DENIED

November 15, 2010

Southwest Royalties
Flying M Section 17 Playa
NMOCD Case # 1RP-1958-0

Characterization Results

prepared for:

Southwest Royalties, Inc.
6 Desta Drive, Suite 2100
Midland, Texas 79705

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

Location: T-9S, R-33E, Sec 17, Unit F
Latitude: North 33.5341
Longitude: West -103.5845
NMOCD#: 1RP-1958-0

1.0 EXECUTIVE SUMMARY

On September 16, 2008 Southwest Royalties reported a release of produced water from a pipeline located in unit letter F, Section 17, Township 9S Range 33E. This site is being called the Flying M Section 17 Playa. The revised C-141 (shown in Appendix A) is based upon facts and conclusions described in this report. As used in this report, the words "conservative" or "worst case" refers to logic or assumptions that result in an overestimate of the potential impact to fresh water or the environment. Because our conclusions are based upon the facts of the release and the area as well as conservative assumptions, they probably overstate impacts to the environment.

- SOURCE OF PRODUCED WATER?
- CHLORIDE CONTENT OF SPILLED WATER
- REASON FOR 24 HR DELAY
- INADEQUATE DELINEATION

Facts known for the site include:

1. The release occurred between September 12 and September 15, 2008.
2. On September 16 vacuum trucks removed about 350 barrels of fluid.
3. Between September 29 and October 10, 2008 Southwest Royalties removed to disposal 5,060 cubic yards of soil and entrained produced water.
4. Sampling shows that no soil sample from either the surface or at depths up to 6 feet below the surface contained BTEX above detection limits.
5. Historic aerial photographs show evidence of at least one produced water release to the playa from a pipeline associated with API 30-025-21038.
6. In 1992, Coastal Oil and Gas plugged and abandoned API 30-025-21038.
7. In 1997, Southwest Royalties purchased the active oil and gas wells and attendant pipelines from Coastal Oil and Gas.

TO WHERE? BY WHOM?

FIND NO SAMPLES FROM 6' IN REPORT

??

The following are conclusions based upon facts and conservative assumptions:

A. The 2008 release introduced about 220 barrels of produced water and 14 barrels of oil into the playa. This release displaced some standing storm water in the playa.

- DOES NOT AGREE w/ C-141 REPORT

B. Although the original C-141 estimated that vacuum trucks removed 275 barrels of produced water, 10 barrels of oil and 65 barrels of storm water, calculations show that vacuum trucks removed about 200 barrels of produced water with 10 barrels of oil and 140 barrels of storm water.

C. Based upon the chloride mass balance described in this report, the soil excavation and disposal effort removed a chloride mass equivalent to more than 400 barrels of released produced water.

D. Southwest Royalties removed 100% of the salt and hydrocarbons entrained in the produced water released during the 2008 line rupture.

E. Southwest Royalties removed an additional mass of chloride equal to 380 barrels of produced water caused by historic releases from API 30-025-21038.

Southwest Royalties volunteers to install a 4-inch monitoring well down gradient (south-southeast) from the playa and collect a sample from this well and a water sample from the playa in order to assist NMOCD in determining if this legacy site poses a threat to fresh water or the environment.

NO RELEASE

Because there is no evidence of hydrocarbon impact at the site and Southwest Royalties has removed more chloride than was released by their operations, we request that NMOCD release Southwest Royalties from additional responsibility regarding this legacy site.

2.0 LOCATION AND LAND USE

The Flying M release site is located in unit letter F, Section 17, Township 9S Range 33E (Plates 1 and 2). To access the site, travel approximately 21.5 miles west of Tatum New Mexico on US 380 to the intersection with Button Mesa Road (State Road 156). Travel north on Button Mesa Road about 10.5 miles to its intersection with Carrol Road (State Road 170). Travel east on Carrol Road about 4.7 miles to its intersection with an oil field service road. Travel 0.3 miles north on this road to the next intersection. Travel 0.7 miles west. At this point, the road crosses over a north-northeast trending pipeline. Travel northeast about 0.2 miles paralleling the pipeline to the location of the release source.

Plate 3 is a 2005 aerial photograph at the same scale as Plate 2 showing that the area is primarily used for grazing and oil production.

Plate 4 shows the outline of the release site (the playa) and sampling points with chloride concentration results from multiple soil sampling events that occurred between September 17 and October 10, 2008.

3.0 GEOLOGY AND HYDROLOGY

The release site is on the High Plains of southeastern New Mexico. The plains are an erosional surface on the Ogallala formation. As the topographic map presented in Plate 2 shows, the surface slopes gently to the east and southeast. Surface drainage channels have shallow relief where present and drain into small closed basins (playas). During large rainfall events, these playas become temporary lakes.

The Ogallala is composed of a fining-upwards sequence with gravels and sand underlying very fine grained sands and silts. During the depositional process, numerous caliche horizons developed within the Ogallala sediments. The Ogallala lies unconformably on the red silts, sands and clays of the Chinle formation. The Ogallala is the principal aquifer in the region.

Paleozoic formations below the Chinle formation contain numerous thick beds of salt and anhydrite. Many researchers suggest that solution cavities and resulting collapse structures in these formations are expressed at the ground surface as depressions or playas.

Plate 5 presents the saturated thickness map of the Ogallala Aquifer for this area (USGS Scientific Investigation Map 3044, Ann Tillery, 2008). This map suggests that the saturated thickness of the Ogallala beneath the site is variable or shows no saturation. Although no OSE well logs exist near the release site to permit verification of the data presented in the USGS publication, data collected from borings associated with another SW Royalties site about a ¾ of a mile to the south-southeast show that the saturated thickness of the Ogallala in this area is less than 20 feet.

Plate 6 presents USGS data for nearby water supply wells plotted over the state geologic map. The depth to ground water at this site is 50-60 feet. Also plotted on Plate 6 are water table elevations for various years. The topographic and geologic variations in this area cause significant differences in water table elevations and prevent creation of a water table elevation map. The data do suggest that local ground water flow may be:

- Southeast, consistent with the regional gradient or
- South, consistent with topography and perpendicular to interpolated ground water contours (Plate 5)

A search of the Petroleum Technology Transfer Center database showed ground water, chloride concentrations ranging from 66-148 mg/L in nearby wells. Plate 7 presents regional concentrations of chloride in ground water near the site.

The WATERS database of the Office of the State Engineer (OSE) shows no wells within one mile of the site. A search of files available at the Roswell office of the OSE found no driller's logs of nearby water wells. Appendix B presents the lithologic log of the monitoring well installed about ¾ of a mile south-southeast of playa.

4.0 DESCRIPTION OF THE RELEASE AND ACTIVITIES AT THE SITE

Southwest Royalties submitted a C-141 to NMOCD on Sept. 18, 2008. As detailed in the notification, the release from a buried pipeline was discovered on Sept 15, 2008. The southwest-northeast trending pipeline passes about 100 feet southeast of the playa. Fluid from the release drained northwestward into the playa which is approximately 300 feet in diameter (see Plate 4). The sequence of events after the release is presented below:

AS PER NMOCD - THIS WAS HAULED FOR MANY DAYS. NOT JUST 3 LOADS

September 16, 2008
A vacuum truck removed about 350 barrels of fluid from the playa.

September 17, 2008
Four soil samples taken from the ground surface of the playa (see Table 1, Plate 4 and Appendix C) show a maximum concentration of 608 mg/kg near where the release entered the playa floor. A minimum concentration of 176 mg/kg occurred at the north end of the playa. No samples detected regulated hydrocarbons.

Table 1. Chloride Concentration Sample Data, 2008

Sample Location	Sample Date	Sample Depth Description	Excavation Stage	Depth Below Original Playa Floor (ft)	Chloride (mg/kg)
East, SP-1	Sept 17	Surface	No excavation	0	608
	Sept 29	2 feet bgs	No excavation	2	1,410
	Oct 7	3 feet bgs	About 0.9 feet removed	3.9	1,380
	Oct 10	1 foot bgs	An additional 1.1 feet have been removed, total of 2 feet removed	3	1,520
		2 feet bgs		4	2,320
		3 feet bgs		5	2,450
SP-2	Sept 29	2 feet bgs	No excavation	2	1,310
	Oct 7	3 feet bgs	About 0.9 feet removed	3.9	2,000
	Oct 10	1 foot bgs	An additional 2.1 feet have been removed, total of 3 feet removed	4	2,650
		2 feet bgs		5	3,820
		3 feet bgs		6	5,040
West, SP-3	Sept 17	Surface	No excavation	0	256
	Sept 29	2 feet bgs	No excavation	2	976
	Oct 7	3 feet bgs	About 0.5 feet removed	3.5	1,180
	Oct 10	1 foot bgs	An additional 0.3 feet have been removed for a total of 0.8 feet	3.8	1,800
		2 feet bgs		4.8	2,720
		3 feet bgs		5.8	3,260

Sample Location	Sample Date	Sample Depth Description	Excavation Stage	Depth Below Original Playa Floor (ft)	Chloride (mg/kg)
North, SP-4	Sept 17	Surface	No excavation	0	176
	Sept 29	2 feet bgs	No excavation	2	896
	Oct 7	3 feet bgs	About 0.5 feet removed	3.5	944
	Oct 10	1 foot bgs	An additional 0.3 feet have been removed for a total of 0.8 feet	3.8	1,310
		2 feet bgs		4.8	2,720
		3 feet bgs		5.8	3,150
South, SP-5	Sept 17	Surface	No excavation	0	496
	Sept 29	2 feet bgs	No excavation	2	1,580
	Oct 7	3 feet bgs	About 0.9 feet removed	3.9	1,600
	Oct 10	1 foot bgs	An additional 1.1 feet have been removed for a total of 2.0 feet.	3	2,280
		2 feet bgs		4	3,440
		3 feet bgs		5	2,820

September 29, 2008
Five additional samples taken at a depth of 2 feet bgs showed a maximum concentration of 1,580 mg/kg at SP5 on Plate 4 and a minimum concentration at SP4 of 896 mg/kg. No samples detected regulated hydrocarbons.

September 30-October 6, 2008
A contractor excavated and removed soil to an average depth of 0.9 feet from the playa floor.

October 7, 2008
Five samples from a depth of three feet below the new ground surface (about 4.0 feet below the original grade of the playa floor) showed concentrations were highest at SP2 in the center of the playa at 2,000 mg/kg and lowest at SP4 to the north at 944 mg/kg (Plate 4). No samples detected regulated hydrocarbons.

October 8-9, 2008
The contractor removed an additional 0.8 feet of soil, on average, from the playa floor. In some areas the excavations extended to 3.0 feet below ground surface. The largest volumes of soil were removed from the southern and central areas of the site.

October 10, 2008
Soil samples from a depth of three feet below the new ground surface (up to 6.0 feet below the original elevation of the playa floor) were taken at the same five sample locations. Concentrations were highest at SP2 (5,040 mg/kg at 6 feet bgs) and lowest at SP4 (1,310 mg/kg at 3.8 feet bgs). No samples detected regulated hydrocarbons.

The data demonstrate that the only constituent of concern relating to this release is chloride.

The results of these deepest soil samples caused Southwest Royalties to cease additional excavation and call for more thorough evaluation of the data.

5.0 HISTORY OF ACTIVITIES NEAR THE RELEASE AREA

1955
The 1955 aerial photo of the site shows no oil field activity and no bare areas from lack of vegetation near the playa. The floor of the playa appears vegetated similarly to the smaller playa 700 feet to the east-northeast (See Plate 8).

1964
Shell Oil Company drilled an oil well (API number 30-025-21038), about 2,000 feet west of the release site. The pipeline servicing the well was also installed, passing on the south-southwest side of the playa. Aerial photographs show no stressed vegetation in the area and the playa floor appears to have vegetation.

1966
Coastal States Gas Producing Company acquires API 30-025-21038 from Shell Oil Company.

1967
API 30-025-21038 is converted to an injection well.

1971
The pipeline that was the source of the Southwest Royalties release is in place on the east-southeast side of the playa. Aerial photographs from 1971 and 1974 show a bare spot in the vegetative cover about 300 feet west-southwest of the playa adjacent to the pipeline servicing API 30-025-21038. The playa floor appears vegetated as before. Photographs show no evidence of a release from the pipeline that was the source of the 2008 release.

1980
Gas Producing Enterprises acquires API 30-025-21038 from Coastal States Gas Producing Company.

1980
Coastal Oil and Gas Corporation acquires API 30-025-21038 from Gas Producing Enterprises.

May, 1992
Coastal Oil and Gas Corporation plugs and abandons API 30-025-21038. As such, as of May, 1992, fluids no longer ran in the pipeline servicing this injection well.

1996-1998
USGS aerial photographs taken in this time interval show that the bare spot observed in the 1971 and 1974 photographs adjacent to the pipeline servicing API 30-025-21038 is lengthened parallel to the pipeline and drains to the playa down a bare arroyo. The playa floor is not vegetated and sediment from the arroyo has formed a delta on the west side of the playa floor. Photographs show no evi-

dence of a release from the pipeline that was the source of the 2008 release.

1997
Southwest Royalties purchased the active wells and their attendant pipelines in the general area of the release. Neither the plugged and abandoned Coastal well (API 30-025-21038) nor its pipeline were part of the Southwest Royalties acquisition.

2005
Aerial photos show minimal revegetation of the playa floor and the bare area draining to the playa. The size of the delta on the playa floor has increased.

2008
Photos of the release site in September 2008 show some grass on the playa floor and on the arroyo delta.

5.1 Interpretation of Historic Air Photographs

Before 1974, there are no direct effects to the playa from oil field activities.

Between 1974 and 1992, at least one release of produced water emanated from the pipeline servicing API 30-025-21038 and reached the playa floor. Precipitation events carried additional chloride from this historic release area and soil from the release area to the playa floor (Plate 8 shows historical aerial photos of the playa).

ASSUMPTION ONLY

The data does not allow an estimate of the chloride mass released to the playa floor from events prior to 1997. However, after Southwest Royalties completed the excavation and removal of brine released during the September 2008 event, samples show that 28,560 kg of chloride remain in the upper 3-feet of playa sediments.

6.0 RELEASE CALCULATIONS AND DISCUSSION

6.1 Mass of Chloride Released by Southwest Royalties

Over the weekend of Sept 13 and 14, 2008, well numbers 051 and 061 were on test at a combined flow that generated a daily rate of 175 barrels of produced water and 11 barrels of oil. On Monday, September 15, Southwest Royalties discovered the pipeline release and flow through the pipeline was stopped.

Based upon this measured ratio of oil to produced water for these two wells, the nature of the release and the visual estimate of the ratio of oil to produced water in the original C-141 leads us to conclude that the most probable release volume of produced water introduced to the playa was about 220 barrels of produced water and 14 barrels of oil. Appendix D presents all data, assumptions, and a discussion of the calculations that support this conclusion.

6.2 Oil Released by Southwest Royalties

Because soil samples did not detect regulated hydrocarbons (BTEX) from either the surface or at depths up to 6 feet below the surface, we conclude that the mass of oil released was removed during the vacuuming on September 16. These data also permit a conclusion that historic releases have not created a significant impact from hydrocarbons at the site.

6.3 Step 3 -Monitor Response to Pumping and Reporting to NMOCD

On Sept. 16, 2008, Southwest Royalties removed about 350 barrels of fluid. Observers estimated that the removed fluid was composed of 275 barrels of produced water, 10 barrels of oil and 65 barrels of rain water. Appendix D presents information and calculations that support a conclusion that about 200 barrels of produced water were removed by vacuuming. This volume removed corresponds to a chloride masse of 3,778 kg. Appendix D also supports a conclusion that the 2008 event released about 200 barrels of produced water.

Records show that the contractor removed a total of 5,060 yards of soil from the playa floor over an area of about 78,400 square feet. This corresponds to an average depth of excavation of 1.7 feet. However, as noted above, the depth of excavation was greater in the eastern, central and southern sectors than to the north and west. The chloride mass of the excavated volume was calculated using the samples from the appropriate depths at each sampling location and an assumed volumetric moisture content of 0.225. This moisture content is less than saturated contents for these soil types (0.42 -0.37) and is conservative. The resultant chloride mass removed is computed as 7,723 kilograms (See Appendix D).

Table 2 presents a summary of all chloride mass introduced to and removed from the playa. The mass of chloride removed through vacuuming and excavation is most probably 275% of the chloride mass introduced to the playa by the Southwest Royalties release.

Table 2 Net Chloride Balance in Playa

	Most Probable Values	Units
Chloride Indroduced to Playa	218.4	barrels
	4,167	kg
Chloride Vacuumed from Playa	198	barrels
	3,778	kg
Chloride Excavated from Playa	405	barrels
	7,723	kg
Total Chloride Removed from Playa	603	barrels
	11,501	kkg
Percent of Chloride Removed from Playa Compared with Chloride Introduced to Playa	276%	
Net Balance	-384.4	barrels
	-7,334	kg

BS

6.4 Origin of Chloride in Deep Playa Samples

The size of the scar adjacent to the pipeline serving API 30-025-21038 in the various historic aerial photographs strongly suggest that between 1967 and 1992, two releases of produced water from the pipeline servicing API 30-025-21038 reached the playa floor before the use of the pipeline was abandoned. Precipitation events since this time have carried additional chloride and soil from the release area to the playa floor, about 300 feet to the northeast of the pipeline.

The pipeline now operated by Southwest Royalties was installed along the east-southeast side of the playa between 1955 and 1971. None of the six historical aerial photos (1955, 1971, 1974, 1996-1998, and 2005) show evidence of a release entering the playa from its eastern side. That is, there is no other historic evidence of a release from the Southwest Royalties pipeline into the playa in addition to the September 2008 event described here.

7.0 CONCLUSIONS AND RECOMMENDATIONS

Most probably the amount of chloride released to the playa by Southwest Royalties is 4,167 kg (218 bbl).

Southwest Royalties removed a mass of chloride equal to about 600 barrels of produced water, which is about 3 times (276 %) of what was introduced during the 2008 event.

Samples taken from depths up to 3-feet below the current playa floor demonstrate a mass of 28,561 kg of chloride (1,497 bbl) remain in this depth interval. All of this chloride originated from historic pipeline releases. This pipeline is not and never was part of the Southwest Royalties operations or part of the 1997 acquisition of operating wells.

IMMATERIAL SOUTHWEST ROYALTIES IS LEASE HOLDER OF RECORD AND ASSUMES ALL RESPONSIBILITY

Because Southwest Royalties removed more chloride than was released during the September 2008 release, no further action is required on the part of Southwest Royalties.

INCORRECT

Because no BTEX was detected in any soil sample from either the surface or at depths up to 6 feet below the original surface, we conclude that there is no significant impact from hydrocarbons at the site.

The chloride mass in the playa may or may not pose a threat to fresh water. As a voluntary effort, Southwest Royalties will:

WRONG CONCLUSION

1. Install a 4-inch diameter monitoring well about 100 feet down gradient (south-southeast) of the playa.
2. Collect one set of ground water samples from this well for laboratory analysis of TDS, regulated hydrocarbons and major cations and anions.
3. Collect one set of surface water samples from the playa for laboratory analysis of TDS, regulated hydrocarbons and major cations and anions
4. Provide the results of the laboratory analyses to NMOCD and the successor company of Coastal Oil.

Plates

R.T. Hicks Consultants, Ltd.
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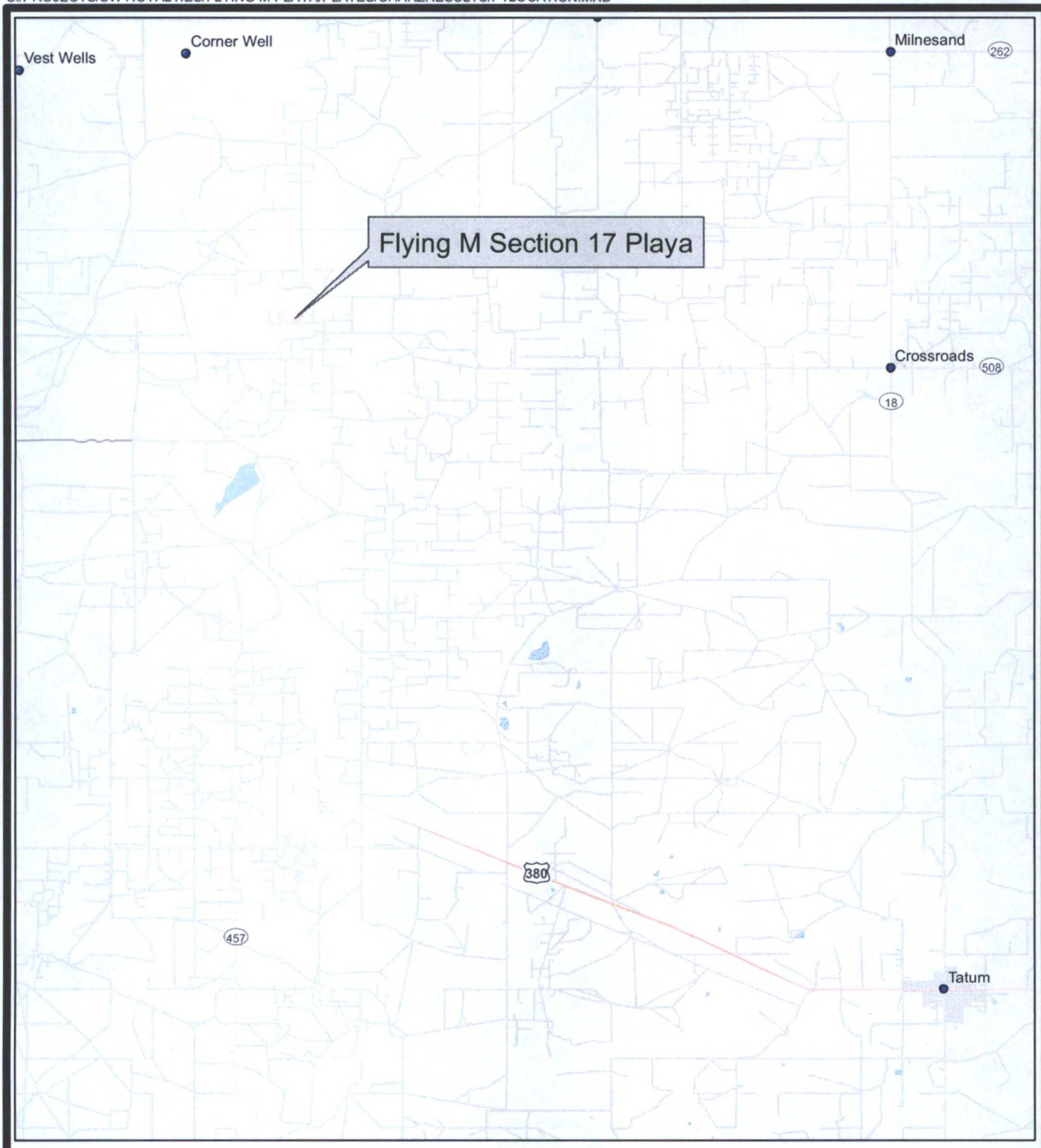
Albuquerque, NM 87104

S:/PROJECTS/SW ROYALTIES/FLYING M PLAYA/PLATES/CHARZRESULTS/P1LOCATION.MXD



R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Location Relative to Tatum, NM	Plate 1
	Southwest Royalties: Flying M Section 17 Playa	Nov. 2010

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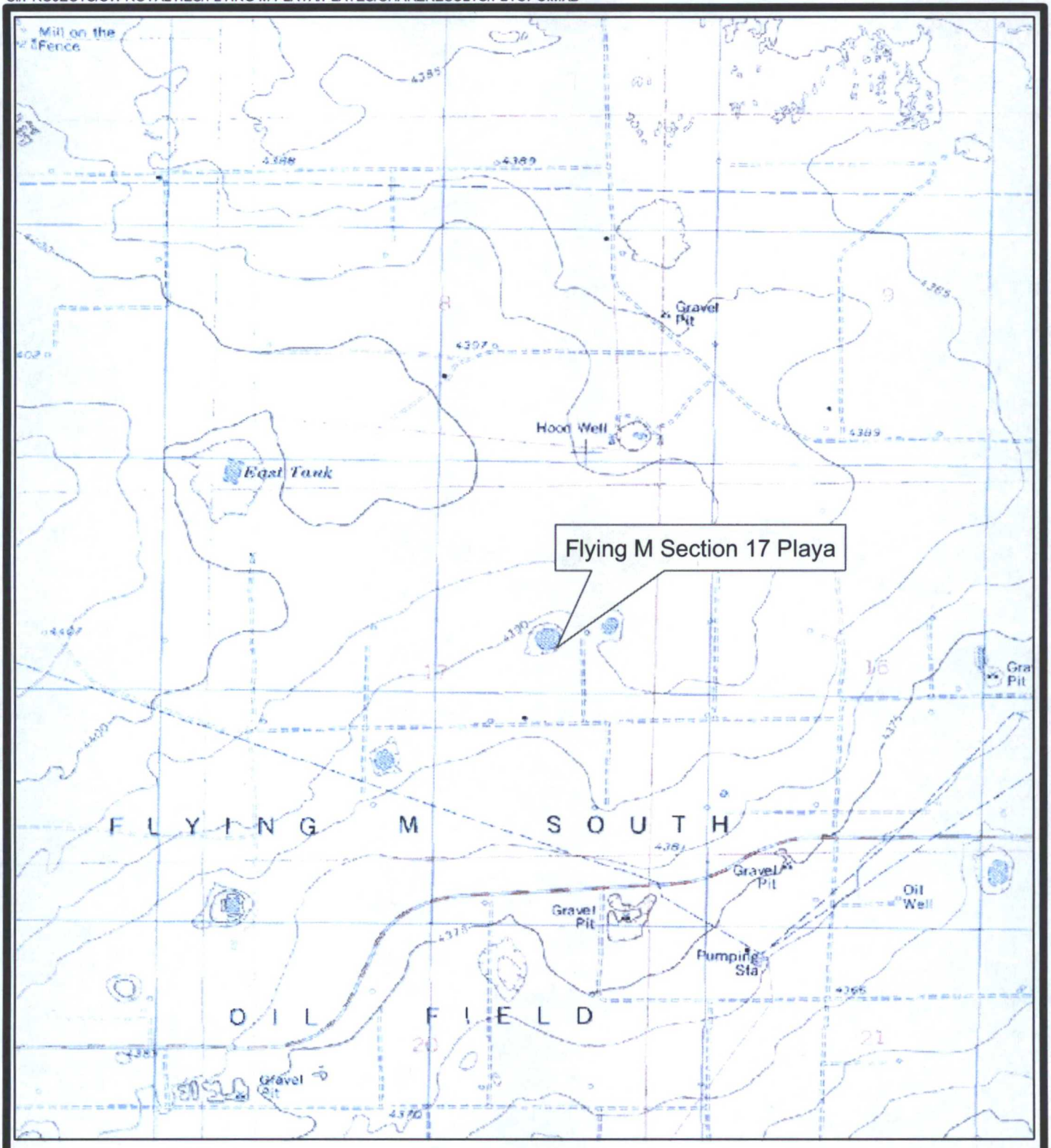

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Topographic Map	Plate 2
	Southwest Royalties: Flying M Section 17 Playa	Nov. 2010

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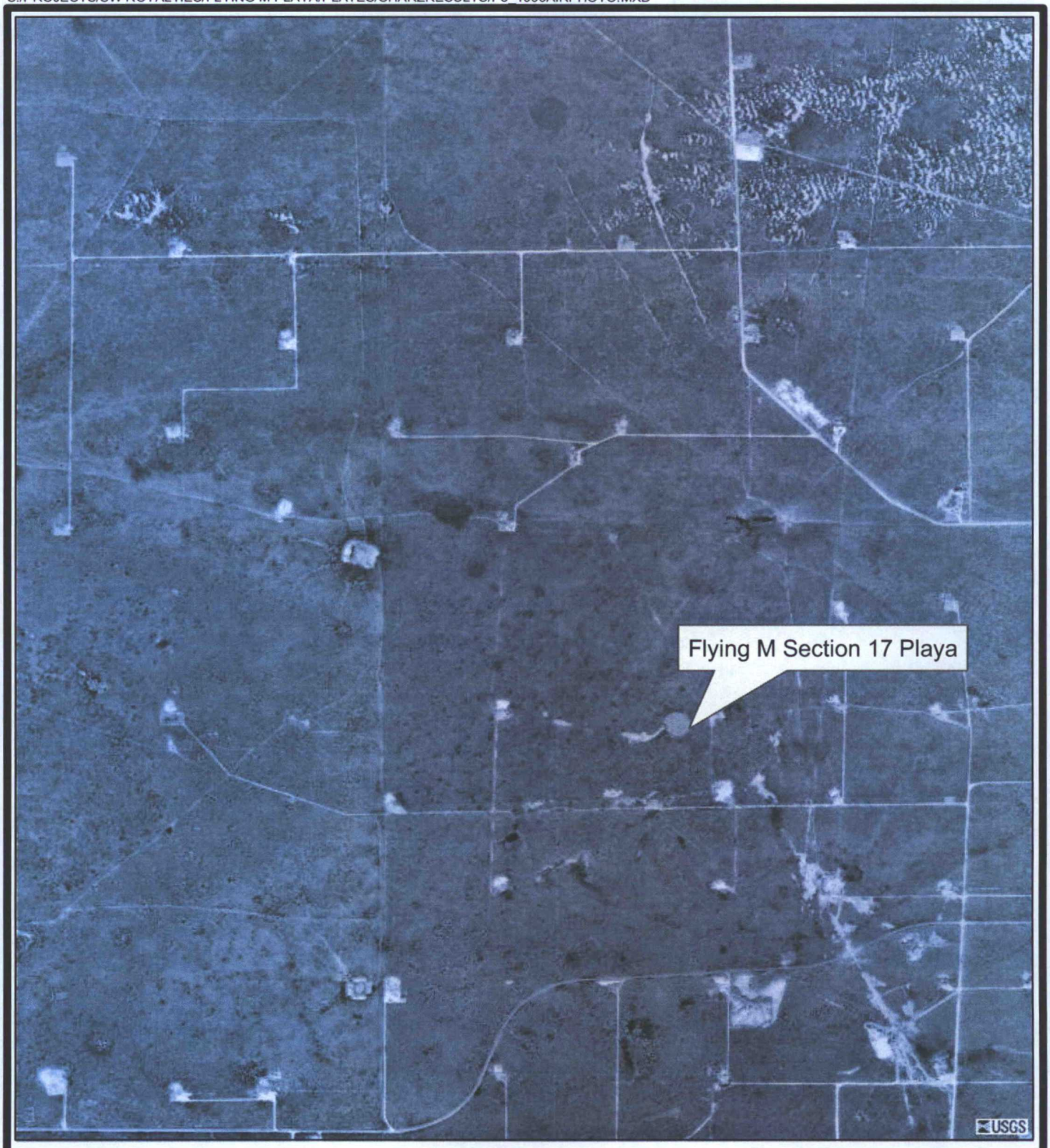

N
W E
S

0 1,000 2,000
Feet

R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	1996 USGS Aerial Photograph	Plate 3
	Southwest Royalties: Flying M Section 17 Playa	Nov. 2010

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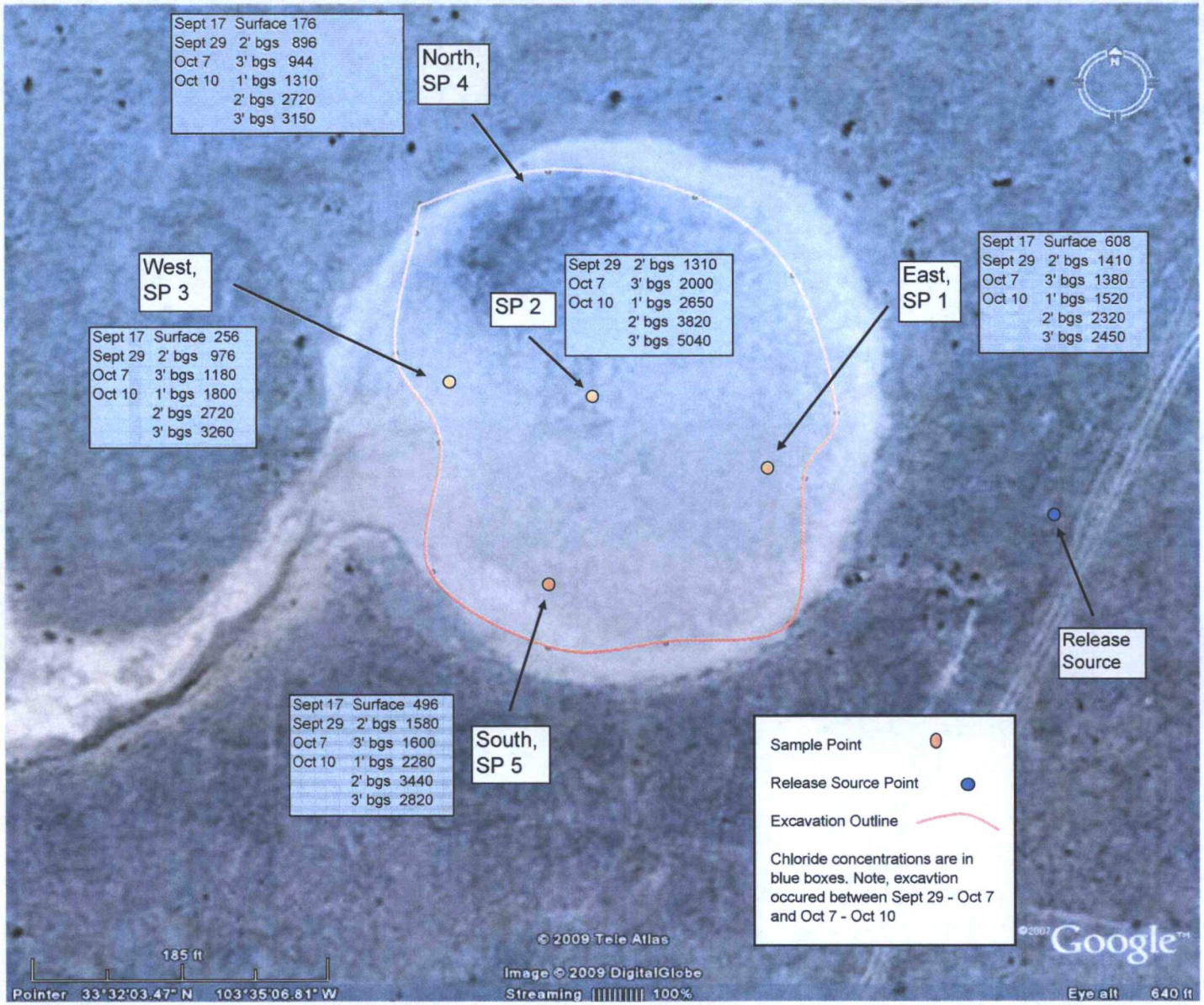
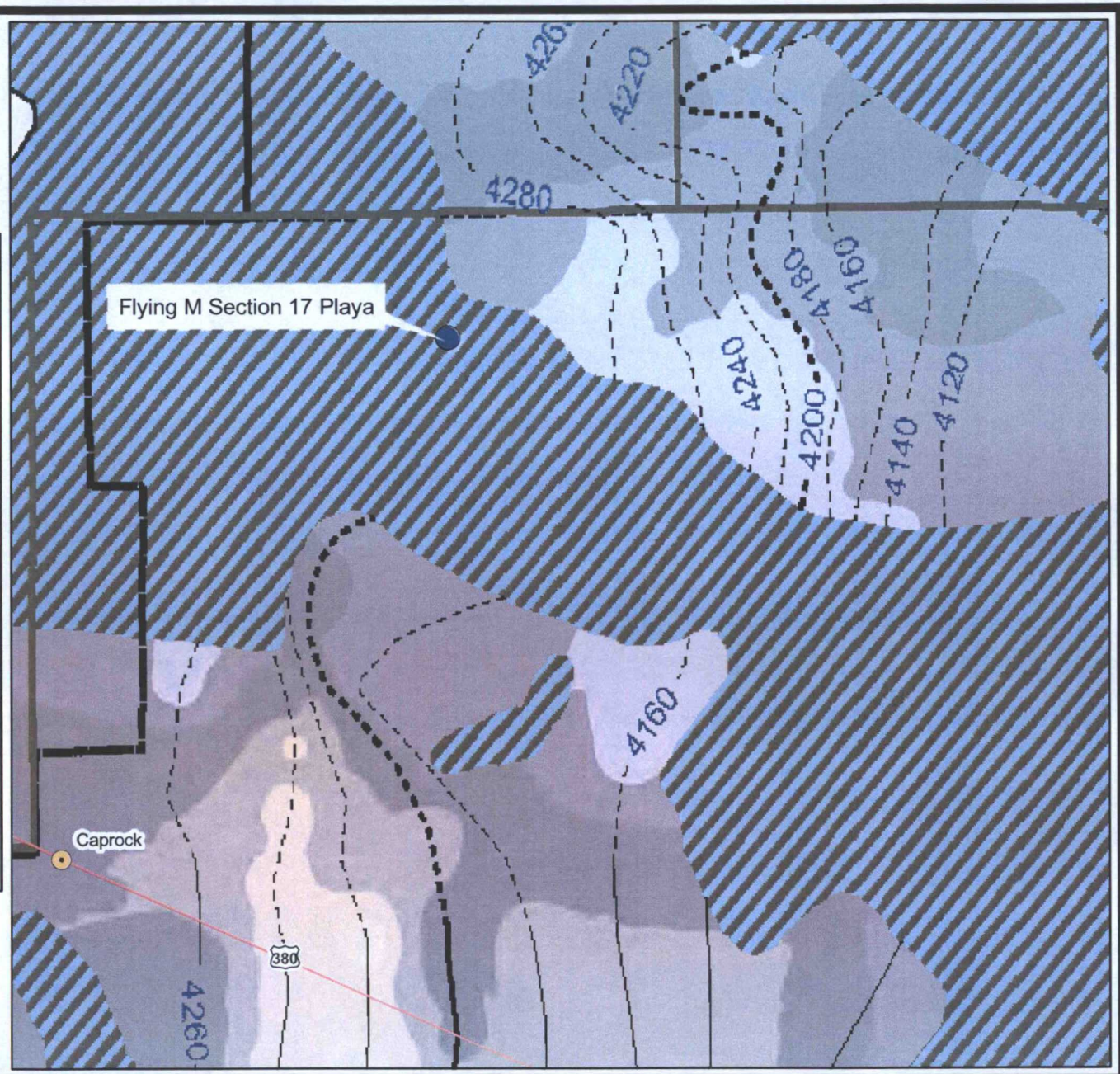


R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 505-266-5004	**Flying M Section 17 Playa**	**Plate 4**
	Southwest Royalties	**November 2010**



EXPLANATION

Saturated Thickness, in feet

2007

0.1	100.1–20
0.2–20	120.1–140
20.1–40	140.1–160
40.1–60	160.1–180
60.1–80	180.1–200
80.1–100	

Area of variable or no saturation

3700 APPROXIMATE WATER-TABLE CONTOUR– Shows altitude of water-level; dashed where approximate. Contour interval 20 ft; North American Vertical Datum of 1988 (NAVD 88).

Source: USGS Scientific Map 3044
(Tillery, A. 2008)

N
W E
S

0 1.5 3
Miles

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Saturated Thickness and Potentiometric Surface (2007) | Plate 5

Southwest Royalties: Flying M Section 17 Playa | Nov. 2010

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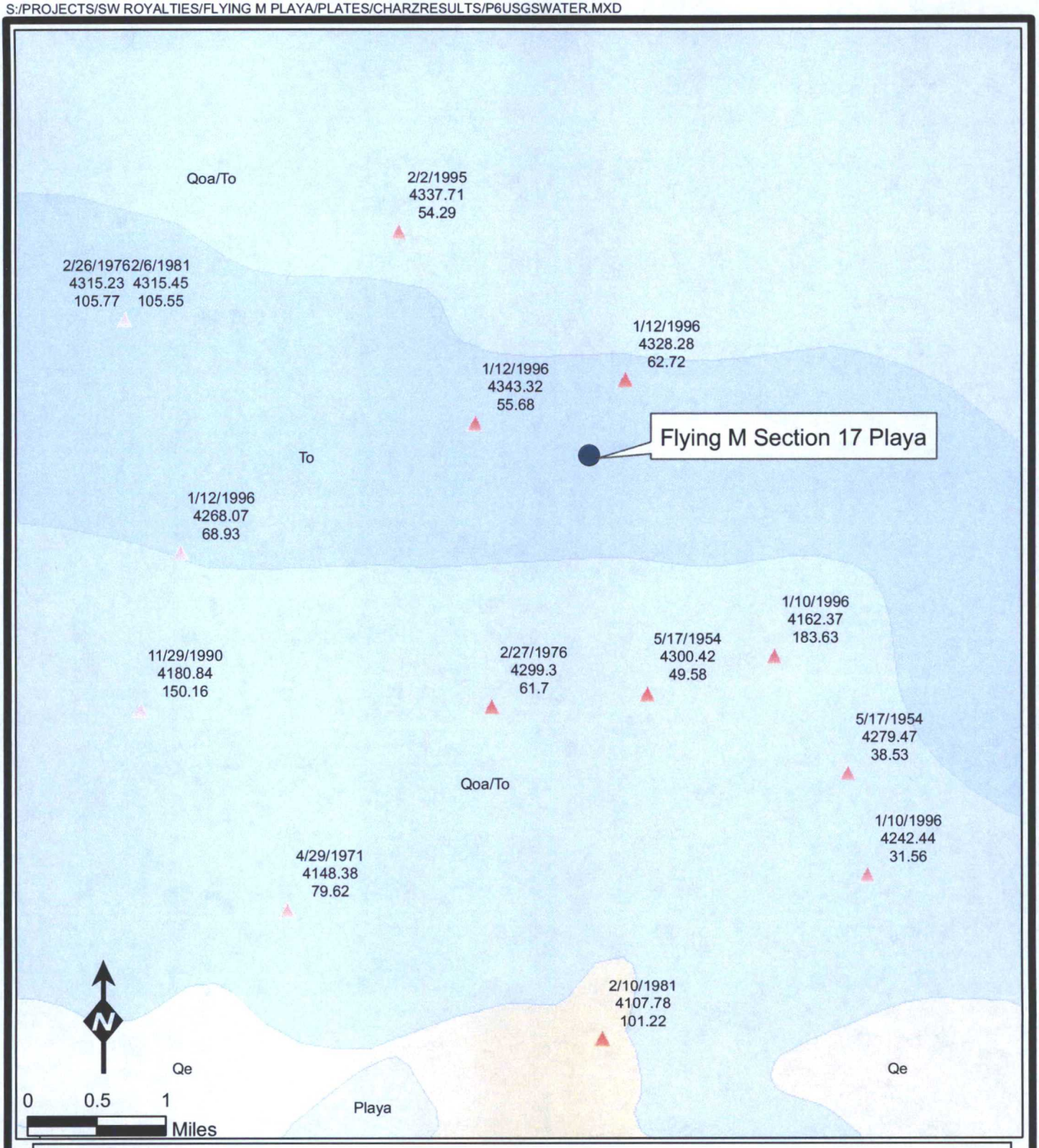

Explanation

USGS gauging well

Date
Groundwater elevation
Depth to Water

Geologic Map

Map Unit, Description

- Playa, Playa Deposits
- Qe, Quaternary-Eolian Deposits
- Qoa/To, Quaternary-Older Alluvial Deposits/Ogalalla
- Qp, Quaternary-Piedmont Alluvial 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	USGS Ground Water Data and Geologic Map	Plate 6
	Southwest Royalties: Flying M Section 17 Playa	Nov. 2010

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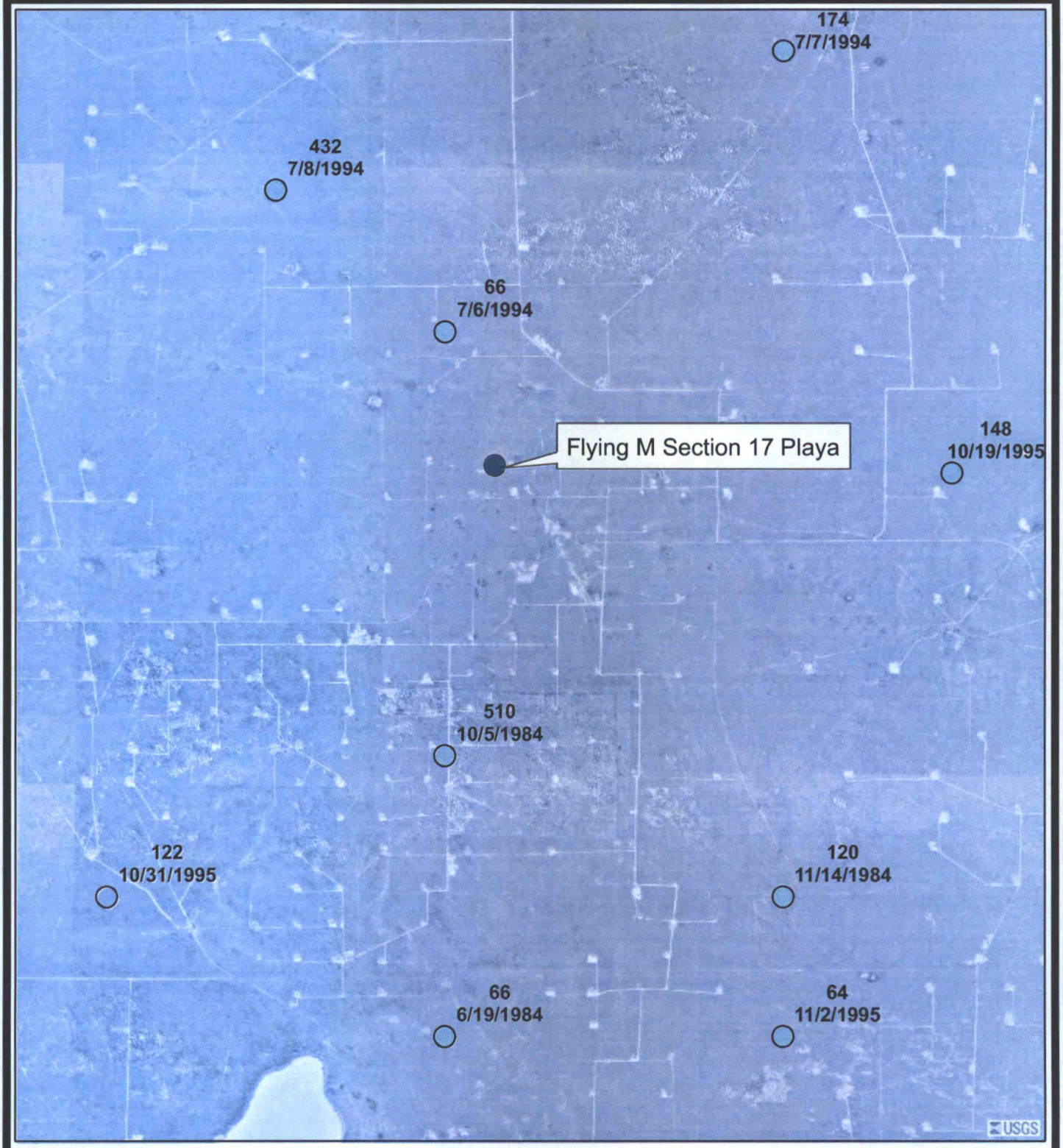


N

0 0.5 1
Miles

Explanation

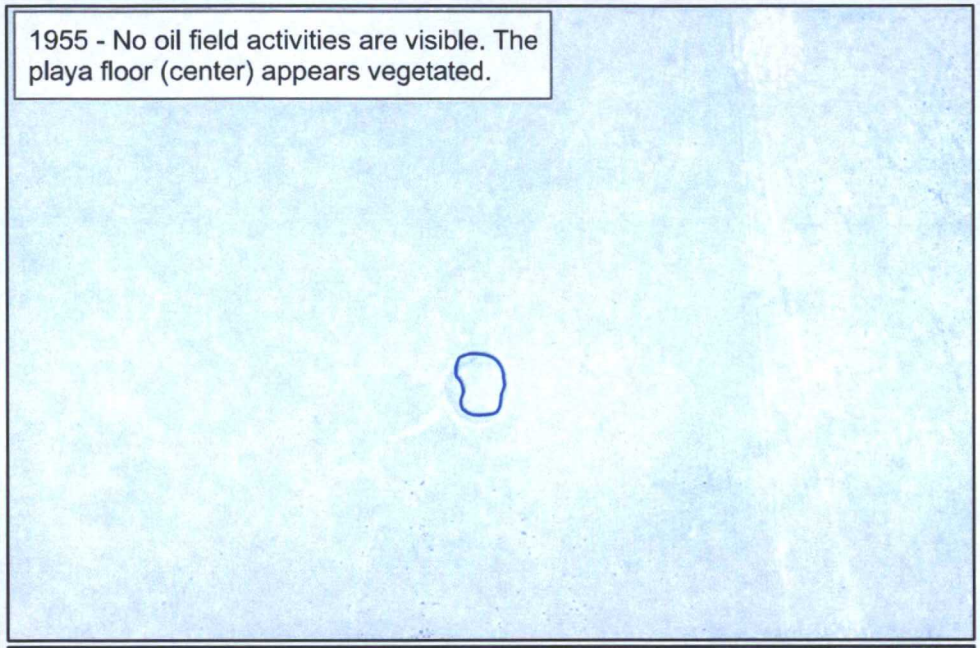
Use - Stock

Chloride (mg/L)
Date collected

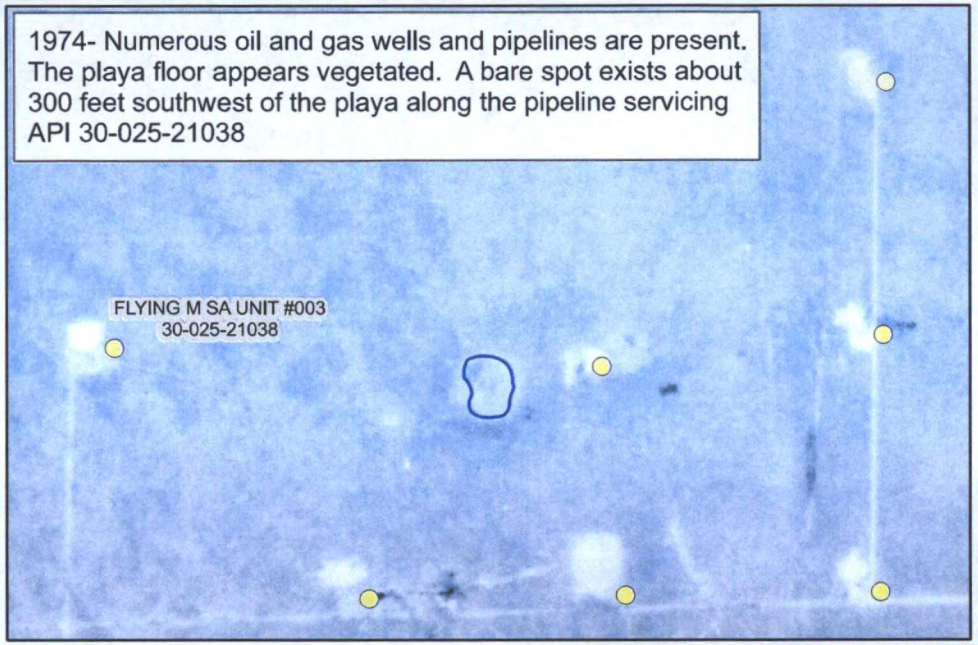
R.T. Hicks Consultants, Ltd 901 Rio Grande Blvd NW Suite F-142 Albuquerque, NM 87104 Ph: 505.266.5004	Dissolved Chloride in Ground Water (PTTC)	Plate 7
	Southwest Royalties: Flying M Section 17 Playa	Nov. 2010

4/1/2010

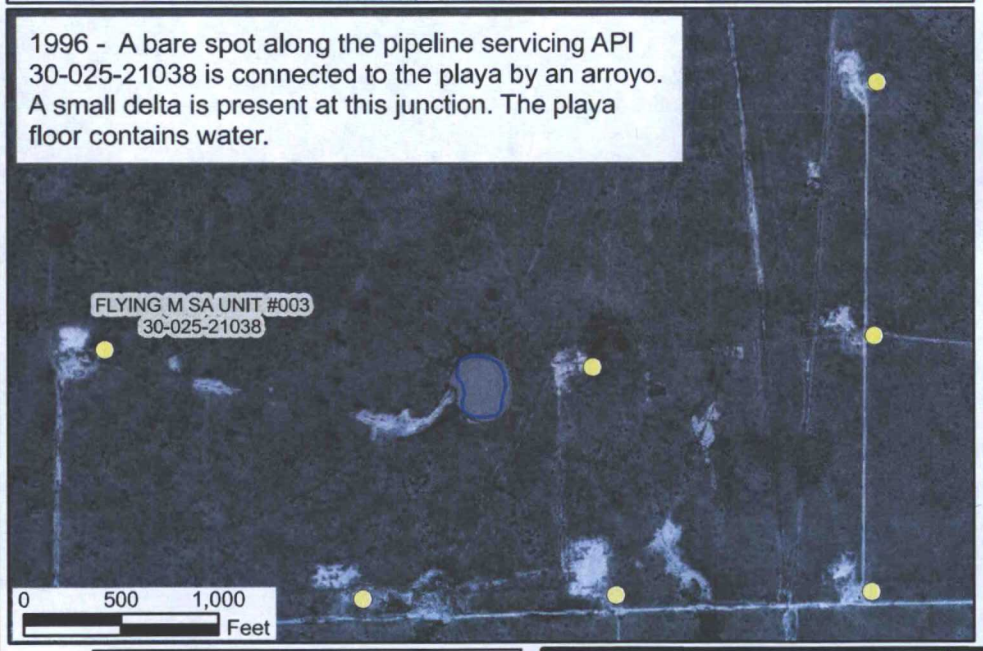
1955 - No oil field activities are visible. The playa floor (center) appears vegetated.



1974- Numerous oil and gas wells and pipelines are present. The playa floor appears vegetated. A bare spot exists about 300 feet southwest of the playa along the pipeline servicing API 30-025-21038



1996 - A bare spot along the pipeline servicing API 30-025-21038 is connected to the playa by an arroyo. A small delta is present at this junction. The playa floor contains water.



2005 - The playa floor appears unvegetated. The delta has increased in size.

N

Explanation

- Outline of playa excavation
- Oil/gas well listed in OCD database

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Historic Aerial Photographs
Clockwise from upper left: 1955, 1974, 1996, 2005)

Plate 8

Southwest Royalties, Inc: Flying M Section 17 Playa

Nov. 2010

S:/PROJECTS/SW ROYALTIES/FLYING M PLAYA/PLATES/CHARZRESULTS/P8_HISTORICTILES.MXD

4/1/2010

Appendix A

September 2008 C-141 Form

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

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-141
Revised October 10, 2003

Submit 2 Copies to appropriate District Office in accordance with Rule 116 on back side of form

Release Notification and Corrective Action

OPERATOR

☒ Initial Report ☐ Final Report

Name of Company Southwest Royalties, Inc.	Contact Dawn Howard
Address 6 Desta Drive, Ste 2100	Telephone No. 432/688-3267
Facility Name Flying M San Andres Unit	Facility Type Buried line closest to Flying M #61 & #51 (wells in Section 16 but no active wells in Section 17 where spill occurred

Surface Owner State of NM	Mineral Owner State of NM	Lease No. NM 058102

LOCATION OF RELEASE

Unit Letter	Section	Township	Range	Feet from the	North/South Line	Feet from the	East/West Line	County
F	17	9S	33E	~ 660	S	~ 660	E	LEA

Latitude _____ Longitude _____

NATURE OF RELEASE

Type of Release Oil & Produced Water	Volume of Release 285 Bbls	Volume Recovered 350 Bbls
Source of Release Buried Line	Date and Hour of Occurrence 9/13/08 Saturday Relief Pumper	Date and Hour of Discovery noon 9/15/08
Was Immediate Notice Given? ☒ Yes ☐ No ☐ Not Required	If YES, To Whom? Maxie Browne NMOCD	
By Whom? Mr. Terry Mabrey	Date and Hour 2 p.m. 9/15/08	
Was a Watercourse Reached? ☐ Yes ☒ No	If YES, Volume Impacting the Watercourse.	

If a Watercourse was Impacted, Describe Fully.*

Describe Cause of Problem and Remedial Action Taken.*
A dresser sleeve on a buried line eroded, burst and fluid escaped to surface and mixed with pooled rain water. Area affected – approximately 500' X 500'. Estimated volume at 10 Bbls oil + 275 Bbls produced water. Vacuumed 350 Bbls fluid – additional fluid recovered was rain water pooled on surface.

Note on location of leak is in Section 17- the nearest active wells are our #61 & 51 in Section 16.

Describe Area Affected and Cleanup Action Taken.*

Vacuuming oil 9/16/08. Still Accessing conditions and requesting the assistance of an environmental services expert.

I hereby certify that the information given above is true and complete to the best of my knowledge and understand that pursuant to NMOCD rules and regulations all operators are required to report and/or file certain release notifications and perform corrective actions for releases which may endanger public health or the environment. The acceptance of a C-141 report by the NMOCD marked as "Final Report" does not relieve the operator of liability should their operations have failed to adequately investigate and remediate contamination that pose a threat to ground water, surface water, human health or the environment. In addition, NMOCD acceptance of a C-141 report does not relieve the operator of responsibility for compliance with any other federal, state, or local laws and/or regulations.

Signature: Dawn Howard	OIL CONSERVATION DIVISION
Printed Name: Dawn M. Howard	Approved by District Supervisor:
Title: Operations Assistant	Approval Date: / Expiration Date:
E-mail Address: Dhoward@claytonwilliams.com	Conditions of Approval: / Attached ☐
Date: 9/16/08 Phone: 432/688-3267	

* Attach Additional Sheets If Necessary

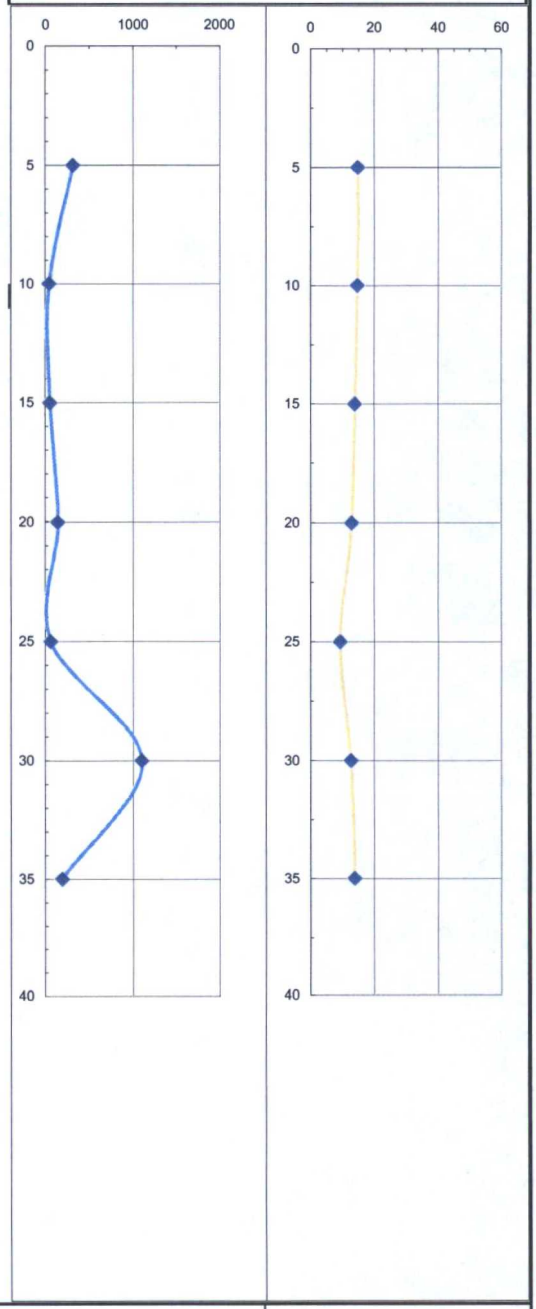
Appendix B

Lithologic Log for Nearby Monitor Well

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

Driller:	Harrison Cooper Drilling		**Client:**	**Boring ID:**
Drilling Method:	Air Rotary		Southwest Royalties	
Start Date:	11/17/2009		**Project Name:**	**MW-1**
End Date:	11/17/2009		Flying M Tank Battery #2	
Logger:	David Hamilton		**Location:**	
			Section 21, Unit D, T9S, R33E	

Depth (feet)	Description	Lithology	Comments
0.0	Surface, tan, 0 - 1.0 feet,		
1.0	F-g sand, silt, some caliche, dark red, 1.0 - 1.5 feet		
2.0	Fine grained-sand, silt, caliche, white to light tan, 1.5 - 6 feet		
3.0			
4.0			
5.0			
6.0	Fine grained-sand, silt, hard caliche, white to light tan, 6-12 feet		White dust from drilling, cuttings composed of caliche chips
7.0			
8.0			
9.0			
10.0	Silt, very fine-grained sand, caliche, light tan to white, 12-23 feet		
11.0			
12.0			
13.0			
14.0			
15.0			
16.0			
17.0			
18.0			
19.0			
20.0			
21.0			
22.0			
23.0	Very fine-grained sand, silt, tan, 22-27 feet		
24.0			
25.0			
26.0			
27.0	Very fine-grained sand, silt, some caliche, tan, 27-30 feet		
28.0			
29.0			
30.0	Very fine-grained sand, silt, tan, 30-33 feet		
31.0			
32.0			
33.0	Fine-grained sand, silt, slight clay, light tan, 33-50 feet		Moist. Small stringers could be rolled.
34.0			
35.0			
36.0			
37.0			
38.0			
39.0			
40.0			
41.0			
42.0			
43.0			
44.0			
45.0			
46.0			
47.0			
48.0			
49.0			
50.0	Clay, red, 50-51 feet		



R.T. Hicks Consultants, Ltd
901 Rio Grande Blvd NW Suite F-142
Albuquerque, NM 87104
505-266-5004

Southwest Royalties	**Plate 4**
Flying M Tank Battery	**February 2010**

Appendix C

Laboratory Reports

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

CARDINAL LABORATORIES

101 East Marland, Hobbs, NM 88240
(575) 393-2326 Fax (575) 393-2476

Page ____ of ____

Company Name:	Hungry Horse Environmental Services
Project Manager:	Vernon K. Black
Address:	PO Box 1058
City:	Hobbs
State:	NM
Zip:	88241
Phone #:	575-393-3386
Fax #:	575-391-4585
Project #:	
Project Owner:	Southwest Royalties
Project Name:	S-1 61 Flying M
Project Location:	Lea Co., NM
Sampler Name:	Vernon K. Black

BILL TO

P.O. #:	
Company:	SAME
Attn:	
Address:	
City:	
State:	Zip:
Phone #:	
Fax #:	

ANALYSIS REQUEST

FOR LAB USE ONLY Lab I.D.	Sample I.D.	# CONTAINERS	GRAB OR COMP	MATRIX: GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER	PRESERV: ACID/BASE	ICE	COOL	OTHER	SAMPLING: DATE	TIME	Chlorides	BTEX	TPH 8015
	Initial Sample Surface																	
	North	1	G			X								1/5/04	12:00	1	1	1
	South	1	G			X												
	East	1	G			X												
	West	1	G			X												

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 the 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 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.

Terms and Conditions: Interest will be charged on all accounts not paid within 30 days after the date of invoice. There will be a minimum charge of $30.00 on all returned checks and a service charge of 1.5% per month on any unpaid balance. All accounts are due and payable in full within 30 days from the date of invoice. You will be responsible for any collection cost incurred, including attorney's fees.

Sampler Relinquished:	Date:	Received By:	
	Time:		
Relinquished By:	Date: 1/5/04	Received By:	
	Time: 8:00		
Delivered By: (Circle One)	Temp.	Sample Condition: Cool Yes / No; Intact Yes / No	CHECKED BY: (Initials)
Sampler - UPS - Bus - Other:			

Phone Result: ☐ No Add'l Phone #:
Fax Result: ☐ No Add'l Fax #:
REMARKS:

† Cardinal cannot accept verbal changes. Please fax written changes to 575-393-2476

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
HUNGRY HORSE ENVIRONMENTAL SERVICES
ATTN: VERNON K. BLACK
P.O. BOX 1058
HOBBS, NM 88241
FAX TO: (575) 391-4585

Receiving Date: 09/17/08
Reporting Date: 09/19/08
Project Owner: SOUTHWEST ROYALTIES
Project Name: 5-1 6-1 FLYING M
Project Location: LEA COUNTY, NM

Sampling Date: 09/17/08
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: CK
Analyzed By: ZL

LAB NUMBER	SAMPLE ID	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYL BENZENE (mg/kg)	TOTAL XYLENES (mg/kg)
ANALYSIS DATE		09/18/08	09/18/08	09/18/08	09/18/08
H15939-1	NORTH	<0.050	<0.050	<0.050	<0.150
H15939-2	SOUTH	<0.050	<0.050	<0.050	<0.150
H15939-3	EAST	<0.050	<0.050	<0.050	<0.150
H15939-4	WEST	<0.050	<0.050	<0.050	<0.150
Quality Control		0.054	0.046	0.047	0.161
True Value QC		0.050	0.050	0.050	0.150
% Recovery		108	92.0	94.0	107
Relative Percent Difference		0.6	0.7	0.6	1.3

METHOD: EPA SW-846 8021B

TEXAS NELAP CERTIFICATION T104704398-08-TX FOR BENZENE, TOLUENE, ETHYL BENZENE, AND TOTAL XYLENES.

Chemist

Date

H15939-8 HHC

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
HUNGRY HORSE ENVIRONMENTAL SERVICES
ATTN: VERNON K. BLACK
P.O. BOX 1058
HOBBS, NM 88241
FAX TO: (575) 391-4585

Receiving Date: 09/17/08
Reporting Date: 09/18/08
Project Owner: SOUTHWEST ROYALTIES
Project Name: 5-1 6-1 FLYING M
Project Location: LEA COUNTY, NM

Sampling Date: 09/17/08
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: CK
Analyzed By: AB/TR

LAB NUMBER	SAMPLE ID	GRO (C_6-C_{10}) (mg/kg)	DRO (>C_{10}-C_{28}) (mg/kg)	Cl* (mg/kg)
ANALYSIS DATE		09/17/08	09/17/08	09/18/08
H15939-1	NORTH	<25.0	<25.0	176
H15939-2	SOUTH	<25.0	<25.0	496
H15939-3	EAST	<25.0	<25.0	608
H15939-4	WEST	<25.0	<25.0	256
Quality Control		452	420	490
True Value QC		500	500	500
% Recovery		90.4	84.0	98.0
Relative Percent Difference		10.3	2.8	2.0

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

Date

H15939 TCL HHE

CARDINAL LABORATORIES

101 East Marland, Hobbs, NM 88240
(575) 393-2326 Fax (575) 393-2476

Page ____ of ____

Company Name:	Hungry Horse Environmental Services	**BILL TO**	
Project Manager:	Vernon K. Black	P.O. #:	
Address:	PO Box 1058	Company:	SAME
City:	Hobbs	State: NM Zip: 88241	Attn:
Phone #:	575-393-3386	Fax #: 575-391-4585	Address:
Project #:		Project Owner: Southwest Royalties	City:
Project Name:	51 61 Flying M Lease		State: Zip:
Project Location:			Phone #:
Sampler Name:	Vernon K. Black		Fax #:

ANALYSIS REQUEST: Chlorides | TPH 8015 | BTEX

FOR LAB USE ONLY													
Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP	# CONTAINERS	MATRIX: GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER	PRESERV: ACID/BASE	ICE / COOL	OTHER	SAMPLING: DATE	TIME
H11051-1	SP #1 2' BGS	G	1				X						2/1/11	1400
-2	SP #2 3' BGS	G	1				X						2/1/11	1410
-3	SP #3 4' BGS	G	1				X						2/1/11	1420
-4	SP #4 5' BGS													
-5	SP #5 6' BGS													

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Terms and Conditions: Interest will be charged on all accounts not paid within 30 days after the date of invoice at the rate of 24% per annum from the date of invoice and all costs of collection, including attorney's fees.

Sampler Relinquished:	Date:	Received By:	Phone Result: ☐	No	Add'l Phone #:
	Time:		Fax Result: ☐	No	Add'l Fax #:
Relinquished By:	Date: 2/1/11	Received By:	REMARKS: Email CC vernon@hungryhorse.net		
	Time: 1430				
Delivered By: (Circle One)	Temp:	Sample Condition: Cool ☐ Yes ☐ No, Intact ☐ Yes ☐ No	CHECKED BY: (Initials)		
Sampler - UPS - Bus - Other:					

† Cardinal cannot accept verbal changes. Please fax written changes to 575-393-2476.

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
HUNGRY HORSE ENVIRONMENTAL SERVICES
ATTN: VERNON K. BLACK
P.O. BOX 1058
HOBBS, NM 88241
FAX TO: (575) 391-4585

Receiving Date: 09/29/08
Reporting Date: 09/30/08
Project Owner: SOUTHWEST ROYALTIES
Project Name: S1 61 FLYING M LINE
Project Location: NOT GIVEN

Analysis Date: 09/30/08
Sampling Date: 09/29/08
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: HM

LAB NO.	SAMPLE ID	Cl^- (mg/kg)
H16003-1	SP #1 2' BGS	1,410
H16003-2	SP #2 :2' BGS	1,310
H16003-3	SP #3 2' BGS	976
H16003-4	SP #4 2' BGS	896
H16003-5	SP #5 2' BGS	1,580

Quality Control	500
True Value QC	500
% Recovery	100
Relative Percent Difference	< 0.1

METHOD: Standard Methods 4500-Cl'B
Note: Analyses performed on 1:4 w:v aqueous extracts.

Chemist

Date

H16003 HHE

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
HUNGRY HORSE ENVIRONMENTAL SERVICES
ATTN: VERNON K. BLACK
P.O. BOX 1058
HOBBS, NM 88241
FAX TO: (575) 391-4585

Receiving Date: 09/29/08
Reporting Date: 10/01/08
Project Owner: SOUTHWEST ROYALTIES
Project Name: S1 61 FLYING M LINE
Project Location: NOT GIVEN

Sampling Date: 09/29/08
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: ML
Analyzed By: AB/ZL

LAB NO.	SAMPLE ID	GRO (C_6-C_{35}) (mg/kg)	DRO (>C_{12}-C_{28}) (mg/kg)	BENZENE (mg/kg)	TOLUENE (mg/kg)	ETHYL BENZENE (mg/kg)	TOTAL XYLENES (mg/kg)
ANALYSIS DATE		09/30/08	09/30/08	09/30/08	09/30/08	09/30/08	09/30/08
H16003-1	SP #1 @ 2' BGS	<25.0	<25.0	<0.050	<0.050	<0.050	<0.050
H16003-2	SP#2 @ 2' BGS	<25.0	<25.0	<0.050	<0.050	<0.050	<0.050
H16003-3	SP#3 @ 2' BGS	<25.0	<25.0	<0.050	<0.050	<0.050	<0.050
H16003-4	SP#4 @ 2' BGS	<25.0	<25.0	<0.050	<0.050	<0.050	<0.050
H16003-5	SP#5 @ 2' BGS	<25.0	<25.0	<0.050	<0.050	<0.050	<0.050
Quality Control		566	466	0.052	0.046	0.048	0.157
True Value QC		500	500	0.050	0.050	0.050	0.150
% Recovery		113	97.2	104	96.0	96.0	105
Relative Percent Difference		13.1	11.1	13.5	1.6	1.0	5.5

METHODS: TPH GRO & DRO - EPA SW-846 8015 M; BTEX - SW-846 8021B.

TEXAS NELAP CERTIFICATION T104704398-08-TX FOR BENZENE, TOLUENE, ETHYL BENZENE, AND TOTAL XYLENES.

Chemist

Date

H16003 BTEX8015 HHE

CARDINAL LABORATORIES

101 East Marland, Hobbs, NM 88240
(575) 393-2326 Fax (575) 393-2476

Page ____ of ____

Company Name:	Hungry Horse Environmental Services
Project Manager:	Vernon K. Black
Address:	PO Box 1058
City:	Hobbs
State:	NM
Zip:	88241
Phone #:	575-393-3386
Fax #:	575-391-4585
Project #:	
Project Owner:	Southwest Royalties
Project Name:	51 61 Flying M Line
Project Location:	Lea County NM
Sampler Name:	Vernon K. Black

BILL TO

P.O. #:	
Company:	SAME
Attn:	
Address:	
City:	
State:	Zip:
Phone #:	
Fax #:	

ANALYSIS REQUEST

Chlorides

Lab I.D.	Sample I.D.	# CONTAINERS	GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER	ACID/BASE	ICE	COOL	OTHER	DATE	TIME
	SP #1 3' BGS	1			X								10CT	1330
	SP #2													
	SP #3													
	SP #4													
	SP #5													

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Terms and Conditions: Interest will be charged on all accounts not paid within 30 days past the date of the first invoice at the rate of 1.5% per month. Fee for notarized affidavit is $25.00. Any additional costs of collection, including attorney's fees.

Sampler Relinquished:	Date:	Received By:	
	Time:		
Relinquished By:	Date: 10CT09	Received By:	
	Time: 1540		
Delivered By: (Circle One)	Temp.	Sample Condition: Cool [ ] Yes [ ] No; Intact [ ] Yes [ ] No	CHECKED BY: (Initials)
Sampler - UPS - Bus - Other:			

Phone Result:	[ ]	No	Add'l Phone #:
Fax Result:	[ ]	No	Add'l Fax #:
REMARKS:			

† Cardinal cannot accept verbal changes. Please fax written changes to 575-393-2476.

CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
HUNGRY HORSE ENVIRONMENTAL SERVICES
ATTN: VERNON K. BLACK
P.O. BOX 1058
HOBBS, NM 88241
FAX TO: (575) 391-4585

Receiving Date: 10/07/08
Reporting Date: 10/08/08
Project Owner: SOUTHWEST ROYALTIES
Project Name: 5-1 6-1 FLYING M LINE
Project Location: LEA COUNTY, NM

Analysis Date: 10/08/08
Sampling Date: 10/07/08
Sample Type: SOIL
Sample Condition: INTACT
Sample Received By: ML
Analyzed By: HM

LAB NO	SAMPLE ID	Cl^- (mg/kg)
H16059-1	SP #1 3' BGS	1,380
H16059-2	SP #2 3' BGS	2,000
H16059-3	SP #3 3' BGS	1,180
H16059-4	SP #4 3' BGS	944
H16059-5	SP #5 3' BGS	1,600

Quality Control	490
True Value QC	500
% Recovery	98.0
Relative Percent Difference	2.0

METHOD: Standard Methods 4500-Cl B
Note: Analyses performed on 1:4 w:v aqueous extracts.

Chemist

Date

H16059 HHE

CARDINAL LABORATORIES

101 East Marland, Hobbs, NM 88240
(575) 393-2326 Fax (575) 393-2476

Company Name:	Hungry Horse Environmental Services
Project Manager:	Vernon K. Black
Address:	PO Box 1058
City:	Hobbs
State:	NM
Zip:	88241
Phone #:	575-393-3386
Fax #:	575-391-4585
Project #:	
Project Owner:	Sid Hurst Royalty
Project Name:	Finley ML #2
Project Location:	Lea County, NM
Sampler Name:	Vernon K. Black

BILL TO

P.O. #:	
Company:	SAME
Attn:	
Address:	
City:	
State:	Zip:
Phone #:	
Fax #:	

ANALYSIS REQUEST

Chlorides

FOR LAB USE ONLY Lab I.D.	Sample I.D.	# CONTAINERS	GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER	ACID/BASE	ICE / COOL	OTHER	DATE	TIME
H10089-1	Delineation Samples												
	Sp #1 1' BGS	1		X								10/1	0920
	2' BGS												
	3' BGS												
	Sp #2 1' BGS												
	2' BGS												
	3' BGS												
	Sp #3 1' BGS												
	2' BGS												
	3' BGS												

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Terms and Conditions: Interest will be charged on all accounts more than 30 days past due at the rate of 24% per annum from the original date of invoice and all costs of collection, including attorneys' fees.

Sampler Relinquished:	Date:	Received By:	
	Time:		
Relinquished By:	Date: 10/2/08	Received By:	
	Time: 1040		
Delivered By: (Circle One)	Temp.	Sample Condition: Cool [ ] Yes [ ] No; Intact [ ] Yes [ ] No	CHECKED BY: (Initials)
Sampler - UPS - Bus - Other:			

Phone Result: [ ] No Add'l Phone #:
Fax Result: [ ] No Add'l Fax #:
REMARKS:

† Cardinal cannot accept verbal changes. Please fax written changes to 575-393-2476

CARDINAL LABORATORIES

101 East Marland, Hobbs, NM 88240
(575) 393-2326 Fax (575) 393-2476

Company Name:	Hungry Horse Environmental Services
Project Manager:	Vernon K. Black
Address:	PO Box 1058
City:	Hobbs State: NM Zip: 88241
Phone #:	575-393-3386 Fax #: 575-391-4585
Project #:	Project Owner: Surfaceflies
Project Name:	Flying M Pit
Project Location:	Lea County, NM
Sampler Name:	Vernon K. Black

BILL TO

P.O. #:	
Company:	SAME
Attn:	
Address:	
City:	
State:	Zip:
Phone #:	
Fax #:	

ANALYSIS REQUEST

FOR LAB USE ONLY Lab I.D.	Sample I.D.	(G)RAB OR (C)OMP	# CONTAINERS	MATRIX: GROUNDWATER	WASTEWATER	SOIL	OIL	SLUDGE	OTHER	PRESERV: ACID/BASE	ICE / COOL	OTHER	SAMPLING: DATE	TIME
	Delivered on Sample Ice													
	S # 4 1' BGS	G	1			X					X		12-9-08	1430
	2' BGS													
	3' BGS													
	S # 5 1' BGS													
	2' BGS													
	3' BGS													

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Sampler Relinquished:	Date:	Received By:		
	Time:			
Relinquished By:	Date: 12-10-08	Received By:		
	Time: 1040			
Delivered By: (Circle One)	Temp.	Sample Condition: Cool [ ] Yes [ ] No	Intact [ ] Yes [ ] No	CHECKED BY: (Initials)
Sampler - UPS - Bus - Other:				

Phone Result:	[ ]	No	Add'l Phone #:
Fax Result:	[ ]	No	Add'l Fax #:
REMARKS:			

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CARDINAL LABORATORIES

PHONE (575) 393-2326 • 101 E. MARLAND • HOBBS, NM 88240

ANALYTICAL RESULTS FOR
HUNGRY HORSE ENVIRONMENTAL SERVICES
ATTN: VERNON K. BLACK
P.O. BOX 1058
HOBBS, NM 88241
FAX TO: (575) 391-4585

Receiving Date: 10/10/08
Reporting Date: 10/14/08
Project Owner: SOUTHWEST ROYALTIES
Project Name: FLYING M LINE
Project Location: LEA COUNTY, NM

Analysis Date: 10/14/08
Sampling Date: 10/10/08
Sample Type: SOIL
Sample Condition: COOL & INTACT
Sample Received By: AB
Analyzed By: HM

LAB NO.	SAMPLE ID	Cl^- (mg/kg)
H16089-1	SP #1 1' BGS	1,520
H16089-2	SP #1 2' BGS	2,320
H16089-3	SP #1 3' BGS	2,480
H16089-4	SP #2 1' BGS	2,880
H16089-5	SP #2 2' BGS	3,920
H16089-6	SP #2 3' BGS	5,040
H16089-7	SP #3 1' BGS	1,800
H16089-8	SP #3 2' BGS	2,720
H16089-9	SP #3 3' BGS	3,280
H16089-10	SP #4 1' BGS	1,310
H16089-11	SP #4 2' BGS	2,720
H16089-12	SP #4 3' BGS	3,160
H16089-13	SP #5 1' BGS	2,280
H16089-14	SP #5 2' BGS	3,440
H16089-15	SP #5 3' BGS	2,920
Quality Control		500
True Value QC		500
% Recovery		100
Relative Percent Difference		< 0.1

METHOD: Standard Methods 4500-ClB

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

Chemist

Date

H16089 HHE

Appendix D

Calculation of Chloride Input & Removal From the Playa

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

APPENDIX D: CALCULATION OF CHLORIDE INPUT AND REMOVAL FROM THE PLAYA

When data are not available, the calculations presented herein use assumptions that are conservative of ground water quality. Within this document, "conservative" is taken to mean that an assumption or calculation is constructed to overstate impacts to the environment. Therefore, by design, the calculations:

- Over estimate chloride mass which could have been released to the playa floor by the release and
- Under estimate chloride mass removed from the playa floor through the actions of Southwest Royalties.

CHLORIDE MASS OF THE RELEASE

The calculation of the maximum mass of chloride that could have been introduced to the playa floor uses greatest values of all unknown variables and the values of all known input data. While this is possible, it is not probable. The purpose of preparing this "worst case" estimate was to create an upper boundary to which we could compare the most probable scenario. The calculation of the most probable mass of chloride introduced to the playa floor uses the most probable values of unknown variables and the values of known variables.

Following is an explanation of the variables required to make these calculations and a discussion of their most probable values where applicable.

Time Duration of Release – The two wells serviced by the pipeline were put on testing facilities on Friday, September 12. The breach in the pipeline was discovered at noon Monday, September 15 and flow ceased. Prior to the test, no leaks were detected during daily inspections of the pipeline.

In the worst case calculation, the duration of the release was taken to be 3.2 days, the maximum possible length of time the line could have leaked (T_R in the calculation below in, [days]). This assumption requires that the pipeline began leaking at the beginning of the test.

Pipeline Flow Rate – The two wells (Numbers 051 and 061) produced a combined total of 175 barrels of produced water per day and 11 barrels of oil per day. These values were used in the calculation of the release volume. (FR_{PW} in the calculation below, [bbl/day])

Percentage of flow released from pipeline – The maximum possible amount that could have been released is 100% of the combined flow of wells numbered 051 and 061 over the course of 3.2 days, or 560 barrels. The "worst case" calculation uses this assumption. While the loss of 100% of the flow is theoretically possible, such a flow rate is inconsistent with the following facts:

- The mode of line failure was leakage at a rubber sleeve, not a rupture of the pipeline. A failure of this type is progressive rather than catastrophic in occurrence.
- Southwest Royalties production staff document that some flow continued to the destination tank battery through the pipeline. The volume that passed through the pipeline is not known because flow from other wells was also being received at the tank battery at this same time.

The most probable volume of the release can be estimated using the measured ratio of oil to produced water for these two wells and comparing this measured ratio to the estimate of oil recovered from the playa. The measured ratio of oil to produced water is 0.063 (11 bbl of oil

to 175 bbl of produced water). Southwest Royalties staff estimated the volume of oil released to the playa as 10 barrels. Applying the oil to water ratio yields an estimate of about 160 barrels of produced water released to the playa. However, the original C-141 form estimates that 275 barrels of produced water were released to the playa. If the produced water estimate is correct, applying the oil/water ratio results in a calculation of an oil loss to the playa of about 17 barrels.

We believe that the estimate of 275 barrels of produced water released is based upon the volume of water pumped from the playa that was beneath an obvious oil film. We also believe that wind and other surface effects will cause the floating oil to disperse over the storm water that was standing in the playa at the time of the release, resulting in an overestimate of the volume of released produced water. Moreover, discerning the volume of produced water v. storm water in the playa would be significantly more difficult than discerning the volume of oil v. water. We believe that field staff are generally skilled at estimating the volume of oil floating on water. While we do not suggest that the 10 barrel estimate is perfect, we can conclude that staff did not under estimate the volume of oil in the playa by 60% (10/17). For the purpose of developing the most reasonable estimate of the release, we conclude that the pipeline released 14 barrels of oil and 218 barrels of produced water (PB_{PW} in the calculation below in [bbl]), which is midway between the 10 barrel visual estimate and the 17 barrel maximum based upon the ratio.

Concentration of Produced Water - Eight laboratory samples of produced water within the Flying M oil field average about 119,300 mg/l chloride. As such, a concentration of 120,000 mg/L chloride was used within the calculations. (C_{PW} in the calculation below, [mg/L])

Possible Mass of Chloride Released – The most probable total mass of chloride released is calculated with ($PTM_{CL\ in}$ the calculation below, [kg]):

$$PTM_{CL} = [PB_{PW} * C_{PW}] * [1/10^6\ kg/mg * 3.7854\ L/gal * 42\ gal/bbl]$$
$$= [PB_{PW} * C_{PW}] * 0.0015899\ [kg]$$

The "worst case" total mass of chloride that could have been released to the playa can be calculated with the equation shown below. The calculated result is presented in Table 2 ($TM_{CL\ in}$ the calculation below, [kg]).

$$TM_{CL} = [FR_{PW} * T_R * R_{\%} * C_{PW}] * [1/10^6\ kg/mg * 3.7854\ L/gal * 42\ gal/bbl]$$
$$= [FR_{PW} * T_R * R_{\%} * C_{PW}] * 0.0015899\ [kg]$$

The most probable mass of chloride released to the playa is 218 barrels of produced water (120,000 mg/L) resulting in 4,167 kg of chloride being introduced to the playa.

Using the "worst case" assumptions described above, less than 560 barrels of produced water (120,000 mg/L) or 10,684 kg of chloride could have entered the playa.

Table 2

Calculation of Chloride Mass in the Release				
		Most Probable Scenario	**"Worst Case" Scenario**	
Inputs for Calculation of Chloride from Release	Duration of Release	3.2	3.2	[days]
	Flow Rate through Pipeline	175.0	175.0	[barrels/day]
	Percentage of Flow Assumed to Release from Pipeline	39	100	%
	Concentration of Produced Water	120,000	120,000	[mg/l]
Resultant Released Chloride	Calculated Total Volume of Produced Water released to Playa	**218.4**	**560.0**	[Barrels]
	Resultant kilograms of Chloride Introduced to Playa	**4167**	**10684**	[kg]

CHLORIDE REMOVED FROM THE PLAYA

Produced Water Removed by Vacuuming

At least 218 barrels but no more than 560 barrels of produced water flowed to the northwest from the break in the pipeline and entered the playa on its eastern side. The playa contained an unknown volume of rain water from recent precipitation events. 350 barrels (almost three 130 barrel loads) were removed by vacuum truck on September 16. Vacuum trucks removed as much of the water in the playa as possible.

Because the playa contained standing water at the time of the release, we believe very little of the produced water infiltrated into the fine-grained sediments that form the bottom of the playa. One could argue that the 350 barrels of water plus oil removed from the playa captured 100% of the release and that the volume release was significantly less than the worst case estimate of 560 barrels.

However, for the purpose of developing the most probable (yet conservative) scenario for the release, the calculations presented herein assume that vacuum trucks removed 10 barrels of oil and 160 barrels of produced water, which is consistent with the measured oil/water ratio of 0.063. Under this most realistic case, 58 barrels of produced water (218 minus 160) remained in the playa after vacuuming.

The worst case release volume is 560 barrels and the total volume of fluid removed from the playa was 350 barrels, some of which was storm water. If vacuum trucks removed only 160 barrels of produced water in accordance with the discussion above, a total of 400 barrels of produced water infiltrated into the fine-grained sediments and remained as puddles in the playa.

Produced Water Removed by Excavation

After vacuuming surface fluid from the playa, surface soil samples from the playa floor showed 3 of 4 chloride concentrations above 250 mg/kg (Appendix A and Table 1 of the report). Samples taken 2-feet below the playa surface showed chloride concentrations from 900 mg/kg to almost 1,600 mg/kg.

After sampling, the contractor removed approximately 2,500 yards of soil from the playa floor (about 1-foot of material) and re- sampled the same locations to a depth of 3-feet below the newly-excavated playa floor (a depth of about 4-feet below the original surface). Because these samples also showed chloride concentrations above 900 mg/kg, the contractor removed an additional 2,500 yards of soil. In total, 5,060 yards of soil were removed from the playa floor.

The initial 2,500 cubic yard excavation removed soil that was almost saturated due to infiltration from recent precipitation events and the release. A volumetric moisture content of 0.37 to 0.42 represents saturation for soil types within the playa. At the time of the second 2,500 cubic yard excavation, infiltration and evaporative loss lowered the volumetric moisture content to some degree.

To be conservative, we used a volumetric moisture content of 0.225 to account for the saturated and high moisture content soils that were present in calculating the chloride mass removed during the first two excavation events (5,000 cubic yards).

Using the soil chloride concentration data at the correct depths for the sampling locations, assuming a dry bulk soil density of 1,590 kg/m^3, and a volumetric moisture content of 0.225; the chloride mass of the excavated soil is calculated as 7,723 kg or 405 barrels at the produced water concentration. Because we assumed a conservative moisture content of 0.225 in the calculations, there is no "worst case" value for removal by excavation – the most probable and worst case are the same.

SUMMARY

Using the most probable inputs described above, about 7,334 more kilograms of chloride were removed from the playa than were introduced by the Southwest Royalties release (about 275%). At the produced water concentration of 120,000 mg/L, this is equivalent to an introduction of 218 barrels into the playa and a removal action of 603 barrels.

Corresponding values using the "worst case" assumptions presented above show that Southwest Royalties removed slightly more chloride mass (about 115%) from the environment than the maximum possible mass of chloride introduced by the pipeline release.

Table 5

Net Chloride Balance in Playa			
	Most Probable Values	"Worst Case" Values	Units
Chloride Introduced to Playa	218.4	560.0	[barrels]
	4167	10684	[kg]
Chloride Vacuumed From Playa	198	275	[barrels]
	3778	5247	[kg]
Chloride Excavated From Playa	405	382	[barrels]
	7723	7286	[kg]
Total Chloride Removed from Playa	603	657	[barrels]
	11501	12533	[kg]
Per cent of Chloride Removed from Playa Compared with Chloride Introduced to Playa	276%	117%	
Net Balance	-384.4	-96.9	[barrels]
	-7334.0	-1848.7	[kg]