R. T. HICKS CONSULTANTS, LTD.

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January 11, 2018

Mr. Mike Bratcher
New Mexico Oil Conservation Division
811 S. 1st Street
Artesia, NM 88210
Via E-Mail

Ms. Shelly J Tucker
Bureau of Land Management
620 E. Greene Street
Carlsbad, NM 88220
Via E-mail

RE: Corrective Action Modification #3 - 2RP-3333 Remnant Oil Company
NSLU #3: Unit J, Sec 19, T16S R31E, Eddy County, NM

Mr. Bratcher and Ms. Tucker:

On behalf of Remnant Oil Company, R.T. Hicks Consultants, Ltd. is pleased to submit this final corrective action plan modification. To refresh the memories of the readers:

- Memorial Production Operating Company reported a 50-bbl release at the location that occurred on October 12, 2015
- eTech submitted a Corrective Action Plan on November 6, 2015 on behalf of Memorial Operating, which was approved by OCD (12-31-15).
- On behalf of Marker Oil, R.T. Hicks submitted the first modification to the eTech plan in August of 2016. This plan included a discussion of the environmental setting of the North Square Lake Unit area.
- Hicks Consultants responded to an OCD query regarding the plan modification in mid-September of 2016, but did not received any subsequent written from BLM or OCD.
- On January 9, 2017, Hicks Consultants submitted a Second Modification to the approved Corrective Action Plan, but did not receive any subsequent response from BLM or OCD.
- Hicks Consultants informally discussed the sites in the North Square Lake Unit with OCD on several occasions
- Mike Stubblefield of Hicks Consultants notified OCD of sampling in accordance with the January 2017 submission on November 1, 2017 and received a response from OCD on that same day
- Sampling occurred on November 2 and this report presents the results.

As stated in the January 2017 modification to the approved plan:

> … natural rainfall events can effectively flush chloride from the root zone in sandy environments within a 2-year period. Several large rainfall events over a 7-14 day period are required for precipitation flushing to succeed. The attached precipitation charts from the Caprock and Artesia weather stations, which lie northeast and southwest of the release site, show favorable rainfall events for flushing have occurred in this part of New Mexico.
>
> …we will conduct another deep sampling event as described in the attachment. We will report the results to BLM and OCD with a schedule for implementing a remedy that makes the most sense when considering the data from the proposed sampling…

Data and Interpretation

Table 1 presents the initial sampling results of eTech and the results of the November 2017 sampling. Images of the sampling program attached to this submission and the latitude/longitude of each sampling location (accurate to within 20-30 feet) show that the November 2017 sampling is approximately the same as the eTech sampling of November 2015, where

- S1 is located near AH 3.
- S2 is located near AH 1.
- S3 is located near AH2.

Figures 1 and 2 from the August 2016 submission, which summarize groundwater and surface water conditions in the area, are attached to this submission.
The data support the following interpretations and calculations:

1. Field titration results agree with the laboratory results for soil samples deeper than 1 foot below ground surface (given the heterogeneity of soil samples)
2. The texture of the excavated material is dominantly dune sand with some clay.
3. The average concentration of samples taken at 3 feet and 5 feet below grade provide a reasonable estimate of the chloride concentration at 4 feet below grade.
4. The November 2015 sampling event provides a good characterization of the site after the October 2015 release. These data show:
    a. Average chloride concentration in the shallow soil zone (0-3 feet) is about 9,100 mg/kg.
    b. Average chloride concentration in the soil zone commonly evaluated by OCD (0-4 feet) is about 8,000 mg/kg.
    c. Average chloride in earth material from 3-13 feet is about 4,000 mg/kg.
    d. Average chloride from 13-24 feet (AH-1 only) is about 1,650 mg/kg .
    e. High chloride concentrations at the surface with declining concentrations to 3 to 5 feet below grade as evidence of the 2015 surface release. However, at AH 1 and AH 2, chloride concentrations increase at 7 and 5 feet, respectively. The increase of chloride concentrations at depth is indicative of a historic release.
    f. At AH 1, the sample location nearest to the release source, show chloride concentrations below 250 mg/kg at 22-24 feet below grade.
5. The data from the November 2017 soil sampling show:
    a. Average laboratory chloride concentration in the shallow soil zone (0-3 feet) is about 350 mg/kg, a 95% decrease from the 2015 results.
    b. Average chloride concentration from 0-4 feet is 600 (titration) and 900 (laboratory) mg/kg, below the 1,000 mg/kg limit generally employed by BLM to allow re-vegetation.
    c. Average chloride concentration from 3-13 feet is 1,200 (titration) mg/kg.

6. Precipitation has caused the salt released in October 2015 and any earlier release to migrate downward.
7. Chloride concentrations at 5 and 7 feet below grade suggest that this horizon contains more clay, which retains water (and salt) more effectively than dune sand.
8. Salt concentration in the shallow soil horizon is suitable for re-establishing vegetation.
9. Where the depth to the groundwater surface is more than 100 feet, salt concentrations in the shallow vadose zone (0-25 feet), as is present at this site, represent no threat to groundwater quality. Depth to the groundwater surface is more than 500 feet at this site (Figure 1, attached).
10. Surface water features and mapped drainages do not exist in the area of the release (Figure 2, attached)
11. Erosion due to the release has not and will not occur.

Proposed Corrective Action

In conclusion, data shows that:

1. Depth to water is greater than 500 feet at the site.
2. Chloride concentrations at 22 feet below grade are less than 250 mg/kg.
3. Natural precipitation has caused surface chloride concentrations (0 to 3 feet below grade) to decrease to levels that support vegetation. Current surface chloride concentration averages 350 mg/kg.

Therefore, we propose that Remnant reseed the site with a mix acceptable to the BLM. Upon the satisfactory inspection of re-vegetation by BLM, we propose closure of the regulatory file with both agencies.

If you have any questions regarding the information, interpretations or recommendations, please contact me.

Sincerely,
R.T. Hicks Consultants

Randall Hicks
Principal

Copy: Carrie Stoker, Remnant Oil Operating

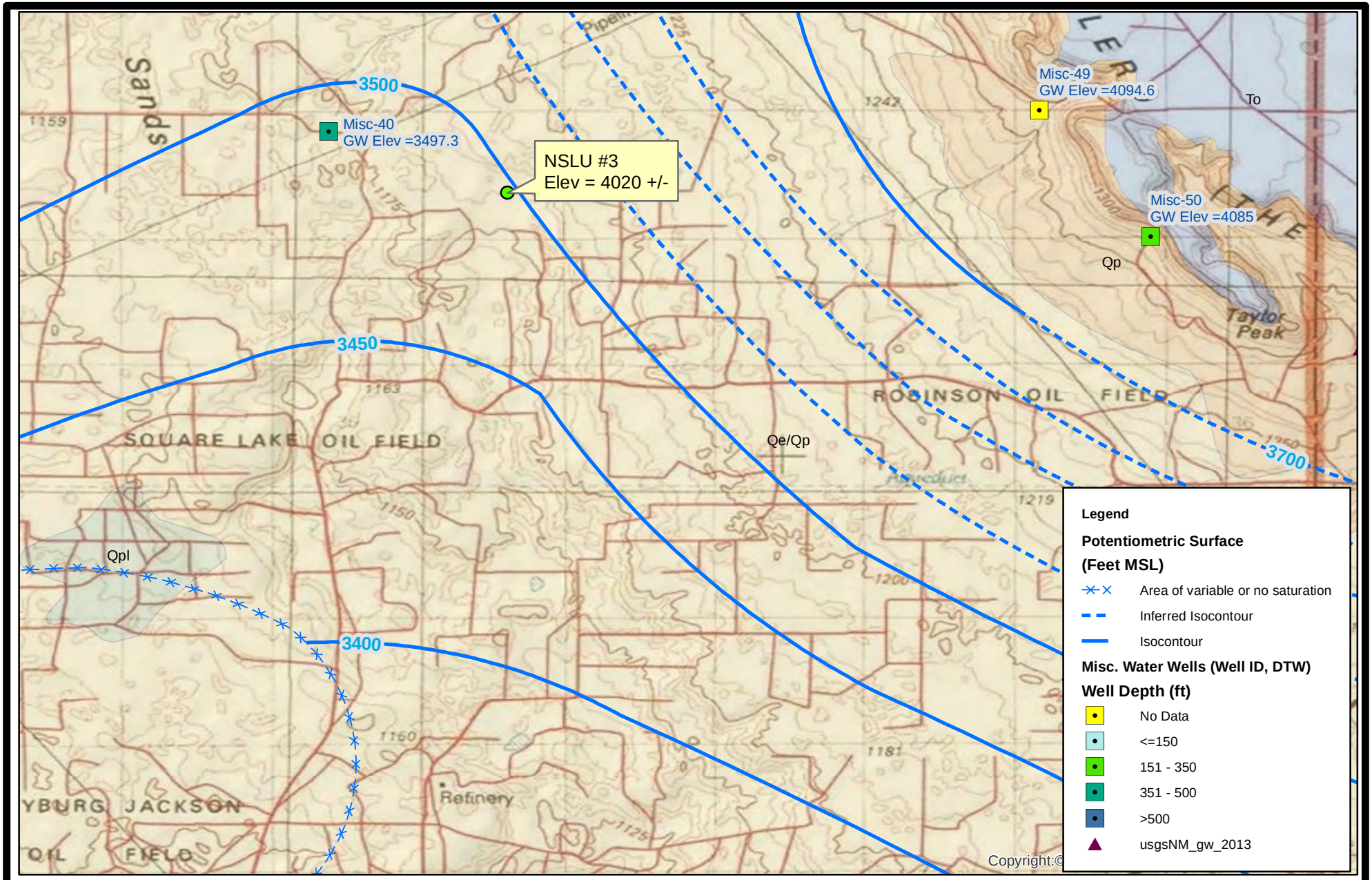
Table 1 - Chloride Concentration of NSLU #3 Samples							
eTech Samples 11-4-2015				Hicks Samples 11-2-2017			
Sample I.D.	Depth (ft.)	Lab Cl		Sample ID	Depth (ft.)	Field Titration	Cardinal Lab
None	1			S2	1	200	12
AH 1	3	15,490		S2	3	200	141
Calculated 4'		9,210		Calculated 4'		1,505	3,901
AH 1	5	2,930		S2	5	2,809	7,660
AH 1	7	6,440		S2	7	1,203	
AH 1	8	4,170					
None	9			S2	9	601	
AH 1	10	5,150					
AH 1	10-11	4,080					
AH 1	11-12	3,430					
AH 1	12-13	2,410		S2	13	401	
AH 1	12-13	2,110					
AH 1	13-14	2,260					
AH 1	14-15	4,320					
AH 1	15-16	1,830					
AH 1	16-17	2,110					
AH 1	17-18	2,260					
AH 1	18-19	1,360					
AH 1	19-20	820					
AH 1	20-21	2,110					
AH 1	21-22	900					
AH 1	22-23	0					
AH 1	23-24	92					
AH 2	0.5	28,160					
None	1			S3	1	200	19
AH 2	1.5	4,170					
AH 2	3	1,860		S3	3	1,404	1,640
Calculated 4'		3,505		Calculated 4'		1,404	1,312
AH 2	5	5,150		S3	5	1,404	983
None	7			S3	7	1,605	
AH 2	7.5	2,010					
AH 2	8-9	1,180					
AH 2	9-10	1,710		S3	9	2,407	
AH 2	10-11	1,510					
AH 2	11-12	3,270					
AH 2	12-13	2,980		S3	13	2,608	
AH 3	0	4,320					
AH 3	0.5	7,340					
None	1			S1	1	200	55
AH 3	1.5	6,450					
AH 3	3	5,470		S1	3	200	320
AH 3	4	1,470		Calculated 4'		802	700
				S1	5	1,404	1,080
				S1	7	1,404	
				S1	9	802	
				S1	13	401	
Average 0-3		9,158				401	364
Average 0-4		7,950				679	900
Average 3-13		4,073				1,254	
Average 13-24		1,642					

Image #1 – Location of eTech sampling points of October 2015 (from eTech Corrective Action Plan of November 2015).

Image #2 – November 2017 sampling within the footprint of the October 2015 release. Sample locations approximate those obtained by eTech in 2015

November 2017 sample locations are

S-1	32.90292, -103.89378
S-2	32.90292, -103.89383
S-3	32.90292, -103.89378



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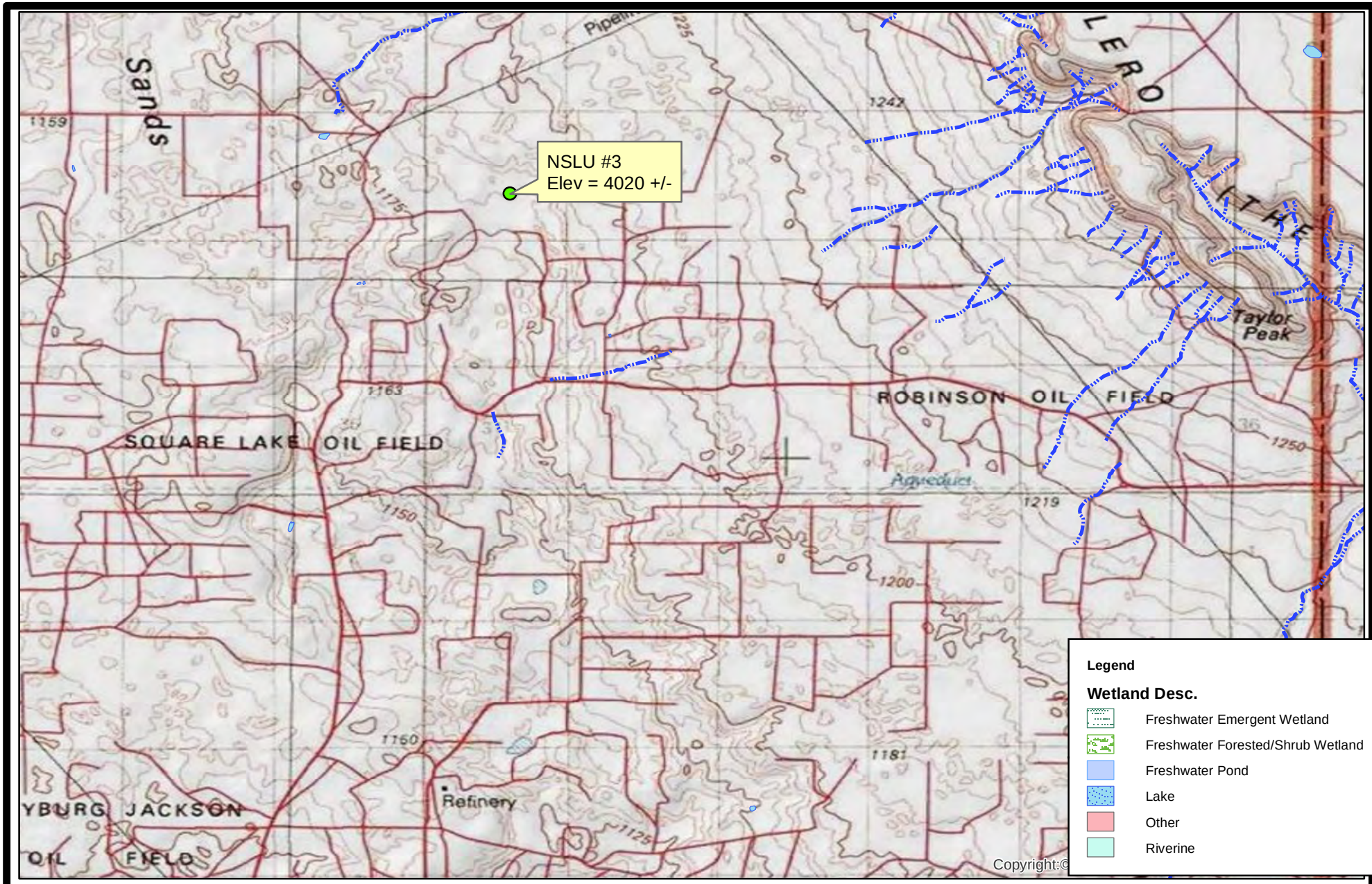
Geology and Groundwater Elevation

Figure 1

Remnant- NSLU #3

Dec 2017



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Mapped Wetlands and Surface Water

Figure 2

Remnant- NSLU #3

Dec 2017