005	BH #2	40' BGS	496
9/22//2005	BH #2	45' BGS	592
9/20/2005	BH #3	15' BGS	432
9/20/2005	BH #3	20' BGS	432
9/20/2005	BH #3	25' BGS	432
9/20/2005	BH #3	30' BGS	688
9/20/2005	BH #3	35' BGS	720
9/20/2005	BH #3	40' BGS	704
9/20/2005	BH #3	45' BGS	368
9/22/2005	BH #4	15' BGS	3551
9/22/2005	BH #4	20' BGS	5998
9/22/2005	BH #4	25' BGS	14080
9/22/2005	BH #4	30' BGS	6718
9/22/2005	BH #4	35' BGS	2799
9/22/2005	BH #4	40' BGS	1424
9/22/2005	BH #4	45' BGS	1232
9/20/2005	BH #5	15' BGS	3007
9/20/2005	BH #5	20' BGS	5726
9/20/2005	BH #5	25' BGS	3039
9/20/2005	BH #5	30' BGS	3839
9/20/2005	BH #5	35' BGS	2031

9/20/2005	BH #5	40' BGS	1104
9/20/2005	BH #5	45' BGS	1168
9/19/2005	BH #6	15' BGS	16
9/19/2005	BH #6	20' BGS	16
9/19/2005	BH #6	25' BGS	32
9/19/2005	BH #6	30' BGS	32
9/19/2005	BH #7	15' BGS	112
9/19/2005	BH #7	20' BGS	80
9/19/2005	BH #7	25' BGS	32
9/19/2005	BH #7	30' BGS	16
9/19/2005	BH #8	15' BGS	16
9/19/2005	BH #8	20' BGS	128
9/19/2005	BH #8	25' BGS	128
9/19/2005	BH #8	30' BGS	112
9/19/2005	BH #9	15' BGS	224
9/19/2005	BH #9	20' BGS	64
9/19/2005	BH #9	25' BGS	240
9/19/2005	BH #9	30' BGS	48

V. Conclusions

Analytical results of soil samples extracted outside the pit area (BH # 6,7,8, and 9) indicate chloride levels do not exceed the MCL of 250 ppm. This would suggest that a horizontal migration is minimal outside the original pit area.

Analytical results of all soil samples extracted inside the pit area (BH #1,2,3,4, and 5) indicate that the MCL for chlorides has been exceeded from 15' bgs to groundwater, which was encountered at 40' bgs. This would suggest that the migratory pathway for the majority of the chloride release is a downward vertical migration.

The analytical results of the TMW completed at 50'bgs were 3999 ppm. This indicates that a groundwater impact has occurred.

Notification of a groundwater impact was reported by phone to Roger Anderson at the NMOCD office in Santa Fe, NM on the 10/04/05.

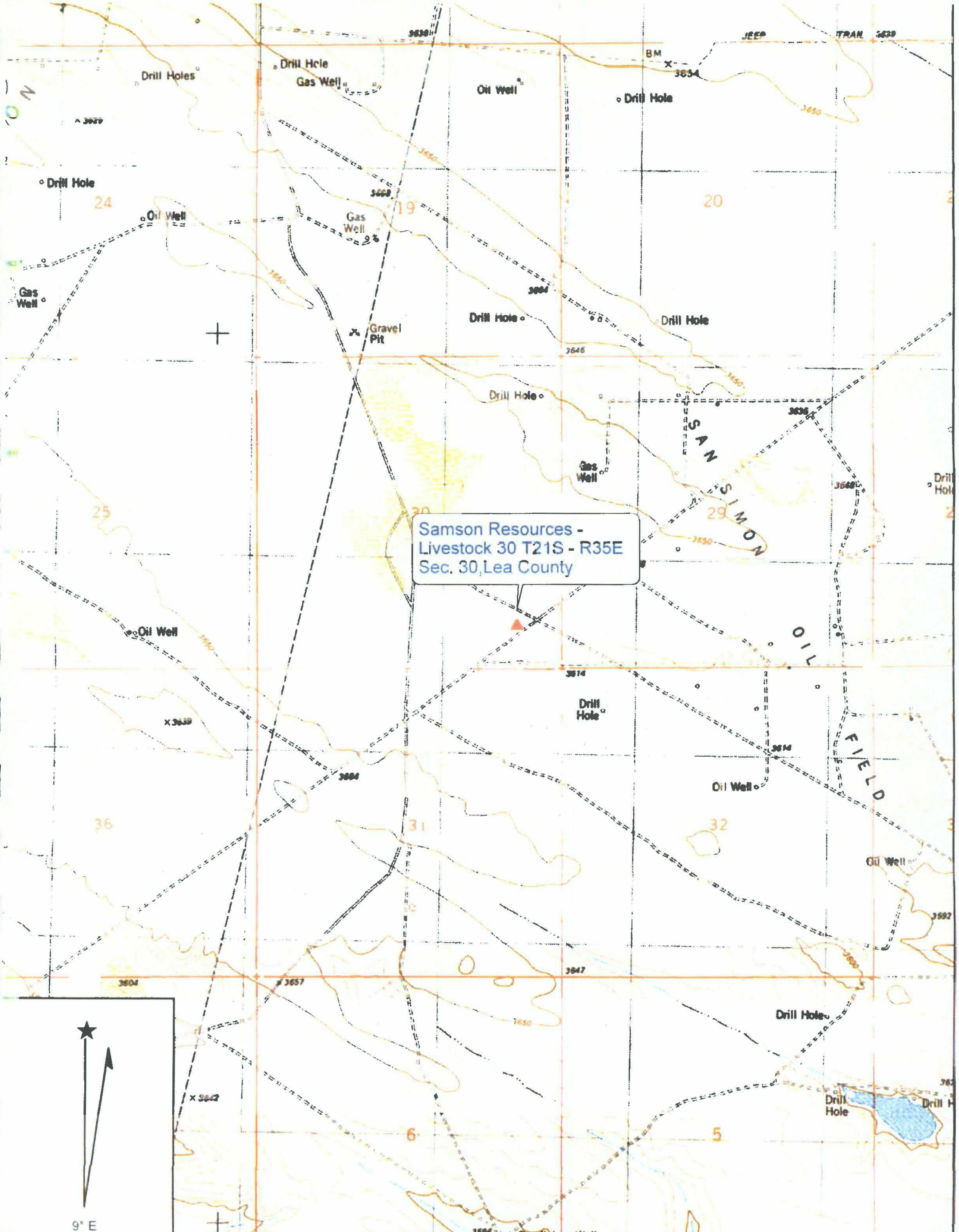
VI. Proposed Action Plan

Based upon the results of this site investigation, we propose the following actions for your consideration and approval:

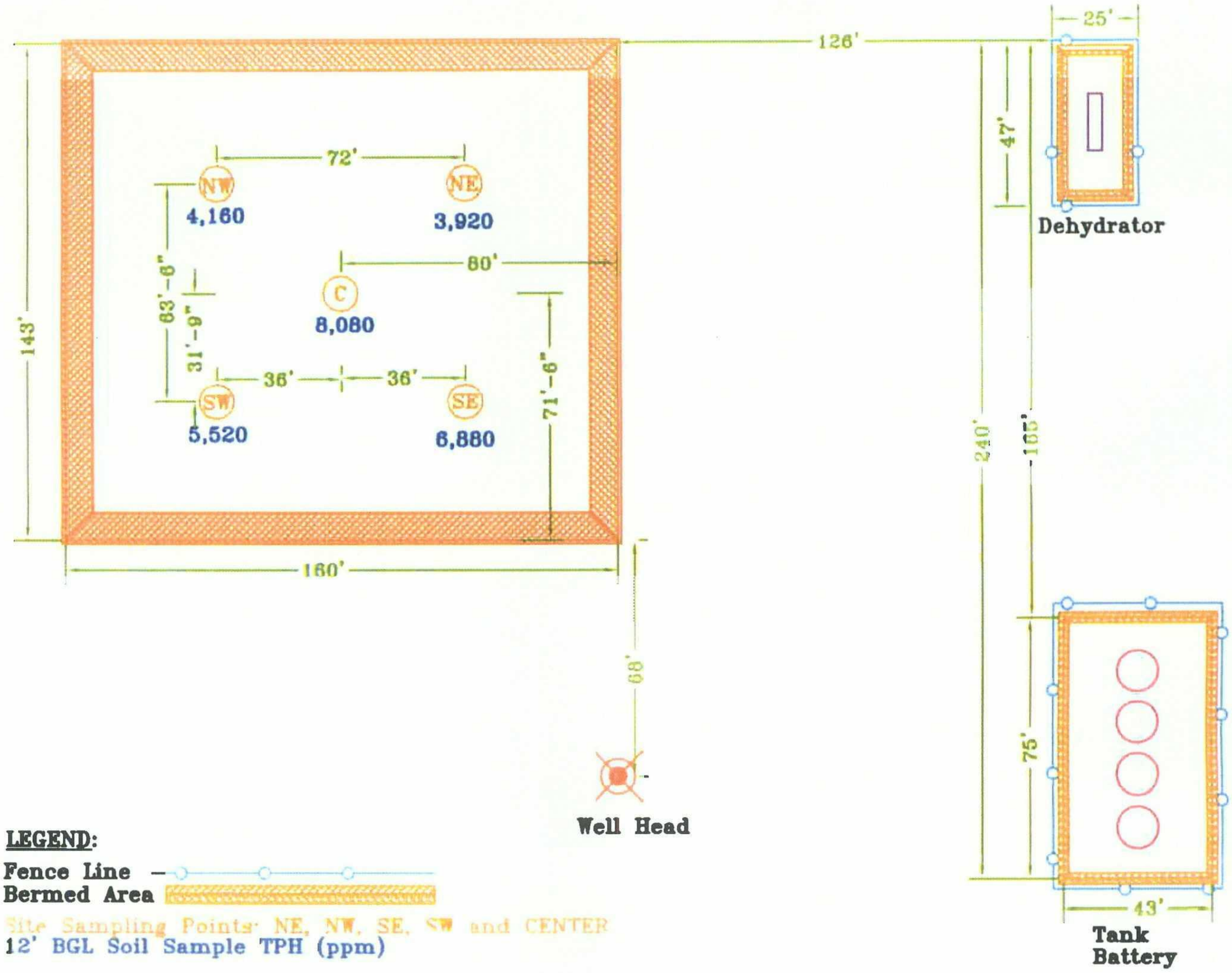
1. remove an additional 20 ft of impacted material from the pit to a depth of 30 ft below ground level (bgl)
2. remove the temporary monitoring well located in the center of the pit area and plug with bentonite
3. cap the excavated bottom with a 20 ml liner
4. backfill to grade with clean soil and return site to natural conditions
5. drill 3 monitoring wells (two down gradient and one upgradient) to determine groundwater flow and gradient
6. begin to establish plume boundaries
7. evaluate data and modify plan accordingly

VII. Figures & Appendices

Figure 1 – Vicinity Map
Figure 2 – Aerial Map
Figure 3 – Koscelny Site Sampling Map
Figure 4 – Proposed Site Delineation Sampling Plan
Figure 5 – Site Map Analytical Results
Appendix A - Site Photos
Appendix B - NM State Engineers Groundwater Records Search
Appendix C - NMOCD Approved C-144
Appendix D - NMOCD Approved Site Delineation Plan
Appendix E - Analytical Results
Appendix F – Chain-of-Custody


Samson Resources -
Livestock 30 T21S - R35E
Sec. 30, Lea County
Drill Holes
Drill Hole
Gas Well
Oil Well
BM
3654
JEEP
TRAIL
24
19
20
25
30
29
36
31
32
6
5
Gravel Pit
SAN SIMON OIL FIELD
9° E


Samson Resources -
Livestock 30 T21S R35E
Sec 30 Lea County

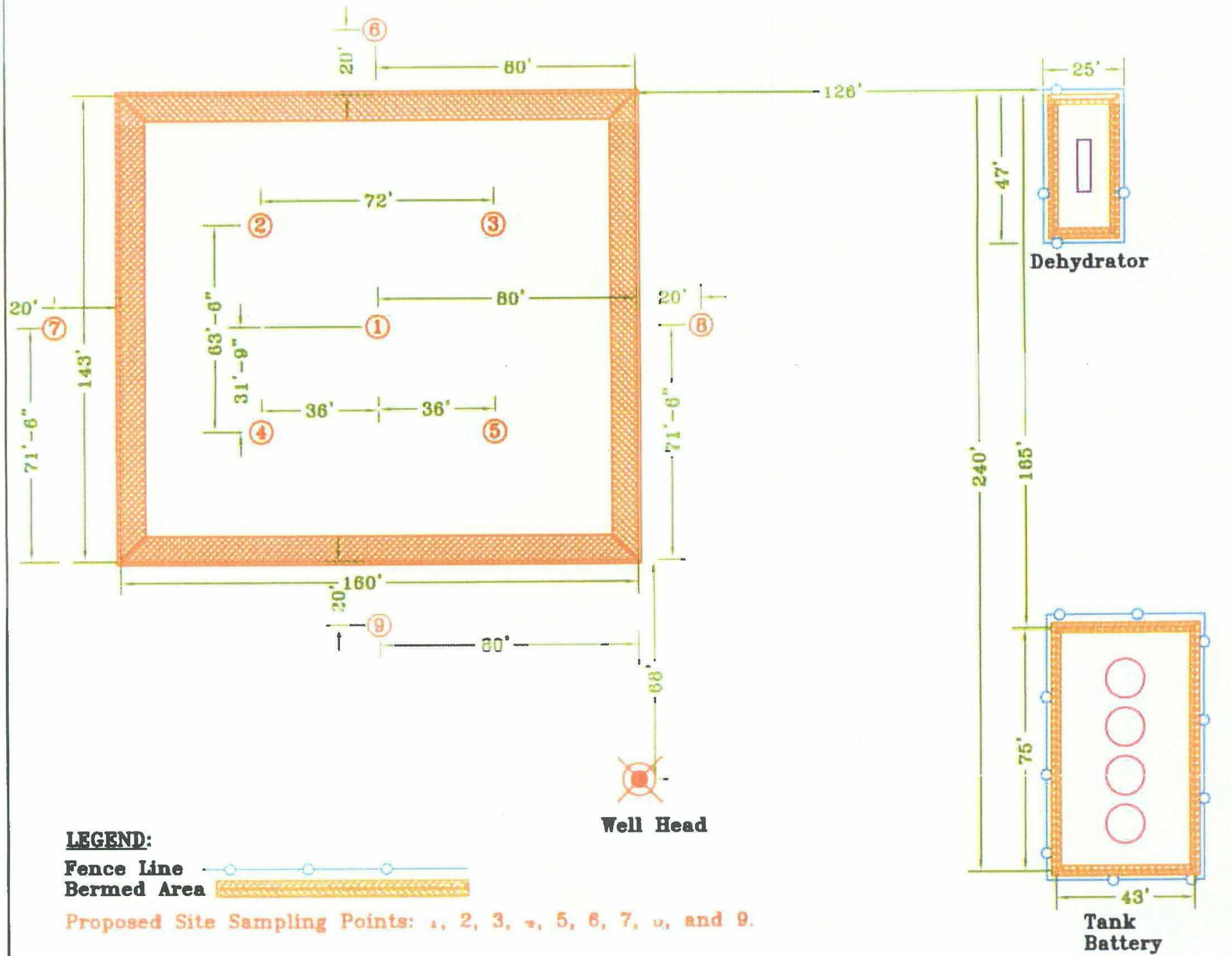


Property: **Livestock 30 State No. 1**
660' FSL and 990' FEL, **Section 30**
Township 21 South, **Range 35 East**
Lea County, New Mexico
API No.: 30-025-35200
N 32° 26' 40.4"
W 103° 24' 05.3"
Elevation 3,624'

Project: SAM-05-001
Location:
Livestock 30 State No. 1
Lea County, New Mexico
Drilling Pit Closure
Site Map - Analytical Results
Sampling Plan
Date: 7/26/05 Scale:1"= 50'

Samson Investment Company
Samson
Samson Plaza
Two West Second Street
Tulsa, OK 74103-3103

P.O. Box 1816
Ocotillo ENVIRONMENTAL
Hobbs, NM 88240



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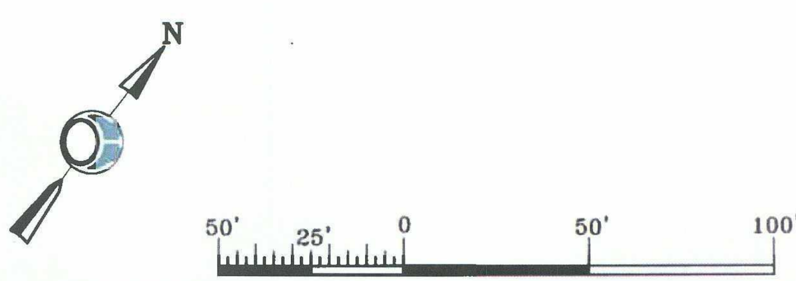
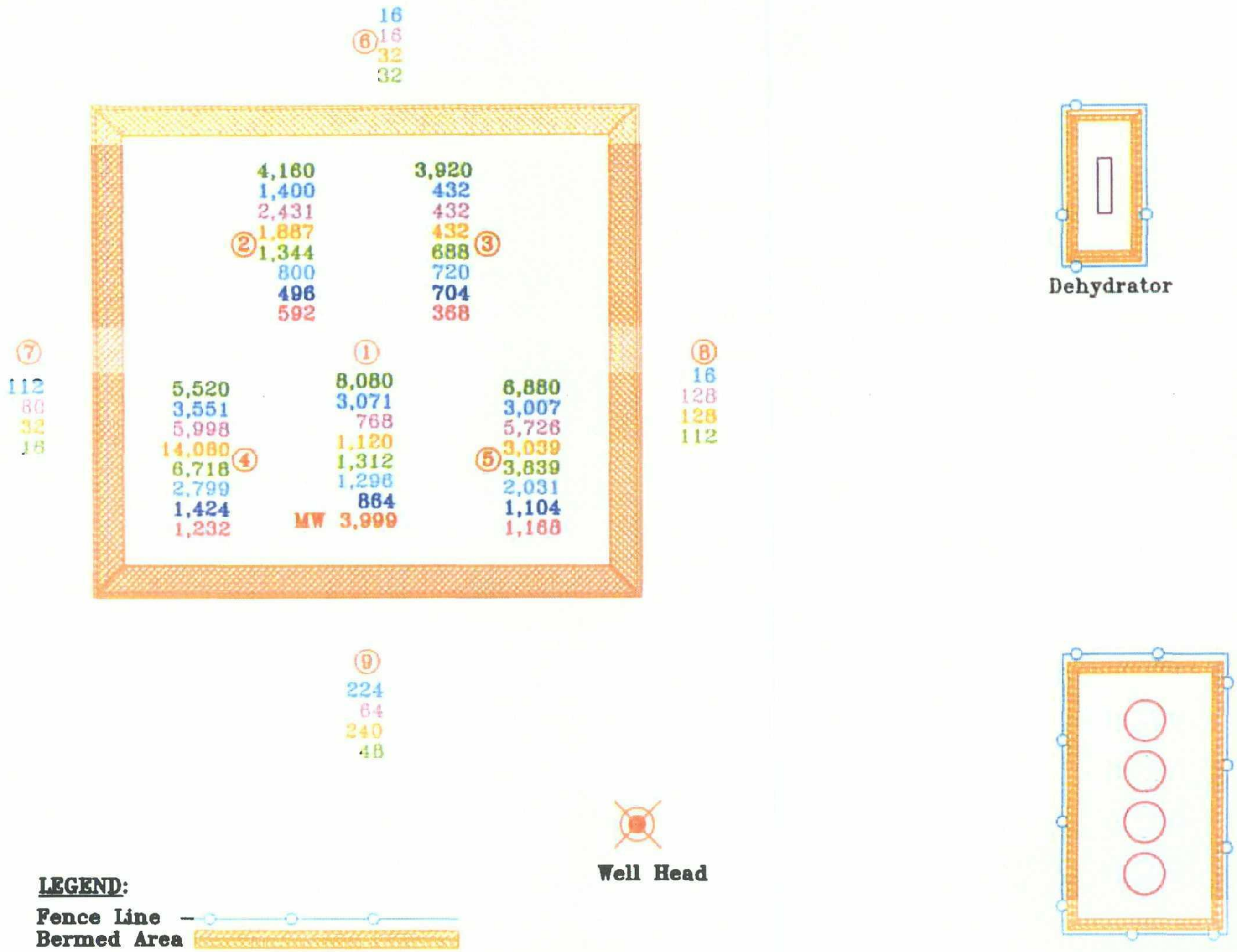


Project: SAM-05-001
Location:
Livestock 30 State No. 1
Lea County, New Mexico
Drilling Pit Closure
Site Map - Proposed Delineation Sampling Plan
Date: 7/26/05 Scale: 1"= 50'

Samson Investment Company
Samson
Samson Plaza
Two West Second Street
Tulsa, OK 74103-3103

P.O. Box 1816
Ocotillo Environmental
Hobbs, NM 88240



LEGEND:

Fence Line

Bermed Area

Site Sampling Points: 1, 2, 3, 4, 5, 6, 7, 8, and 9.

10' BGS – Soil Sample Cl (ppm)
15' BGS – Soil Sample Cl (ppm)
20' BGS – Soil Sample Cl (ppm)
25' BGS – Soil Sample Cl (ppm)
30' BGS – Soil Sample Cl (ppm)
35' BGS – Soil Sample Cl (ppm)
40' BGS – Soil Sample Cl (ppm)
45' BGS – Soil Sample Cl (ppm)
50' BGS – MW – Monitor Well Cl (ppm)

Property: Livestock 30 State No. 1
660' FSL and 990' FEL, Section 30
Township 21 South, Range 35 East
Lea County, New Mexico
API No.: 30-025-35200
N 32° 26' 40.4"
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Elevation 3,624'

Project: SAM-05-001
Location:
Livestock 30 State No. 1
Lea County, New Mexico
Drilling Pit Closure
Site Map – Analytical Results
Delineation Sampling Plan
Date: 10/18/05 Scale: 1"= 50'

Samson Investment Company
Samson
Samson Plaza
Two West Second Street
Tulsa, OK 74103-3103

P.O. Box 1816
Ocotillo
Hobbs, NM 88240

New Mexico Office of the State Engineer
Well Reports and Downloads

Township: 21S Range: 35E Sections: 19,20,24,30,31,32

NAD27 X: Y: Zone: Search Radius:

County: LE Basin: L Number: Suffix:

Owner Name: (First) (Last) Non-Domestic Domestic All

Well / Surface Data Report Avg Depth to Water Report Water Column Report

Clear Form WATERS Menu Help

WELL / SURFACE DATA REPORT 07/11/2005

DB File Nbr	Use	Diversion (acre ft per annum)	Owner	Well Number	(quarters (quarters Sourc

No Records found, try again

District I
1625 N. French Dr., Hobbs, NM 88240
District II
1301 W. Grand Avenue, Artesia, NM 88210
District III
1000 Rio Brazos Road, Aztec, NM 87410
District IV
1220 S. St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy Minerals and Natural Resources

Oil Conservation Division
1220 South St. Francis Dr.
Santa Fe, NM 87505

Form C-144
March 12, 2004

For drilling and production facilities, submit to appropriate NMOCD District Office.
For downstream facilities, submit to Santa Fe office

Pit or Below-Grade Tank Registration or Closure

Is pit or below-grade tank covered by a "general plan"? Yes ☐ No ☒
Type of action: Registration of a pit or below-grade tank ☒ Closure of a pit or below-grade tank ☐

Operator: SAMSON RESOURCES CO Telephone: 918/591-1386 e-mail address: TKOSCELNY@SAMSON.COM
Address: TWO WEST SECOND ST., TULSA, OK 74103-3103
Facility or well name: Livestock 30-1 API #: ______ U/L or Qtr/Qtr ______ Sec 30 T 21S R 35E
County: Lea Latitude 32.444 Longitude -103.40093 NAD: 1927 ☒ 1983 ☐ Surface Owner Federal ☐ State ☐ Private ☒ Indian ☐

Pit
Type: Drilling ☒ Production ☐ Disposal ☐
Workover ☐ Emergency ☐
Lined ☒ Unlined ☐
Liner type: Synthetic ☒ Thickness 20 mil Clay ☐ Volume ______ bbl

Below-grade tank
Volume: ____bbl Type of fluid: ______
Construction material: ______
Double-walled, with leak detection? Yes ☐ If not, explain why not.

Depth to ground water (vertical distance from bottom of pit to seasonal high water elevation of ground water.)	Less than 50 feet 50 feet or more, but less than 100 feet 100 feet or more	(20 points) (10 points) (0 points)
Wellhead protection area: (Less than 200 feet from a private domestic water source, or less than 1000 feet from all other water sources.)	Yes No	(20 points) (0 points)
Distance to surface water: (horizontal distance to all wetlands, playas, irrigation canals, ditches, and perennial and ephemeral watercourses.)	Less than 200 feet 200 feet or more, but less than 1000 feet 1000 feet or more	(20 points) (10 points) (0 points)
	Ranking Score (Total Points)	30

If this is a pit closure: (1) attach a diagram of the facility showing the pit's relationship to other equipment and tanks. (2) Indicate disposal location: onsite ☐ offsite ☐ If offsite, name of facility ______. (3) Attach a general description of remedial action taken including remediation start date and end date. (4) Groundwater encountered: No ☐ Yes ☐ If yes, show depth below ground surface ______ft. and attach sample results. (5) Attach soil sample results and a diagram of sample locations and excavations.

I hereby certify that the information above is true and complete to the best of my knowledge and belief. I further certify that the above-described pit or below-grade tank has been/will be constructed or closed according to NMOCD guidelines ☒, a general permit ☐, or an (attached) alternative OCD-approved plan ☐.
Date: 2/16/05
Printed Name/Title TOM KOSCELNY, ENVIRONMENTAL SUPERVISOR Signature
Your certification and NMOCD approval of this application/closure does not relieve the operator of liability should the contents of the pit or tank contaminate ground water or otherwise endanger public health or the environment. Nor does it relieve the operator of its responsibility for compliance with any other federal, state, or local laws and/or regulations.

Approval:
Date: ______
Printed Name/Title ______ Signature ______

wtr @ 32'

Ocotillo
ENVIRONMENTAL
Dirt Work . On-Site Remediation . Soil Testing . Excavation . Consultation

July 28, 2005

Mr. Larry Johnson
Environmental Engineer Specialist
NM Oil Conservation Division
1625 N. French Dr.
Hobbs, NM 88240

Reference:
Site Delineation Plan-Samson Resources
Livestock 30 State # 1
Sec. 30, T21S-R35E
Lea County, NM

Mr. Johnson:

On 5/11/05, a sampling event was conducted at the Livestock 30-State #1 lease. Five samples were taken at the base of the excavation [approx. 12' below ground level (bgl)]. Samples were taken in the NE corner, NW corner, SE corner, SW corner, and center locations. Analytical results for Cl^- were 3920 ppm, 4160 ppm, 6880 ppm, 5520 ppm, and 8080 ppm respectively (see attached "Site Map-Analytical Results").

All samples exceed the accepted MCL's. We propose the following delineation plan to determine the vertical and horizontal extent of possible Cl^- contamination.

1. Drill 5 soil borings within the pit and 4 on the outside perimeter (see attached "Site Map-Proposed Delineation Sampling Plan").
2. Conduct split spoon sampling every 5'.
3. Use field analytical techniques for chloride (HACH Field Test Kit) and evaluate the chloride concentration in each split spoon sample.
4. Evaluate the lithology of the samples.
5. Cease drilling/sampling when chloride concentration is <250ppm (plus 4').
6. Collect 3 representative samples for laboratory analysis.
7. If field chloride sampling suggests that the release reached groundwater, complete a 2-inch PVC glued and coupled monitoring well with 10 feet of well screen within the uppermost portion of the saturated zone.

If you need additional information regarding the delineation plan, please contact me by telephone at (505) 393-6371, or by e-mail at jbrian@valornet.com.

Sincerely,
Jerry R. Brian, REM
Geologist

414 North Turner . Hobbs, New Mexico 88240 . (505) 393-6371 . Fax (505) 393-6374

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603

PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/19/05
Reporting Date: 09/19/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30 STATE #1
Project Location: LEA COUNTY, NM

Analysis Date: 09/19/05
Sampling Date: 09/16/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: HM

LAB NUMBER	SAMPLE ID	Cl^- (mg/Kg)
H10200-1	BH #1 15' BGS	3071
H10200-2	BH #1 20' BGS	768
H10200-3	BH #1 25' BGS	1120
H10200-4	BH #1 30' BGS	1312
H10200-5	BH #1 35' BGS	1296
H10200-6	BH #1 40' BGS	864
Quality Control		1020
True Value QC		1000
% Recovery		102
Relative Percent Difference		0.2

METHOD: Standard Methods	$4500\text{-}Cl^-B$

Note: Analyses performed on 1:4 w:v aqueous extracts.

Amy Hill
Chemist

9/19/05
Date

H10200

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/19/05
Reporting Date: 09/20/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30 STATE #1
Project Location: LEA COUNTY, NM

Sampling Date: 09/16/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: HM

LAB NUMBER	SAMPLE ID	Na (mg/L)	Ca (mg/L)	Mg (mg/L)	K (mg/L)	Conductivity (u S/cm)	T-Alkalinity ($mgCaCO_3/L$)
ANALYSIS DATE:		09/19/05	09/19/05	09/19/05	09/19/05	09/19/05	09/19/05
H10200-6	BH #1 40' BGS	647	64	12	25	3511	400
Quality Control		NR	46	54	5.24	1391	NR
True Value QC		NR	50	50	5.00	1413	NR
% Recovery		NR	92.0	108.0	105.0	98.4	NR
Relative Percent Difference		NR	1.0	1.6	5.6	4.9	NR
METHODS:			SM3500-Ca-D	3500-Mg E	8049	120.1	310.1

LAB NUMBER	SAMPLE ID	Cl^- (mg/L)	SO_4 (mg/L)	CO_3 (mg/L)	HCO_3 (mg/L)	pH (s.u.)
ANALYSIS DATE:		09/19/05	09/19/05	09/19/05	09/19/05	09/19/05
H10200-6	BH #1 40' BGS	864	77	211*	0	9.63
Quality Control		1020	48.52	NR	985	7.20
True Value QC		1000	50.00	NR	1000	7.00
% Recovery		102	97.0	NR	98.5	103
Relative Percent Difference		2.0	4.8	NR	0.9	1.1
METHODS:		SM4500-Cl-B	375.4	310.1	310.1	150.1

Note: Analyses performed on a 1:4 aqueous extract.

*OH = 16.3

Amy Hill
Chemist

9/20/05
Date

H10200

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/20/05
Reporting Date: 09/20/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30
Project Location: LEA COUNTY, NM

Analysis Date: 09/20/05
Sampling Date: 09/19/05
Sample Type: GROUNDWATER
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: HM

LAB NUMBER	SAMPLE ID	Cl^- (mg/L)
H10206-8	BH #1 (T.M.W.) 50' BGS	3999
Quality Control		1020
True Value QC		1000
% Recovery		102
Relative Percent Difference		0.2

METHOD: Standard Methods	4500-Cl^-B

Amy Hill
Chemist

9/20/05
Date

H10206a

CARDINAL LABORATORIES
PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/21/05
Reporting Date: 09/22/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30
Project Location: LEA COUNTY, NM

Analysis Date: 09/22/05
Sampling Date: 09/20/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: AH

LAB NUMBER	SAMPLE ID	Cl^- (mg/Kg)
H10213-1	BH #2-15' BGS	1400
H10213-2	BH #2-20' BGS	2431
H10213-3	BH #2-25' BGS	1887
H10213-4	BH #2-30' BGS	1344
H10213-5	BH #2-35' BGS	800
H10213-6	BH #2-40' BGS	496
H10213-7	BH #2-45' BGS	592
Quality Control		1020
True Value QC		1000
% Recovery		102
Relative Percent Difference		2.0

METHOD: Standard Methods	4500-Cl⁻B

Note: Analyses performed on 1:4 w:v aqueous extracts.

Amy Hill
Chemist

9/22/05
Date

H10213

CARDINAL
LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/20/05
Reporting Date: 09/20/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30
Project Location: LEA COUNTY, NM

Analysis Date: 09/20/05
Sampling Date: 09/19/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: HM

LAB NUMBER	SAMPLE ID	Cl^- (mg/Kg)
H10205-1	BH #3-15' BGS	432
H10205-2	BH #3-20' BGS	432
H10205-3	BH #3-25' BGS	432
H10205-4	BH #3-30' BGS	688
H10205-5	BH #3-35' BGS	720
H10205-6	BH #3-40' BGS	704
H10205-7	BH #3-45' BGS	368
Quality Control		1020
True Value QC		1000
% Recovery		102
Relative Percent Difference		0.2

METHOD: Standard Methods	4500-Cl⁻B

Note: Analyses performed on 1:4 w:v aqueous extracts.

Amy Hill
Chemist

9/20/05
Date

H10205

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/21/05
Reporting Date: 09/22/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30
Project Location: LEA COUNTY, NM

Analysis Date: 09/22/05
Sampling Date: 09/20/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: AH

LAB NUMBER	SAMPLE ID	Cl^- (mg/Kg)
H10212-1	BH #4-15' BGS	3551
H10212-2	BH #4-20' BGS	5998
H10212-3	BH #4-25' BGS	14080
H10212-4	BH #4-30' BGS	6718
H10212-5	BH #4-35' BGS	2799
H10212-6	BH #4-40' BGS	1424
H10212-7	BH #4-45' BGS	1232
Quality Control		1020
True Value QC		1000
% Recovery		102
Relative Percent Difference		2.0

METHOD: Standard Methods	$4500\text{-}Cl^-B$

Note: Analyses performed on 1:4 w:v aqueous extracts.

Amy Hill
Chemist

9/22/05
Date

H10212

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/20/05
Reporting Date: 09/20/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30
Project Location: LEA COUNTY, NM

Analysis Date: 09/20/05
Sampling Date: 09/19/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: HM

LAB NUMBER	SAMPLE ID	Cl^- (mg/Kg)
H10206-1	BH #5-15' BGS	3007
H10206-2	BH #5-20' BGS	5726
H10206-3	BH #5-25' BGS	3039
H10206-4	BH #5-30' BGS	3839
H10206-5	BH #5-35' BGS	2031
H10206-6	BH #5-40' BGS	1104
H10206-7	BH #5-45' BGS	1168
Quality Control		1020
True Value QC		1000
% Recovery		102
Relative Percent Difference		0.2

METHOD: Standard Methods	4500-Cl⁻B

Note: Analyses performed on 1:4 w:v aqueous extracts.

Amy Hill
Chemist

9/20/05
Date

H10206

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
OCOTILLO ENVIRONMENTAL
ATTN: J. BRIAN
414 N. TURNER
HOBBS, NM 88240
FAX TO: (505) 393-6374

Receiving Date: 09/19/05
Reporting Date: 09/19/05
Project Number: SAM-05-001
Project Name: LIVESTOCK 30 STATE #1
Project Location: LEA COUNTY, NM

Analysis Date: 09/19/05
Sampling Date: 09/16-09/15/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: NF
Analyzed By: HM

LAB NUMBER	SAMPLE ID	Cl^- (mg/Kg)
H10201-1	BH #6-15' BGS	16
H10201-2	BH #6-20' BGS	16
H10201-3	BH #6-25' BGS	32
H10201-4	BH #6-30' BGS	32
H10201-5	BH #7-15' BGS	112
H10201-6	BH #7-20' BGS	80
H10201-7	BH #7-25' BGS	32
H10201-8	BH #7-30' BGS	16
H10201-9	BH #8-15' BGS	16
H10201-10	BH #8-20' BGS	128
H10201-11	BH #8-25' BGS	128
H10201-12	BH #8-30' BGS	112
H10201-13	BH #9-15' BGS	224
H10201-14	BH #9-20' BGS	64
H10201-15	BH #9-25' BGS	240
H10201-16	BH #9-30' BGS	48
Quality Control		1020
True Value QC		1000
% Recovery		102
Relative Percent Difference		0.2

METHOD: Standard Methods	4500-Cl^-B

Note: Analyses performed on 1:4 w:v aqueous extracts.

Amy Hill
Chemist

9/19/05
Date

PLEASE NOTE: **Liability and Damages.** **Cardinal's** liability and client's exclusive remedy for any claim arising, whether based in contract or tort, shall be limited to the amount paid by client for analyses. All claims, including those for negligence and any other cause whatsoever shall be deemed waived unless made in writing and received by **Cardinal** within thirty (30) days after completion of the applicable service. In no event shall **Cardinal** be liable for incidental or consequential damages, including, without limitation, business interruptions, loss of use, or loss of profits incurred by client, its subsidiaries, affiliates or successors arising out of or related to the performance of services hereunder by **Cardinal**, regardless of whether such claim is based upon any of the above-stated reasons or otherwise.

H10201

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603
PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

RECEIVED
Environmental & Safety Services
MAY 20 2005

ANALYTICAL RESULTS FOR
SAMSON
ATTN: TOM KOSCELNY
TWO WEST SECOND ST.
TULSA, OK 74103-3103
FAX TO: (918) 591-7386

Receiving Date: 05/11/05
Reporting Date: 05/13/05
Project Number: NOT GIVEN
Project Name: NEW MEXICO PIT SAMPLING
Project Location: NOT GIVEN

Sampling Date: 05/11/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: AH
Analyzed By: BC/AH

LAB NUMBER	SAMPLE ID	GRO (C_6-C_{10}) (mg/Kg)	DRO (>C_{10}-C_{28}) (mg/Kg)	Cl* (mg/Kg)
ANALYSIS DATE		05/11/05	05/11/05	05/12/05
H9786-1	NE CORNER PQ OSUDO #2	<10.0	15.1	1600
H9786-2	NW CORNER PQ OSUDO #2	<10.0	238	1380
H9786-3	SE CORNER PQ OSUDO #2	<10.0	238	176
H9786-4	SW CORNER PQ OSUDO #2	<10.0	529	144
H9786-5	CENTER PQ OSUDO #2	<10.0	262	12400
H9786-6	NE CORNER LIVESTOCK	<10.0	70.6	3920
H9786-7	NW CORNER LIVESTOCK	<10.0	<10.0	4160
H9786-8	SE CORNER LIVESTOCK	<10.0	549	6880
H9786-9	SW CORNER LIVESTOCK	<10.0	<10.0	5520
H9786-10	CENTER LIVESTOCK	<10.0	262	8080
Quality Control		738	792	960
True Value QC		800	800	1000
% Recovery		92.2	99.0	96.0
Relative Percent Difference		0.7	3.2	1.0

METHODS: TPH GRO & DRO: EPA SW-846 8015 M; Cl^-: Std. Methods 4500-Cl^-B
*Analyses performed on 1:4 w:v aqueous extracts.

Chemist

5/13/05
Date

H9786A.XLS

CARDINAL LABORATORIES

PHONE (325) 673-7001 • 2111 BEECHWOOD • ABILENE, TX 79603

PHONE (505) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
SAMSON
ATTN: TOM KOSCELNY
TWO WEST SECOND ST.
TULSA, OK 74103-3103
FAX TO: (918) 591-7386

RECEIVED
Environmental & Safety Services

MAY 20 2005

Receiving Date: 05/11/05
Reporting Date: 05/13/05
Project Number: NOT GIVEN
Project Name: NEW MEXICO PIT SAMPLING
Project Location: NOT GIVEN

Sampling Date: 05/11/05
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: AH
Analyzed By: BC

LAB NO.	SAMPLE ID	BENZENE (mg/Kg)	TOLUENE (mg/Kg)	ETHYL BENZENE (mg/Kg)	TOTAL XYLENES (mg/Kg)
ANALYSIS DATE		05/11/05	05/11/05	05/11/05	05/11/05
H9786-1	NE CORNER PQ OSUDO #2	<0.005	<0.005	<0.005	<0.015
H9786-2	NW CORNER PQ OSUDO #2	<0.005	<0.005	<0.005	<0.015
H9786-3	SE CORNER PQ OSUDO #2	<0.005	<0.005	<0.005	<0.015
H9786-4	SW CORNER PQ OSUDO #2	<0.005	<0.005	<0.005	<0.015
H9786-5	CENTER PQ OSUDO #2	0.026	0.528	0.128	0.889
H9786-6	NE CORNER LIVESTOCK	<0.005	<0.005	<0.005	<0.015
H9786-7	NW CORNER LIVESTOCK	<0.005	<0.005	<0.005	<0.015
H9786-8	SE CORNER LIVESTOCK	<0.005	<0.005	<0.005	<0.015
H9786-9	SW CORNER LIVESTOCK	<0.005	<0.005	<0.005	<0.015
H9786-10	CENTER LIVESTOCK	<0.005	<0.005	<0.005	<0.015
Quality Control		0.090	0.087	0.094	0.276
True Value QC		0.100	0.100	0.087	0.300
% Recovery		89.7	87.2	87.2	92.1
Relative Percent Difference		2.7	<0.1	3.0	0.7

METHOD: EPA SW-846 8260

Burgess J.A. Cooke
Chemist

5/13/05
Date

H9786B.XLS

APPENDIX B

Revised June 1972

FILED ... 10

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Pogo Producing Co. Owner's Well No. State C # 3
Street or Post Office Address P.O. Box 10340
City and State Midland, Texas 79704

Well was drilled under Permit No. CP-667 and is located in the:
1930' FSL, 1830' FWL
a. ___ ¼ SW ¼ NE ¼ SW ¼ of Section 20 Township 21S Range 35E N.M.P.M.

b. Tract No. ___ of Map No. ___ of the ___

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

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

(B) Drilling Contractor Abbott Bros. Drilling License No. WD-46

Address P.O. Box 637, Hobbs, New Mexico 88240

Drilling Began 9/25/84 Completed 9/25/84 Type tools ___ Size of hole 8½ in.

Elevation of land surface or ___ at well is ___ ft. Total depth of well 85 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 0 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
			DRY HOLE	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
NONE-DRY HOLE								

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

Plugging Contractor Abbott Bros. Drilling
Address P.O. Box 637, Hobbs, New Mexico 88240
Plugging Method Filled with ruble, Cement at top.
Date Well Plugged 9/25/84
Plugging approved by:

State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received September 28, 1984

Quad ___ FWL ___ FSL ___

File No. CP-667 Use OWD Location No. 21.35.20.32321

21.35.20.32321

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	3	3	Surface soil
3	30	27	Caliche
30	40	10	Sand-loose
40	68	18	Sand
68	75	7	Sandy clay
75	85	10	Red clay
			DRY HOLE

Section 7. REMARKS AND ADDITIONAL INFORMATION

SEP 20 9 38 AM '84
STATE ENGINEER
ROSWELL, NM

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

Murrell Abbott
Driller H.B.

INSTRUCTIONS: This form ... ld be ... ecuted in triplicate, preferably typewritten, and ... ubmitte... e appropriate district office of the State Engineer. All ... ns, ex... t Section 5, shall be answered as completely ... d accur... s possible when any well is drilled, repaired or deepened. ... hen this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well MERCHANTS LIVESTOCK Owner's Well No. ______
Street or Post Office Address c/o Glenn's Water Well Service
City and State Box 692 Tatum, NM 88267

Well was drilled under Permit No. CP- 917 and is located in the:

a. ____ ¼ SW ¼ NE ¼ SW ¼ of Section 30 Township 21-S. Range 35-E. N.M.P.M.

b. Tract No. ______ of Map No. ______ of the ______

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

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

(B) Drilling Contractor Glenn's Water Well Service License No. WD-421

Address P.O. Box 692 Tatum, NM 88267

Drilling Began 11/10/03 Completed 11/10/03 Type tools rotary Size of hole 9 7/8 in.

Elevation of land surface or ______ at well is ______ ft. Total depth of well 146 ft.

Completed well is [X] shallow [ ] artesian. Depth to water upon completion of well 40 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
62	138	76	Sand	100

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6 5/8	.188	PE	1	146	146	none	30	146

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

Plugging Contractor ______
Address ______
Plugging Method ______
Date Well Plugged ______
Plugging approved by:

______
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY 287671

Date Received 11-20-03

Quad ______ FWL ______ FSL ______

File No. CP-917 Use Stock Location No. 21.35.30.323

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	3	3	soil
3	11	8	white clay
11	18	7	calche
18	22	4	red sand
22	62	40	white clay
62	138	76	red sand
138	146	8	red clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Corky Holm

Driller

INSTRUCTIONS: Th[illegible]n should be executed in triplicate, preferably typewritten, and submitte[illegible] the appropriate district office of the State Enginee[illegible] sections, [illegible]pt Section 5, shall be answered as complete and accur[illegible] as possible when any well is drilled, repaired or deep[illegible]ned. When this form is used as a plugging record, only Section 1(a) and Sectio[illegible] 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

FIELD ENGR. LOG

Section 1. GENERAL INFORMATION

(A) Owner of well Merchant Livestock Company Owner's Well No. ____

Street or Post Office Address Box 1105

City and State Eunice, New ~~MEXXXX~~ Mexico 88231

Well was drilled under Permit No. CP-635 and is located in the:

a. ____ ¼ SE ¼ SW ¼ ____ ¼ of Section 30 Township 21-S Range 35-E N.M.P.M.

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

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

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

(B) Drilling Contractor W. L. Van Noy License No. WD-208

Address P. O. Box 74 Oil Center, New Mex. 88266

Drilling Began April 26, 1981 Completed April 30, 1981 Type tools ~~X~~Spudder Size of hole 10 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 60 ft.

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

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
40	60	20	water sand	

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
7	welded		0	60	60	none	40	60

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

Plugging Contractor ____

Address ____

Plugging Method ____

Date Well Plugged ____

Plugging approved by:

____

State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY

Date Received May 8, 1981

Quad ____ FWL ____ FSL ____

File No. CP-635 Use DOM & STK Location No. 21.35.30.34

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	5	5	top soil
5	15	10	caliche
15	40	25	brown sand
40	60	20	water sand.

Section 7. REMARKS AND ADDITIONAL INFORMATION

'81 MAY 8 AM 8 30
STATE ENGINEER OFFICE
ROSWELL N. M.

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

W. L. Van Noy
Driller

INSTRUCTIONS: Th[illegible] rm should be executed in triplicate, preferably typewritten, and submitted to the appropriate district offic of the State Enginee[illegible] section[illegible] cept Section 5, shall be answered as compl[illegible] and ac[illegible]ly as possible when any well drilled, repaired or deep[illegible]ned. When this form is used as a plugging record, only Section [illegible](a) and S[illegible]n 5 need be completed.

Revised June 1972

STATE ENGINEER OFFICE
WELL RECORD

T # 131740

Section 1. GENERAL INFORMATION

(A) Owner of well Merchant Livestock Co. Owner's Well No. ____
Street or Post Office Address c/o Glenn's Water Well Service
City and State Box 692 Tatum, NM 88267

Well was drilled under Permit No. CP-866 and is located in the:

a. NE ¼ ~~NW~~ NE ¼ ~~SW~~ SE ¼ ~~SW~~ SW ¼ of Section 30 Township 21-S. Range 35-E. N.M.P.M.

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

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

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

(B) Drilling Contractor Glenn's Water Well Service License No. WD 421

Address Box 692 Tatum, NM 88267

Drilling Began September 24 97 Completed 9/24/97 Type tools rotary Size of hole 7 7/8 in.

Elevation of land surface or ____ at well is ____ ft. Total depth of well 140 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 42 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
60	127	67	Red sand	100

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
8 5/8	.188	PE	1	8	8			
6 5/8	.188	PE	1	114	114	none	38	114

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

Plugging Contractor ____
Address ____
Plugging Method ____
Date Well Plugged ____
Plugging approved by:

____
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY 21.35.30.34223

Date Received 10/02/97

Quad ____ FWL ____ FSL ____

File No. CP-866 Use Stock Location No. 21.35.30.34223

Section 6. LOG OF HOLE

Depth in Feet		Thickness in Feet	Color and Type of Material Encountered
From	To		
0	2	2	soil
2	12	10	clay (white)
12	25	13	sandy caleche
25	60	35	white clay
60	127	67	red sand
127	140	13	red clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

'97 OCT 2 AM 11 07

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

Driller

INSTRUCTIONS: This form should be executed in triplicate, preferably typewritten, and submitted to the appropriate district office of the State Engineer. All [illegible]ns, except Section 5, shall be answered as completely and accurate[illegible] possible when any well is drilled, repaired or deepene[illegible] n this [illegible]m is used as a plugging record, only Section 1[illegible] nd Sectio[illegible] d be completed.

Revised June 1972

STATE ENGINEER OFFICE

WELL RECORD

Section 1. GENERAL INFORMATION

(A) Owner of well Merchants Livestock Owner's Well No.
Street or Post Office Address c/o Glenn's Water Well Box 692
City and State Tatum, New Mexico 88267

Well was drilled under Permit No. CP-916 and is located in the:

a. ___ ¼ NW ¼ SW¼ SE ¼ of Section 30 Township 21-S. Range 35-E. N.M.P.M.

b. Tract No. ___ of Map No. ___ of the ___

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

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

(B) Drilling Contractor Glenn's Water Well Service, Inc. License No. WD-421

Address P.O. Box 692 Tatum, New Mexico 88267

Drilling Began 10/18/03 Completed 10/18/03 Type tools rotary Size of hole 9 7/8 in.

Elevation of land surface or ___ at well is ___ ft. Total depth of well 110 ft.

Completed well is ☒ shallow ☐ artesian. Depth to water upon completion of well 42 ft.

Section 2. PRINCIPAL WATER-BEARING STRATA

Depth in Feet		Thickness in Feet	Description of Water-Bearing Formation	Estimated Yield (gallons per minute)
From	To			
42	98	56	sand	100

Section 3. RECORD OF CASING

Diameter (inches)	Pounds per foot	Threads per in.	Depth in Feet		Length (feet)	Type of Shoe	Perforations	
			Top	Bottom			From	To
6 5/8	.188	PE	1	110	110	none	34	110

Section 4. RECORD OF MUDDING AND CEMENTING

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

Section 5. PLUGGING RECORD

Plugging Contractor ___
Address ___
Plugging Method ___
Date Well Plugged ___
Plugging approved by:

___
State Engineer Representative

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

FOR USE OF STATE ENGINEER ONLY 286121

Date Received 10-24-03

Quad ___ FWL ___ FSL ___

File No. CP-916 Use Stock Location No. 21-35.30.431

Section 6. LOG OF HOLE

Depth in Feet From	Depth in Feet To	Thickness in Feet	Color and Type of Material Encountered
0	2	2	soil
2	14	12	white clay
14	49	35	sandy caleche
49	50	1	hard rock
50	53	3	void
53	98	45	red sand and rock ledges
98	110	12	red clay

Section 7. REMARKS AND ADDITIONAL INFORMATION

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

Corky [illegible]

Driller

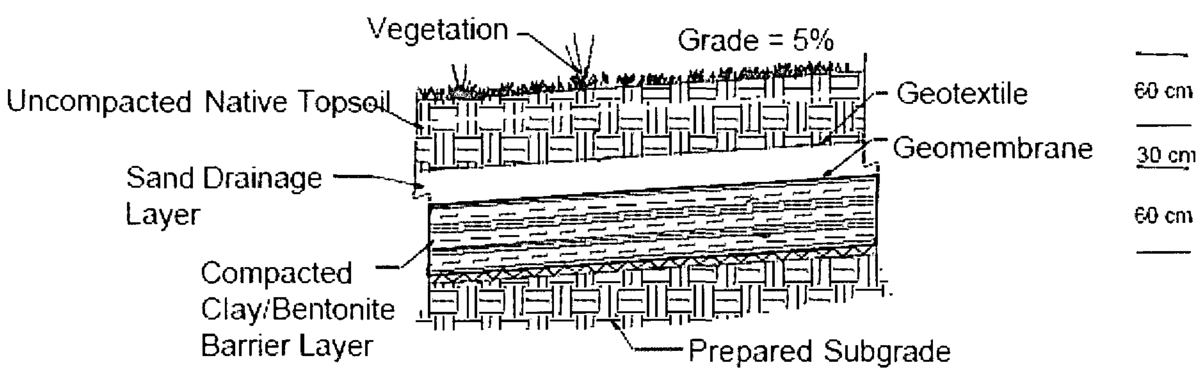
INSTRUCTIONS: Th[illegible] should be [illegible]cuted in triplicate, preferably typewritten, a[illegible] ubmitte[illegible] appropriate district office of the State Engineer. [illegible] sections, except Section 5, shall be answered as completely and accurate[illegible] as possible when any well is drilled, repaired or deepe[illegible]ed. When this form is used as a plugging record, only Section 1(a) and Section 5 need be completed.

APPENDIX C

Landfill 3 (RCRA Subtitle C)
Compacted Clay Cover designed and constructed in accordance with minimum regulatory requirements for closure of hazardous and mixed waste landfills. These regulations are somewhat vague. To overcome this vagueness, the Environmental Protection Agency (EPA) recommended a cover profile for the RCRA Subtitle 'C' final cover design profile described below, from bottom layer to top layer:

1. A composite barrier layer consisting of a minimum 60-cm thick layer of compacted natural or amended soil with a maximum saturated hydraulic conductivity of 1 x 10-7 cm/sec in intimate contact with a minimum 40-mil geomembrane overlying this soil layer.The function of this composite barrier layer is to limit downward moisture movement.
2. A drainage layer consisting of a minimum 30-cm thick sand layer having a minimum saturated hydraulic conductivity of 1 x 10-2 cm/sec, or a layer of geosynthetic material having the same characteristics;
3. A top vegetation/soil layer consisting of a minimum 60-cm of soil graded at a slope between 3 and 5 percent with vegetation or an armored top surface.

The installed Compacted Clay Cover is 1.5 m thick which basically matches the recommended EPA design described above. The profile for this cover consists of three layers. See figure below.



Profile of Baseline Test Cover 2 (Landfill 3)

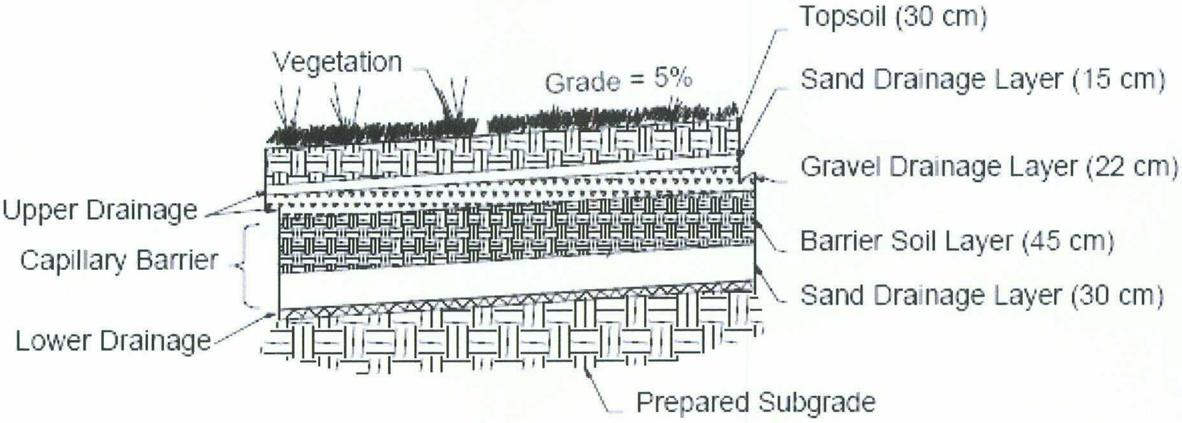
The bottom layer is a 60 cm thick compacted soil barrier layer. The native soil required amendment to meet the saturated hydraulic conductivity requirement (maximum of 1 x 10-7 cm/sec) for this barrier layer. Laboratory tests determined that a mixture of 6% by weight of sodium bentonite with the native soil compacted 'wet of optimum' to a minimum of 98% of maximum dry density would be adequate.

A 40 mil linear low density polyethylene (LLDPE) geomembrane was placed directly on the compacted soil barrier layer to create a composite barrier layer. The purpose of this composite barrier layer is to create an impermeable barrier that blocks the infiltration of water. Eight 1-cm2 defects (puncture holes) were purposely and randomly placed in this geomembrane to be representative of a geomembrane installation with average quality control conditions (Dwyer et al. 1998).

Welding Seams of Geomembrane Panels

Landfill 5 (Capillary Barrier)

This cover system consists of four primary layers from bottom to top: (1) a lower drainage layer; (2) a barrier soil layer; (3) an upper drainage layer; and (4) a topsoil layer. The barrier soil layer and lower drainage layer comprise the capillary barrier. The lower drainage layer is composed of 30 cm of washed concrete sand. See figure below.



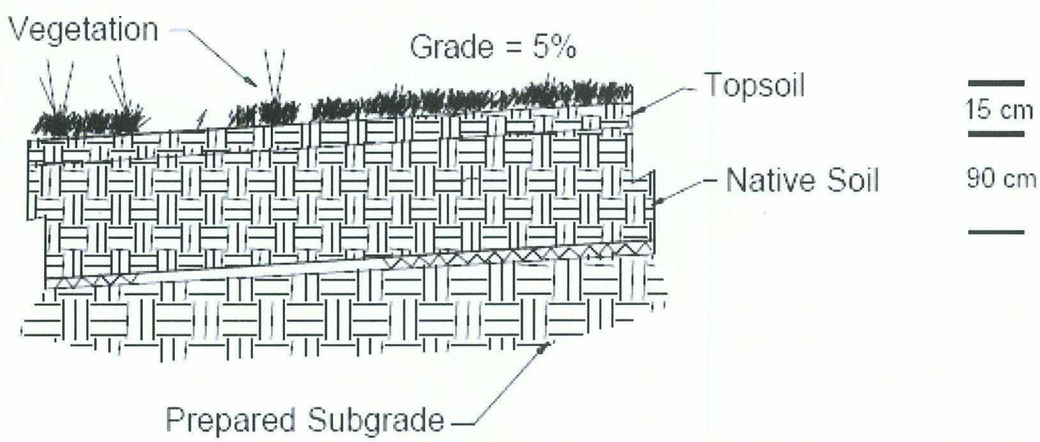
Profile of Alternative Test Cover 3 (Landfill 5)

The 45 cm barrier soil layer was installed directly on the sand. The upper drainage layers were placed over the barrier soil layer. This upper drainage layer consists of two materials containing 22 cm of clean pea gravel and 15 cm of washed concrete sand. Finally, a 30 cm thick layer of topsoil was placed on the sand.

Capillary Barrier Installation

Landfill 6 (Evapotranspiration)

The ET Cover consists of a single, vegetated soil layer constructed to represent an optimum mix of soil texture, soil thickness, and vegetation cover. The installed test cover is a 105 cm thick monolithic soil cover. The bottom 90 cm of native soil was compacted while the top 15 cm of topsoil was loosely placed. The soil allows for water storage, which combined with the vegetation, is designed to optimize evapotranspiration. See figure below.



Profile of Alternative Cover 4 (Landfill 6)

A thin gravel veneer (2 to 4 cm) was placed on the surface after the cover was seeded. The objective of the gravel veneer was to enhance the vegetation establishment and minimize erosion.

Compacting Soil in ET Cover

APPENDIX D

HYDRUS-1D numerically solves the Richard's equation for water flow and the Fickian-based advection-dispersion equation for heat and solute transportation. The HYDRUS-1D flow equation includes a sink term (a term used to specify water leaving the system) to account for transpiration by plants. The solute transport equation considers advective, dispersive transport in the liquid phase, diffusion in the gaseous phase, nonlinear and non-equilibrium sorption, linear equilibrium reactions between the liquid and gaseous phases, zero-order production, and first-order degradation.

The ground water mixing model uses the chloride flux from the vadose zone to ground water provided by HYDRUS-1D and instantaneously mixes this chloride and water with the ground water flux of chloride plus water that enters the mixing cell beneath the subject site. We refer the reader to API Publication 4734, Modeling Study of Produced Water Release Scenarios (Hendrickx and others, 2005) for a general description of the techniques employed for this simulation experiment.

A description of the model input parameters are listed below.

Soil Profile - Information for the soil profile (or vadose zone thickness and texture) is based upon the boring log from the monitoring well installed at the site. A vadose zone thickness of 38 feet was used in the modeling based upon recent depth to ground water measurements in the monitoring well.

Dispersion lengths - Conservative dispersion lengths were employed. Standard practice calls for employing a dispersion length that is 10% of the model length.

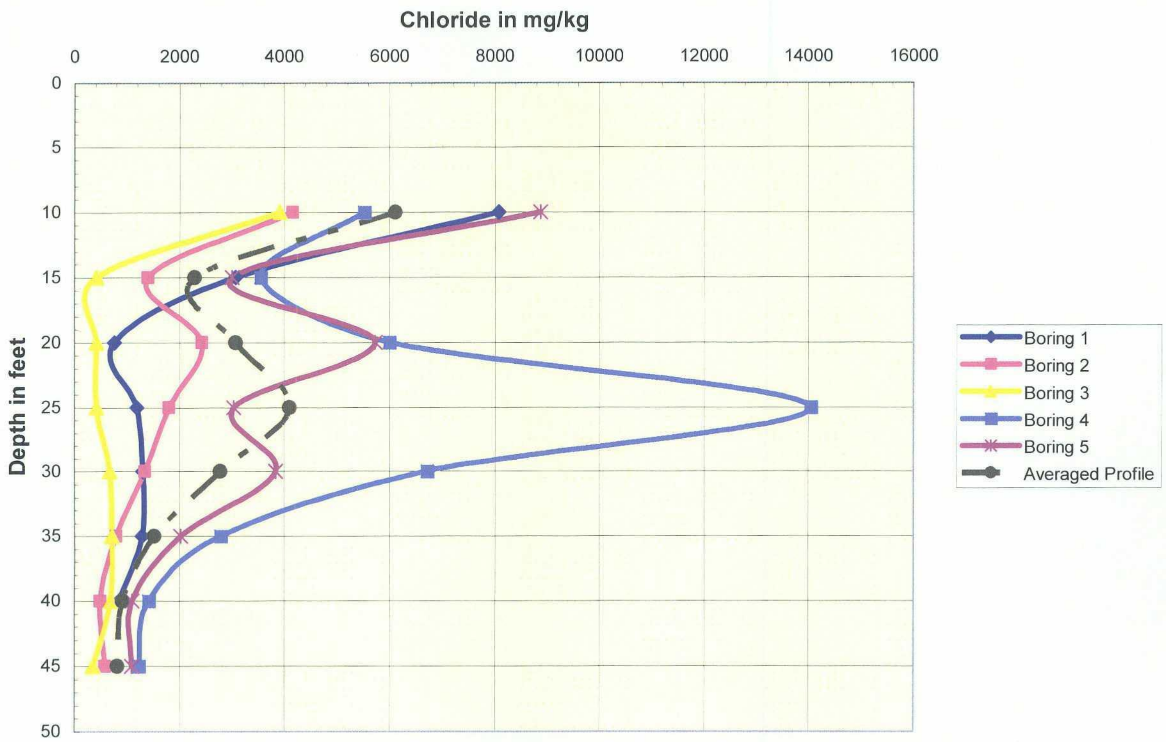
Climate - Weather data used in the predictive modeling was from the Pearl Weather Station (46 years of data), approximately 14 miles north of the Livestock site. This is the closest station featuring sufficiently complete weather data for the HYDRUS-1D input files.

HYDRUS-1D can also employ a uniform yearly infiltration rate that will obviously smooth the temporal variations. Because the atmospheric data are of high quality and nearby to the site, we have elected to allow HYDRUS-1D to predict the deep percolation rate and the resultant variable flux to ground water. This choice results in higher peak chloride concentrations in ground water due to temporally variable high fluxes from the vadose zone. As such, this choice is conservative and will over-predict impairment to ground water quality.

Soil Moisture - Because soils are relatively dry in this climate and vadose zone hydraulic conductivity varies with moisture content, it is important that simulation experiments of different remedial strategies begin with an initial "steady state" soil moisture content. The calculation of soil moisture content begins with using professional judgment as an initial input and then running sufficient years of weather data through the model to establish a "steady state" moisture content. Because only minimal changes in the HYDRUS-1D soil moisture content profile occurred after year 40 of the initial condition calculation, 92 years (2 cycles of the 46 years of weather data) was considered more than sufficient to establish the initial moisture condition. All simulations of chloride movement used soil profiles hydrated in this manner.

Initial Chloride Profile – Field chloride soil concentrations (mg/kg) were obtained at depths of 10,15,20,25,30 and 35 feet below ground surface (bgs) from the 5 borings drilled within the pit at the Livestock site (Figure 1). The chloride data from the five borings were averaged with equal area weighting to calculate a representative chloride concentration profile. An integration of the chloride contained within the profile yielded a chloride load of 41.7 kg/m^2 . The averaged soil concentration values (mg/kg) were linearly interpolated to correspond to the HYDRUS 1-D soil profile nodes. Using the volumetric moisture content from the HYDRUS 1-D initial condition and a default dry bulk soil density of 1390 kg/m^3 , soil water moisture concentrations (mg/L) were calculated for the HYDRUS 1-D soil profile nodes. These chloride concentrations were installed in the HYDRUS-1D model. An integration of the chloride contained within the soil moisture summed to a chloride load of 40.4 kg/m^2.

Figure 1, Chloride Concentration in Soil at the Livestock Site



As described in API Publication 4734, the ground water mixing model takes the background chloride concentration in ground water multiplied by the ground water flux to calculate the total mass of ground water chloride entering the ground water mixing cell, which lies below the area of interest. The chloride and water flux from HYDRUS-1D is added to the ground water chloride mass and flux to create a final chloride concentration in ground water at an imaginary monitoring well located at the down gradient edge of the mixing cell (the edge of the release site).

Influence Distance - The influence distance is defined as the maximal length of the release parallel to groundwater flow direction. As this exact direction is not known, the maximum dimension of the approximately 120 feet by 140 feet pit of 185 feet was used.

Background Chloride Concentration – from regional data, a value of 100 mg/L chloride for ground water was used at this location.

Hydraulic Conductivity - R.T. Hicks Consultants believes that the hydraulic conductivity of the saturated zone at the release site is similar to that observed for the Ogallala Aquifer throughout the general area. McAda (1984) simulated water level declines using a two-dimensional digital model and employed hydraulic conductivity values of 51-75 feet/day (1.9 E-4 to 2.8 E-4 m/s) in the area. More recently, Musharrafieh and Chudnoff (1999) employed values for hydraulic conductivity within this area of interest between 81 and 100 ft/day, for their simulation. According to Freeze and Cherry (1979), these values correspond to clean sand, which agrees with nearby lithologic descriptions of the saturated zone. For the Livestock site, the saturated hydraulic conductivity of the uppermost saturated zone is assumed as 75 feet/day.

Groundwater Gradient - From USGS well data (1996) ground water flows southeast in the area under a hydraulic gradient of approximately 0.002 ft/ft. The resulting ground water flux is 4.6 cm/day.

Aquifer Thickness - A restricted aquifer thickness of 10 feet was employed in the mixing model as a conservative measure to cause over-estimation of chloride concentration in an imaginary receptor well.

For all variables for which field data did not exist, assumptions conservative of ground water quality were made. A summary of the input parameters and a description of the source information used in the HYDRUS-1D model for this application are provided in Table 1 below.

Table 1: Modeling Inputs for Samson Livestock Site

Input Parameter	Source
Vadose Zone Thickness - 38 feet	Monitoring Well at Site
Vadose Zone Texture	Monitoring Well Bore Log
Dispersion Length - 10% of model length	Professional judgment
Climate	Pearl, N.M. Weather Station Data
Soil Moisture	HYDRUS-1D initial condition simulation
Initial soil chloride concentration profile	From 5 Borings within Site
Length of release parallel to ground water flow - 185 feet	Maximum Dimension of Pit
Background Chloride in Ground Water - 100 ppm	Regional Data
Ground Water Flux - 4.6 cm/day	Calculated from published data
Aquifer Thickness - 10-feet	Conservative Assumption

Vegetation was allowed at the site.

Model of the Livestock Site with an Installed Infiltration Barrier

The remedy modeled consists of backfilling the pit with six feet of material from on-site; installation of the infiltration barrier; and then, placement of an additional 4 feet of loam with vegetation above the barrier. In order to model this remedy, the following steps were necessary.

1) An initial condition was calculated for the lithologic column from 10 feet bgs to 38 feet bgs. It is assumed that the pit has been open for sufficient time for this to occur. The column is composed of caliche from 10 to 30 feet bgs and of sandy caliche from 30-38 feet bgs.

2) On top of this 28 foot soil column, an additional 6 feet of sandy caliche was placed. Moisture content of this material was taken as an approximate average of values from material in the upper column. It is not possible to know what sequences of this material will be placed above the intact soil column. Hence this moisture content can only be estimated.

3) The soil water concentrations were calculated and installed as explained earlier. Within the 6 feet of sandy caliche added above the pit floor, a soil concentration of 250 mg/kg is conservative as all samples from the background borings had concentrations less than this measurement.

4) The as above described soil profile was run for 80 years with a non-degrading liner installed on top (a no flux boundary condition).

5) Next, a linear degradation of the liner was assumed to take place over a period of 20 years. This was accomplished by allowing precipitation and evapotranspiration to increase from values of zero at year 80 to their full values at year 100 (20 years later). Placed on top of the liner was 4 feet of loam with pre–established vegetation. This 4 foot profile was run with vegetation and a no-flux lower boundary condition to calculate its initial condition for installation in the modeling of the degradation of the liner.

6) At the end of the 20 year degradation period, it is assumed that the liner no longer exists. The full profile is then run until a peak concentration has passed through the water table-vadose zone boundary.

7) The outputs from the different HYDRUS-1D runs were used as inputs to the later HYDRUS-1D models as well as being input to the mixing model. As explained earlier, output from the mixing model represents the impact of the release in ground water in an imaginary well at the down gradient edge of the pit.