SUBSIDENCE MONITORING REPORTS

Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD

Sent: Monday, August 10, 2020 9:49 AM

To: 'Zbrozek, Michael'

Cc: Ayarbe, John; susan@thestandardenergy.com; Pieter Bergstein

(pieter@bergsteinenterprises.com); Polak, Tiffany, EMNRD

Subject: RE: BW-8 Subsidence monitoring Salty Dog Brine Station 07/2020

Mr. Zbrozek:

Received. All looks well.

Thank you.

Mr. Carl J. Chavez, CHMM (#13099) New Mexico Oil Conservation Division (Albuquerque Office) Energy Minerals and Natural Resources Department 5200 Oakland Avenue, NE Albuquerque, New Mexico 87113 Ph. (505) 660-7923

E-mail: CarlJ.Chavez@state.nm.us

"Why not prevent pollution, minimize waste to reduce operating costs, reuse or recycle, and move forward with the rest of the Nation?" (To see how, go to: http://www.emnrd.state.nm.us/OCD and see "Publications")

From: Zbrozek, Michael <mzbrozek@geo-logic.com>

Sent: Friday, August 7, 2020 2:35 PM

To: Chavez, Carl J, EMNRD < Carl J. Chavez@state.nm.us>

Cc: Ayarbe, John <jayarbe@geo-logic.com>; susan@thestandardenergy.com; Pieter Bergstein

(pieter@bergsteinenterprises.com) <pieter@bergsteinenterprises.com> Subject: [EXT] Subsidence monitoring Salty Dog Brine Station 07/2020

Good afternoon Carl,

In accordance with Condition 2.B.1 of DP BW-8 (OCD 03/24/2019), Salty Dog (PAB services) has been monitoring for potential land subsidence in the area of the brine well. Salty dog is required to report these data to OCD within 15 days of receipt. Basin Surveys of Hobbs, New Mexico surveyed each monitoring point semiannually after their installation; to the nearest 0.10 foot. The initial survey was conducted on March 23, 2018 using the nearest U.S. Geological Survey (USGS) benchmark referenced to NMSPCE (NAD 83).

The survey data for the most recent monitoring event (7/20/2020), reported in the table below, show no indication of land subsidence. The semiannually surveyed elevations are within ± 0.01 foot of the initial survey, and have not showed any deviation from the December 2019 survey. Salty Dog, will continue to monitor for subsidence in this area.

First Semiannual Surface Subsidence Monitoring, 2020

	Elevation (feet msl)				
Survey Monitoring Point	Initial 3/23/2018	Second Semiannual 12/12/2019	First Semiannual monitoring 7/20/2020		
SMP-01	3,810.11	3,810.10	3,810.10		
SMP-02	3,809.01	3,809.00	3,809.00		
SMP-03	3,808.80	3,808.81	3,808.81		
SMP-04	3,806.32	3,806.32	3,806.32		
SMP-05 (brine well)	3,811.72	3,811.72	3,811.72		

Thank you Carl, please contact John or myself if you have any questions. Have a great day.

Michael C Zbrozek

Geologist

Daniel B. Stephens & Associates, Inc.

a Geo-Logic Company

6020 Academy Road NE, Suite 100 Albuquerque, New Mexico 87109

Office: (505) 822-9400 | Direct: (505) 353-9106 | Mobile: (303) 895-7521

MZbrozek@dbstephens.com or MZbrozek@geo-logic.com

www.dbstephens.com | www.geo-logic.com

Chavez, Carl J, EMNRD

From: Zbrozek, Michael <mzbrozek@geo-logic.com>

Sent: Friday, August 7, 2020 2:35 PM

To: Chavez, Carl J, EMNRD

Cc: Ayarbe, John; susan@thestandardenergy.com; Pieter Bergstein

(pieter@bergsteinenterprises.com)

Subject: [EXT] Subsidence monitoring Salty Dog Brine Station 07/2020

Good afternoon Carl,

In accordance with Condition 2.B.1 of DP BW-8 (OCD 03/24/2019), Salty Dog (PAB services) has been monitoring for potential land subsidence in the area of the brine well. Salty dog is required to report these data to OCD within 15 days of receipt. Basin Surveys of Hobbs, New Mexico surveyed each monitoring point semiannually after their installation; to the nearest 0.10 foot. The initial survey was conducted on March 23, 2018 using the nearest U.S. Geological Survey (USGS) benchmark referenced to NMSPCE (NAD 83).

The survey data for the most recent monitoring event (7/20/2020), reported in the table below, show no indication of land subsidence. The semiannually surveyed elevations are within ± 0.01 foot of the initial survey, and have not showed any deviation from the December 2019 survey. Salty Dog, will continue to monitor for subsidence in this area.

First Semiannual Surface Subsidence Monitoring, 2020

	Elevation (feet msl)				
Survey Monitoring Point	Initial 3/23/2018	Second Semiannual 12/12/2019	First Semiannual monitoring 7/20/2020		
SMP-01	3,810.11	3,810.10	3,810.10		
SMP-02	3,809.01	3,809.00	3,809.00		
SMP-03	3,808.80	3,808.81	3,808.81		
SMP-04	3,806.32	3,806.32	3,806.32		
SMP-05 (brine well)	3,811.72	3,811.72	3,811.72		

Thank you Carl, please contact John or myself if you have any questions. Have a great day.

Michael C Zbrozek

Geologist

Daniel B. Stephens & Associates, Inc.

a Geo-Logic Company

6020 Academy Road NE, Suite 100 Albuquerque, New Mexico 87109

Office: (505) 822-9400 | Direct: (505) 353-9106 | Mobile: (303) 895-7521

MZbrozek@dbstephens.com or MZbrozek@geo-logic.com

www.dbstephens.com | www.geo-logic.com

Chavez, Carl J, EMNRD

From: Zbrozek, Michael <mzbrozek@geo-logic.com>

Sent: Tuesday, July 16, 2019 11:51 AM

To: Chavez, Carl J, EMNRD

Cc: Ayarbe, John; susan@thestandardenergy.com; 'Pieter Bergstein

(pieter@bergsteinenterprises.com)'

Subject: [EXT] Subsidence monitoring Salty Dog Brine Station 06/2019

Attachments: SALTY DOG BRINE-34616.pdf

Good afternoon Carl,

In accordance with Condition 2.B.1 of DP BW-8 (OCD 03/24/2019), Salty Dog (PAB services) has been monitoring for potential land subsidence in the area of the brine well. Salty dog is required to report these data to OCD within 15 days of receipt. Basin Surveys of Hobbs, New Mexico surveyed each monitoring point semiannually after their installation; to the nearest 0.10 foot. The initial survey was conducted on March 23, 2018 using the nearest U.S. Geological Survey (USGS) benchmark referenced to NMSPCE (NAD 83).

The survey data for the most recent monitoring event (6/10/2019), reported in the table below, show no indication of land subsidence. The semiannually surveyed elevations are within ± 0.02 foot of the initial survey, and have not showed any deviation from the December 2019 survey. Salty Dog, will continue to monitor for subsidence in this area.

First Semiannual Surface Subsidence Monitoring, 2019

	Elevation (feet msl)					
Survey Monitoring Point	Initial 3/23/2018	Second Semiannual 12/15/2018	First Semiannual monitoring 06/10/2019			
SMP-01	3,810.11	3,810.10	3,810.10			
SMP-02	3,809.01	3,809.00	3,809.00			
SMP-03	3,808.80	3,808.81	3,808.81			
SMP-04	3,806.32	3,806.32	3,806.32			
SMP-05 (brine well)	3,811.72	3,811.72	3,811.72			

Thank you Carl, please contact John or myself if you have any questions. Have a great day.

Michael C Zbrozek

Geologist

Daniel B. Stephens & Associates, Inc.

a Geo-Logic Company

6020 Academy Road NE, Suite 100 Albuquerque, New Mexico 87109

Office: (505) 822-9400 | Direct: (505) 353-9106 | Mobile: (303) 895-7521

MZbrozek@dbstephens.com or MZbrozek@geo-logic.com

www.dbstephens.com | www.geo-logic.com

SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO.



ALL COORDINATES ARE BASED ON NMSPCE (NAD83)

NAME	SECTION CALLS	NORTHING	EASTING	LA TITUDE	LONGITUDE	ELEVATION TOP CASING	ELEVATION CONCRETE
SMP-1	2153' FSL & 2020' FEL	615475.977	836301.437	N32°41′17.960"	W103°22'28.520"	3810.10'	3810.38'
SMP-2	2032' FSL & 2058' FEL	615354.850	836264.338	N32°41′16.795″	W103°22'28.966"	3809.00'	3809.41'
SMP-3	2350' FSL & 2089' FEL	615673.004	836230.083	N32°41'19.945"	W103°22'29.334"	3808.81	3809.18
SMP-4	2291' FSL & 1776' FEL	615615.830	836543.487	N32°41'19.352"	W103°22'25.673"	3806.32	3806.72'
SMP-5	2216' FSL & 1972' FEL	615539.029	836348.733	N32°41′18.609"	W103°22'27.960"	3811.72'	
DBS-9	2520' FSL & 1831' FEL	615844.539	836485.906	N32°41'21.593"	W103°22'26.317"		
DBS-10	1389' FSL & 1060' FEL	614720.368	837270.028	N32°41′10.428″	W103°22'17.269"	3807.48'	3805.44
BENCH MARK		615608.14	836310.07	N32°41′19.27"	W103°22′28.40″	3808.62'	



200 0 200 400 FEET

DANIEL B. STEPHENS & ASSOCIATES, INC

REF: SALTY DOG BRINE FACILITY

MONITOR WELLS AND SUSTENANCE MONITORING POINTS

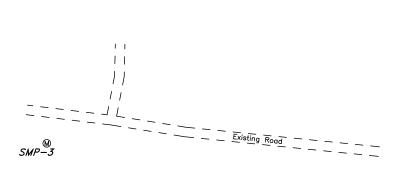
LOCATED IN SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST,

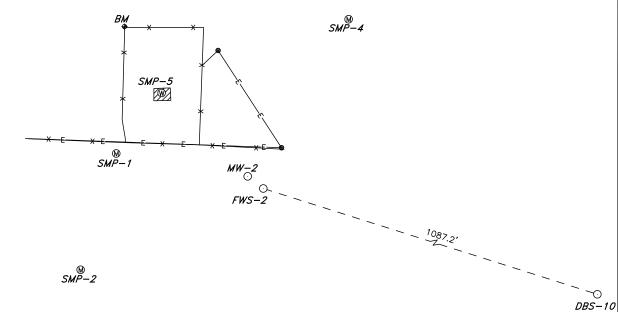
N.M.P.M., LEA COUNTY, NEW MEXICO.

W.O. Number: 34616 | Drawn By: **K. GOAD** | Date: 06-12-2019 | Survey Date: 06-10-2019 | Sheet 1 of 1 Sheets

SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO.

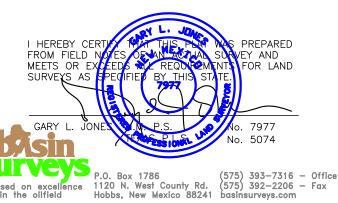
DBS−9 ⊙





ALL COORDINATES ARE BASED ON NMSPCE (NAD83)

	vill containing the line of the containing the cont						
NAME	SECTION CALLS	NORTHING	EASTING	LA TITUDE	LONGITUDE	ELEVATION TOP CASING	ELE VATION CONCRETE
SMP-1	2153' FSL & 2020' FEL	615475.977	836301.437	N32°41′17.960"	W103°22'28.520"	3810.10'	3810.38'
SMP-2	2032' FSL & 2058' FEL	615354.850	836264.338	N32°41'16.795"	W103°22'28.966"	<i>3809.00</i> ′	3809.41'
SMP-3	2350' FSL & 2089' FEL	615673.004	836230.083	N32°41′19.945″	W103°22′29.334″	3808.81	3809.18'
SMP-4	2291' FSL & 1776' FEL	615615.830	836543.487	N32°41′19.352"	W103°22'25.673"	3806.32	3806.72'
SMP-5	2216' FSL & 1972' FEL	615539.029	836348.733	N32°41′18.609″	W103°22'27.960"	3811.72'	
DBS-9	2520' FSL & 1831' FEL	615844.539	836485.906	N32°41'21.593"	W103°22′26.317"		
DBS-10	1389' FSL & 1060' FEL	614720.368	837270.028	N32°41′10.428″	W103°22′17.269"	3807.48'	3805.44
BENCH MARK		615608.14	836310.07	N32°41'19.27"	W103°22'28.40"	3808.62'	



200 0 200 400 FEET

DANIEL B. STEPHENS & ASSOCIATES, INC

REF: SALTY DOG BRINE FACILITY

MONITOR WELLS AND SUSTENANCE MONITORING POINTS

LOCATED IN SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST,

N.M.P.M., LEA COUNTY, NEW MEXICO.

W.O. Number: 34616 | Drawn By: K. GOAD | Date: 06-12-2019 | Survey Date: 06-10-2019 | Sheet 1 of 1 Sheets

Chavez, Carl J, EMNRD

From: Chavez, Carl J, EMNRD

Sent: Tuesday, June 26, 2018 4:11 PM

To: Ayarbe, John

Cc: Pieter Bergstein (pieter@bergsteinenterprises.com); susan@thestandardenergy.com;

McVey, Mike; Griswold, Jim, EMNRD

Subject: RE: Installation of Monitor Well and Subsidence Survey Monitoring Points - Salty Dog

Brine Station (BW-8)

John:

The New Mexico Oil Conservation Division (OCD) is in receipt of your electronic file and is working to place it into the OCD Administrative Record.

OCD will contact you if there are any issues on the documentation.

Thank you.

Mr. Carl J. Chavez, CHMM (#13099) New Mexico Oil Conservation Division Energy Minerals and Natural Resources Department 1220 South St Francis Drive Santa Fe, New Mexico 87505 Ph. (505) 476-3490

E-mail: CarlJ.Chavez@state.nm.us

"Why not prevent pollution, minimize waste to reduce operating costs, reuse or recycle, and move forward with the rest of the Nation?" (To see how, go to: http://www.emnrd.state.nm.us/OCD and see "Publications")

From: Ayarbe, John <jayarbe@geo-logic.com>

Sent: Tuesday, June 26, 2018 3:57 PM

To: Chavez, Carl J, EMNRD < Carl J. Chavez@state.nm.us>

Cc: Pieter Bergstein (pieter@bergsteinenterprises.com) < pieter@bergsteinenterprises.com >;

susan@thestandardenergy.com; McVey, Mike <mmcvey@geo-logic.com>

Subject: Installation of Monitor Well and Subsidence Survey Monitoring Points - Salty Dog Brine Station

Carl,

Attached is an electronic copy of the letter report documenting the installation of a downgradient monitor well and subsidence survey monitoring points at the Salty Dog Brine Station.

Please let me know if you would like a hardcopy mailed to you or OCD, and if you need us to upload the file to the OCD Imaging online system.

Please let Mike or I know if you have questions.

Thanks

John P. Ayarbe

Senior Hydrogeologist

Daniel B. Stephens & Associates, Inc.

a Geo-Logic Company

6020 Academy Road NE, Suite 100 Albuquerque, New Mexico 87109

Office: (505) 822-9400 | Direct: (505) 353-9137

Mobile: (505) 280-4339

jayarbe@dbstephens.com or jayarbe@geo-logic.com

www.dbstephens.com | www.geo-logic.com

The contents of this e-mail message, including any attachments, are for the sole use of the intended recipient named above. This email may contain confidential and/or legally privileged information. If you are not the intended recipient of this message, be advised that any dissemination, distribution, or use of the contents of this message is strictly prohibited. If you receive this message in error, please notify the sender by return e-mail and permanently delete all copies of the original e-mail and any attached documentation. Thank you.



Mr. Carl Chavez 1220 South St. Francis Drive Santa Fe, New Mexico 87505

Delivered via e-mail: CarlJ.Chavez@State.nm.us

Re: Installation of Monitor Well and Subsidence Survey Monitoring Points

Salty Dog Brine Station (API No. 30-025-26307)

Dear Mr. Chavez:

On behalf of PAB Services, Inc., Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this letter report documenting the installation of five survey monuments and one groundwater monitor well at the Salty Dog Brine Station (Salty Dog) located in Lea County, New Mexico. The well was installed to monitor groundwater conditions at the downgradient extent of the chloride plume in the brine well area. The five survey monuments were installed to monitor for potential land subsidence in the area of the brine well, satisfying Condition 2.B.1 of discharge permit (DP) BW-8.

DBS&A contracted with Peterson Drilling and Testing, Inc. (Peterson) to provide drilling services associated with installation of the monitor well and subsidence survey monument points. DBS&A provided oversight during installation, directing and documenting construction activities. Work activities were conducted between March 12 and 14, 2018. Construction of the subsidence survey monitoring points followed the design presented in the *Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization* (DBS&A, 2014), with the exception of minor design changes to accommodate field conditions.

Figure 1 shows the locations of the monitor well (DBS-10) and the survey monuments. Attachment 1 provides photographs and descriptions of daily work activities. Attachment 2 provides lithologic logs and construction diagrams for the monitor well and survey monuments.

The following sections provide background information and describe the installation of the new groundwater monitor well and survey monuments.

Background

Salty Dog is a brine water production and loading station consisting of fresh water supply wells, a brine production well, and a concrete truck loading pad with two brine filling stations. Produced brine is pumped from the brine well to a bermed tank battery consisting of six 750-barrel (bbl) aboveground storage tanks (ASTs), where the brine is stored for sale. The brine well is located approximately 0.5 mile southwest of the brine filling station and is permitted as a UIC Class III well (Brine Supply Well #1 [API No. 30-025-26307]). Brine is produced from the

Daniel B. Stephens & Associates, Inc.

Mr. Carl Chavez June 25, 2018 Page 2

in situ extraction of salt at the brine well. The brine well is approximately 3,000 feet deep and has been in operation since the early 1980s. The Salty Dog brine well is configured for reverse-circulation brine recovery, where fresh water is circulated down the casing annulus into the Salado Formation—a Permian Age sedimentary rock unit composed of halite (salt) and other evaporative beds. Fresh water dissolves the salt, and the brine is extracted through the center tubing of the well.

In May 2008, the Oil Conservation Division (OCD) of the New Mexico Energy, Minerals and Natural Resources Department issued Salty Dog an Administrative Compliance Order (ACO) (ACO-2008-02) to address chloride-impacted groundwater at the site. Two chloride plumes exist at the site: (1) the former brine pond area plume and (2) the brine well area plume. Salty Dog has been operating groundwater extraction systems to provide hydraulic containment and remove chloride-impacted groundwater since 2012. While the downgradient extent of chloride-impacted groundwater has been defined in the former brine pond area, it has not been defined in the brine well area. The new groundwater monitor well (DBS-10) was installed to help define the downgradient extent of chloride-impacted groundwater in the brine well area. Before installation of DBS-10, well MW-5 was the farthest downgradient monitor well in the brine well area. Since February 2008, the chloride concentration at well MW-5 has ranged from 710 to 1,500 milligrams per liter (mg/L) (DBS&A, 2018).

Surface Subsidence Survey Monitoring Points

Condition 2.B.1 of DP BW-08 requires Salty Dog to monitor for potential land subsidence in the area of the brine well (OCD, 2013). Five survey monuments were installed to help meet this condition. Figure 1 shows the locations of the subsidence survey monitoring points, which include three points located approximately 200 feet from the brine well, one point located approximately 60 feet from the brine well, and one point that is a metal tab welded to the brine well casing. Construction and placement of the monitoring points were conducted in accordance with DBS&A (2014). DBS&A identified locations for the monuments in the field; locations were selected where vehicle traffic is minimal.

Engineering Analytics, Inc. of Fort Collins, Colorado prepared the design used to construct the four survey monuments placed around the brine well (SMP-1 through SMP-4) (DBS&A, 2014). The design allows for the detection of subsurface movement that could be attributable to a brine cavern collapse, while avoiding the measurement of movements associated with near-surface disturbances, such as the shrinking and swelling of surface soil. Attachment 2 provides construction diagrams for the four survey monuments, which were constructed as follows:

- Each survey monument was placed in a 6.5-inch-diameter borehole that was advanced using the air-rotary drilling method.
- Boreholes were terminated once competent sandstone was encountered, as determined by DBS&A. Competent sandstone units were encountered at approximately 15 to 17 feet below ground surface (feet bgs) at each of the four boring locations (Attachment 2). The competent

sandstone units are well indurated and were used to anchor the rods associated with the subsidence survey monitoring points due to their rigidity.

- Survey monuments consist of a stainless steel rod placed within a 1-inch-diameter, Schedule (SCH) 40 polyvinyl chloride (PVC) sleeve, with a stainless steel anchor plate welded to the bottoms of the rods. The rods protrude through the tops of the PVC sleeves and serve as the monitoring points at the land surface. The spaces between the PVC sleeves and rods are filled with grease to allow the rods to move freely within the PVC sleeves.
- Anchor plates and bottom 2-foot sections of rods were cemented into the competent sandstone units. The remaining annular space was filled with the following to land surface:
 - Approximately 2 feet of 12/20 silica sand to allow for movement of the rod
 - Approximately 2 feet of a mixture of sand and bentonite chips
 - Approximately 0.5 foot of 3/8-inch bentonite chips to serve as a seal
 - Cement grout to land surface to hold the PVC sleeve in place while allowing the rod to move independently
- Flush-mounted well vaults and four steel bollards were placed around each survey monument for protection.

Basin Surveys of Hobbs, New Mexico surveyed the locations and elevations of the subsidence survey monitoring points after installation (Attachment 3). The survey was conducted on March 23, 2018, and used the nearest U.S. Geological Survey (USGS) benchmark referenced to NMSPCE (NAD83).

In accordance with Condition 2.B.1 of DP BW-8, Salty Dog will have each surface subsidence survey monitoring point surveyed semiannually to at least the nearest 0.1 foot (OCD, 2013). Survey results will be submitted to OCD within 15 days of the survey and will be included in the annual Class III well reports.

Monitor Well Installation

A new groundwater monitor well designated DBS-10, was installed in the brine well area. The well was placed 300 feet downgradient of MW-5, as requested by OCD (Figure 1). The purpose of the well is to help define the downgradient extent of chloride-impacted groundwater in the brine well area.

The well was constructed in a 6.5-inch-diameter borehole that was advanced using the air-rotary drilling method. Once groundwater was encountered, the water level in the borehole was allowed to stabilize before well construction. The water level stabilized to 62.10 feet bgs. The well casing and screen were suspended in the borehole while the filter pack and annular seal materials were emplaced. The well was completed to a depth of 85 feet bgs and was constructed of 2-inch-diameter SCH 40 PVC. Additional well specifications are as follows:

Mr. Carl Chavez June 25, 2018 Page 4

- 20 feet of 0.020-inch slotted screen, with 5 feet of screen set above the water table and the bottom sealed with a threaded PVC end cap
- Centralizer placed at the top of the screen
- Filter pack consisting of 12/20 silica sand installed from the bottom of the borehole to 5 feet above the top of screen
- Well seal consisting of approximately 37 feet of 3/8-inch coated bentonite pellets placed above the filter pack
- Cement grout extending from approximately 15 feet bgs to ground surface
- Surface completion consisting of a 2.5-foot-tall stickup with a locking well plug (J-plug), covered by a 6-inch-diameter protective steel riser with a locking cap and a 0.5-foot-thick concrete well pad protected by 4 steel bollards

After well construction, DBS-10 was developed by pumping until produced water contained little to no sand and was visually clear of suspended solids. Given the small volumes of water produced, well development water was discharged to the land surface.

The DBS&A field geologist providing oversight described drill cuttings at 5-foot intervals. The descriptions include lithology, color, texture, and observed hydrologic conditions including static water level. Lithologic descriptions are included in the well completion logs provided in Attachment 2. Basin Surveys surveyed the well location on March 23, 2018 (Attachment 3).

Well DBS-10 will be monitored during the next semiannual groundwater monitoring event. Groundwater levels and chloride concentrations are reported semiannually in accordance with DP BW-8.

Closing

This letter report documents monitor well and survey monument installation activities conducted at Salty Dog in March 2018. If you have any questions or comments, please feel free to call us at (505) 822-9400.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

John Ayarbe, P.G.

Senior Hydrogeologist

Michael D. McVey, C.P.G., P.G.

Senior Hydrogeologist

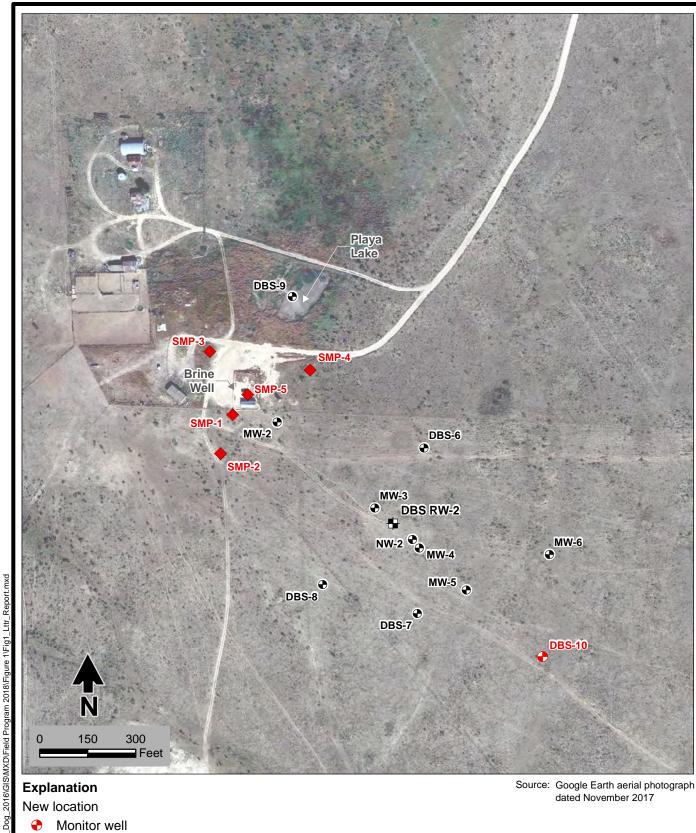
7:1).

JA/MDM/rpf Attachments Mr. Carl Chavez June 25, 2018 Page 5

References

- Daniel B. Stephens & Associates, Inc. (DBS&A). 2014. Work plan for surface subsidence monitoring and solution cavern characterization, Salty Dog Brine Station. Prepared for New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division, Environmental Bureau. September 17, 2014.
- DBS&A. 2018. Semiannual groundwater monitoring and O&M report, July 1 through December 31, 2017, Salty Dog Brine Station, Lea County, New Mexico. Prepared for New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division, Environmental Bureau. March 30, 2018.
- Oil Conservation Division, New Mexico Energy, Minerals and Natural Resources Department (OCD). 2013. Discharge Permit (BW-8) Standard Energy, UIC Class III Brine Well Brine Supply Well No.1 API No. 30-025-26307 UL: J Section 5 Township 19 South, Range 36 East, Lea County, New Mexico. November 8, 2013.

Figure



Explanation

New location

Monitor well

Survey monument

Existing location

Recovery well

Monitor well

Source: Google Earth aerial photograph dated November 2017

SALTY DOG BRINE STATION

New Monitor Well and Land Subsidence Survey Monitoring Point Locations

S:\Projects\ES08.0118.06_Salty_

Attachment 1
Photographs



Peterson assembling a survey monument consisting of a stainless steel
rod inside a PVC sleeve. The crew greased the inside of the sleeve to
allow the rod to move freely within the sleeve.



Installation of survey monument SMP-3. The monument was centered and suspended within the borehole, and the anchor plate and sleeve were carefully placed before installing cement grout to anchor the monument in sandstone.

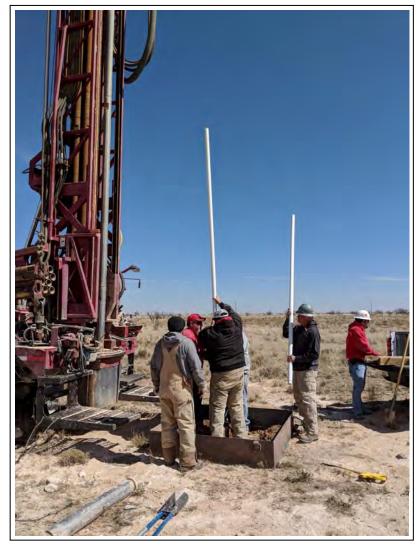


3. Installation of survey monument SMP-1: anchor plate being grouted. Sand was then placed on top of the grout to fill the annular space. Then the sleeve was cut and grouted at the land surface.



4. Survey monument SMP-5, consisting of a stainless steel plate welded directly onto the brine well casing.





Monitor well DBS-10: Peterson suspending and assembling 2-inchdiameter SCH 40 PVC well casing.



6. Monitor well DBS-10: silica sand being poured down the borehole, extending from bottom of borehole to approximately 5 feet above the top of well screen. Bentonite chips were then placed on top of the silica sand filter pack, extending to depth of 15 feet bgs. Cement grout was then used to fill the remainder of the annulus.

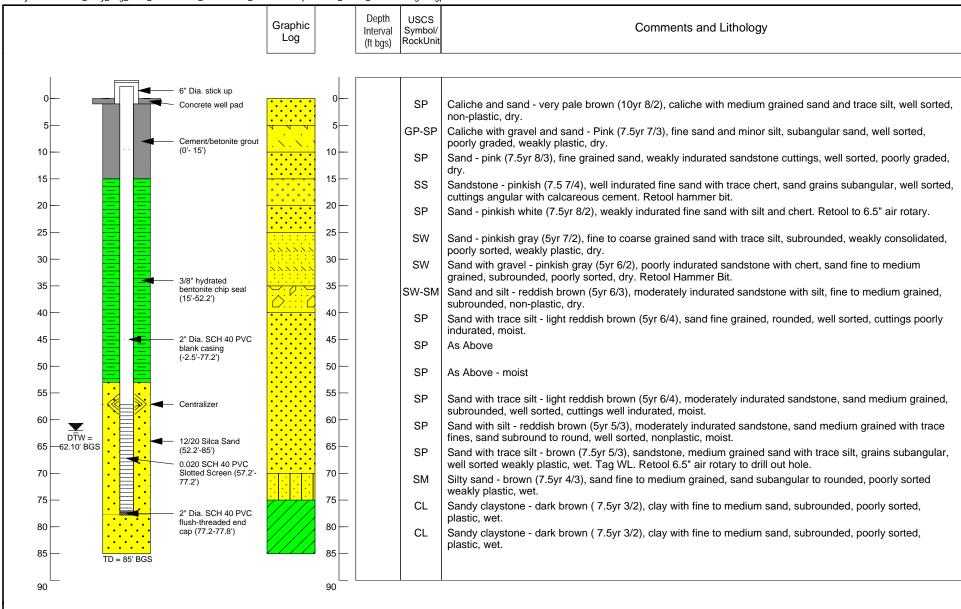


SALTY DOG BRINE STATION **Photographs**



7. Monitor well DBS-10: Peterson constructing the well pad.

Attachment 2
Boring Logs



Geologist: M. Zbrozek Driller: Peterson Drilling, Inc. Date started: 03.13.2018

Date completed: 03.13.2018

Drilling method: Air Rotary Bit diameter: 6" I.D. / 7" O.D. Sampling: Cuttings Coordinates are New Mexico State Plane, NAD 83 Flevation expressed in feet above

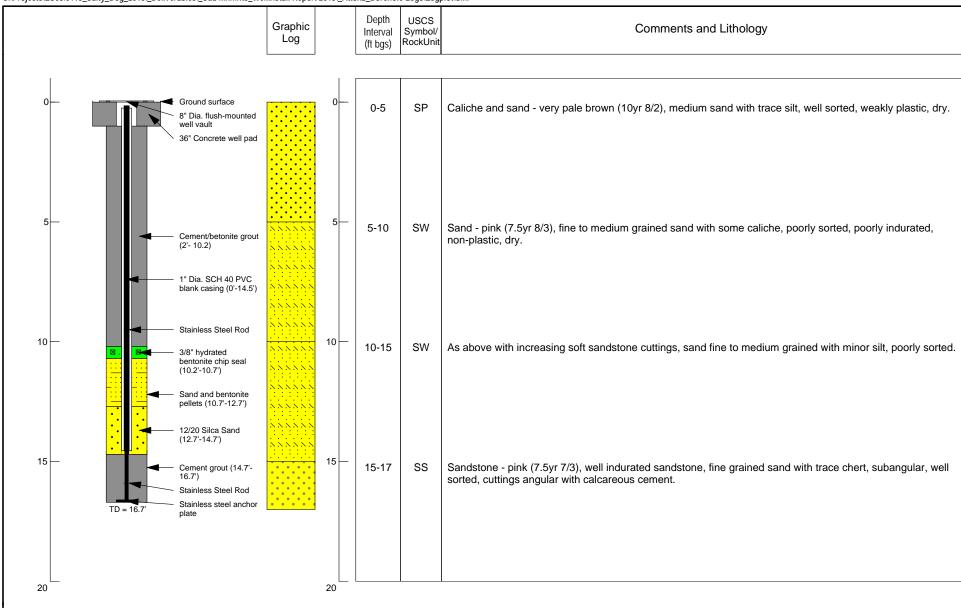
Elevation expressed in feet above mean sea level (feet msl).

Northing: 614720.4 Easting: 837270.0

Elevation (Top of Casing):3807.48'

Daniel B. Stephens & Associates, Inc. 6/22/2018 ES08.0118.06

SALTY DOG BRINE STATION **DBS-10**



Geologist: M. Zbrozek Driller: Peterson Drilling, Inc. Date started: 03.12.2018 Date completed: 03.13.2018

6/10/2018

Drilling method: Air Rotary Bit diameter: 6" I.D. / 7" O.D. Sampling: Cuttings

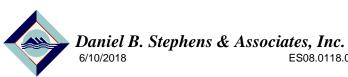
Coordinates are New Mexico State Plane, NAD 83

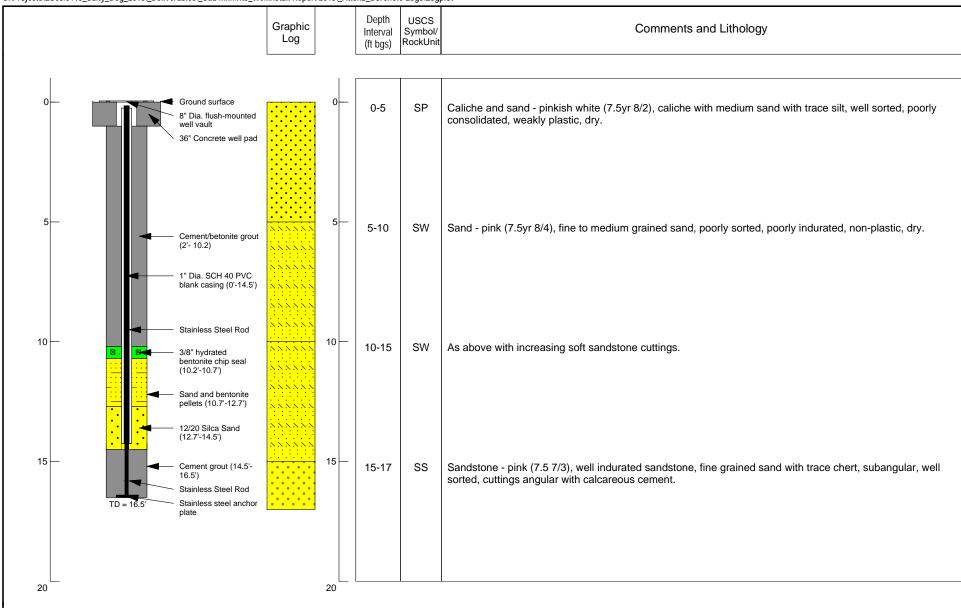
Elevation expressed in feet above mean sea level (feet msl).

Northing: 83630.4 Easting: 615476.0

Elevation (Top of Casing):3810.1'

SALTY DOG BRINE STATION SMP-1





Geologist: M. Zbrozek Driller: Peterson Drilling, Inc. Date started: 03.13.2018

Date completed: 03.14.2018

6/20/2018

Drilling method: Air Rotary Bit diameter: 6" I.D. / 7" O.D. Sampling: Cuttings

Coordinates are New Mexico State Plane, NAD 83

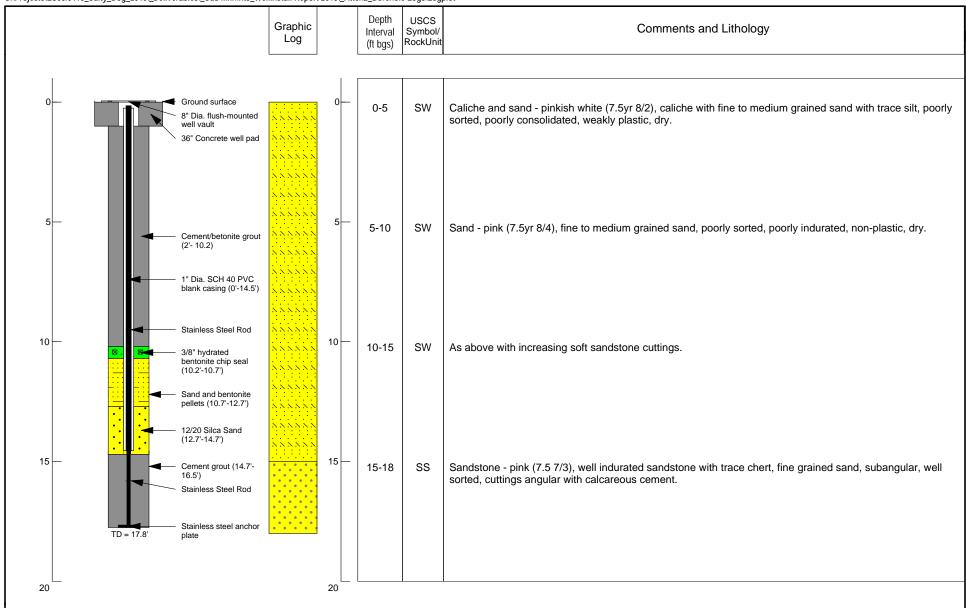
Elevation expressed in feet above mean sea level (feet msl).

Northing: 836264.3 Easting: 615354.9

Elevation (Top of Casing):3809.0'

SALTY DOG BRINE STATION SMP-2





Geologist: M. Zbrozek
Driller: Peterson Drilling, Inc.
Date started: 03.12.2018

Date completed: 03.13.2018

Drilling method: Air Rotary Bit diameter: 6" I.D. / 7" O.D. Sampling: Cuttings Coordinates are New Mexico State Plane, NAD 83

Elevation expressed in feet above mean sea level (feet msl).

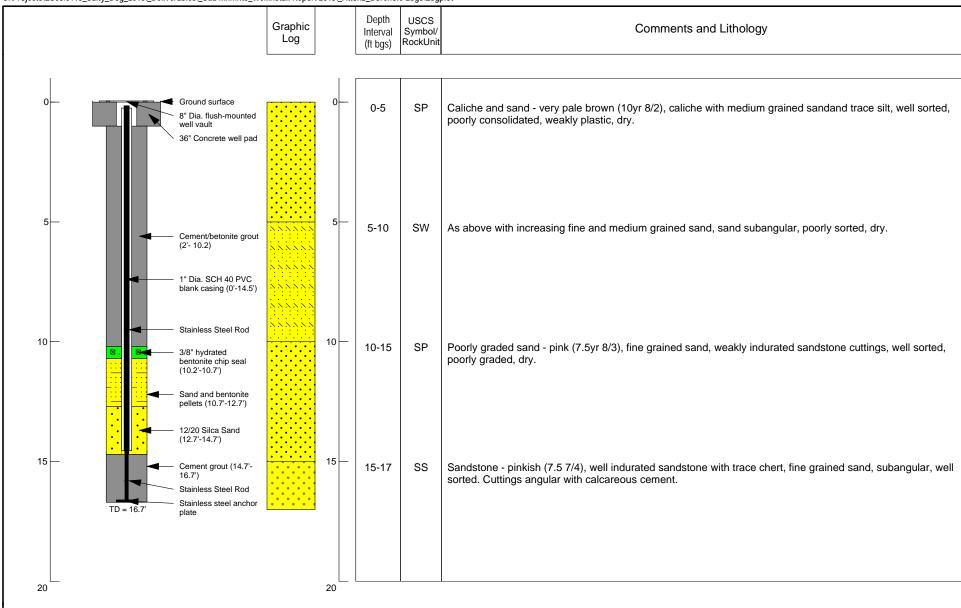
Northing: 836230.1 Easting: 615673.0

Elevation (Top of Casing):3808.8'



SMP-3

SALTY DOG BRINE STATION



Geologist: M. Zbrozek Driller: Peterson Drilling, Inc. Date started: 03.12.2018 Date completed: 03.13.2018

6/10/2018

Drilling method: Air Rotary Bit diameter: 6" I.D. / 7" O.D. Sampling: Cuttings

Coordinates are New Mexico State Plane, NAD 83

Elevation expressed in feet above mean sea level (feet msl).

Northing: 836543.5 Easting: 615615.8

Elevation (Top of Casing):3806.3'

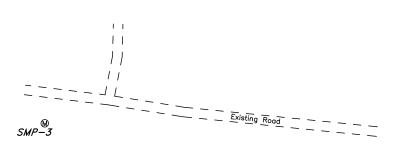
SALTY DOG BRINE STATION SMP-4

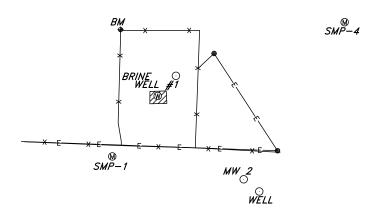


Attachment 3
Survey

SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO.

MW





™ SMP-2

ALL COORDINATES ARE BASED ON NMSPCE (NAD83)

NAME	SECTION CALLS	NORTHING	EASTING	LA TITUDE	LONGITUDE	ELEVATION TOP CASING	ELEVATION CONCRETE
BRINE WELL #1	2216' FSL & 1972' FEL	615539.0	836348.7	N32°41'18.6"	W103°22'28.0"	3811.7'	
SMP-1	2153' FSL & 2020' FEL	615476.0	836301.4	N32°41'18.0"	W103°22'28.5"	3810.1'	3810.4'
SMP-2	2032' FSL & 2058' FEL	615354.9	836264.3	N32°41'16.8"	W103°22'29.0"	3809.0'	3809.4'
SMP-3	2350' FSL & 2089' FEL	615673.0	836230.1	N32°41'19.9"	W103°22'29.3"	3808.8'	3809.2'
SMP-4	2291' FSL & 1776' FEL	615615.8	836543.5	N32°41'19.4"	W103°22'22.7"	3806.3'	3806.7'
DBS-10	1389' FSL & 1060' FEL	614720.4	837270.0	N32°41'10.4"	W103°22'17.3"	3807.5'	3805.4'
BENCH MARK		615608.1	836310.1	N32°41'19.3"	W103°22'28.4"		

I HEREBY CERTH, MAT THIS PLAN WAS PREPARED FROM FIELD NOTES OF AN ACTUAL SURVEY AND MEETS OR EXCEEDS ALL REQUIREMENTS FOR LAND SURVEYS AS SPECIFIED BY THIS STATE.

GARY L. JONES J.M. P.S. No. 7977
No. 5074

P.O. Box 1786
1120 N. West County Rd. (575) 393-7316 — Office the oilfield Hobbs, New Mexico 88241

DANIEL B. STEPHENS & ASSOCIATES, INC

200

400 FEET

REF: SALTY DOG BRINE FACILITY

200

MONITOR WELLS LOCATED IN

SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST,

N.M.P.M., LEA COUNTY, NEW MEXICO.

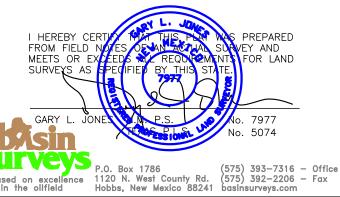
W.O. Number: 33610 Drawn By: **K. GOAD** Date: 03-29-2018 Survey Date: 03-23-2018 Sheet 1 of 1 Sheets

SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST, N.M.P.M., LEA COUNTY, NEW MEXICO.



ALL COORDINATES ARE BASED ON NMSPCE (NAD83)

	··						
NAME	SECTION CALLS	NORTHING	EASTING	LA TITUDE	LONGITUDE	ELEVATION TOP CASING	ELE VA TION CONCRETE
BRINE WELL #1	2216' FSL & 1972' FEL	615539.0	836348.7	N32°41'18.6"	W103°22'28.0"	3811.7'	
SMP-1	2153' FSL & 2020' FEL	615476.0	836301.4	N32°41'18.0"	W103°22'28.5"	3810.1	3810.4'
SMP-2	2032' FSL & 2058' FEL	615354.9	836264.3	N32°41'16.8"	W103°22'29.0"	3809.0'	3809.4'
SMP-3	2350' FSL & 2089' FEL	615673.0	836230.1	N32°41'19.9"	W103°22'29.3"	3808.8'	3809.2'
SMP-4	2291' FSL & 1776' FEL	615615.8	836543.5	N32°41'19.4"	W103°22'22.7"	3806.3'	3806.7'
DBS-10	1389' FSL & 1060' FEL	614720.4	837270.0	N32°41'10.4"	W103°22'17.3"	3807.5'	3805.4'
BENCH MARK		615608.1	836310.1	N32°41'19.3"	W103°22'28.4"		



DANIEL B. STEPHENS & ASSOCIATES, INC

200

400 FEET

REF: SALTY DOG BRINE FACILITY

200

MONITOR WELLS LOCATED IN

SECTION 5, TOWNSHIP 19 SOUTH, RANGE 36 EAST,

N.M.P.M., LEA COUNTY, NEW MEXICO.

W.O. Number: 33610 | Drawn By: **K. GOAD** | Date: 03-29-2018 | Survey Date: 03-23-2018 | Sheet 1 of 1 Sheets

Chavez, Carl J, EMNRD

From: McVey, Michael <mmcVey@dbstephens.com>

Sent: Thursday, November 10, 2016 9:41 AM

To: Chavez, Carl J, EMNRD

Cc: Ayarbe, John; pieter@bergsteinenterprises.com

Subject: RE: BW-8 Subsidence Monitoring Work Plan & Cavern Characterization Report

Attachments: Salty Dog Work Plan_9-17-2014.pdf; 3rd Qtr 2016 Monitoring_Salty Dog_11-09-2016.pdf

Carl,

Thanks for following up with me. The Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization was submitted to Jim in September 2014. I've attached a copy of that work plan for your review.

The change from quarterly groundwater monitoring (as stipulated in the new discharge permit for the Salty Dog Brine Station) to semiannual groundwater monitoring was proposed by DBS&A in the 2nd Qtr 2016 Monitoring report and in the 3rd Qtr Monitoring report that was just submitted to Tomas on November 9, 2016. I've attached a pdf of the 3rd Qtr Monitoring report for your review.

Please let me know if you have any questions. We're looking for approval of the Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization and approval to change to semiannual groundwater monitoring as I discussed with Jim.

Thanks,

Michael D. McVev

Senior Hydrogeologist

Daniel B. Stephens & Associates, Inc.

Hydrology | Engineering | Geoscience

Providing solutions for water, natural resources, and the environment

6020 Academy Road NE, Suite 100 Albuquerque, New Mexico 87109 T (505) 822-9400 D (505) 353-9130 F (505) 822-8877 mmcvey@dbstephens.com | www.dbstephens.com

Facebook | LinkedIn | YouTube | Google+

From: Chavez, Carl J, EMNRD [mailto:CarlJ.Chavez@state.nm.us]

Sent: Thursday, November 10, 2016 9:01 AM

To: McVey, Michael Cc: Griswold, Jim, EMNRD

Subject: BW-8 Subsidence Monitoring Work Plan & Cavern Characterization Report

Mike:

Good morning. I met with Jim Griswold this morning and he requested that I follow-up on the above subject reports with you.

OCD could not locate the above subject reports.

Could you please send pdf versions of the reports to me for review.

Thank you.

Mr. Carl J. Chavez New Mexico Oil Conservation Division Energy Minerals and Natural Resources Department 1220 South St Francis Drive Santa Fe, New Mexico 87505 Ph. (505) 476-3490

E-mail: <u>CarlJ.Chavez@state.nm.us</u>

"Why not prevent pollution, minimize waste to reduce operating costs, reuse or recycle, and move forward with the rest of the Nation?" (To see how, go to: http://www.emnrd.state.nm.us/OCD and see "Publications")



Mr. Jim Griswold New Mexico Oil Conservation Division Environmental Bureau 1220 South St. Francis Drive Santa Fe, NM 87505-4225

Re: Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization Salty Dog Brine Station

Dear Mr. Griswold:

On behalf of PAB Services, Inc., Daniel B. Stephens & Associates, Inc. (DBS&A) is pleased to submit the enclosed work plan for surface subsidence monitoring and solution cavern characterization at the Salty Dog Brine Station in Lea County, New Mexico. The work plan was prepared in accordance with the requirements of Conditions 2.B.1 and 2.B. 2 of discharge permit (DP) BW-8.

Please do not hesitate to call us at (505) 822-9400 if you have any questions or require additional information.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

Senior Hydrogeologist

Michael D. McVey, C.P.G., P.G.

Senior Hydrogeologist

JA/rpf **Enclosures**

cc: Pieter Bergstein, PAB Services, Inc.

Brenda Patterson, Aqueous Operating

Terry Wallace, Salty Dog, Inc.

Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization Salty Dog Brine Station

Prepared for New Mexico Energy, Minerals and

Natural Resources Department

Oil Conservation Division

September 17, 2014



Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109



Daniel B. Stephens & Associates, Inc.

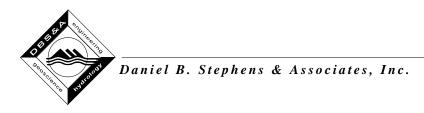
Table of Contents

Se	ection	Page
1.	Introduction	1
2.	Background	1
3.	Surface Subsidence Monitoring Plan	3
4.	Solution Cavern Characterization Program	4
5.	Reporting	7
6.	Schedule	7
Re	eferences	8

List of Figures

Figure

- 1 Site Location and Facilities
- 2 2014 Aerial Photograph of Salty Dog Brine Station
- 3 Generalized Brine Well Schematic
- 4 Monitor and Extraction Well Locations
- 5 Proposed Subsidence Monitoring Locations
- 6 Subsidence Survey Monument Design
- 7 Subsurface Anomalies Identified by Geophysical Methods at the I&W Site



Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization Salty Dog Brine Station

1. Introduction

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this work plan on behalf of PAB Services, Inc. (PAB) to satisfy Conditions 2.B.1 and 2.B. 2 of recently renewed discharge permit BW-8 (DP BW-8). The Oil Conservation Division (OCD) of the New Mexico Energy, Minerals and Natural Resources Department (NMEMNRD) renewed DP BW-8 on November 8, 2013, permitting continued operation of the Salty Dog Brine Station (Salty Dog) and the associated Underground Injection Control (UIC) Class III well (Brine Supply Well #1 [API No. 30-025-26307]) (NMEMNRD, 2013). The facility is located in Lea County, New Mexico, approximately 11 miles west of Hobbs, New Mexico along Highway 180 (Figure 1).

This work plan describes the proposed technical approach to be used to satisfy Conditions 2.B.1 and 2.B.2 of DP BW-8, including (1) the design of survey monuments and establishment of a program to monitor for potential surface subsidence, and (2) investigation activities to characterize the size and shape of the solution cavern created by brine production. Section 2 provides pertinent background information, such as the history of the facility, site geology, and brine well construction. Sections 3 and 4 present the proposed plans for surface subsidence monitoring and solution cavern characterization, respectively. Reporting is discussed in Section 5. Section 6 presents a schedule for the proposed work.

2. Background

Salty Dog is a brine water production and loading station, consisting of a fresh water supply well, a brine production well, and a concrete truck loading pad with two brine filling stations. Fresh water is stored in two 1,000-barrel (bbl) fresh water aboveground storage tanks (ASTs). Brine is stored at a bermed tank battery consisting of six 750-bbl ASTs. Figure 1 shows the



Daniel B. Stephens & Associates, Inc.

locations of the Salty Dog facilities. The brine well is located approximately 0.5 mile southwest of the brine station. Figure 2 presents a 2014 aerial photograph of the brine station showing the layout of the current facility infrastructure.

Brine is produced from the in situ extraction of salt at the UIC Class III well (Brine Supply Well #1 [API No. 30-025-26307]). The physical location of the brine well is 1,980 feet from south line (FSL) and 1,980 feet from east line (FEL) (NW/4 SE/4, Unit Letter J) in Section 5, Township 19 South, Range 36 East, New Mexico Principal Meridian (NMPM) (Figure 1). The brine well was installed in June 1979. The original discharge permit for the brine well (GWB-2) appears to have been issued on December 18, 1982 (OCD, 1994). The discharge permit was last renewed on November 8, 2013 (NMEMNRD, 2013).

Figure 3 shows a generalized schematic of the brine well illustrating its construction, tubing depths, and the penetrated geologic units. The brine well was drilled to a total depth of 2,958 feet below ground surface (bgs). Surface casing (85%-inch) extends from land surface to a depth of 1,877 feet bgs and is cemented in place. The well is completed open hole from 1,877 to 2,958 feet bgs. The well was originally completed with open-ended 21%-inch tubing, hung to a depth of 2,887 feet bgs and perforated from 2,872 to 2,887 feet bgs (NRE, 1982). In August 1999, holes in the surface casing were repaired, and a 51½-inch casing liner was installed and cemented to 1,829 feet bgs; open-ended 21%-inch tubing was hung to a depth of 2,534 feet bgs (Salty Dog, 1999). The tubing is currently set at 2,665 feet bgs.

The Salty Dog brine well is configured for reverse circulation brine recovery, where fresh water is circulated down the casing annulus into the Salado Formation—a Permian Age sedimentary rock unit composed of halite (salt) and other evaporative beds. Fresh water dissolves the salt, and the brine is extracted through the center tubing of the well (Figure 3). The total dissolved solids (TDS) concentrations of the fresh water and produced brine are approximately 600 milligrams per liter (mg/L) and 320,000 to 350,000 mg/L, respectively (Martin, 1982; Unichem, 1987).

Figure 3 shows the geologic stratigraphy at the brine well. The Ogallala Formation is the uppermost geologic unit, extending from land surface to a depth of approximately 150 feet bgs. At the Salty Dog site, the Ogallala Formation consists primarily of sand, with the upper 40 feet



Daniel B. Stephens & Associates, Inc.

containing appreciable amounts of caliche. Regional groundwater is present within the formation under a water-table condition and is considered part of the Ogallala Aquifer. This groundwater is used as the fresh water supply for the brine station, and is pumped from an on-site well (Figure 2). Depth to groundwater is approximately 60 feet bgs (DBS&A, 2009a). The Rustler Formation underlies the Ogallala Formation and consists of redbed and anhydrite sequences from approximately 150 to 1,800 feet bgs and 1,800 to 2,000 feet bgs, respectively. The Salado Formation is present from approximately 2,000 to 2,900 feet bgs.

In addition to the fresh water pumped from the supply well, chloride-impacted groundwater recovered at two on-site groundwater extraction wells is used as injection water at the brine well. Figure 4 shows the locations of the two extraction wells (RW-1 and RW-2).

3. Surface Subsidence Monitoring Plan

Condition 2.B.1 of DP BW-8 requires surface subsidence monitoring at the Salty Dog Brine Station. DBS&A proposes to install four survey monuments near the brine well to be surveyed semiannually by a licensed professional surveyor to satisfy this condition.

Figure 5 shows the proposed locations of the survey monuments. One survey monument would be placed about 50 feet from the brine well; the other three monuments would be placed about 200 feet from the brine well. A 2009 sonar survey identified a maximum radius of a solution cavern along an azimuth of 200 degrees (Section 4.1). Two of the proposed survey monuments are positioned along this direction (SMP-1 and SMP-2).

Figure 6 provides a design schematic for the survey monuments prepared by Engineering Analytics, Inc., a geotechnical engineering firm based in Fort Collins, Colorado. Each monument will be constructed from stainless steel rod sleeved within 1-inch-diameter SCH 80 polyvinyl chloride (PVC) pipe, with the top of the rod serving as the surface subsidence monitoring point. The stainless steel rod will be anchored in 2 feet of concrete at a depth of approximately 25 to 30 feet bgs. Final depths will be determined in the field and selected such that the stainless steel rods are anchored in hard and well-indurated sand that often appears as stone due to the presence of appreciable amounts of caliche. Several monitor and recovery wells have been completed within the Ogallala Aquifer at the site. Lithologic data collected at



Daniel B. Stephens & Associates, Inc.

these wells show the presence of sandstone or well-indurated sand units at depths of up to approximately 40 feet bgs (DBS&A, 2009a and 2009b). At RW-2, the closest existing well to the brine well, hard and well-indurated sand exists between 20 and 35 feet bgs (DBS&A, 2009b).

The space between the PVC pipe and stainless steel rod will be filled with grease to allow the rod to move independent of the PVC pipe and surface completion (Figure 6). The survey monuments have been designed to detect ground movement at depth, which would more likely be associated with a cavern collapse than near-surface disturbances that are not associated with cavern subsidence (e.g., shrinking and swell of surface soil). Each monument will be constructed in an approximately 8¾-inch-diameter borehole, advanced using the air-rotary drilling method or other comparable drilling technology.

After installation, the location and elevation of each survey monument will be established relative to the nearest U.S. Geological Survey (USGS) benchmark. A licensed New Mexico land surveyor will survey the elevation of each monument semiannually to at least the nearest 0.01 foot. Survey results will be submitted to OCD within 15 days of the survey and included in the Annual Class III Well Reports.

In accordance with DP BW-8, if subsidence is measured at or greater than 0.1 foot, Salty Dog will suspend operations at the brine well and conduct an analysis to determine the cause of the movement and integrity of the cavern.

4. Solution Cavern Characterization Program

Condition 2.B.2 of DP BW-8 requires a characterization program to delineate the size and shape of the solution cavern using a geophysical method. The following sections summarize a previous characterization effort and the proposed geophysical approach to satisfy Condition 2.B.2.

4.1 Previous Characterization Survey

In 2009, SOCON Sonar Well Services, Inc. of Conroe, Texas conducted a sonar survey at the Salty Dog brine well in an attempt to determine the extent of the solution cavern (SOCON,



Daniel B. Stephens & Associates, Inc.

2009). The sonar survey was performed to satisfy an OCD requirement (NMEMNRD, 2008), and was run from a depth of 1,871 to 1,903 feet bgs, a vertical distance of 32 feet. Available lithologic information shows that the top of the Salado Formation is at a depth of approximately 2,000 feet bgs, indicating that the section surveyed was the anhydrite sequence of the Rustler Formation (Figure 3). Survey results show a cavern volume of 720 bbls, with a maximum radius of 41 feet at a depth of 1,882 feet bgs along an azimuth of 200 degrees.

OCD has estimated a volume of 1,022,196 bbls for the Salty Dog solution cavern based on brine production records (NMEMNRD, 2012). The volume determined from the sonar survey (720 bbls) accounts for less than 1 percent of this estimated volume.

4.2 Proposed Geophysical Approach

DBS&A proposes to use the digital high-resolution magnetotellurics (HRMT) method to determine the size and shape of the Salty Dog solution cavern. The selection of this approach is based on the general success of the method at the former I&W brine facility in Carlsbad, New Mexico. OCD has conducted extensive testing of several geophysical methods to delineate the solution cavern at the I&W site, including two-dimensional (2D) seismic reflection (August 2009), sonar logging (September 2010), electrical resistivity (April 2011), and digital HRMT (March 2011 and April 2013) (NMEMNRD, 2012). Because the geologic environment at the I&W site is similar to that at the Salty Dog Brine Station, DBS&A relied heavily on available information regarding the geophysical surveys conducted at the I&W site when selecting an appropriate cavern characterization approach.

Each of the four geophysical methods used at the I&W site identified one or more subsurface anomalies, as shown in Figure 7. The following is a brief summary of the findings from the I&W site:

 Sonic logging reportedly identified the upper part of a cavity approximately 150 feet in diameter and 25 feet high, but was unable to delineate the cavern at depth, possibly due to the presence of insoluble residues or broken rubble (NMEMNRD, 2012).



- Seismic data interpretation indicated a pear-shaped anomaly measuring about 610 feet north to south and up to 420 feet across; evidence of the most extensive dissolution was around the brine extraction well (RESPEC, 2009).
- Electrical resistivity data interpretation indicated a J-shaped low-resistivity anomaly approximately 900 feet north to south and approximately 85 feet wide that was coincident with the sonar anomaly (Figure 7). The survey also identified four smaller anomalies that were interpreted to represent brine-saturated areas of the Rustler Formation that were either highly fractured or brecciated, rather than open void space (Land and Veni, 2011).
- HRMT data indicated a roughly oval-shaped anomaly approximately 1,660 feet north to south and 790 feet wide (DMT, 2011 and 2013).

Only the HRMT approach identified a large anomaly at the I&W site that might approach the volume indicated by historical production data (Figure 7). OCD has estimated a cavern volume of 1,050,386 bbls based on brine production at the former I&W facility (NMEMNRD, 2012).

HRMT is a passive electromagnetic (EM) system commonly used for oil and gas exploration. It relies on natural EM waves (telluric currents) generated by the interaction of the earth's magnetic field with solar wind. A large-amplitude, very-low-frequency EM signal enters the earth perpendicular to the land surface, propagating into the subsurface. The amplitude and phase of individual frequencies intersect conductive formations, are modified, and are reflected back to the land surface. The air-ground interface marks a large impedance mismatch to the reflected EM waves, generating a series of higher-frequency EM waves: telluric (electric field) and geomagnetic (magnetic field). These electric and magnetic fields are recorded, and their frequency, amplitude, and phase responses are analyzed to map subsurface conditions.

DBS&A proposes to contract with DMT Technologies, LLC (DMT) in Broken Arrow, Oklahoma to perform the HRMT survey. This is the same company that conducted the HRMT survey at the I&W site. The HRMT survey will be performed using a rectangular grid of survey stations. DMT (or other contractor, if necessary), will establish the grid based on professional judgment and initial field findings at the time of the survey. Station density will be sufficient to obtain an



accurate cavern volume. Each station will be surveyed, either by a licensed New Mexico land surveyor or using a global positioning system (GPS) unit accurate to within 0.01 foot.

A best effort will be made to accurately determine the volume of the Salty Dog brine cavern; however, the results of an HRMT survey, or any geophysical survey, are interpretive. While best judgments are used in developing data interpretations, the accuracy of the HRMT survey cannot be guaranteed.

5. Reporting

After the completion of field activities and receipt of the final geophysical survey report, DBS&A will prepare a Subsidence Monitoring and Solution Cavern Characterization Report. This report will document the construction of the survey monuments and present results of the cavern characterization, including estimates of its volume and lateral extent. The final report will be submitted to the OCD, and will provide the following:

- As-built diagrams of the survey monuments, including surveyed locations and elevations
- A figure showing the locations of the survey monuments
- The report prepared by the geophysical survey contractor and associated data
- Calculation of the solution cavern volume based on brine production records and a comparison of this volume to results of the geophysical survey
- Figures illustrating the extent and depth of the cavern based on the geophysical survey
- Conclusions and recommendations

6. Schedule

Upon OCD approval of this work plan, DBS&A will work with PAB to (1) contract a driller for the installation of the survey monuments, (2) contract DMT to perform the geophysical survey, (3) contract a licensed land surveyor to perform the surveying, and (4) obtain any necessary access agreements from adjacent landowners.



DBS&A anticipates that the installation of the subsidence survey monuments and geophysical survey can begin within approximately 30 days of receiving signed access agreements and that the geophysical survey and data processing can be completed within approximately 45 days.

DBS&A will prepare a draft report for initial review within 30 days of receipt of the geophysical survey report.

References

- Daniel B. Stephens & Associates, Inc. (DBS&A). 2009a. *Monitoring well installation and groundwater monitoring report, Salty Dog Brine Station, Lea County, New Mexico*. Prepared for New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division, Environmental Bureau. September 18, 2009.
- DBS&A. 2009b. Recovery well installation and pump test report, Salty Dog Brine Station, Lea County, New Mexico. Prepared for New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division, Environmental Bureau. November 20, 2009.
- DMT Technologies (DMT). 2011. Final report for EMNRD/Oil Conservation Division: Z-scan review, Former I&W facility, Carlsbad, New Mexico. April 11, 2011.
- DMT. 2013. Final report for AMEC Environment and Infrastructure, Inc. and EMNRD/Oil Conservation Division: I&W brine cavern project, Z-scan review, Stage II, Carlsbad, New Mexico. July 26, 2013.
- Martin Water Laboratories, Inc. (Martin). 1982. Result of water analyses for raw water and brine water samples collected November 1, 1982. Prepared for Natural Resources Engineering Inc. November 1, 1982.
- Land, L. and G. Veni. 2011. *Electrical resistivity survey: I&W brine well, Eddy County, New Mexico*. National Cave and Karst Research Institute Report of Investigations 2. June 2011.



- Natural Resources Engineering Inc. (NRE). 1982. Well bore sketch for Brine supply well #1. NRE Job Number NB01-001-001. November 9, 1982.
- New Mexico Energy, Minerals and Natural Resources Department (NMEMNRD). 2008. E-mail from Carl J. Chavez to multiple recipients regarding Brine well sonar testing requirement with this season's upcoming MIT schedule 2009. November 12, 2008.
- NMEMNRD. 2012. Presentation from pre-proposal conference, Request for professional & technical services, I&W Brine Cavern project, Carlsbad, New Mexico. May 9, 2012.
- NMEMNRD. 2013. Letter from Jami Bailey to Pieter Bergstein, Salty Dog, Inc., regarding Renewal of discharge permit BW-8 for brine supply well #1 in Unit J of Section 5, Township 19 South, Range 36 East NMPM, Lea County, New Mexico. November 8, 2013.
- Oil Conservation Division, New Mexico Energy, Minerals and Natural Resources Department (OCD). 1994. Letter from Roger C. Anderson to Larry Squires, Salty Dog, regarding Discharge plan BW-08 renewal, Salty Dog Inc. water station, Lea County, New Mexico. March 4, 1994.
- RESPEC Consulting & Services (RESPEC). 2009. *Two-dimensional seismic evaluation of the I&W brine cavern, Carlsbad, New Mexico*. Prepared for New Mexico Oil Conservation Division, Santa Fe, New Mexico. Topical Report RSI-2083. November 2009.
- Salty Dog, Inc. (Salty Dog). 1988. Letter report outlining facility data for quarter ending September 1987. February 25, 1988.
- Salty Dog. 1999. Form C-103 report on Brine supply well #1. Submitted September 8, 1999. Approved by OCD December 1, 1999.
- SOCON Sonar Well Services, Inc. (SOCON). 2009. ECHO-LOG, Salty Dog, Inc. Brine well No: 1, Hobbs, New Mexico: First SOCON Sonar Well Services survey. February 5, 2009.



Unichem International (Unichem). 1987. Laboratory results for water samples collected on November 25, 1987. Prepared for Larry Squires. December 1, 1987.

Figures

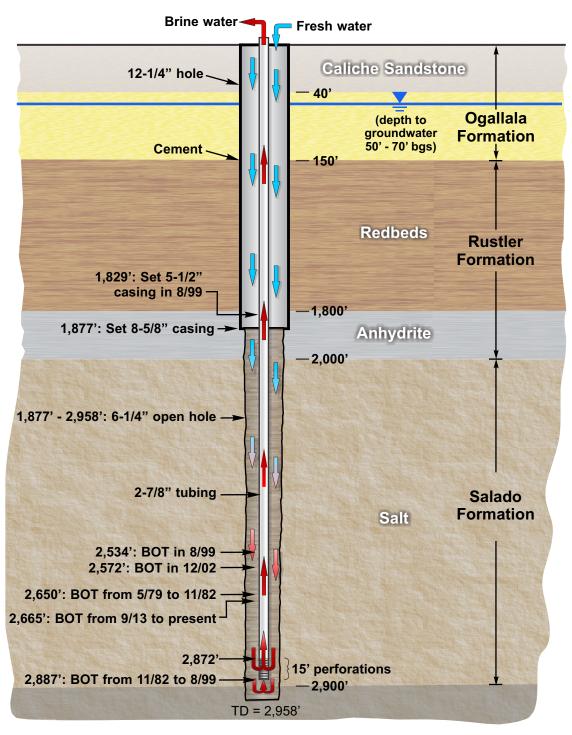
S:\PROJECTS\ES08.0118.05_SALTY_DOG_DP_BW-8\GIS\MXD\FIG01_SITE_LOCATION_AND_FACILITIES.MXD

Water supply well

SALTY DOG BRINE STATION

2014 Aerial Photograph of Salty Dog Brine Station

Salty Dog Brine Well



Notes:

- 1. BOT = Bottom of tubing
- 2. Figure not to scale

Sources:

- 1. Completion data based on OCD well reports
- 2. Lithology from Salty Dog (1988)

SALTY DOG BRINE STATION

Generalized Brine Well Schematic



rojects/es08.0118.05 Salty Dog DP BW-8\VR Drawings/fig03 generalized brine well schematic.cdf

Daniel B. Stephens & Associates, Inc. 9-17-14 JN ES08.0118.05

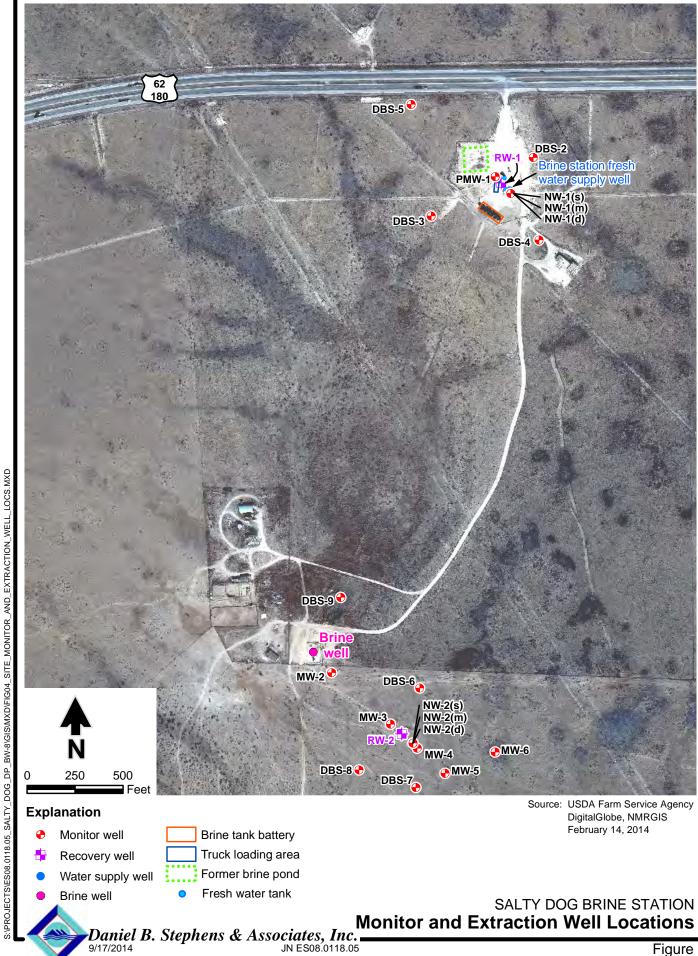
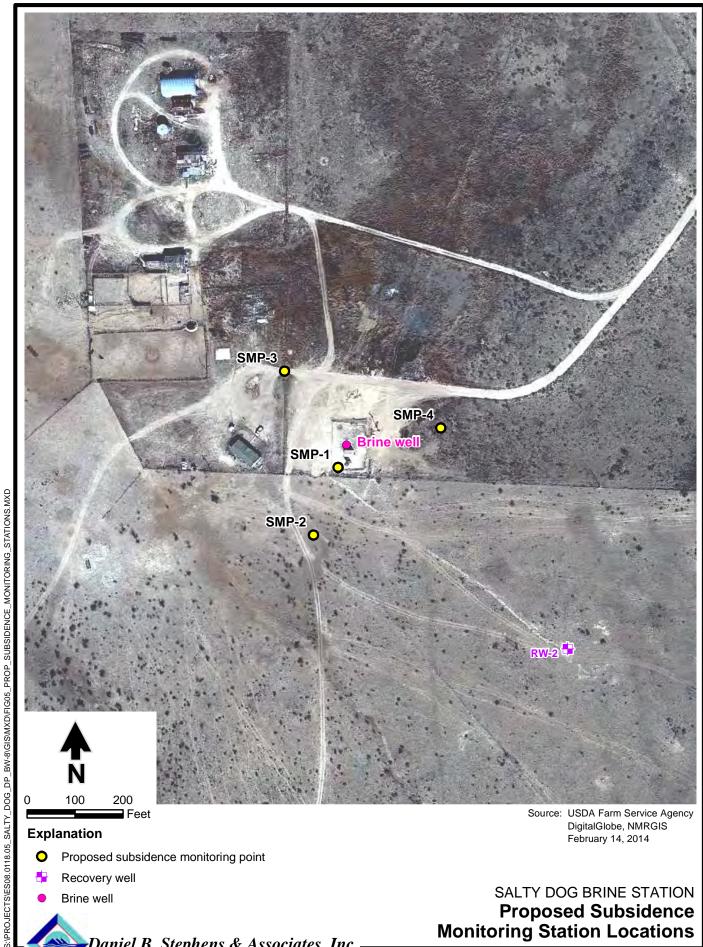


Figure 4



Proposed subsidence monitoring point

Recovery well

Brine well

SALTY DOG BRINE STATION Proposed Subsidence Monitoring Station Locations

Daniel B. Stephens & Associates, Inc., JN ES08.0118.05

Source:

PROJECTS/ES08.0118.05 SALTY DOG DP BW-8\VR DRAWINGS\FIG06 SUBSIDENCE SURVEY MONUMENT DESIGN.CDR

Prepared by Engineering Analytics, Inc. (2014)

SALTY DOG BRINE STATION **Subsidence Survey Monument Design**

Explanation

HRMT = High-resolution magnetotellurics

ER = Electrical resistivity

IPR = Induced polarization resistivity

SEI = Seismic

SON = Sonic

Source:

New Mexico Energy, Minerals & Natural Resources Department (2012)

SALTY DOG BRINE STATION

Subsurface Anomalies Identified by Geophysical Methods at the I&W Site



Dr. Tomas Oberding New Mexico Oil Conservation Division Environmental Bureau 1220 South St. Francis Drive Santa Fe, New Mexico 87505-4225

Re: Third Quarter 2016 Groundwater Monitoring and O&M Report, Salty Dog Brine Station

Dear Dr. Oberding:

On behalf of PAB Services, Inc., Daniel B. Stephens & Associates, Inc. (DBS&A) is pleased to submit the enclosed groundwater monitoring and operation and maintenance (O&M) report for the Salty Dog brine station located in Lea County, New Mexico. The report documents results of third quarter 2016 groundwater monitoring activities completed at the site on September 13 and 14, 2016, as well as groundwater extraction system O&M information.

Please note that we recommend reducing the monitoring and reporting frequency from quarterly to semiannually. We are seeking your approval for this reduction and will continue quarterly monitoring and reporting until we receive that approval. The Settlement Agreement & Stipulated Revised Final Oder NM-OCD 2008-2A allows Salty Dog to request that the monitoring schedule be reduced. This is stipulated on page 15 under subsection f.vi of item 15. We respectively request the reduction on behalf of Salty Dog for the reasons described in the report.

Please do not hesitate to call us at (505) 822-9400 if you have any questions or require additional information.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

John Ayarbe, P.G.

Senior Hydrogeologist

Michael D. McVey, P.G. Senior Hydrogeologist

JA/MDM/rpf Enclosure

cc: Pieter Bergstein, PAB Services, Inc.

Jim Sayre, Salty Dog, Inc.

Third Quarter 2016 Groundwater Monitoring and O&M Report

Salty Dog Brine Station Lea County, New Mexico

Prepared for

New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division

November 9, 2016



Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109



Table of Contents

Se	ection	Page
1.	Introduction	1
2.	Scope of Work	2
3.	Monitoring Activities	2
4.	Analytical Results	4
5.	Groundwater Extraction System O&M 5.1 Former Brine Pond Area 5.2 Brine Well Area 5.3 Facility and System Maintenance 5.4 Future Extraction System Operation	6 6
6.	Recommendations	7

List of Figures

Figure

- 1 Site Location Map
- 2 Former Brine Pond Area Potentiometric Surface Elevations, September 2016
- 3 Playa Lake and Brine Well Area Potentiometric Surface Elevations, September 2016
- 4 Former Brine Pond Area Chloride Concentrations in Groundwater, September 2016
- 5 Playa Lake and Brine Well Area Chloride Concentrations in Groundwater, September 2016



List of Tables

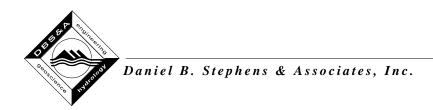
Table

- 1 Historical Fluid Level Measurements
- 2 Chloride Groundwater Analytical Data
- 3 Cumulative Extracted Groundwater Volumes

List of Appendices

Appendix

- A Laboratory Analytical Report
- B Field Notes



Third Quarter 2016 Groundwater Monitoring and O&M Report Salty Dog Brine Station, Lea County, New Mexico

1. Introduction

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this groundwater monitoring and operations and maintenance (O&M) report for submission to the New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division (OCD) Environmental Bureau on behalf of PAB Services, Inc. (PAB) for the Salty Dog brine station (the site) located in Lea County, New Mexico (Figure 1). The report summarizes activities conducted at the site on September 13 and 14, 2016.

The site consists of a northern portion, where the brine pond was located prior to closure in October 2008, and a southern portion, where the brine well is located. The brine pond area and the brine well area are separated by approximately 2,500 feet, joined by a dirt road (Figure 1). Injection water for the brine well comes from two fresh water supply wells (FWS-1 and FWS-2) and remedial pumping at recovery wells in both the former brine pond area (RW-1) and brine well area (RW-2). Groundwater extraction at RW-1 is limited due to pumping from FWS-1. However, pumping at FWS-1 provides hydraulic containment and removal of chloride-impacted groundwater in the former brine pond area.

Brine that is produced for sale is stored at a tank battery on the southern boundary of the former brine pond area. The tank battery consists of six 750-barrel aboveground storage tanks (ASTs) surrounded by a berm. A concrete truck loading pad with two brine filling stations is located north of the tank battery. An operations shed is located adjacent to the loading pad to the west.

Six monitor wells (PMW-1, DBS-1R, and DBS-2 through DBS-5), one nested well (NW-1), one fresh water supply well (FWS-1), and one recovery well (RW-1) are located in the former brine pond area. Nine monitor wells (MW-2 through MW-6, DBS-6 through DBS-9), one nested well (NW-2), one fresh water supply well (FWS-2), and one recovery well (RW-2) are located in the brine well area (Figure 1).



Daniel B. Stephens & Associates, Inc.

DBS&A installed groundwater extraction systems at the site in early April 2012 to provide hydraulic containment and removal of chloride-impacted groundwater in the former brine pond and brine well areas. The extraction systems consist of submersible pumps, conveyance lines, electrical power, and controls to extract impacted groundwater from the recovery wells. Extracted groundwater is conveyed to the on-site ASTs for reinjection at the brine well.

2. Scope of Work

The scope of work for groundwater monitoring consisted of (1) measuring fluid levels in and collecting groundwater samples from 11 monitor wells, and (2) performing maintenance on the groundwater extraction systems, as necessary. Groundwater samples were submitted to Hall Environmental Analysis Laboratory (HEAL) in Albuquerque, New Mexico for chloride analysis using U.S. Environmental Protection Agency (EPA) method 300.0. The monitor wells included in the quarterly sampling were selected in consultation with Jim Griswold on October 4, 2010; Mr. Griswold was the OCD Project Manager for the site at that time. The selected monitor wells are shown in Figures 2 through 5.

3. Monitoring Activities

3.1 Fluid Level Measurement

On September 13, 2016, DBS&A measured water levels in monitor wells DBS-1R, DBS-2 through DBS-5, and PMW-1 in the former brine pond area (Figure 2) and DBS-6, DBS-8, DBS-9, MW-3, and MW-5 in the brine well area (Figure 3) using a properly decontaminated electronic water level meter. Table 1 reports water level measurements and groundwater elevations.

During this monitoring event, the average depths to water beneath the former brine pond area and brine well area were 68.3 feet below ground surface (bgs) and 63.2 feet bgs, respectively. On average, water levels in the former brine pond area declined by approximately 0.9 foot since the last monitoring event in June 2016, while water levels in the brine well area declined by 0.4 foot.



Daniel B. Stephens & Associates, Inc.

Figures 2 and 3 present potentiometric surface maps for the former brine pond area and the brine well area, respectively. The direction of groundwater flow beneath the former brine pond area remains to the southeast at a gradient of approximately 0.006 foot per foot (ft/ft) (Figure 2)—increasing slightly since the previous monitoring event. A broad cone of depression was observed in the vicinity of the fresh water supply well (FWS-1) due to increased fresh water production when depth to water level measurements were recorded. The direction of groundwater flow beneath the brine well area remains to the southeast at a gradient of approximately 0.004 ft/ft (Figure 3)—decreasing slightly relative to the previous monitoring event.

3.2 Groundwater Sampling

On September 14, 2016, groundwater samples were collected from monitor wells DBS-1R, DBS-2 through DBS-6, DBS-8, DBS-9, MW-3, MW-5, and PMW-1 following standard sampling procedures developed from EPA guidance. Before sampling, each well was purged of a minimum of three casing volumes using a submersible pump so that a representative groundwater sample was collected. While purging, DBS&A measured water quality field parameters consisting of temperature, specific conductance, and pH. Samples were collected once three casing volumes were purged. Sample containers were then filled, labeled, and placed in an ice-filled cooler. Groundwater samples were submitted under chain of custody to HEAL for chloride analysis.

Samples of the brine well injection water and the produced brine were also collected to meet requirements under discharge permit BW-8. Analytical results of these samples will be reported in the 2016 Annual Class III Well Report.

4. Analytical Results

Table 2 summarizes chloride analytical results for the 11 groundwater samples. Figures 4 and 5 show the distribution of chloride in groundwater beneath the former brine pond area and the brine well area, respectively. The laboratory report and chain of custody documentation are



Daniel B. Stephens & Associates, Inc.

provided in Appendix A. Field notes recorded during groundwater monitoring activities are provided in Appendix B.

4.1 Former Brine Pond Area Wells

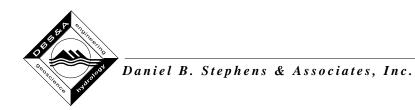
Since the last monitoring event in June 2016, minor to no changes in chloride concentrations were observed at monitor wells DBS-2 through DBS-5 (Table 2). DBS-1R and PMW-1 continue to exhibit chloride concentrations above the New Mexico Water Quality Control Commission (NMWQCC) standard of 250 milligrams per liter (mg/L) (Figure 4). The chloride concentration at DBS-1R showed a slight decrease from 570 mg/L to 360 mg/L, while the concentration at PMW-1 increased slightly, from 8,500 mg/L to 9,300 mg/L.

The chloride plume in the former brine pond area remains bounded by the existing monitor well network (Figure 4). Pumping from PAB's fresh water supply well FSW-1 provides hydraulic containment of the chloride plume. The chloride concentration at downgradient monitor well DBS-4 remains below the NMWQCC standard, as do chloride concentrations at the two crossgradient monitor wells, DBS-2 and DBS-3.

4.2 Brine Well Area Wells

Since the last monitoring event in June 2016, minor changes in chloride concentrations were observed at most of the monitor wells in the brine well area (Table 2). Monitor wells MW-3 (the well closest to extraction well RW-2), MW-5 (the farthest downgradient well), and DBS-6 (the northernmost cross-gradient well) continue to exhibit chloride concentrations above the NMWQCC standard (Figure 5). The chloride concentration at MW-3 decreased from 9,400 mg/L to 9,100 mg/L. The chloride concentration at MW-5 increased from 970 mg/L to 1,000 mg/L. The chloride concentration at DBS-6 decreased from 300 mg/L to 290 mg/L.

During previous monitoring events, monitor well DBS-9 (an upgradient monitor well) has exhibited chloride concentrations above the NMWQCC standard; however, during this reporting period, the chloride concentration at DBS-9 was 190 mg/L, below the NMWQCC standard



(Table 2). DBS-9 was installed in the playa located northeast of the brine well to help characterize groundwater impacts from documented releases in 2002 and 2005.

5. Groundwater Extraction System O&M

Remedial groundwater extraction in the former brine pond and brine well areas began in April 2012 by pumping from recovery wells RW-1 and RW-2. Extracted groundwater volumes at RW-1 and RW-2 are reported in Table 3.

Production from the fresh water supply well (FWS-1) also supports hydraulic containment and removal of chloride-impacted groundwater in the former brine pond area.

5.1 Former Brine Pond Area

Other than some brief shutdowns to address a few maintenance issues, the groundwater extraction system at RW-1 operated continually until approximately March 2015 (Table 3). Pumping from the nearby fresh water supply well (FWS-1) is inhibiting the effectiveness of RW-1 as an extraction well by lowering groundwater levels at this well. PAB attempted to set the pump at RW-1 to a deeper depth in the well so that pumping from RW-1 could continue, but the pump is already set near the bottom of the well. Although pumping from RW-1 has ceased, pumping at FWS-1 provides containment of the chloride plume in the former brine pond area. The average pumping rate at FWS-1 during the third quarter 2016 was approximately 5 gallons per minute (gpm).

Monitor wells DBS-1R and PMW-1 are the only wells that exhibit chloride concentrations above the NMWQCC standard. Pumping of the fresh water supply well is preventing the downgradient migration of the chloride groundwater plume; although the chloride concentrations in wells DBS-1R and PMW-1 remain elevated, they have decreased from historical highs (Table 2) and are expected to continue to decrease through time with continued pumping at the fresh water supply well. The chloride concentration at downgradient monitor well DBS-4 is well below the NMWQCC standard.



5.2 Brine Well Area

The groundwater extraction system at RW-2 has been operated continually since April 6, 2012 with the exception of addressing a few maintenance issues. A total of 18,453,822 gallons of chloride-impacted groundwater have been pumped from RW-2 (Table 3). Historically, pumping of recovery well RW-2 at flow rates of 2.5 to 4.3 gpm produced little drawdown in the brine well area. However, after increasing the average pumping rate to 66 gpm after the second quarter 2015 monitoring event (Table 3), a cone of depression became evident, thereby improving hydraulic containment and removal of the chloride plume.

The average pumping rate at RW-2 during this reporting period was approximately 6 gpm. A cone of depression was not observed during this monitoring event (Figure 3), although RW-2 was pumping at the time water level measurements were recorded.

The chloride plume remains undefined downgradient and cross-gradient to the north of the recovery well (RW-2). Since April 2009, chloride concentrations in the northernmost cross-gradient well (DBS-6) have fluctuated between 290 and 410 mg/L. Since February 2008, chloride concentrations in the downgradient well (MW-5) have fluctuated between 970 and 1,500 mg/L. The chloride concentration in monitor well MW-3, the well closest to the extraction well (RW-2), decreased by almost half between September and December 2015, but has been showing a slight rebound since that time (Table 2).

5.3 Facility and System Maintenance

On June 13, 2016 the pump at RW-2 was damaged during a lightning storm. Operations manager Jim Sayre promptly replaced the pump on June 15, 2016. The pump at FWS-2, upgradient from RW-2 (Figure 1), was also damaged and subsequently replaced.

5.4 Future Extraction System Operation

Pumping of the fresh water supply well (FWS-1) has lowered groundwater levels at RW-1, precluding groundwater extraction at this well. Pumping of FWS-1 provides hydraulic



Daniel B. Stephens & Associates, Inc.

containment and removal of the chloride plume. Future monitoring data will be used to evaluate the effectiveness of FWS-1 in providing hydraulic containment and removal of chloride-impacted groundwater in the former brine pond area.

Pumping of extraction well RW-2 will continue. Increased pumping at RW-2 since the second quarter of 2015 provides improved hydraulic containment and removal of the chloride plume in the brine well area. Future monitoring data will be used to evaluate the effectiveness of RW-2 in providing hydraulic containment and removal of chloride-impacted groundwater in the former brine well area.

6. Recommendations

Based on the current groundwater monitoring results and site O&M activities, DBS&A has the following recommendations:

- Continue groundwater extraction at FWS-1 and RW-2 to provide hydraulic containment of the chloride plumes in the former brine pond area and brine well area, respectively.
- Reduce the monitoring and reporting frequency from quarterly to semiannually. Groundwater extraction from FWS-1 and RW-2 has shown continued containment of the chloride plume in both the former brine pond and brine well areas. Although chloride concentrations at monitor wells immediately adjacent to FWS-1 and RW-2 are elevated, chloride concentrations at the downgradient and cross-gradient monitor wells generally meet the NMWQCC standard and remain stable. Implementation of this recommendation requires OCD approval.

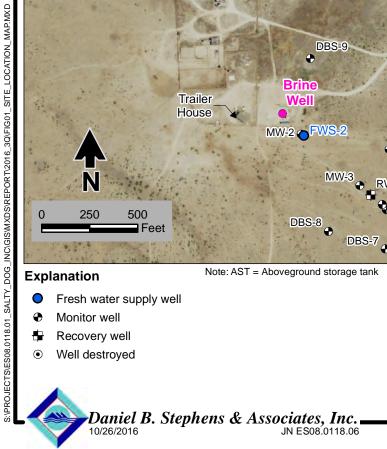
Figures

Explanation

Note: AST = Aboveground storage tank Source: National Agriculture Imagery Program (NAIP), May 10, 2014

- Fresh water supply well
- Monitor well
- Recovery well
- Well destroyed

SALTY DOG BRINE STATION **Site Location Map**



Daniel B. Stephens & Associates, Inc. JN ES08.0118.06

Figure 2

APROJECTS/ES08.0118.01_SALTY_DOG_INC\GIS\MXDS\REPORT\2016_3Q\FIG03_GWE_201609_BRINE_WELL.MXD

3745.49 Groundwater elevation, ft msl

Fresh water supply well

Monitor well Potentiometric surface elevation contour (ft msl),

dashed where inferred Recovery well

SALTY DOG BRINE STATION

Groundwater flow direction Playa Lake and Brine Well Area **Potentiometric Surface Elevations** September 2016

Daniel B. Stephens & Associates, Inc., JN ES08.0118.06

Explanation

DBS-5 Well designation

Chloride concentration (mg/L) 170

Monitor well

Recovery well

Red indicates concentration equal to or greater than the NMWQCC standard.

Source: National Agriculture Imagery Program (NAIP), May 10, 2014

SALTY DOG BRINE STATION

Former Brine Pond Area Chloride Concentrations in Groundwater September 2016

Daniel B. Stephens & Associates, Inc. JN ES08.0118.06

Explanation

DBS-8 Well designation

- Chloride concentration (mg/L)
- Monitor well
- Recovery well

Red indicates concentration equal to or greater than the NMWQCC standard.

Source: National Agriculture Imagery Program (NAIP), May 10, 2014

SALTY DOG BRINE STATION

Playa Lake and Brine Well Area **Chloride Concentrations in Groundwater** September 2016

Daniel B. Stephens & Associates, Inc. JN ES08.0118.06

Tables

Table 1. Historical Fluid Level Measurements Salty Dog Brine Station, Lea County, New Mexico Page 1 of 7

	Coroon	Top of		Donth to	Cravedovatar
Monitor	Screen Interval	Casing Elevation ^a	Date	Depth to Water	Groundwater Elevation
Well	(ft bgs)	(ft msl)	Measured	(ft btoc)	(ft msl)
DBS-1	56.0–76.0	3,817.09	4/08/2009	62.38	3,754.71
			5/11/2011	64.70	3,752.39
			10/04/2011	Well destroyed	
DBS-1R	58.0–78.0	3,817.00 b	4/30/2012	63.60	3,753.40
			9/10/2012	65.65	3,751.35
			6/23/2013	64.40	3,752.60
			1/09/2014	67.23	3,749.77
			4/07/2014	66.36	3,750.64
			3/20/2015	67.17	3,749.83
			7/01/2015	67.92	3,749.08
			9/29/2015	67.07	3,749.93
			12/16/2015	67.54	3,749.46
			3/22/2016	66.61	3,750.39
			6/08/2016	66.23	3,750.77
			9/13/2016	67.43	3,749.57
DBS-2	58.0–78.0	3,820.50	4/08/2009	65.45	3,755.05
			5/11/2011	66.80	3,753.70
			10/04/2011	65.87	3,754.63
			2/08/2012	65.96	3,754.54
			4/30/2012	66.26	3,754.24
			9/10/2012	67.45	3,753.05
			6/23/2013	67.03	3,753.47
			1/09/2014	69.08	3,751.42
			4/07/2014	68.67	3,751.83
			3/20/2015	69.32	3,751.18
			6/30/2015	69.29	3,751.21
			9/29/2015	69.41	3,751.09
			12/16/2015	69.71	3,750.79
			3/22/2016	69.13	3,751.37
			6/08/2016	68.91	3,751.59
			9/13/2016	69.76	3,750.74

ft btoc = Feet below top of casing ft bgs = Feet below ground surface

ft msl = Feet above mean sea level NA = Not available

^a Top of casing elevations surveyed by Pettigrew & Assoc. on May 28, 2009. ^b Top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012.

Table 1. Historical Fluid Level Measurements Salty Dog Brine Station, Lea County, New Mexico Page 2 of 7

	Screen	Top of Casing		Depth to	Groundwater
Monitor	Interval	Elevation a	Date	Water	Elevation
Well	(ft bgs)	(ft msl)	Measured	(ft btoc)	(ft msl)
DBS-3	56.0–76.72	3,816.66	4/08/2009	60.67	3,755.99
			5/11/2011	61.25	3,755.41
			10/04/2011	61.25	3,755.41
			2/08/2012	61.11	3,755.55
			4/30/2012	61.41	3,755.25
			9/10/2012	61.81	3,754.85
			6/23/2013	62.08	3,754.58
			1/09/2014	63.30	3,753.36
			4/07/2014	63.43	3,753.23
			3/20/2015	63.93	3,752.73
			6/30/2015	63.99	3,752.67
			9/29/2015	64.17	3,752.49
			12/16/2015	64.41	3,752.25
			3/22/2016	63.88	3,752.78
			6/08/2016	63.92	3,752.74
			9/13/2016	64.56	3,752.10
DBS-4	56.0–76.0	3,820.37	4/08/2009	66.27	3,754.10
			5/11/2011	67.23	3,753.14
			10/04/2011	66.67	3,753.70
			2/08/2012	66.76	3,753.61
			4/30/2012	67.02	3,753.35
			9/10/2012	67.78	3,752.59
			6/23/2013	67.70	3,752.67
			1/09/2014	69.37	3,751.00
			4/07/2014	69.23	3,751.14
			3/20/2015	69.81	3,750.56
			6/30/2015	69.85	3,750.52
			9/29/2015	70.00	3,750.37
			12/16/2015	70.25	3,750.12
			3/22/2016	69.74	3,750.63
			6/08/2016	69.62	3,750.75
			9/13/2016	70.35	3,750.02

^a Top of casing elevations surveyed by Pettigrew & Assoc. on May 28, 2009.

ft bgs = Feet below ground surface ft btoc = Feet below top of casing

b Top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012.

Table 1. Historical Fluid Level Measurements Salty Dog Brine Station, Lea County, New Mexico Page 3 of 7

Monitor Well	Screen Interval (ft bgs)	Top of Casing Elevation ^a (ft msl)	Date Measured	Depth to Water (ft btoc)	Groundwater Elevation (ft msl)
DBS-5	56.9–76.9	3,820.66	4/08/2009	62.99	3,757.67
			5/11/2011	63.45	3,757.21
			10/04/2011	63.41	3,757.25
			2/08/2012	63.46	3,757.20
			4/30/2012	63.70	3,756.96
			9/10/2012	63.92	3,756.74
			6/23/2013	64.30	3,756.36
			1/09/2014	65.28	3,755.38
			4/07/2014	65.48	3,755.18
			3/20/2015	65.9	3,754.76
			7/01/2015	66.18	3,754.48
			9/29/2015	66.25	3,754.41
			12/16/2015	66.47	3,754.19
			3/22/2016	66.08	3,754.58
			6/08/2016	66.16	3,754.50
			9/13/2016	66.64	3,754.02
DBS-6	56.7–76.7	3,812.65	4/07/2009	62.75	3,749.90
			5/11/2011	63.11	3,749.54
			10/04/2011	63.16	3,749.49
			2/08/2012	63.20	3,749.45
			4/30/2012	63.43	3,749.22
			9/10/2012	63.60	3,749.05
			6/23/2013	63.74	3,748.91
			1/09/2014	64.00	3,748.65
			4/07/2014	64.22	3,748.43
			3/19/2015	64.78	3,747.87
			7/01/2015	64.81	3,747.84
			9/29/2015	65.48	3,747.17
			12/16/2015	65.26	3,747.39
			3/22/2016	65.38	3,747.27

 $^{^{\}rm a}_{\cdot}$ Top of casing elevations surveyed by Pettigrew & Assoc. on May 28, 2009.

ft bgs = Feet below ground surface ft btoc = Feet below top of casing

b Top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012.

Table 1. Historical Fluid Level Measurements Salty Dog Brine Station, Lea County, New Mexico Page 4 of 7

	Screen	Top of		Donth to	Groundwater
Monitor	Interval	Casing Elevation ^a	Date	Depth to Water	Elevation
Well	(ft bgs)	(ft msl)	Measured	(ft btoc)	(ft msl)
DBS-6 (cont.)	56.7–76.7	3,812.65	6/08/2016	65.37	3,747.28
			9/13/2016	65.51	3,747.14
DBS-7	55.1–75.1	3,810.21	4/07/2009	61.74	3,748.47
DBS-8	55.2–75.2	3,810.70	4/07/2009	61.20	3,749.50
			5/11/2011	61.67	3,749.03
			10/04/2011	61.71	3,748.99
			2/08/2012	61.77	3,748.93
			4/30/2012	62.00	3,748.70
			9/10/2012	62.15	3,748.55
			6/23/2013	62.28	3,748.42
			1/09/2014	62.47	3,748.23
			4/07/2014	62.67	3,748.03
			3/19/2015	63.19	3,747.51
			6/30/2015	63.25	3,747.45
			9/29/2015	63.82	3,746.88
			12/16/2015	63.58	3,747.12
			3/22/2016	63.76	3,746.94
			6/08/2016	63.72	3,746.98
			9/13/2016	63.83	3,746.87
DBS-9	48.0–68.0	3,806.26	4/08/2009	53.93	3,752.33
			5/11/2011	54.39	3,751.87
			10/04/2011	54.59	3,751.67
			2/08/2012	54.53	3,751.73
			4/30/2012	54.68	3,751.58
			9/10/2012	54.77	3,751.49
			6/23/2013	55.04	3,751.22
			1/09/2014	55.27	3,750.99
			4/07/2014	55.56	3,750.70
			3/19/2015	55.95	3,750.31
			7/01/2015	56.14	3,750.12
			9/29/2015	56.49	3,749.77

^a Top of casing elevations surveyed by Pettigrew & Assoc. on May 28, 2009.

ft btoc = Feet below top of casing ft bgs = Feet below ground surface

b Top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012.

Table 1. Historical Fluid Level Measurements Salty Dog Brine Station, Lea County, New Mexico Page 5 of 7

Monitor Well	Screen Interval (ft bgs)	Top of Casing Elevation ^a (ft msl)	Date Measured	Depth to Water (ft btoc)	Groundwater Elevation (ft msl)
DBS-9 (cont.)	48.0–68.0	3,806.26	12/16/2015	56.52	3,749.74
			3/22/2016	56.51	3,749.75
			6/08/2016	56.64	3,749.62
			9/13/2016	56.81	3,749.45
NW-1s	52.95-72.95	3,817.33	4/08/2009	62.35	3,754.98
NW-1m	99.31–119.31	3,817.35	4/08/2009	62.25	3,755.10
NW-1d	149.45–169.45	3,817.35	4/08/2009	62.04	3,755.31
NW-2s	53.35–73.35	3,812.50	4/08/2009	63.08	3,749.42
NW-2m	93.72–113.72	3,812.45	4/08/2009	63.27	3,749.18
NW-2d	126.87–146.87	3,812.46	4/08/2009	66.41	3,746.05
PMW-1	63–78	3,821.17	6/23/2008	67.51	3,753.66
			4/08/2009	65.97	3,755.20
			5/11/2011	68.70	3,752.47
			10/04/2011	66.95	3,754.22
			2/08/2012	66.69	3,754.48
			4/30/2012	67.27	3,753.90
			9/10/2012	69.77	3,751.40
			6/23/2013	68.40	3,752.77
			1/09/2014	71.24	3,749.93
			4/07/2014	69.97	3,751.20
			3/20/2015	70.78	3,750.39
			7/01/2015	71.41	3,749.76
			9/29/2015	70.76	3,750.41
			12/16/2015	71.03	3,750.14
			3/22/2016	70.30	3,750.87
			6/08/2016	69.65	3,751.52
			9/13/2016	71.08	3,750.09
MW-1	120–140	NA	6/23/2008	59.90	NA
MW-2	127–147	3,812.68	6/23/2008	61.42	3,751.26
			4/07/2009	61.65	3,751.03

^a Top of casing elevations surveyed by Pettigrew & Assoc. on May 28, 2009.

ft btoc = Feet below top of casing

b Top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012. ft bgs = Feet below ground surface ft btoc = Feet below top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012.

Table 1. Historical Fluid Level Measurements Salty Dog Brine Station, Lea County, New Mexico Page 6 of 7

Monitor Well	Screen Interval (ft bgs)	Top of Casing Elevation ^a (ft msl)	Date Measured	Depth to Water (ft btoc)	Groundwater Elevation (ft msl)
MW-3	NA	3,812.05	6/23/2008	62.06	3,749.99
			4/07/2009	62.02	3,750.03
			5/11/2011	62.91	3,749.14
			10/04/2011	62.91	3,749.14
			2/08/2012	62.95	3,749.10
			4/30/2012	63.39	3,748.66
			9/10/2012	63.50	3,748.55
			6/23/2013	63.36	3,748.69
			1/09/2014	63.55	3,748.50
			4/07/2014	63.88	3,748.17
			3/19/2015	64.27	3,747.78
			7/01/2015	64.34	3,747.71
			9/29/2015	67.94	3,744.11
			12/16/2015	64.75	3,747.30
			3/22/2016	64.84	3,747.21
			6/08/2016	64.89	3,747.16
			9/13/2016	66.33	3,745.72
MW-4	111–131	3,811.33	6/23/2008	62.12	3,749.21
			4/07/2009	62.51	3,748.82
MW-5	112–132	3,808.96	6/23/2008	60.60	3,748.36
			4/07/2009	60.79	3,748.17
			5/11/2011	61.17	3,747.79
			10/04/2011	61.72	3,747.24
			2/08/2012	61.23	3,747.73
			4/30/2012	61.50	3,747.46
			9/10/2012	61.65	3,747.31
			6/23/2013	61.75	3,747.21
			1/09/2014	61.90	3,747.06
			4/07/2014	62.18	3,746.78
			3/19/2015	62.96	3,746.00
			6/30/2015	62.71	3,746.25

^a Top of casing elevations surveyed by Pettigrew & Assoc. on May 28, 2009.

ft btoc = Feet below top of casing ft bgs = Feet below ground surface

b Top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012.

Daniel B. Stephens & Associates, Inc.

Table 1. Historical Fluid Level Measurements Salty Dog Brine Station, Lea County, New Mexico Page 7 of 7

Monitor Well	Screen Interval (ft bgs)	Top of Casing Elevation ^a (ft msl)	Date Measured	Depth to Water (ft btoc)	Groundwater Elevation (ft msl)
MW-5 (cont.)	112–132	3,808.96	9/29/2015	63.92	3,745.04
			12/16/2015	63.02	3,745.94
			3/22/2016	63.14	3,745.82
			6/08/2016	63.47	3,745.49
			9/13/2016	63.66	3,745.30
MW-6	NA	3,810.17	6/23/2008	62.17	3,748.00
			4/07/2009	62.41	3,747.76

ft bgs = Feet below ground surface ft btoc = Feet below top of casing

^a Top of casing elevations surveyed by Pettigrew & Assoc. on May 28, 2009. ^b Top of casing elevation surveyed by Pettigrew & Assoc. on June 13, 2012.



Table 2. Chloride Groundwater Analytical Data Salty Dog Brine Station, Lea County, New Mexico Page 1 of 7

Monitor Well	Date	Chloride Concentration (mg/L) ^a
	NMWQCC Standard	
DBS-1	I	250
DD9-1	4/08/2009	320
	5/12/2011	940
DDC 4D	10/04/2011	Well destroyed
DBS-1R	5/01/2012	3,000
	9/11/2012	3,200
	6/25/2013	3,300
	1/10/2014	1,000
	4/08/2014	1,700
	3/20/2015	1,200
	7/01/2015	860
	9/30/2015	670
	12/17/2015	760
	3/23/2016	560
	6/09/2016	570
	09/14/2016	360
DBS-2	4/08/2009	14
	5/12/2011	25
	10/05/2011	18
	2/09/2012	22
	5/01/2012	24
	9/11/2012	44
	6/25/2013	36
	1/10/2014	45
	4/08/2014	22
	3/20/2015	29
	6/30/2015	28
	9/30/2015	40
	12/17/2015	35
	3/23/2016	46
	6/09/2016	41
	9/14/2016	41

^a All samples analyzed using EPA method 300.0, unless otherwise noted.

b Samples analyzed using Standard Method 4500-Cl B. mg/L = Milligrams per liter



Table 2. Chloride Groundwater Analytical Data Salty Dog Brine Station, Lea County, New Mexico Page 2 of 7

Monitor Well	Date	Chloride Concentration (mg/L) ^a
	NMWQCC Standard	
DBS-3	4/08/2009	250 36
	5/12/2011	35
	10/05/2011	34
	2/09/2012	34
	5/01/2012	33
	9/11/2012	34
	6/24/2013	32
	1/10/2014	34
	4/08/2014	32
	3/20/2015	35
	6/30/2015	35
	9/30/2015	34
	12/17/2015	34
	3/23/2016	36
	6/09/2016	35
	9/14/2016	37
DBS-4	4/08/2009	38
	5/12/2011	33
	10/05/2011	32
	2/09/2012	32
	5/01/2012	31
	9/11/2012	32
	6/25/2013	31
	1/10/2014	32
	4/08/2014	30
	3/20/2015	33
	6/30/2015	31
	9/30/2015	33
	12/17/2015	35
	3/23/2016	38

^a All samples analyzed using EPA method 300.0, unless otherwise noted.

b Samples analyzed using Standard Method 4500-Cl B. mg/L = Milligrams per liter



Table 2. Chloride Groundwater Analytical Data Salty Dog Brine Station, Lea County, New Mexico Page 3 of 7

Monitor Well	Date	Chloride Concentration (mg/L) ^a
NA	NMWQCC Standard	
DBS-4 (cont.)	6/09/2016	35
(3.2.1)	9/14/2016	37
DBS-5	4/08/2009	65
	5/12/2011	140
	10/05/2011	140
	2/09/2012	140
	4/30/2012	150
	9/11/2012	160
	6/24/2013	160
	1/10/2014	180
	4/08/2014	160
	3/20/2015	140
	7/01/2015	140
	9/30/2015	150
	12/17/2015	160
	3/23/2016	150
	6/09/2016	150
	9/14/2016	170
DBS-6	4/07/2009	380
	5/12/2011	410
	10/05/2011	400
	2/09/2012	380
	4/30/2012	400
	9/11/2012	390
	6/24/2013	340
	1/10/2014	390
	4/07/2014	400
	3/19/2015	370
	7/01/2015	360
	9/30/2015	370
	12/17/2015	380

^a All samples analyzed using EPA method 300.0, unless otherwise noted.

b Samples analyzed using Standard Method 4500-Cl B. mg/L = Milligrams per liter



Table 2. Chloride Groundwater Analytical Data Salty Dog Brine Station, Lea County, New Mexico Page 4 of 7

Monitor Well	Date	Chloride Concentration (mg/L) ^a
NA	IWQCC Standard	250
DBS-6 (cont.)	3/23/2016	310
2200 (00)	6/09/2016	300
	9/14/2016	290
DBS-7	4/07/2008	570
DBS-8	4/07/2009	58
	5/12/2011	36
	10/05/2011	140
	2/09/2012	41
	4/30/2012	41
	9/10/2012	42
	6/24/2013	45
	1/09/2014	38
	4/07/2014	36
	3/19/2015	36
	7/01/2015	34
	9/30/2015	35
	12/17/2015	33
	3/23/2016	35
	6/09/2016	34
	9/14/2016	34
DBS-9	4/08/2009	210
	5/12/2011	600
	10/05/2011	440
	2/09/2012	290
	4/30/2012	330
	9/11/2012	320
	6/24/2013	200
	1/10/2014	170
	4/07/2014	220
	3/19/2015	260
	7/01/2015	210

^a All samples analyzed using EPA method 300.0, unless otherwise noted.

b Samples analyzed using Standard Method 4500-Cl B. mg/L = Milligrams per liter



Table 2. Chloride Groundwater Analytical Data Salty Dog Brine Station, Lea County, New Mexico Page 5 of 7

		Chloride Concentration
Monitor Well	Date	(mg/L) ^a
NN	IWQCC Standard	250
DBS-9 (cont.)	9/30/2015	260
	12/17/2015	230
	3/23/2016	200
	6/09/2016	190
	9/14/2016	190
NW-1s	4/08/2009	630
NW-1m	4/08/2009	57
NW-1d	4/08/2009	38
NW-2s	4/08/2009	410
NW-2m	4/08/2009	570
NW-2d	4/08/2009	4,700
PMW-1	2/27/2008	9,500 ^b
	5/30/2008	8,600 ^b
	6/23/2008	12,700
	4/08/2009	11,000
	5/12/2011	13,000
	10/05/2011	12,000
	2/09/2012	12,000
	5/01/2012	12,000
	9/11/2012	14,000
	6/25/2013	14,000
	1/10/2014	11,000
	4/08/2014	12,000
	3/20/2015	8,500
	7/01/2015	8,600
	9/30/2015	9,700
	12/17/2015	9,800
	3/23/2016	8,200
	6/09/2016	8,500
	9/14/2016	9,300

 $^{^{\}rm a}_{\scriptscriptstyle .}$ All samples analyzed using EPA method 300.0, unless otherwise noted.

b Samples analyzed using Standard Method 4500-Cl B. mg/L = Milligrams per liter



Table 2. Chloride Groundwater Analytical Data Salty Dog Brine Station, Lea County, New Mexico Page 6 of 7

Monitor Well	Date	Chloride Concentration (mg/L) ^a
N	//WQCC Standard	250
MW-1	5/30/2008	75 ^b
10100	6/23/2008	243
MW-2	2/27/2008	120 b
2	5/30/2008	80 b
	6/23/2008	1,480
	4/07/2009	1,200
MW-3	2/27/2008	348 ^b
-	5/30/2008	360 b
	6/23/2008	1,090
	4/07/2009	17,000
	5/12/2011	16,000
	10/05/2011	14,000
	2/09/2012	15,000
	4/30/2012	14,000
	9/10/2012	16,000
	6/24/2013	12,000
	1/10/2014	10,000
	4/07/2014	12,000
	3/19/2015	9,700
	7/01/2015	10,000
	9/30/2015	9,600
	12/17/2015	5,100
	3/23/2016	8,200
	6/09/2016	9,400
	9/14/2016	9,100
MW-4	2/27/2008	476 ^b
	5/30/2008	512 ^b
	6/23/2008	5,730
	4/07/2009	6,600
MW-5	2/27/2008	1,280 ^b
	5/30/2008	1,220 ^b

^a All samples analyzed using EPA method 300.0, unless otherwise noted.

b Samples analyzed using Standard Method 4500-Cl B. mg/L = Milligrams per liter

Table 2. Chloride Groundwater Analytical Data Salty Dog Brine Station, Lea County, New Mexico Page 7 of 7

Monitor Well	Date	Chloride Concentration (mg/L) ^a
NV	//////////////////////////////////////	250
MW-5 (cont.)	6/23/2008	1,260
	4/07/2009	1,300
	5/12/2011	1,500
	10/05/2011	1,500
	2/09/2012	1,500
	4/30/2012	1,400
	9/10/2012	1,500
	6/24/2013	1,300
	1/10/2014	1,300
	4/07/2014	1,300
	3/19/2015	1,200
	7/01/2015	1,200
	9/30/2015	1,000
	12/17/2015	1,000
	3/23/2016	980
	6/09/2016	970
	9/14/2016	1,000
MW-6	2/27/2008	32 ^b
	5/30/2008	36 ^b
	6/23/2008	31.4
	4/07/2009	25
Ranch Headquarters Supply Well	6/23/2008	35.4
Brine Station Fresh	2/27/2008	630 ^b
Water Supply Well	5/30/2008	590 ^b
	6/23/2008	650

^a All samples analyzed using EPA method 300.0, unless otherwise noted.

^b Samples analyzed using Standard Method 4500-Cl B. mg/L = Milligrams per liter



Table 3. Cumulative Extracted Groundwater Volumes Salty Dog Brine Station, Lea County, New Mexico

Recovery Well	Date	Days of Operation	Average Flow Rate (gpm)	Extracted Volume (gallons)
RW-1	4/07/2012	Gro	undwater extractio	n started
	5/01/2012	24	2.1	73,740
	9/11/2012	154	2.9	636,237
	6/25/2013	441	4.1	2,599,392
	11/15/2013 a	585	3.6	3,060,181
	3/20/2015	1,075	2.4	3,668,511
	6/30/2015 b	1,167	_	3,668,511
	9/30/2015	1,259		3,668,511
FWS-1	12/17/2015	_		1,232,787
	3/22/2016	359	12.8	3,011,469
	6/08/2016	437	33.9	6,818,179
	9/13/2016	534	5.4	7,578,404
RW-2	4/06/2012	Gro	undwater extractio	n started
	5/01/2012	25	2.5	91,450
	9/11/2012	158	4.3	963,789
	12/14/2012 ^c	252	3.9	1,406,748
	6/25/2013 ^d			_
	9/21/2013 ^e	335	2.9	1,407,005
	9/30/2015 ^f	1,074	68 ^f	7,313,515
	12/17/2015	1,152	44	12,266,210
	3/22/2016	1,248	32	16,657,635
	6/08/2016	1,326	9.0	17,661,576
	9/13/2016	1,423	5.7	18,453,822

^a Pump went down in RW-1 on approximately November 15, 2013.

gpm = Gallons per minute

b Meter appears to not be functioning correctly, but the pumping well is functioning.

Pump in RW-2 went down on December 14, 2012 due to a blown inner shaft motor seal.

New pump installed in RW-2 and started on June 25, 2013.

e Meter and pump were removed from RW-2 on approximately September 21, 2013 by facility manager to install a new, larger-capacity pump.

Meter reinstalled and pumping increased after the June 30 and July 1, 2015 monitoring event; flowrate assumes 60 days of operation (August 1 through September 30, 2015) based on personal communication with Jim Sayre (PAB).

Appendix A

Laboratory Analytical

Report



Hall Environmental Analysis Laboratory 4901 Hawkins NE Albuquerque, NM 87109 TEL: 505-345-3975 FAX: 505-345-4107 Website: www.hallenvironmental.com

October 12, 2016

John Ayarbe

Daniel B. Stephens & Assoc. 6020 Academy NE Suite 100

Albuquerque, NM 87109 TEL: (505) 822-9400

FAX (505) 822-8877

RE: Salty Dog OrderNo.: 1609828

Dear John Ayarbe:

Hall Environmental Analysis Laboratory received 13 sample(s) on 9/15/2016 for the analyses presented in the following report.

These were analyzed according to EPA procedures or equivalent. To access our accredited tests please go to www.hallenvironmental.com or the state specific web sites. In order to properly interpret your results it is imperative that you review this report in its entirety. See the sample checklist and/or the Chain of Custody for information regarding the sample receipt temperature and preservation. Data qualifiers or a narrative will be provided if the sample analysis or analytical quality control parameters require a flag. When necessary, data qualifers are provided on both the sample analysis report and the QC summary report, both sections should be reviewed. All samples are reported, as received, unless otherwise indicated. Lab measurement of analytes considered field parameters that require analysis within 15 minutes of sampling such as pH and residual chlorine are qualified as being analyzed outside of the recommended holding time.

Please don't hesitate to contact HEAL for any additional information or clarifications.

ADHS Cert #AZ0682 -- NMED-DWB Cert #NM9425 -- NMED-Micro Cert #NM0190

Sincerely,

Andy Freeman

Laboratory Manager

andyl

4901 Hawkins NE

Albuquerque, NM 87109

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-1R

Project: Salty Dog
 Collection Date: 9/14/2016 3:30:00 PM

 Lab ID: 1609828-001
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qual Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS			Analy	st: LGT
Chloride	360	50 * mg/L	100 9/20/2016 8:45:19 PM	/I R37349

xceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
Diluted Due to Matrix	E	Value above quantitation range
times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 1 of 17
ected at the Reporting Limit	P	Sample pH Not In Range
tside accepted recovery limits	RL	Reporting Detection Limit
very outside of range due to dilution or matrix	\mathbf{W}	Sample container temperature is out of limit as specified
	xceeds Maximum Contaminant Level. Diluted Due to Matrix g times for preparation or analysis exceeded sected at the Reporting Limit straide accepted recovery limits very outside of range due to dilution or matrix	Diluted Due to Matrix E stimes for preparation or analysis exceeded J ected at the Reporting Limit P tside accepted recovery limits RL

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-2

Project: Salty Dog
 Collection Date: 9/14/2016 2:00:00 PM

 Lab ID: 1609828-002
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qu	al Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS				Analy	st: LGT
Chloride	41	5.0	mg/L	10 9/20/2016 8:57:44 PN	/ R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 2 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-3

Project: Salty Dog
 Collection Date: 9/14/2016 3:05:00 PM

 Lab ID: 1609828-003
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qu	al Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS				Analy	st: LGT
Chloride	37	5.0	mg/L	10 9/20/2016 9:22:33 PM	/ R37349

-				
Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	Е	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 3 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-4

Project: Salty Dog
 Collection Date: 9/14/2016 12:30:00 PM

 Lab ID: 1609828-004
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qu	al Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS				Analy	st: LGT
Chloride	37	5.0	mg/L	10 9/20/2016 9:47:23 PM	/ R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 4 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-5

 Project:
 Salty Dog
 Collection Date: 9/14/2016 2:30:00 PM

 Lab ID:
 1609828-005
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qu	al Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS				Analy	/st: LGT
Chloride	170	5.0	mg/L	10 9/20/2016 10:37:02 F	PM R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 5 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Analytical Report

Lab Order 1609828

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-6

Project: Salty Dog
 Collection Date: 9/14/2016 11:45:00 AM

 Lab ID: 1609828-006
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qual Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS			Anal	yst: LGT
Chloride	290	50 * mg/L	100 9/20/2016 11:14:17	PM R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 6 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-8

 Project:
 Salty Dog
 Collection Date: 9/14/2016 9:05:00 AM

 Lab ID:
 1609828-007
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qu	al Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS				Analy	/st: LGT
Chloride	34	5.0	mg/L	10 9/20/2016 11:26:42 F	PM R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 7 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: DBS-9

 Project:
 Salty Dog
 Collection Date: 9/14/2016 8:25:00 AM

 Lab ID:
 1609828-008
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qu	al Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS				Anal	yst: LGT
Chloride	190	50	mg/L	100 9/21/2016 12:03:56	AM R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 8 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: MW-3

Project: Salty Dog
 Collection Date: 9/14/2016 11:10:00 AM

 Lab ID: 1609828-009
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qual Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS			Analy	/st: LGT
Chloride	9100	500 * mg/L	1E 9/21/2016 12:28:45 A	AM R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 9 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Date Reported: 10/12/2016

Hall Environmental Analysis Laboratory, Inc.

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: MW-5

Project: Salty Dog
 Collection Date: 9/14/2016 10:10:00 AM

 Lab ID: 1609828-010
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qual Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS			Analy	st: LGT
Chloride	1000	50 * mg/L	100 9/21/2016 1:18:24 AM	Л R37349

*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
D	Sample Diluted Due to Matrix	Е	Value above quantitation range
Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limit Page 10 of 17
ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified
	D H ND	 D Sample Diluted Due to Matrix H Holding times for preparation or analysis exceeded ND Not Detected at the Reporting Limit R RPD outside accepted recovery limits 	D Sample Diluted Due to Matrix E H Holding times for preparation or analysis exceeded J ND Not Detected at the Reporting Limit P R RPD outside accepted recovery limits RL

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: PMW-1

 Project:
 Salty Dog
 Collection Date: 9/14/2016 4:05:00 PM

 Lab ID:
 1609828-011
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Qual Units	DF Date Analyzed	Batch
EPA METHOD 300.0: ANIONS			Analy	st: LGT
Chloride	9300	500 * mg/L	1E 9/21/2016 1:43:14 AM	/I R37349

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limit Page 11 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: Injection

Project: Salty Dog
 Collection Date: 9/14/2016 3:45:00 PM

 Lab ID: 1609828-012
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result	PQL Q	ual Units	DF Date Analyzed	Batch
SPECIFIC GRAVITY				Analys	t: LGT
Specific Gravity	0.9915	0		1 9/21/2016 3:49:00 PM	R37370
EPA METHOD 300.0: ANIONS				Analys	t: LGT
Chloride	240	50	mg/L	100 9/21/2016 2:08:04 AM	R37349
SM2540C MOD: TOTAL DISSOLVE	D SOLIDS			Analys	t: KS
Total Dissolved Solids	725	20.0	* mg/L	1 9/23/2016 1:36:00 PM	27634
SM4500-H+B: PH				Analys	t: JRR
рН	8.11	1.68	H pH units	1 9/19/2016 9:35:15 PM	R37296

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limit Page 12 of 17
	ND	Not Detected at the Reporting Limit	P	Sample pH Not In Range
	R	RPD outside accepted recovery limits	RL	Reporting Detection Limit
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

Date Reported: 10/12/2016

CLIENT: Daniel B. Stephens & Assoc. Client Sample ID: Brine

Project: Salty Dog
 Collection Date: 9/14/2016 4:07:00 PM

 Lab ID: 1609828-013
 Matrix: AQUEOUS
 Received Date: 9/15/2016 10:30:00 AM

Analyses	Result PQL Qual Uni		Units	DF	Date Analyzed	Batch	
SPECIFIC GRAVITY						Analys	t: LGT
Specific Gravity	1.148	0			1	9/21/2016 3:49:00 PM	R37370
EPA METHOD 300.0: ANIONS						Analys	t: LGT
Chloride	160000	5000	*	mg/L	1E	9/21/2016 2:20:29 AM	R37349
SM2540C MOD: TOTAL DISSOLVED	SOLIDS					Analys	t: KS
Total Dissolved Solids	241000	2000	*D	mg/L	1	9/23/2016 1:36:00 PM	27634
SM4500-H+B: PH						Analys	t: JRR
рН	7.32	1.68	Н	pH units	1	9/19/2016 9:39:11 PM	R37296
EPA METHOD 200.7: METALS						Analys	t: ELS
Sodium	140	2.0		mg/L	1	9/30/2016 8:22:30 PM	27612

Qualifiers:	*	Value exceeds Maximum Contaminant Level.	В	Analyte detected in the associated Method Blank
	D	Sample Diluted Due to Matrix	E	Value above quantitation range
	Н	Holding times for preparation or analysis exceeded	J	Analyte detected below quantitation limits Page 13 of 17
ND Not Detected at the Reporting Limit				Sample pH Not In Range
R RPD outside accepted recovery limits		RL	Reporting Detection Limit	
	S	% Recovery outside of range due to dilution or matrix	W	Sample container temperature is out of limit as specified

Hall Environmental Analysis Laboratory, Inc.

WO#: **1609828**

12-Oct-16

Client: Daniel B. Stephens & Assoc.

Project: Salty Dog

Sample ID MB-27612 SampType: MBLK TestCode: EPA Method 200.7: Metals

Client ID: PBW Batch ID: 27612 RunNo: 37369

Prep Date: 9/20/2016 Analysis Date: 9/21/2016 SeqNo: 1160993 Units: mg/L

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

Sodium ND 1.0

Sample ID LCS-27612 SampType: LCS TestCode: EPA Method 200.7: Metals

Client ID: LCSW Batch ID: 27612 RunNo: 37369

Prep Date: 9/20/2016 Analysis Date: 9/21/2016 SeqNo: 1160994 Units: mg/L

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

Sodium 49 1.0 50.00 0 98.1 85 115

Sample ID LLLCS-27612 SampType: LCSLL TestCode: EPA Method 200.7: Metals

Client ID: BatchQC Batch ID: 27612 RunNo: 37369

Prep Date: 9/20/2016 Analysis Date: 9/21/2016 SeqNo: 1161051 Units: mg/L

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

Sodium ND 1.0 0.5000 0 105 50 150

Qualifiers:

* Value exceeds Maximum Contaminant Level.

D Sample Diluted Due to Matrix

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

R RPD outside accepted recovery limits

S % Recovery outside of range due to dilution or matrix

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

P Sample pH Not In Range

RL Reporting Detection Limit

W Sample container temperature is out of limit as specified

Page 14 of 17

Hall Environmental Analysis Laboratory, Inc.

WO#: **1609828**

12-Oct-16

Client: Daniel B. Stephens & Assoc.

Project: Salty Dog

Sample ID MB SampType: MBLK TestCode: EPA Method 300.0: Anions

Client ID: PBW Batch ID: R37349 RunNo: 37349

Prep Date: Analysis Date: 9/20/2016 SeqNo: 1160322 Units: mg/L

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

Chloride ND 0.50

Sample ID LCS SampType: LCS TestCode: EPA Method 300.0: Anions

Client ID: LCSW Batch ID: R37349 RunNo: 37349

Prep Date: Analysis Date: 9/20/2016 SeqNo: 1160323 Units: mg/L

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

Chloride 4.8 0.50 5.000 0 95.4 90 110

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- D Sample Diluted Due to Matrix
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits
- S % Recovery outside of range due to dilution or matrix
- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH Not In Range
- RL Reporting Detection Limit
- W Sample container temperature is out of limit as specified

Page 15 of 17

Hall Environmental Analysis Laboratory, Inc.

WO#: **1609828**

12-Oct-16

Client: Daniel B. Stephens & Assoc.

Project: Salty Dog

Sample ID 1609828-012ADUP SampType: DUP TestCode: Specific Gravity

Client ID: Injection Batch ID: R37370 RunNo: 37370

Prep Date: Analysis Date: 9/21/2016 SeqNo: 1161076 Units:

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

 Specific Gravity
 0.9934
 0
 0.191
 20

Qualifiers:

* Value exceeds Maximum Contaminant Level.

D Sample Diluted Due to Matrix

H Holding times for preparation or analysis exceeded

ND Not Detected at the Reporting Limit

R RPD outside accepted recovery limits

S % Recovery outside of range due to dilution or matrix

B Analyte detected in the associated Method Blank

E Value above quantitation range

J Analyte detected below quantitation limits

P Sample pH Not In Range

RL Reporting Detection Limit

W Sample container temperature is out of limit as specified

Page 16 of 17

Hall Environmental Analysis Laboratory, Inc.

WO#: **1609828**

12-Oct-16

Client: Daniel B. Stephens & Assoc.

Project: Salty Dog

Sample ID MB-27634 SampType: MBLK TestCode: SM2540C MOD: Total Dissolved Solids

Client ID: PBW Batch ID: 27634 RunNo: 37439

Prep Date: 9/21/2016 Analysis Date: 9/23/2016 SeqNo: 1163956 Units: mg/L

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

Total Dissolved Solids ND 20.0

Sample ID LCS-27634 SampType: LCS TestCode: SM2540C MOD: Total Dissolved Solids

Client ID: LCSW Batch ID: 27634 RunNo: 37439

Prep Date: 9/21/2016 Analysis Date: 9/23/2016 SeqNo: 1163957 Units: mg/L

Analyte Result PQL SPK value SPK Ref Val %REC LowLimit HighLimit %RPD RPDLimit Qual

Total Dissolved Solids 1030 20.0 1000 0 103 80 120

Qualifiers:

- * Value exceeds Maximum Contaminant Level.
- D Sample Diluted Due to Matrix
- H Holding times for preparation or analysis exceeded
- ND Not Detected at the Reporting Limit
- R RPD outside accepted recovery limits
- S % Recovery outside of range due to dilution or matrix
- B Analyte detected in the associated Method Blank
- E Value above quantitation range
- J Analyte detected below quantitation limits
- P Sample pH Not In Range
- RL Reporting Detection Limit
- W Sample container temperature is out of limit as specified

range

Page 17 of 17



riau Environmeniai Analysis Laboratory 4901 Hawkins NE Albuquerque, NM 87109

TEL: 505-345-3975 FAX: 505-345-4107

Sample Log-In Check List

Website: www.hallenvironmental.com

Client Name: DBS	1609828		RcptNo: 1		
Received by/date:	09/15/14				
Logged By: Lindsay Mangin	9/15/2016 10:30:00 AM		July Hlago		
Completed By: Lindsay Mangin	9/15/2016 2:01:34 PM		June Hange		
Reviewed By:	9/16/16				
Chain of Custody	/ /				
1. Custody seals intact on sample bottles?		Yes 🗌	No 🗆	Not Present 🗹	
2. Is Chain of Custody complete?		Yes 🗹	No 🗌	Not Present	
3. How was the sample delivered?		<u>Client</u>			
<u>Log In</u>					
4. Was an attempt made to cool the samples	\$?	Yes 🗹	No 🗌	na 🗆	
5. Were all samples received at a temperature	re of >0° C to 6.0°C	Yes Approved	No ✓ by client.	NA \square	
6. Sample(s) in proper container(s)?		Yes 🗸	No 🗔		
7. Sufficient sample volume for indicated test	(s)?	Yes 🗸	No 🗌		
8. Are samples (except VOA and ONG) propo	erly preserved?	Yes 🗹	No 🗆		
9. Was preservative added to bottles?		Yes 🗌	No 🗹	NA 🗀	
10.VOA vials have zero headspace?		Yes 🗌	No 🗆	No VOA Viais 🗹	
11. Were any sample containers received bro	ken?	Yes U	No 🗹	# of preserved bottles checked	1
12. Does paperwork match bottle labels? (Note discrepancies on chain of custody)		Yes 🗹	No 🗆	for pH:	>12 unless noted)
13. Are matrices correctly identified on Chain	of Custody?	Yes 🗹	No 🗆	Adjusted?	No
14. Is it clear what analyses were requested?		Yes 🗹	No 🗆		Dr.
15. Were all holding times able to be met? (If no, notify customer for authorization.)		Yes 🗹	No ∐	Checked by:]
Special Handling (if applicable)					
16. Was client notified of all discrepancies with	n this order?	Yes 🗌	No 🗆	NA 🗹	
Person Notified:	Date	/			
By Whom:	Via: [eMail	Phone Fax	☐ In Person	
Regarding:					
Client Instructions:					
17. Additional remarks:					
18. Cooler Information					
Cooler No Temp °C Condition		Seal Date	Signed By		
1 8.7 Good N	lot Present	<u>.</u>			

Chain-of-Custody Record				Turn-Around	Turn-Around Time:					НΔ		FI	NV	/TE	20	NN	лF	NT	Δ1	
ent:	DBS	8_A			cs Standard □ Rush													\TC		
	_			Project Name	Project Name:				www.hallenvironmental.com											
ailing Address: 6020 Academy RD NE #100					SALTY DOG			4901 Hawkins NE - Albuquerque, NM 87109												
			Project #:			Tel. 505-345-3975 Fax 505-345-4107														
116ng re17 11 NM 87109 10ne #: 505-822-9400			ESOE	1.0118.00	5	Analysis Request														
nail or Fax#: JAYARBEODBSteghens.com			Project Mana	ager:		(8021)	only)	<u> </u>			İ	(}								
√QC Package: Standard □ Level 4 (Full Validation)				15	J. AYARBE			ည္သ	(O / MRO)		SIMS)		2O ₄ ,SC	PCB's				<u></u>		
	itation				7. C60ze		TMB'	TPH (/ DRO		0.8		ο̈́	/ 8082						
NEL	AP	□ Ot	her	On Ice;	≱≤Yes	□ No	[=	18. 18.	4.	827		3,7	8/8		₹		Spec		N N
EDD	(Type)			Sample Tem	perature: ろ,	7°C 3000	BE	BE	(GRO od 418.	2 pc	o o	itals	Ĭ.,	ides	₽		9	•		ک
)ate	Time	Matri	x Sample Request ID	Container Type and #	Preservative Type	HEAL No. 1609828	BTEX + MTBE	BTEX + MTBE	TPH 8015B (GRO / I TPH (Method 418.1)	EDB (Method 504.1)	PAH's (8310 or 8270	RCRA 8 Metals	Anions (F,CI,NO ₃ ,NO ₂ ,PO ₄ ,SO ₄)	8081 Pesticides	8260B (VOA)	8270 (Semi-VOA)	Chlor	PH TDS	No	Air Bubbles (Y or N)
.16	1530	GW	DBS-IR	1 poly	none	-001												ightharpoonup	\bot	
	1400		DBS-2			-002											\angle			
	1505		DBS-3			-003														
1	1230		DBS-4			-004														
	1430		DB5-5			-005														
	1145		DBS-6			-006										ļ				
:	0905		DBS-8	·		-007											\angle	\perp		
	0825		DBS-9			-008											4	\perp	_	
	1110		MW-3			-009											4	\perp	\perp	
	1010		MW-5			-010											4	_	\perp	
	1605		PMW-1			-011								\bigsqcup		<u> </u>	4	\rightarrow		
	1545 1607		BRINE	2 Poly 3 poly Received by:	2000e l'HNO	-012 -013												<u> </u>		
te: 5 <u>/1-८</u> te:	Time: 1032		shed by:	Received by:		Pate Time 9//5//6 /01,30 Date Time		narks:												
	11110.			Trooprod by.		1000														

Appendix B Field Notes

3/23								
<u> </u>	M. 76	cozek			M. Zbe	ozek	9	.14.16
	brozek ons	ite 601 quarter	ly 0	735 M.	Chrotex or	isite for		
	ound water /				toring			
i -		He for reconn	19		np at i	,		
		r sunny clear a			ibrate Y			
		c RW-2 - Tres	1	pH 4.	24.02			
— <u>doe</u> s	not appe	ac to be insecu	ice.	10	24.40			
	photos.			7	24.32	2		
1515 Bea	·	/	E.	PC 1413		2		
1	·	on acid sheet		1510				
I.	- I	7ec - Pump Or			23.958			
W .	405876.6	į .	nd L	0% 767.	i mm Ho	78.3 Dog	, 100,9	102
- 1610 Mh	1-2 Totall							
1770	0.2 ь				in Sampil		35-9	
Na contract of the contract of		FESIte - return	1		the @ O	1	· .	
9.79	4.16 For Sc	mplina			pat DB:			
		-			ple 50 09			
					npat N			
-			10	> < <- L	ample @	1010		
	W	n			np at M			
			<i>K</i>		ample, 6			
			70		-2. Tota 930.3 bb	I I	rmp of	6.0
		9.13.2016	11:		430.3 66 NPO!		0050W	
		1,13.0016	-176			11112		
			12	205 55	APODE	77-17 R - U		
				*				———))
			-	Sample	· 6 1230			

3/2 9.14.16 M. to rozek M. 70 rozek 914.16 1610 - May not be recording properly 1241 Setup AT DBS-2 and that we may want to check his sample o 1400 = ale mumbers to verify pumping output Pump Will not pump to top OF wintch has increased due to casing consistently - Toouble Shoot often oftellowted to pump housing recent growth in oil deilling. 1645 in Ebrozek offsite innable to repair. Used poly Bailer 1420 Attempted pring, Still does All samples preserved on Ice for transport to Hall Environmental not propto topof easting use of Barler For remaining Wells - Phmp 15 Wocking DBS-5 sampled at 1430 1445 SETUP and DBS-3 Sample 6 1505 1515 Setup at DBS-1R sample @ 1530 1541 Sample at Injection OD 1545 FW5-1 Totalleer 80438.8 661 Pumpon ~ 3156 BPD 1550 SETUP AT PMWI Sample 0 1605 1607 SAMPLE at Brine Tanks Na, pH, TDS, Spec, grav, Cl 6/607 1610 Jim Sarr onsite, Jim mentioned that the totalizers Dear . RW-2 -



GROUNDWATER ELEVATION DATA SHEET

Project Name: <u>Salty Dog</u>	Sampler: <u>M. Zbrozek</u>
Project #: _ES08.0118.06	Sample Date:09/13/16
Project Manager: <u>John Ayarbe</u>	Sheet# 1 of 1

Well ID	Depth to NAPL	Depth to Water	Total Depth	Comments: (well dia., sampled, condition)
DBS-1R	_	67.43	74.39	
DBS-2	-	69.76	75.38	
DBS-3	_	64.56	74.73	
DBS-4	_	70.35	78.83	
DBS-5	_	66.64	75.84	
DBS-6	~	65.51	76.03	
DBS-7	_	64.34	75.77	WL only
DBS-8	_	63.83	69.92	
DBS-9	_	56.81	67.59	
MW-3	_	66.33	147.05	
MW-4	-	66.31	147.49	WL only
MW-5	-	63.66	128.79	
MW-6	_	65.11	119.15	WL only
PMW-1		71.08	77.82	
NW-1				WL only

Comments:			

GROUNDWATER MONITORING DATA SHEET

Project Name: Salty Dog Project #: ES08.0118.06 Project Manager: John Ayarbe			S	ampler: M. Z ample Date: ample Time:	09/14/2016	3
Well #: DB	S-1R		_			
Well Diame	eter:2	2"	_(inches) Hei	ght of Water	Column: 6.	<u>96</u> (feet)
Depth to NAPL:(feet btoc) Casing Volume:(gal						(gal)
Depth to W	ater: <u> </u>	7. 43 (f	eet btoc) Purge	Volume:	3.33	(gal)
Total Depth	of Well:	74.39	(feet) Pur	ge Method:_	Grab pum	P
Note:			casing = 0.16 gal/f		/	1
-	,	•	casing - 0.10 gai/i	t, 4.0 – 0.03 ga	ai/it, 0.0 – 1.47	y gaint
Groundwat	ter Paramet	ters:				
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.67	21.73	1356	10a.2	11.38	Hazy
1	7.51	19.75	1375	106.6	10.67	
1.5	7,40	19.57	1403	112.5	10.44	
2	7.18	19.50	1457	123.9	10.30	Harrelear
2.5	6.95	19.44	1500	133.1	10.23	
3	6.69	19.42	1567	145.3	10.12	Hazy
3.5						
4						
4.5				1		
5						
Sample Des	scription:					

Physical Ob	servations:					



GROUNDWATER MONITORING DATA SHEET

Project Nan	ne: Salty D	og	Sa	mpler: M. Z	′brozek	
	S08.0118.		Sa	mple Date:	<u>09/14/2016</u>	
	nager: John		Sa	mple Time:	1400	·
Well #: DB	S-2		_			
Well Diame	ter:2)" 	(inches) Heig	ght of Water	Column: 5.	<u>62</u> (feet)
Depth to NA	Depth to NAPL:(feet btoc) Casing Vol. 15(gal)					
			eet btoc) Purge			
			(feet) Puro		Grab Phm	Pail_
Noto:					useo	Barrel
One casing vo	olume (SCH 40) PVC): 2.0" ID	casing = 0.16 gal/ft	; 4.0" = 0.65 g	ai/π ; $6.0^{\circ} = 1.47$	gai/it
Groundwa	ter Paramet	ters:				
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.62	25.12	532	111.4	8.28	Hazy Tan Cleal
1	7.35	2219	530	132.4	8.32	
1.5		ane t		(27)	- 47	
2	7.60		254	107.9	7.03	
2.5					 	
3						
3.5						
4.5						
5						
-						
Physical O	bservations	Pump	not finetion	ing hised	Pole Bo	ile
Analytical I	Method(s): _	Sodium, Ch	nloride, TD S, Sp	ec Gravity,	pH	

GROUNDWATER MONITORING DATA SHEET

Project Name: Salty Dog Project #: ES08.0118.06 Project Manager: John Ayarbe			S	ampler: M. 2 ample Date: ample Time:	09/14/2016	
Well #: DB	S-3		_			
Well Diame	eter:2	2"	(inches) Hei	ght of Water	Column:_/	<u>), /</u> (feet)
			eet btoc) Casing			
Depth to Water: 64.56 (feet btoc) Purge Volume: 4.88 (gal)						(gal)
Total Depth	of Well:	4.73	(feet) Pur	ge Method: _	Pump	
Note: One casing vo) PVC): 2.0" ID	casing = 0.16 gal/f			gal/ft
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.73	20.00	522	112.7	11.03	Houth Brown
1	7.61	19.91	521	116.2	10.60	Hazy
1.5	7.30	19,72	520	130.4	10.03	
2	7.09	19.71	520	141.1	9.99	
2.5	6.83	19.67	519	152.0	9.96	
3	6.75	19.66	519	156.3	9.95	
3.5						
4						
4.5						
5						
Sample Des	scription:					
——————————————————————————————————————	servations:					

GROUNDWATER MONITORING DATA SHEET

	GR	CONDVAIL		IG DATA SH		
Project Nar	_{ne:} Salty D	og	s	ampler: M. Z	Zbrozek	
Project #: [ES08.0118.	.06	S	ample Date:	<u>09/14/2016</u>	3
Project Mai	nager: Johr	n Ayarbe	S	ample Time:	1230	
Well#: DB	S-4		_			
Well Diame	eter:2	2"	(inches) Hei	ght of Water	Column: 8	<u>Ƴ₿</u> (feet)
Depth to NA	4PL:	(fe	eet btoc) Casing	g Volume:	1.36	(gal)
Depth to W	ater: 70	35(fe	eet btoc) Purge	Volume:	4.07	(gal)
			(feet) Pur			
Note: One casing vo) PVC): 2.0" ID	casing = 0.16 gal/f			7 gal/ft
O O O O O O O O O O O O O O O O O O O				1	<u> </u>	[
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.71	23.32	482	128.7	8.67	Hazy Brown Turbid
1	7.58	20.87	505	123.9	9.42	
1.5	7.41	20.47	505	126.6	9.52	Brown
2	7.41	20.38	504	127.4	9.51	
2.5	7.37	20.01	505	129.8	9.64	
3	FP. 34	19.98	504	131.7	9.58	Horzyclear
3.5						-
4				1		
4.5						
5						
Sample Des	scription:	1 poly				
Physical Ob	servations					



GROUNDWATER MONITORING DATA SHEET

D : (N	Salty F)oa		. 1/1 7	hrozek	
	me: Salty D			Sampler: M. Zbrozek		
-	ES08.0118		S	ample Date:	09/14/2016	<u> </u>
Project Ma	nager: Johr	n Ayarbe	Sa	ample Time:	1930	
Well#: DE	S-5		_			
Well Diame	eter:2	2"	_(inches) Hei	ght of Water	Column: 9	$\overline{\mathcal{Z}}$ (feet)
Depth to N	APL:	(f	eet btoc) Casing	g Volume:	1.47	(gal)
Depth to W	/ater: <u>66</u>	6.64 (f	eet btoc) Purge	Volume:	4.42	(gal)
Total Depth	n of Well:	75.84	(feet) Pur	ge Method:	(Pump	
Note:			casing = 0.16 gal/f			′ gal/ft
_	ter Parame	·	out in grant of gain.	, no oros ge		g
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.20	20.31	1148	120.3	9.32	
1	7.15	20.10	1143	121.5	9.07	
1.5	7.07	20.04	1140	124.4	8.86	
2	6,77	20.03	1131	133.3	8.63	
2.5	6.57	20.03	1728	141.0	8.55	
3	6.39	19.99	1123	147.5	8.49	
3.5						
4						
4.5						
5						
Sample Des	scription:					
Physical Ob	oservations:					

	GR	CONDWAI	ER MONITORII	NG DATA SH	IEEI	
Project Nar	_{ne:} Salty D)og	S	ampler: M. Z	Zbrozek	
Project #: 5	ES08.0118	.06	S	ample Date:	09/14/2016	3
Project Mai	nager: Johr	n Ayarbe	S	ample Time:	1145	
Well #: DB	S-6		_			
Well Diameter:(inches) Height of Water Column: _/o. 52(feet						. <u>52</u> (feet)
Depth to NAPL:(feet btoc) (g Volume:	1.68	(gal)
Depth to W	ater: <u>65</u> .	<u>51</u> (f	eet btoc) Purge	· Volume:	5.05	(gal)
Total Depth	of Well:	76.03	(feet) Pur	ge Method:	Pump	
Note:			casing = 0.16 gal/			
Groundwa	ter Parame	ters:				
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.22	23.58	1544	91.3	8.06	Mod Throso
1	7.06	20.07	1471	107.5	8.02	
1.5	7.00	19.81	1467	111.5	8.20	Hatr Tan
2	6.95	19.64	1455	114.1	8.21	
2.5	6.92	19.62	1445	115.0	7.11	
3	6.91	19.64	1439	114.7	8,04	
3.5			_			
4						
4.5						
5						
Sample Des	scription;				_	

 $T: \label{thm:linear_continuous_continuous} T: \label{thm:linear_continuous$

Physical Observations:

	GR	OUNDWATE	ER MONITORIN	IG DATA SH	EET	
Project Nar	_{ne:} Salty D	og	S	ampler: M. Z	Zbrozek	
Project #: E	ES08.0118	.06	S	Sample Date: <u>09/14/2016</u>		
Project Mai	nager: Johr	n Ayarbe	S	Sample Time: <u>0905</u>		
Well #: DB	S-8		_			
Well Diame	Vell Diameter:2"(inches) Height of Water Column:_ <u>6.09</u> (feet)					
Depth to NAPL:(feet btoc) Casing Volume:(ga					(gal)	
Depth to W	Depth to Water: 63.83 (feet btoc) Purge Volume: 2.92 (gal)					
Total Depth	of Well:	5992	(feet) Pur	ge Method: _	Pump	
Note: One casing vo	olume (SCH 40) PVC): 2.0" ID	casing = 0.16 gal/f	t; 4.0" = 0.65 ga	al/ft; 6.0" = 1.47	⁷ gal/ft
Groundwa	ter Paramet	ters:				
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.23	20.03	614	149.2	8.39	Hazyclear
1	7.05	20,11	618	129.8	8.30	

Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.23	20.03	614	149.2	8.39	Hazyclear
1	7.05	20,11	618	129.8	8.30	
1.5	7.02	20.12	620	129.0	8.40	
2	6.99	19.91	619	128.8	8.40	
2.5	6.97	19.85	613	128.8	8,29	
3	6.97	19.83	611	128.8	8.25	
3.5						
4						
4.5						
5						

Sample Description:	
Physical Observations:	
Analytical Method(s): Sodium, Chloride, TDS, Spec Gravity, pH	

GROUNDWATER MONITORING DATA SHEET

Project Na	me: Salty D)og	S	Sampler: M. Zbrozek						
Project #:	ES08.0118	.06	S	Sample Date: <u>09/14/2016</u>						
Project Ma	nager: Johr	n Ayarbe	S	ample Time:	0825					
Well #: DBS-9										
Well Diameter:(inches) Height of Water Column: _/O.78 (feet										
Depth to NAPL: (feet btoc) Casing Volume: (gal)										
			eet btoc) Purge			(gal)				
			(feet) Pur			,				
Note:										
One casing v	olume (SCH 40	0 PVC); 2.0" ID	casing = 0.16 gal/f	t; 4.0" = 0.65 g	al/ft; 6,0" = 1.47	7 gal/ft				
Groundwa	ter Paramet	ters:								
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)				
1,5141,51		19.83	1584	101 7	104 500	51.927				
Initial	6.94	17.00	1301	141.7	104.5%	Tan Houry				
1	6.92	18.91	1217	120.7	9.36 mg/L	Tan Hozy Hazy clear				
1	6.92	18.91	1217	120.7	9.36 mg/L					
1.5	6.92	18.91 18.84	1217	128.7	9.36 mg/L 9.28					
1 1.5 2	6.92 6.91 6.89	18.91 18.84 18.80	1217 1148 1150	128.7 129.8 129.6	9.36 mg/L 9.28 9.28					
1 1.5 2 2.5	6.92 6.91 6.89 6.87	18.91 18.84 18.80 18.78	1217 1148 1150 1119	128.7 129.8 129.6 129.6	9.36 mg/L 9.28 9.29 9.29					
1 1.5 2 2.5 3	6.92 6.91 6.89 6.87 6.81	18.91 18.84 18.80 18.78	1217 1148 1150 1119 1195	120.7 129.8 129.6 129.6 132.0	9.36 mg/L 9.28 9.29 9.29 9.31					
1 1.5 2 2.5 3 3.5	6.92 6.91 6.89 6.87 6.81	18.91 18.84 18.80 18.78	1217 1148 1150 1119 1195	120.7 129.8 129.6 129.6 132.0	9.36 mg/L 9.28 9.29 9.29 9.31					
1 1.5 2 2.5 3 3.5 4	6.92 6.91 6.89 6.87 6.81	18.91 18.84 18.80 18.78	1217 1148 1150 1119 1195	120.7 129.8 129.6 129.6 132.0	9.36 mg/L 9.28 9.29 9.29 9.31					
1 1.5 2 2.5 3 3.5 4 4.5 5	6.92 6.91 6.89 6.87 6.81	18.91 18,84 18.80 18.78 19.09 19.14	1217 1148 1150 1119 1195	128.7 128.8 129.6 129.6 132.0 130.5	9.36 mg/L 9.28 9.29 9.29 9.31					
1 1.5 2 2.5 3 3.5 4 4.5 5	6.92 6.91 6.89 6.87 6.81	18.91 18,84 18.80 18.78 19.09 19.14	1217 1148 1150 1119 1195 1105	128.7 128.8 129.6 129.6 132.0 130.5	9.36 mg/L 9.28 9.29 9.29 9.31					

GROUNDWATER MONITORING DATA SHEET								
Project Name: Salty Dog Sampler: M. Zbrozek								
-				ample Date:	09/14/2016	3		
•	nager: Johr			ample Time:				
Well#: MV	V-3		_					
Well Diame	eter:2	2"	_(inches) Hei	ght of Water	Column: 3	<u>0.72</u> (feet)		
Depth to N	APL;	(f	eet btoc) Casin	g Volume:	12.91	(gal)		
Depth to W	/ater: <u>66</u>	5.33(f	eet btoc) Purge	Volume:	38.74	(gal)		
Total Depth	n of Well:	147.05	(feet) Pur	ge Method: _	Pump			
Note: One casing v	olume (SCH 4	0 PVC): 2.0" ID	casing = 0.16 gal/f	t; 4.0" = 0.65 ga	al/ft; 6.0" = 1.47	7 gal/ft		
Groundwa	ter Parame	ters:						
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)		
Initial	6.97	20.17	81	130.9	5.03	Clear		
1	6.89	19.61	1/582	124.3	5.64	Clear		
1.5	6.73	19.54	12999	129.8	6.4.96			
2	6.53	19,49	15932	126.9	4.34			
2.5	6.51	19,76	19076	121.0	4.28	clear		
3	6.53	19.56	20552	117.7	4.24			

Sample Description:
Physical Observations:
Analytical Method(s). Sodium, Chloride, TDS, Spec Gravity, pH

4.5

GROUNDWATER MONITORING DATA SHEET

	O, v	CONDITAL		IO DATA OF					
Project Na	me: Salty D	og og	S	ampler: M. Z	Zbrozek				
Project #: 1	ES08.0118.	.06	S	ample Date:	<u>09/14/</u> ∠016	<u> </u>			
Project Ma	nager: Johr	n Ayarbe	S	ample Time:	1010				
Well #: MV	V-5		_						
Well Diameter:(inches) Height of Water Column: 65.13 (fe									
Depth to N	APL:	(f	eet btoc) Casin	g Volume:	10.42	(gal)			
Depth to W	/ater: <u>63</u>	3. 66 (f	eet btoc) Purge	Volume:	31.26	(gal)			
Total Depth	n of Well:/	128.79	(feet) Pui	ge Method: _	Pump				
Note:									
One casing v	olume (SCH 40	0 PVC); 2,0" ID	casing = 0.16 gal/	ft; 4.0" = 0.65 ga	al/ft; 6.0" = 1.47	7 gal/ft			
Groundwa	ter Paramet	ters:							
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)			
Initial	6.52	20.09	159	161.1	10.93	Clear			
1	6.43	19.55	3188	132.9	4.54				
1.5	6.51	19.66	3106	130.3	4.59				
2	6.52	19.67	3070	130.0	4.60				
2.5	6.54	19.71	3021	129.1	4.61	Clear			
3	6.54	1968	2995	128.5	4.64	clear			
3.5									
4									
4.5									
5									
0		1 anti-							
Sample Des	scription:	POIP							
Physical Oh	servations:	Clear							

 $T: Admin\ Field\ Forms\ Att\ 1.5-1_GROUNDWATER\ MONITORING\ DATA\ SHEET_rev1.pdf$

GROUNDWATER MONITORING DATA SHEET									
Project Nar	_{ne:} Salty D	og	S	Sampler: M. Zbrozek					
Project #: E	S08.0118.	06		ample Date:		3			
Project Mar	nager: Johr	Ayarbe	S	ample Time:	1605				
Well #: PN	IW-1		_						
Well Diame	eter:2	2"	(inches) He	ght of Water	Column: <u>6</u>	. 7/ (feet			
Depth to N	APL:	(fe	eet btoc) Casin	g Volume:	1.07	(gal)			
Depth to W	ater: <u>7/</u> .	<u>08</u> (fe	eet btoc) Purge	Volume:	3.32	(gal)			
Total Depth	of Well:	77.82	(feet) Pur	ge Method: _l	Pump				
Note: One casing vo	olume (SCH 40) PVC): 2.0" ID	casing = 0.16 gal/	ft; 4.0" = 0.65 ga	al/ft; 6.0" = 1.47	7 gal/ft			
Groundwa	ter Paramet	ters:							
Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)			
Initial	7.13	21.17	35 477	114.7	9.56	milky Uhi			
1	7.16	20.26	23120	102.8	9.19	HOZY			
			i	1		The Part of the Pa			

Casing Volume	рН	Temp (°F)	Conductivity (µS/cm)	ORP (mv)	D.O. (mg/L)	Turbidity (NTU)
Initial	7.13	21.17	35 477	milky Uhits		
1	7.16	20.26	23120	102.8	9.19	HOZY
1.5	7.13	20.23	22420	103.3	9.15	Hazy
2	7.10	20,10	22067	103.7	9.16	
2.5	7.09	20.06	22064	104.3	9.13	
3	7.09	20.04	21877	104.9	9.10	Hozy
3.5						
4						
4.5						
5						

Sample Description:							
Physical Observations							
Analytical Method(s):	Sodium, Chloride, TDS, Spec Gravity, pH						

	hain-	of-Cu	stody Record	Turn-Around	Time:		HALL ENVIRONMENTA				CAI									
Client:	DRS	8 A		☐ Standard	□ Rush		ANALYSIS LABORATOR													
				Project Name):		www.hallenvironmental.com													
Mailing	Address	1020	Arademy RD NE 1100	SAL	TY DOG	9 11 3 4		490	1 Hav	vkins							109			
			VM 87109	Project #:						345-3						4107				
			-9400	€508	.0118.06							-		-	uest	_	E.			10000
			EDUBLA Thens.com	Project Mana	ger:		_	(ylu	30				04)							
QA/QC I	Package:		☐ Level 4 (Full Validation)	5.	AYARBE		TMB's (8021)	TPH (Gas only)	DRO / MRO)		SIMS)		04,80	PCB's				No.		
Accredi			Level 4 (I dii Validation)	Sampler: M			/B's) H	DR				O ₂ ,F	382				6		
□ NEL	AP	□ Othe	r		□ Yes	□ No	1 +	+ 1	30/	1.0	8270	7	N,E	/ 80		F		30		N N
□ EDD	(Type)_			Sample Temp	perature:	7 (BE	BE	(GF	4 bo	0 or	tals	N,	ides	8	-0	2	V		2
Date	Time	Matrix	Sample Request ID	Container Type and #	Preservative Type	HEAL No.	BTEX + MTBE	BTEX + MTBE	TPH 8015B (GRO	EDB (Method 504.1)	PAH's (8310 or	RCRA 8 Metals	Anions (F,CI,NO ₃ ,NO ₂ ,PO ₄ ,SO ₄)	8081 Pesticides / 8082	8260B (VOA)	8270 (Semi-VOA)	Chlor	PH TOS	No	Air Bubbles (Y or N)
14.16	1530	GW	DES-IR	1 poly	none	4,74											1			
1	1900		DRS-2	1													1			
	1505		DB5-3														1			
	1230		DB5-4														1			
	1430		DBS-S						\top	+							/			
	1145		DBS-6			· 1											/			+
	0905		PBS-8		e comment												/			
	0825		DBS-9										-				1			
	1110		MW-3	and the same													1			
	1010	and to be designed	MW-5														1			
	1605		PMW-1														/			
	1645		BRINE	2 Paly 3 paly	anone Innellik															
Date:	Time:	Relinquishe		Received by:	11	Date Time	Ren	narks									*			
/15/12 Date:	1032 Time:	Relinquishe	ed by:	Received by:	1/-	Date Time														
Date.	Time:	remiquistie	o by.	nceceived by.		Date Time								Ÿ						



Mr. Jim Griswold New Mexico Oil Conservation Division Environmental Bureau 1220 South St. Francis Drive Santa Fe, NM 87505-4225

Re: Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization Salty Dog Brine Station

Dear Mr. Griswold:

On behalf of PAB Services, Inc., Daniel B. Stephens & Associates, Inc. (DBS&A) is pleased to submit the enclosed work plan for surface subsidence monitoring and solution cavern characterization at the Salty Dog Brine Station in Lea County, New Mexico. The work plan was prepared in accordance with the requirements of Conditions 2.B.1 and 2.B. 2 of discharge permit (DP) BW-8.

Please do not hesitate to call us at (505) 822-9400 if you have any questions or require additional information.

Sincerely,

DANIEL B. STEPHENS & ASSOCIATES, INC.

John Ayarbe, P.G.

Senior Hydrogeologist

Michael D. McVey, C.P.G., P.G.

Senior Hydrogeologist

JA/rpf Enclosures

cc: Pieter Bergstein, PAB Services, Inc.

Brenda Patterson, Aqueous Operating

Terry Wallace, Salty Dog, Inc.

Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization Salty Dog Brine Station

Prepared for New Mexico Energy, Minerals and

Natural Resources Department

Oil Conservation Division

September 17, 2014



Daniel B. Stephens & Associates, Inc.

6020 Academy NE, Suite 100 • Albuquerque, New Mexico 87109



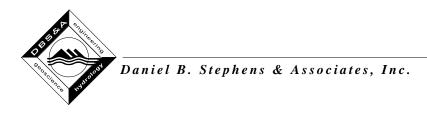
Table of Contents

Se	Section						
1.	Introduction	1					
2.	Background	1					
3.	Surface Subsidence Monitoring Plan	3					
4.	Solution Cavern Characterization Program	4					
5.	Reporting	7					
6.	Schedule	7					
Re	eferences	8					

List of Figures

Figure

- 1 Site Location and Facilities
- 2 2014 Aerial Photograph of Salty Dog Brine Station
- 3 Generalized Brine Well Schematic
- 4 Monitor and Extraction Well Locations
- 5 Proposed Subsidence Monitoring Locations
- 6 Subsidence Survey Monument Design
- 7 Subsurface Anomalies Identified by Geophysical Methods at the I&W Site



Work Plan for Surface Subsidence Monitoring and Solution Cavern Characterization Salty Dog Brine Station

1. Introduction

Daniel B. Stephens & Associates, Inc. (DBS&A) has prepared this work plan on behalf of PAB Services, Inc. (PAB) to satisfy Conditions 2.B.1 and 2.B. 2 of recently renewed discharge permit BW-8 (DP BW-8). The Oil Conservation Division (OCD) of the New Mexico Energy, Minerals and Natural Resources Department (NMEMNRD) renewed DP BW-8 on November 8, 2013, permitting continued operation of the Salty Dog Brine Station (Salty Dog) and the associated Underground Injection Control (UIC) Class III well (Brine Supply Well #1 [API No. 30-025-26307]) (NMEMNRD, 2013). The facility is located in Lea County, New Mexico, approximately 11 miles west of Hobbs, New Mexico along Highway 180 (Figure 1).

This work plan describes the proposed technical approach to be used to satisfy Conditions 2.B.1 and 2.B.2 of DP BW-8, including (1) the design of survey monuments and establishment of a program to monitor for potential surface subsidence, and (2) investigation activities to characterize the size and shape of the solution cavern created by brine production. Section 2 provides pertinent background information, such as the history of the facility, site geology, and brine well construction. Sections 3 and 4 present the proposed plans for surface subsidence monitoring and solution cavern characterization, respectively. Reporting is discussed in Section 5. Section 6 presents a schedule for the proposed work.

2. Background

Salty Dog is a brine water production and loading station, consisting of a fresh water supply well, a brine production well, and a concrete truck loading pad with two brine filling stations. Fresh water is stored in two 1,000-barrel (bbl) fresh water aboveground storage tanks (ASTs). Brine is stored at a bermed tank battery consisting of six 750-bbl ASTs. Figure 1 shows the



Daniel B. Stephens & Associates, Inc.

locations of the Salty Dog facilities. The brine well is located approximately 0.5 mile southwest of the brine station. Figure 2 presents a 2014 aerial photograph of the brine station showing the layout of the current facility infrastructure.

Brine is produced from the in situ extraction of salt at the UIC Class III well (Brine Supply Well #1 [API No. 30-025-26307]). The physical location of the brine well is 1,980 feet from south line (FSL) and 1,980 feet from east line (FEL) (NW/4 SE/4, Unit Letter J) in Section 5, Township 19 South, Range 36 East, New Mexico Principal Meridian (NMPM) (Figure 1). The brine well was installed in June 1979. The original discharge permit for the brine well (GWB-2) appears to have been issued on December 18, 1982 (OCD, 1994). The discharge permit was last renewed on November 8, 2013 (NMEMNRD, 2013).

Figure 3 shows a generalized schematic of the brine well illustrating its construction, tubing depths, and the penetrated geologic units. The brine well was drilled to a total depth of 2,958 feet below ground surface (bgs). Surface casing (85%-inch) extends from land surface to a depth of 1,877 feet bgs and is cemented in place. The well is completed open hole from 1,877 to 2,958 feet bgs. The well was originally completed with open-ended 21%-inch tubing, hung to a depth of 2,887 feet bgs and perforated from 2,872 to 2,887 feet bgs (NRE, 1982). In August 1999, holes in the surface casing were repaired, and a 51½-inch casing liner was installed and cemented to 1,829 feet bgs; open-ended 21%-inch tubing was hung to a depth of 2,534 feet bgs (Salty Dog, 1999). The tubing is currently set at 2,665 feet bgs.

The Salty Dog brine well is configured for reverse circulation brine recovery, where fresh water is circulated down the casing annulus into the Salado Formation—a Permian Age sedimentary rock unit composed of halite (salt) and other evaporative beds. Fresh water dissolves the salt, and the brine is extracted through the center tubing of the well (Figure 3). The total dissolved solids (TDS) concentrations of the fresh water and produced brine are approximately 600 milligrams per liter (mg/L) and 320,000 to 350,000 mg/L, respectively (Martin, 1982; Unichem, 1987).

Figure 3 shows the geologic stratigraphy at the brine well. The Ogallala Formation is the uppermost geologic unit, extending from land surface to a depth of approximately 150 feet bgs. At the Salty Dog site, the Ogallala Formation consists primarily of sand, with the upper 40 feet



Daniel B. Stephens & Associates, Inc.

containing appreciable amounts of caliche. Regional groundwater is present within the formation under a water-table condition and is considered part of the Ogallala Aquifer. This groundwater is used as the fresh water supply for the brine station, and is pumped from an on-site well (Figure 2). Depth to groundwater is approximately 60 feet bgs (DBS&A, 2009a). The Rustler Formation underlies the Ogallala Formation and consists of redbed and anhydrite sequences from approximately 150 to 1,800 feet bgs and 1,800 to 2,000 feet bgs, respectively. The Salado Formation is present from approximately 2,000 to 2,900 feet bgs.

In addition to the fresh water pumped from the supply well, chloride-impacted groundwater recovered at two on-site groundwater extraction wells is used as injection water at the brine well. Figure 4 shows the locations of the two extraction wells (RW-1 and RW-2).

3. Surface Subsidence Monitoring Plan

Condition 2.B.1 of DP BW-8 requires surface subsidence monitoring at the Salty Dog Brine Station. DBS&A proposes to install four survey monuments near the brine well to be surveyed semiannually by a licensed professional surveyor to satisfy this condition.

Figure 5 shows the proposed locations of the survey monuments. One survey monument would be placed about 50 feet from the brine well; the other three monuments would be placed about 200 feet from the brine well. A 2009 sonar survey identified a maximum radius of a solution cavern along an azimuth of 200 degrees (Section 4.1). Two of the proposed survey monuments are positioned along this direction (SMP-1 and SMP-2).

Figure 6 provides a design schematic for the survey monuments prepared by Engineering Analytics, Inc., a geotechnical engineering firm based in Fort Collins, Colorado. Each monument will be constructed from stainless steel rod sleeved within 1-inch-diameter SCH 80 polyvinyl chloride (PVC) pipe, with the top of the rod serving as the surface subsidence monitoring point. The stainless steel rod will be anchored in 2 feet of concrete at a depth of approximately 25 to 30 feet bgs. Final depths will be determined in the field and selected such that the stainless steel rods are anchored in hard and well-indurated sand that often appears as stone due to the presence of appreciable amounts of caliche. Several monitor and recovery wells have been completed within the Ogallala Aquifer at the site. Lithologic data collected at



Daniel B. Stephens & Associates, Inc.

these wells show the presence of sandstone or well-indurated sand units at depths of up to approximately 40 feet bgs (DBS&A, 2009a and 2009b). At RW-2, the closest existing well to the brine well, hard and well-indurated sand exists between 20 and 35 feet bgs (DBS&A, 2009b).

The space between the PVC pipe and stainless steel rod will be filled with grease to allow the rod to move independent of the PVC pipe and surface completion (Figure 6). The survey monuments have been designed to detect ground movement at depth, which would more likely be associated with a cavern collapse than near-surface disturbances that are not associated with cavern subsidence (e.g., shrinking and swell of surface soil). Each monument will be constructed in an approximately 8¾-inch-diameter borehole, advanced using the air-rotary drilling method or other comparable drilling technology.

After installation, the location and elevation of each survey monument will be established relative to the nearest U.S. Geological Survey (USGS) benchmark. A licensed New Mexico land surveyor will survey the elevation of each monument semiannually to at least the nearest 0.01 foot. Survey results will be submitted to OCD within 15 days of the survey and included in the Annual Class III Well Reports.

In accordance with DP BW-8, if subsidence is measured at or greater than 0.1 foot, Salty Dog will suspend operations at the brine well and conduct an analysis to determine the cause of the movement and integrity of the cavern.

4. Solution Cavern Characterization Program

Condition 2.B.2 of DP BW-8 requires a characterization program to delineate the size and shape of the solution cavern using a geophysical method. The following sections summarize a previous characterization effort and the proposed geophysical approach to satisfy Condition 2.B.2.

4.1 Previous Characterization Survey

In 2009, SOCON Sonar Well Services, Inc. of Conroe, Texas conducted a sonar survey at the Salty Dog brine well in an attempt to determine the extent of the solution cavern (SOCON,



Daniel B. Stephens & Associates, Inc.

2009). The sonar survey was performed to satisfy an OCD requirement (NMEMNRD, 2008), and was run from a depth of 1,871 to 1,903 feet bgs, a vertical distance of 32 feet. Available lithologic information shows that the top of the Salado Formation is at a depth of approximately 2,000 feet bgs, indicating that the section surveyed was the anhydrite sequence of the Rustler Formation (Figure 3). Survey results show a cavern volume of 720 bbls, with a maximum radius of 41 feet at a depth of 1,882 feet bgs along an azimuth of 200 degrees.

OCD has estimated a volume of 1,022,196 bbls for the Salty Dog solution cavern based on brine production records (NMEMNRD, 2012). The volume determined from the sonar survey (720 bbls) accounts for less than 1 percent of this estimated volume.

4.2 Proposed Geophysical Approach

DBS&A proposes to use the digital high-resolution magnetotellurics (HRMT) method to determine the size and shape of the Salty Dog solution cavern. The selection of this approach is based on the general success of the method at the former I&W brine facility in Carlsbad, New Mexico. OCD has conducted extensive testing of several geophysical methods to delineate the solution cavern at the I&W site, including two-dimensional (2D) seismic reflection (August 2009), sonar logging (September 2010), electrical resistivity (April 2011), and digital HRMT (March 2011 and April 2013) (NMEMNRD, 2012). Because the geologic environment at the I&W site is similar to that at the Salty Dog Brine Station, DBS&A relied heavily on available information regarding the geophysical surveys conducted at the I&W site when selecting an appropriate cavern characterization approach.

Each of the four geophysical methods used at the I&W site identified one or more subsurface anomalies, as shown in Figure 7. The following is a brief summary of the findings from the I&W site:

 Sonic logging reportedly identified the upper part of a cavity approximately 150 feet in diameter and 25 feet high, but was unable to delineate the cavern at depth, possibly due to the presence of insoluble residues or broken rubble (NMEMNRD, 2012).



- Seismic data interpretation indicated a pear-shaped anomaly measuring about 610 feet north to south and up to 420 feet across; evidence of the most extensive dissolution was around the brine extraction well (RESPEC, 2009).
- Electrical resistivity data interpretation indicated a J-shaped low-resistivity anomaly approximately 900 feet north to south and approximately 85 feet wide that was coincident with the sonar anomaly (Figure 7). The survey also identified four smaller anomalies that were interpreted to represent brine-saturated areas of the Rustler Formation that were either highly fractured or brecciated, rather than open void space (Land and Veni, 2011).
- HRMT data indicated a roughly oval-shaped anomaly approximately 1,660 feet north to south and 790 feet wide (DMT, 2011 and 2013).

Only the HRMT approach identified a large anomaly at the I&W site that might approach the volume indicated by historical production data (Figure 7). OCD has estimated a cavern volume of 1,050,386 bbls based on brine production at the former I&W facility (NMEMNRD, 2012).

HRMT is a passive electromagnetic (EM) system commonly used for oil and gas exploration. It relies on natural EM waves (telluric currents) generated by the interaction of the earth's magnetic field with solar wind. A large-amplitude, very-low-frequency EM signal enters the earth perpendicular to the land surface, propagating into the subsurface. The amplitude and phase of individual frequencies intersect conductive formations, are modified, and are reflected back to the land surface. The air-ground interface marks a large impedance mismatch to the reflected EM waves, generating a series of higher-frequency EM waves: telluric (electric field) and geomagnetic (magnetic field). These electric and magnetic fields are recorded, and their frequency, amplitude, and phase responses are analyzed to map subsurface conditions.

DBS&A proposes to contract with DMT Technologies, LLC (DMT) in Broken Arrow, Oklahoma to perform the HRMT survey. This is the same company that conducted the HRMT survey at the I&W site. The HRMT survey will be performed using a rectangular grid of survey stations. DMT (or other contractor, if necessary), will establish the grid based on professional judgment and initial field findings at the time of the survey. Station density will be sufficient to obtain an



accurate cavern volume. Each station will be surveyed, either by a licensed New Mexico land surveyor or using a global positioning system (GPS) unit accurate to within 0.01 foot.

A best effort will be made to accurately determine the volume of the Salty Dog brine cavern; however, the results of an HRMT survey, or any geophysical survey, are interpretive. While best judgments are used in developing data interpretations, the accuracy of the HRMT survey cannot be guaranteed.

5. Reporting

After the completion of field activities and receipt of the final geophysical survey report, DBS&A will prepare a Subsidence Monitoring and Solution Cavern Characterization Report. This report will document the construction of the survey monuments and present results of the cavern characterization, including estimates of its volume and lateral extent. The final report will be submitted to the OCD, and will provide the following:

- As-built diagrams of the survey monuments, including surveyed locations and elevations
- A figure showing the locations of the survey monuments
- The report prepared by the geophysical survey contractor and associated data
- Calculation of the solution cavern volume based on brine production records and a comparison of this volume to results of the geophysical survey
- Figures illustrating the extent and depth of the cavern based on the geophysical survey
- Conclusions and recommendations

6. Schedule

Upon OCD approval of this work plan, DBS&A will work with PAB to (1) contract a driller for the installation of the survey monuments, (2) contract DMT to perform the geophysical survey, (3) contract a licensed land surveyor to perform the surveying, and (4) obtain any necessary access agreements from adjacent landowners.



DBS&A anticipates that the installation of the subsidence survey monuments and geophysical survey can begin within approximately 30 days of receiving signed access agreements and that the geophysical survey and data processing can be completed within approximately 45 days.

DBS&A will prepare a draft report for initial review within 30 days of receipt of the geophysical survey report.

References

- Daniel B. Stephens & Associates, Inc. (DBS&A). 2009a. *Monitoring well installation and groundwater monitoring report, Salty Dog Brine Station, Lea County, New Mexico*. Prepared for New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division, Environmental Bureau. September 18, 2009.
- DBS&A. 2009b. Recovery well installation and pump test report, Salty Dog Brine Station, Lea County, New Mexico. Prepared for New Mexico Energy, Minerals and Natural Resources Department Oil Conservation Division, Environmental Bureau. November 20, 2009.
- DMT Technologies (DMT). 2011. Final report for EMNRD/Oil Conservation Division: Z-scan review, Former I&W facility, Carlsbad, New Mexico. April 11, 2011.
- DMT. 2013. Final report for AMEC Environment and Infrastructure, Inc. and EMNRD/Oil Conservation Division: I&W brine cavern project, Z-scan review, Stage II, Carlsbad, New Mexico. July 26, 2013.
- Martin Water Laboratories, Inc. (Martin). 1982. Result of water analyses for raw water and brine water samples collected November 1, 1982. Prepared for Natural Resources Engineering Inc. November 1, 1982.
- Land, L. and G. Veni. 2011. *Electrical resistivity survey: I&W brine well, Eddy County, New Mexico*. National Cave and Karst Research Institute Report of Investigations 2. June 2011.



- Natural Resources Engineering Inc. (NRE). 1982. Well bore sketch for Brine supply well #1. NRE Job Number NB01-001-001. November 9, 1982.
- New Mexico Energy, Minerals and Natural Resources Department (NMEMNRD). 2008. E-mail from Carl J. Chavez to multiple recipients regarding Brine well sonar testing requirement with this season's upcoming MIT schedule 2009. November 12, 2008.
- NMEMNRD. 2012. Presentation from pre-proposal conference, Request for professional & technical services, I&W Brine Cavern project, Carlsbad, New Mexico. May 9, 2012.
- NMEMNRD. 2013. Letter from Jami Bailey to Pieter Bergstein, Salty Dog, Inc., regarding Renewal of discharge permit BW-8 for brine supply well #1 in Unit J of Section 5, Township 19 South, Range 36 East NMPM, Lea County, New Mexico. November 8, 2013.
- Oil Conservation Division, New Mexico Energy, Minerals and Natural Resources Department (OCD). 1994. Letter from Roger C. Anderson to Larry Squires, Salty Dog, regarding Discharge plan BW-08 renewal, Salty Dog Inc. water station, Lea County, New Mexico. March 4, 1994.
- RESPEC Consulting & Services (RESPEC). 2009. *Two-dimensional seismic evaluation of the I&W brine cavern, Carlsbad, New Mexico*. Prepared for New Mexico Oil Conservation Division, Santa Fe, New Mexico. Topical Report RSI-2083. November 2009.
- Salty Dog, Inc. (Salty Dog). 1988. Letter report outlining facility data for quarter ending September 1987. February 25, 1988.
- Salty Dog. 1999. Form C-103 report on Brine supply well #1. Submitted September 8, 1999. Approved by OCD December 1, 1999.
- SOCON Sonar Well Services, Inc. (SOCON). 2009. ECHO-LOG, Salty Dog, Inc. Brine well No: 1, Hobbs, New Mexico: First SOCON Sonar Well Services survey. February 5, 2009.



Unichem International (Unichem). 1987. Laboratory results for water samples collected on November 25, 1987. Prepared for Larry Squires. December 1, 1987.

Figures

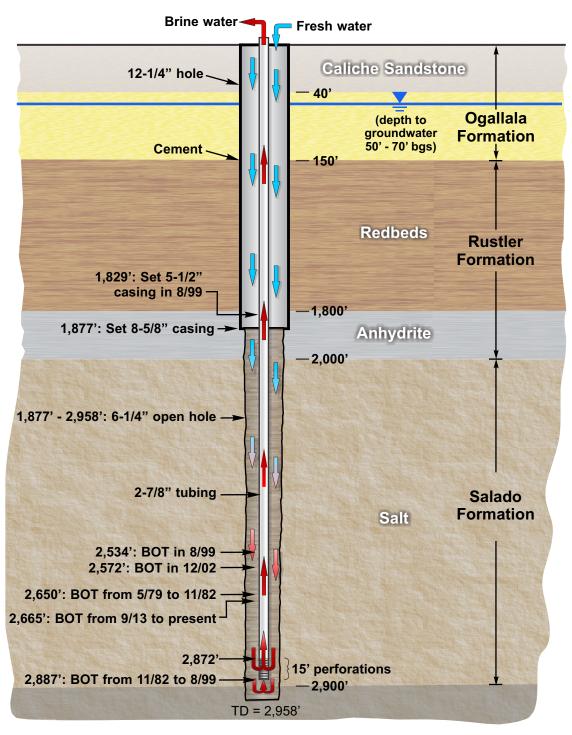
S:\PROJECTS\ES08.0118.05_SALTY_DOG_DP_BW-8\GIS\MXD\FIG01_SITE_LOCATION_AND_FACILITIES.MXD

Water supply well

SALTY DOG BRINE STATION

2014 Aerial Photograph of Salty Dog Brine Station

Salty Dog Brine Well



Notes:

- 1. BOT = Bottom of tubing
- 2. Figure not to scale

Sources:

- 1. Completion data based on OCD well reports
- 2. Lithology from Salty Dog (1988)

SALTY DOG BRINE STATION

Generalized Brine Well Schematic



rojects/es08.0118.05 Salty Dog DP BW-8\VR Drawings/fig03 generalized brine well schematic.cdf

Daniel B. Stephens & Associates, Inc. 9-17-14 JN ES08.0118.05

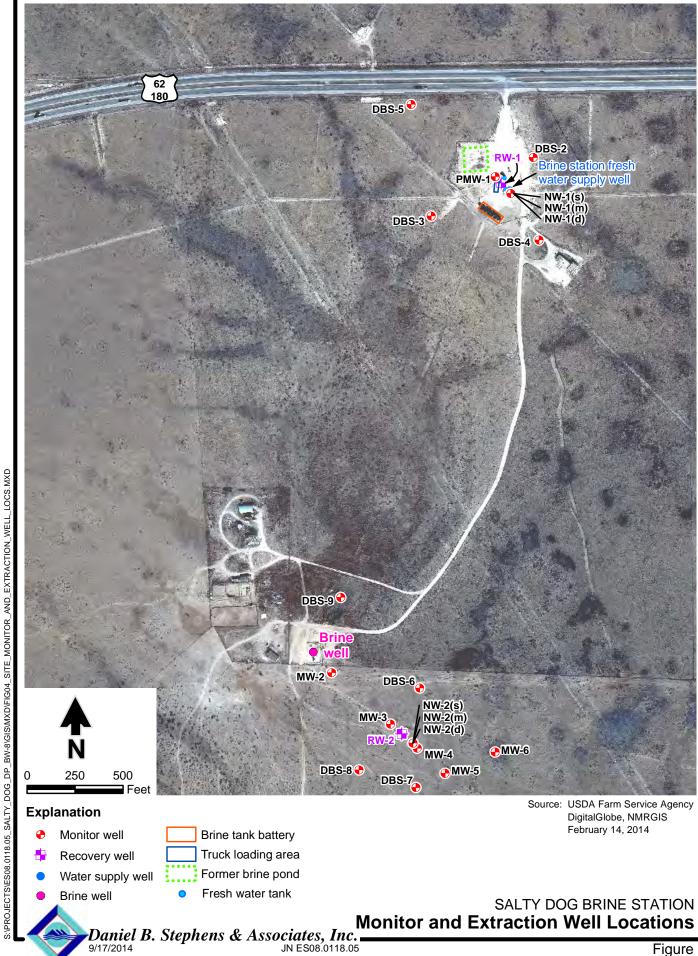
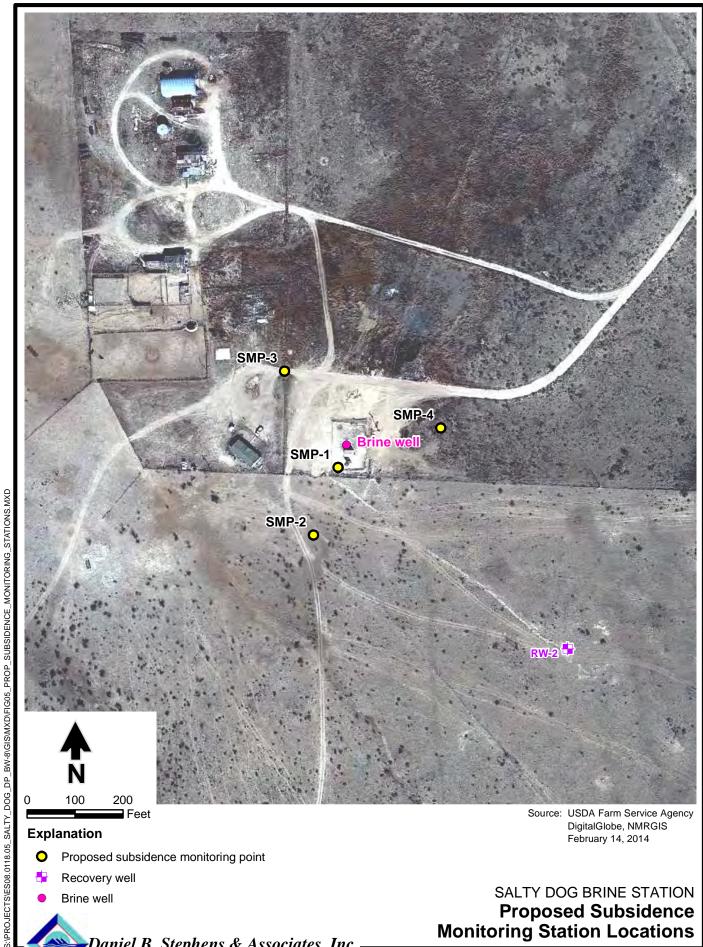


Figure 4



Proposed subsidence monitoring point

Recovery well

Brine well

SALTY DOG BRINE STATION Proposed Subsidence Monitoring Station Locations

Daniel B. Stephens & Associates, Inc., JN ES08.0118.05

Source:

PROJECTS/ES08.0118.05 SALTY DOG DP BW-8\VR DRAWINGS\FIG06 SUBSIDENCE SURVEY MONUMENT DESIGN.CDR

Prepared by Engineering Analytics, Inc. (2014)

SALTY DOG BRINE STATION **Subsidence Survey Monument Design**

Explanation

HRMT = High-resolution magnetotellurics

ER = Electrical resistivity

IPR = Induced polarization resistivity

SEI = Seismic

SON = Sonic

Source:

New Mexico Energy, Minerals & Natural Resources Department (2012)

SALTY DOG BRINE STATION

Subsurface Anomalies Identified by Geophysical Methods at the I&W Site

From:

Chavez, Carl J, EMNRD

Sent:

Friday, November 14, 2008 4:38 PM

To:

'ziatransports@gmail.com'; 'jrmillett@gmail.com'; 'rharrisnm@aim.com'; 'gandy2@leaco.net';

'seay04@leaco.net'; 'iwcarlsbad@plateautel.net'; 'Patterson, Bob'; 'Dimas Herrera';

'gil@mull.us'; 'David Pyeatt'; 'Wayne E Roberts'; Dennis L Shearer; 'garymschubert@aol.com';

'dgibson@keyenergy.com'; 'Clay Wilson'; 'Prather, Steve'; Ronnie D Devore

Cc:

Hill, Larry, EMNRD; Gum, Tim, EMNRD; Price, Wayne, EMNRD

Subject:

Brine Well Moratorium Press Release Today

Attachments: PR-OCD Brine Well Moratorium.pdf

FYI, please see the attached NM OCD Press Release issued today. Thank you.

Carl J. Chavez, CHMM

New Mexico Energy, Minerals & Natural Resources Dept.

Oil Conservation Division, Environmental Bureau

1220 South St. Francis Dr., Santa Fe, New Mexico 87505

Office: (505) 476-3491 Fax: (505) 476-3462

E-mail: CarlJ.Chavez@state.nm.us

Website: http://www.emnrd.state.nm.us/ocd/index.htm (Pollution Prevention Guidance is under "Publications")

From:

Porter, Jodi, EMNRD

Sent:

Friday, November 14, 2008 2:35 PM

Subject:

PR-Energy, Minerals and Natural Resources Cabinet Secretary Prukop Orders a Six Month Moratorium on New

Brine Wells

Attachments: PR-OCD.Brine.Well.Moratorium.pdf; image001.jpg; image015.jpg



Bill Richardson

Joanna Prukop Cabinet Secretary Reese Fullerton Deputy Cabinet Secretary Mark Fesmire
Division Director
Oil Conservation Division



November 14, 2008

Contact: Jodi McGinnis Porter,

Public Information Officer 505.476.3226

Energy, Minerals and Natural Resources Cabinet Secretary Prukop Orders a Six Month Moratorium on New Brine Wells

Oil Conservation Division to Investigate Brine Well Collapses and Provide Recommendations

SANTA FE, NM – Secretary Joanna Prukop today ordered the Oil Conservation Division to place a six month moratorium on any new brine well applications located in geologically sensitive areas. Secretary Prukop's action comes following the second brine well collapse in less than four months in southeastern New Mexico. The Secretary has also directed the Oil Conservation Division to work with the Environmental Protection Agency, other states, technical experts and oil and gas industry representatives to examine the causes of recent collapses, and provide a report with recommendations to the Oil Conservation Commission for a safe path forward. The report should be completed by May 1, 2009.

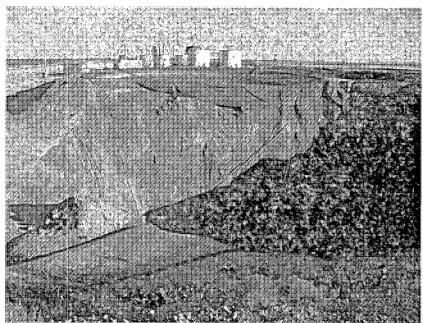
"I am deeply concerned by these two serious incidents and we are taking action to ensure the safety of our citizens and to protect the environment," stated Secretary Prukop.

Brine wells are an essential part of the oil and gas drilling industry, particularly in the southeastern part of the state. Oil and gas operators use brine water in the drilling process. Brine is saturated salt water which can be more salty than sea water. Brine is created by injecting fresh water into salt formations, allowing the water to absorb the salt and then pumping it out of the well. This method creates an underground cavity.

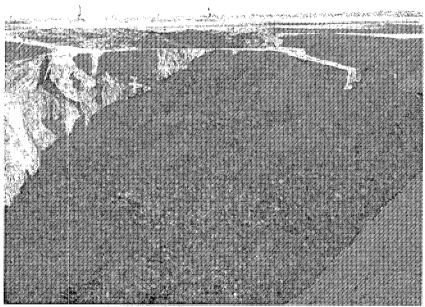
"The moratorium will provide time to properly evaluate the causes of the recent collapses and to discuss the development of new rules or guidelines to ensure the safety and stability of brine well systems," added Secretary Prukop.

The moratorium will only affect new wells and will not impact existing wells and facilities.

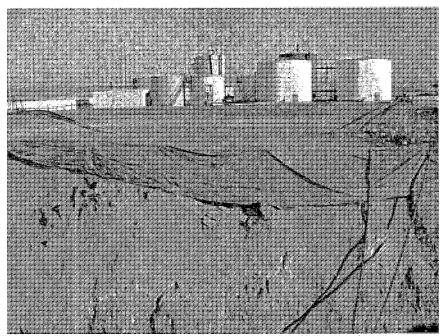
Below are photographs of the two recent collapses:



Loco Hills brine well collapse, morning, November 7, 2008, sinkhole with fresh water pond in foreground.

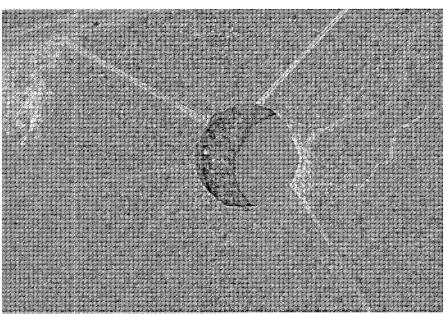


Loco Hills brine well collapse, morning, November 7, 2008 sinkhole. Photo courtesy of Oil Conservation Division

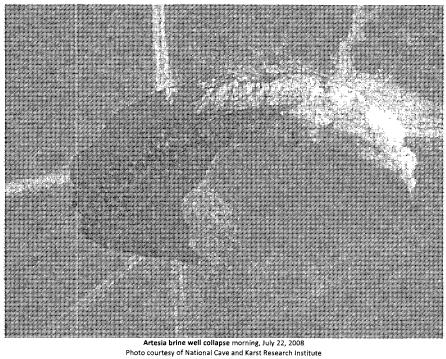


Loco Hills brine well collapse, morning, November 7, 2008 status of fresh water pond.

Photo courtesy of Oil Conservation Division



Artesta brine well colleges, recruing, July 10, 2008 at 10744 are. Photo courtesy of National Cave and Karst Research Institute



#30#

The Energy, Minerals and Natural Resources Department provides resource protection and renewable energy resource development services to the public and other state agencies.

Oil Conservation Division 1220 South St. Francis Drive • Santa Fe, New Mexico 87505 Phone (505) 476-3440 • Fax (505) 476-3462 • www.emnrd.state.nm.us/OCD



Jodí

Jodi McGinnis Porter Public Information Officer Energy, Minerals and Natural Resources Department (EMNRD) 1220 South St. Francis Drive Santa Fe, NM 87505

Phone: (505) 476-3226 Fax: (505) 476-3220 Cell: (505) 690-1689

E-mail: jodi.porter@state.nm.us Website: www.emnrd.state.nm.us

From: Chavez, Carl J, EMNRD

Sent: Wednesday, November 12, 2008 11:50 AM

To: 'ziatransports@gmail.com'; 'jrmillett@gmail.com'; 'Patterson, Bob'; Philliber, Mark;

'rharrisnm@aim.com'; 'gandy2@leaco.net'; 'David Pyeatt'; 'garymschubert@aol.com'

Cc: Price, Wayne, EMNRD; Sanchez, Daniel J., EMNRD; Hill, Larry, EMNRD; Gum, Tim, EMNRD

Subject: Brine Well Sonar Testing Requirement with this season's upcoming MIT Schedule 2009

Gentlemen:

Re: MITs and OCD Sonar Test Requirement

Good morning. It is that time of season when the OCD requests your proposed MIT schedule. The OCD is requiring a sonar test in addition to the MIT this season. The OCD objective is to complete the MITs on or before July 31, 2009. If circumstances require it, the deadline for MITs may be extended to on or before October 31, 2009. Please contact me within 30 days to schedule your MIT and sonar test with date and time that you prefer. Note that brine well operators scheduled for the annual OCD 4-hr. formation MIT may conduct the EPA 5-Yr. 30 minute MIT (+/- 10% to pass) at 300 – 500 psig on casing in lieu of the OCD annual formation MIT this season.

After reviewing the site files and your responses to the recent OCD questionnaire following the Jims Water Service (BW-5) brine well collapse SE of Artesia in Eddy County on 7/16/2008, and the more recent collapse at Loco Hills (BW-21) in Eddy County on 11/3/2008, the OCD is requiring Sonar Testing along with your MIT this season to assess the configuration of your brine well cavern and any threats to public health and safety in your areas. The OCD is focused on the maturity of brine wells and the "Calculation" from the recent questionnaire attempts to assess brine well maturity by comparing the total brine production relative to the depth of the brine well casing shoe. This is one of the reasons why fresh water and brine well production record reporting to the OCD is so critical. Any operators that are planning to plug and abandon their brine wells are required by the OCD to conduct a sonar test of the well in advance of plugging and abandonment. Also, the OCD requires that the brine cavern be filled with brine fluid as this adds structural stability to the cavern and well. This will be required in a C-103 approved with conditions by the OCD. Currently, 3 brine well operators have been required by the OCD to conduct sonar testing within 30 days due to the maturity issue mentioned above. The OCD is continuing to assess its EPA Class III Brine Well program and will keep you updated on improvements and/or changes as needed.

If you feel that your brine well is too new to require sonar testing or a sonar was recently completed at your brine well, please provide the basis for requesting an exemption to this OCD sonar test requirement ASAP for OCD approval.

Please contact me if you have questions. Thanks in advance for your cooperation in this matter.

Carl J. Chavez, CHMM New Mexico Energy, Minerals & Natural Resources Dept. Oil Conservation Division, Environmental Bureau 1220 South St. Francis Dr., Santa Fe, New Mexico 87505

Office: (505) 476-3491 Fax: (505) 476-3462

E-mail: CarlJ.Chavez@state.nm.us

Website: http://www.emnrd.state.nm.us/ocd/ index.htm (Pollution Prevention Guidance is under "Publications")



Bill Richardson

Governor

2008 OCT 31 PM 1 01

Joanna Prukop Cabinet Secretary Reese Fullerton Deputy Cabinet Secretary Mark Fesmire
Division Director
Oil Conservation Division



OIL CONSERVATION DIVISION BRINE WELL INFORMATION REQUEST

GENERAL INFORMATION:	
Operator Name Salty Dog Well Name(s) Salty Dog #	
API Number 30-625-26307 Brine Well Permit # BW-008	
Date Permit Expires? April 18, 2009	
Location: Section 5 Ts 19 Rg 36 FNL FSL 1980 FEL 1980 FWL GPS of well(s): Lat: Long:	
Have you reviewed and understand all of your permit conditions? Yes ☑ No□	
Have you reviewed and understand all of your permit conditions? Yes VNo Don't know weare Are you presently deficient of any condition in your permit? Yes No Don't know working to you operate below grade tanks or pits at the site? Yes No	nthis
Do all tanks, including fresh water tanks, have secondary containment? Yes No	
Do you think you have the expertise, knowledge and general understanding of what causes a brine well to collapse? Yes ✓ No□	
Do you think OCD should provide guidelines on subsidence and collapse issues? Yes No	
bo you mink OCD should provide guidennes on subsidence and contapse issues? Tesz No	
SITING INFORMATION: Please provide the following information and depict on 7.5	
minute (1": 2000') USGS Quad Map. Limit search to one mile radius.	
Is the brine well located within a municipality or city limits? Yes No	
Distance and direction to nearest permanent structure, house, school, etc. if less than one mile:	
. /	
1/2 mile a barn	
Distance and direction to nearest water well if less than one mile:	
1/4 of amile	
Distance to nearest watercourse(s), floodplain, playa lake(s), or man-made canal(s) or pond(s)	
if less than one mile: 14 Mile	
Distance and direction to nearest known karst features or mines if less than one mile:	



Distance and direction to nearest producing oil or gas well(s) if less than one mile:
n '1 ADIN 1
Provide API Number:
Distance and direction to nearest tank battery(ies) if less than one mile:
\mathcal{N}/\mathcal{R}
Distance and direction to nearest pipeline(s), including fresh water pipelines if less than one
mile: W P Distance and direction to nearest paved or maintained road or railroad if less than one mile:
i (
Depth to ground water found above the Salado (salt section), regardless of yield:
Depth to ground water found above the Salado (salt section), regardless of yield:
Name of aquifer(s):
Traine of aquifer(b).
WELL CONSTRUCTION: Please provide the following information and attach a
diagram depicting the brine well. Check box if attached:
Copy of a current well diagram: Attached
Copy of formation record with tops: Attached Attached If not well logs within one mile Attached If not well logs within one mile Attached If not well logs within one mile If not well logs within one well and If not well and If not well and If not well and If not well and If no well and If no well and If no well and If no well and If no well and If no well and If no well and If no well and If no well and If no well and If no well and If no well a
Copy of geophysical well logs if available: Attached ☐ If not, well logs within one mile ☐ Depth of the top of the salt below ground surface (feet):
1860fr
Depth to the bottom of the salt below ground surface (feet):
Not Sure
Depth(s) to and thickness(es) of any anhydrite section(s) (located above the salt):
360 for at least
Depth of casing(s) shoe below ground surface (feet): 1900 ft
Is the casing shoe set in the anhydrite or other layer above the salt? Yes ► No □
Is the casing shoe set into the salt? Yes No If yes, how far into the salt?
Depth of tubing(s):
2400 ft
Do you suspect that your cavern has partially caved in? Yes□ No□ Don't know □
OPERATIONS: Please provide the following information.
OT BRUITIONS. I rease provide the journal myormation.
Start date of brine well operation:
3-6-1981)
Total volume of fresh water injected into the brine well to date (bbls) and how determined:
UNSUIC

Total volume of brine water produced (bbls) to date and how determined:
Have you ever lost casing or tubing? If yes, please provide details. Yes in the 90's Document attached
Do you maintain a surface pressure on your well during idle times? Yes ✓ No□
Have you noticed large amounts of air built up during cavity pressurization? Yes□ No⊡
Have you ever noticed fluids or air/gas bubbling up around the casing during testing or normal operations? Yes No
MONITORING: Please provide the following information.
Are you currently monitoring ground water contamination from your brine well or system? Yes ☐ No□
Have you ever run a sonar log? Yes□ No□ If yes, please provide last date:
Provide cavern configuration (dimensions and volume) and method(s) used to estimate: If sonar report please attach \Box If other, please specify and provide a sketch of cavern: \Box
Do you have a subsidence monitoring program in place? Yes \(\subseteq \text{NoID} \)
Do you have any geophysical monitoring devices, such as a seismic device positioned near your brine well? Yes \(\Bar{\text{No}} \) No\(\Bar{\text{No}} \)
Have you submitted all of your monthly, quarterly, or annual reports to the OCD? Yes No We are Now but previously some had been or
Have you failed a brine well mechanical integrity test (MIT)? If yes, please attach details and results. Attached \Box
Have you ever had a casing leak? Yes ☐ No☐ Don't know ☐ Have you ever had a cavern leak? Yes ☐ No☐ Don't know ☐ Have you ever exceeded the cavern fracture pressure? Yes ☐ No☐ Don't know ☐ Do you know how to calculate your maximum pressure? Yes ☐ No☐ Don't know ☐
Have you foutinely looked for cracks or fissures in the ground surface around your brine well? Yes □ No□
Do you have any minor or major cracks, fissures, tank settlement, line breakage from settlement or any minor subsidence. Yes \(\text{No} \)
During operations have you experienced any ground vibration, ground movement, or well movement after opening or shunting valves, pump start-up, shut-down, etc.? Yes \(\) No \(\)

Have you ever experienced unexpected pressure gain or loss in the cavern? Yes Not Yes, was there a difference in your normal flow rate? Yes Not Yes					
Anytime during the past 5 years, have you experienced a noticeable difference between fresh water volume pumped into the well verses brine water produced? Yes \(\sigma \) No \(\sigma \)					
Are you concerned about pulling the tubing due to the fact it may be difficult to re-enter the hole? Yes No					
Are you concerned about running a sonar tool in fear of losing tool because of debris in hole? Yes No					
Have you ever conducted a fly over of your well site? No \(\text{Yes} \) if yes, please provide photo. \(\text{Photo}(s) \) attached \(\text{Wo} \) Photo \(\text{Sol} \)					
Calculation: Please divide your estimated total volume of produced brine by $180,000$ and multiply by 50. Example: If you have produced a total of $18,000,000$ bbls of brine in the life time of the well then your calculation would be $18,000,000/180,000 = 100 \times 50 = 5000$.					
 Provide the calculated number above here: Now provide the depth (ft) from the surface to your casing shoe: 					
Is the calculated number found in #1 above greater than #2? Yes□ No□					
Comments or recommendations for OCD:					
While we have not previously been there to submit all reports we are now strucing to do everything					
submit all reports we are the					

"I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments and that, based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information including the possibility of fine and imprisonment."

Company Name print name above

Company Representative- print name

Company Representative- Signature

Title <u>Manayer</u>

Date: 10-14-2008

2724 2724 1800ty TX

Wayne Price

OCD

1220 5 St. Francis Or

Santa Fe, WM 87505

8750594225 CO11

New Mexico Energy, Minerals and Natural Resources Department

Bill Richardson

Governor

Joanna Prukop Cabinet Secretary Reese Fullerton Deputy Cabinet Secretary Mark Fesmire
Division Director
Oil Conservation Division



Certified Receipt/Return Requested:

August 01, 2008

Attention Brine Well Operator(s):

One of the permitted brine wells has experienced a total collapse and created an enormous sinkhole. The well was located approximately 17 miles SE of Artesia, NM. on State Trust Land. The operator was Jim's Water Service and the brine well permit is BW-005. OCD has enclosed a press release with photos of the event.

The magnitude of this event warrants an immediate investigation of all brine wells in the state. Therefore, please find enclosed a "BRINE WELL INFORMATION REQUEST" form to be filled out and returned to this office no later than September 05, 2008. Failure to properly fill out and return the form in a timely manner may result in OCD requesting you shut down your operations until further notice. If you have any questions please do not hesitate to call me at 505-476-3490 or E-mail wayne.price@state.nm.us.

Sincerely.

Wayne Price

Environmental Bureau Chief Oil Conservation Division

Attachments: (2)

Cc: EMNRD Cabinet Secretary-Joanna Prukop

OCD Director-Mark Fesmire

NMSLO- Brian Henington SF, Jim Carr-Carlsbad

BLM-Carlsbad Office- Dave Herrell

Eddy Co. Emergency Management-Joel Arnwine

NM State Police -Roswell Sqt. Les Clements

National Cave and Karst Research Institute- Dr. George Veni

NMOSE-John Stewart

Solution Mining Research Institute-John Voigt

Price, Wayne, EMNRD

From:

Porter, Jodi, EMNRD

Sent:

Wednesday, July 23, 2008 5:00 PM

Subject:

PR-Secretary Prukop Proposes Stricter Conditions on Brine Wells State-wide

Attachments: PR-OCD.Brine.Wells07.23.08.pdf



Bill Richardson

Governor

Joanna Prukop Cabinet Secretary Reese Fullerton Deputy Cabinet Secretary Mark Fesmire
Division Director
Oil Conservation Division



NEWS RELEASE

July 23, 2008

Contact: Jodi McGinnis Porter.

Public Information Officer 505.476.3226

Energy, Minerals and Natural Resources Cabinet Secretary Joanna Prukop Proposes Stricter Conditions on Brine Wells State-wide

Artesia brine well collapse prompts statewide review

SANTA FE, NM – Secretary Joanna Prukop has directed the Oil Conservation Division (OCD) to conduct a complete evaluation of the rules and regulations concerning brine wells, a method of creating saturated salt water used in oil and gas production. The OCD evaluation will include an internal audit and inspection of all existing brine wells in New Mexico. Secretary Prukop is considering strengthening oversight of brine wells to protect against well failures such as the recent collapse in Artesia that created a huge sinkhole and forced the closure of an Eddy County road.

"There are several brine wells in New Mexico and we must ensure that they are all properly monitored to ensure safety and stability," stated Cabinet Secretary Joanna Prukop. "We have now seen that these wells can collapse and the extensive damage such a collapse can generate."

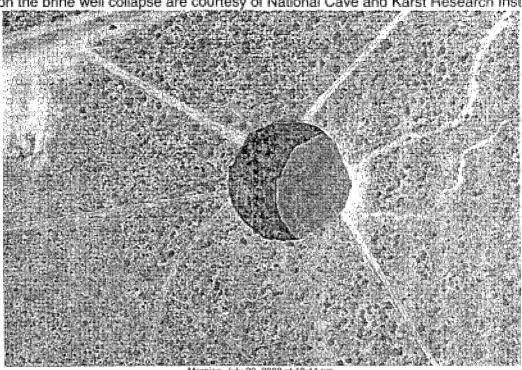
The Oil Conservation Division is continuing to monitor and investigate the collapse of the brine well, located on state trust land 17.3 miles southeast of Artesia, which is still active. The well is owned by Jim's Water Service. County Road 217 remains closed as a safety precaution, and a command center is on site. Division engineers estimate that the well is approximately 300 to 400 feet in diameter, 70 feet to the water level, and the actual depth to the bottom is unknown.

Scientists from the Oil Conservation Division, the Bureau of Land Management, State Land Office, the New Mexico

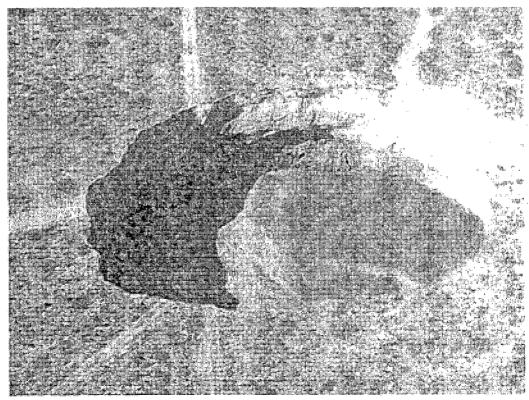
Bureau of Geology and Mineral Resources, and the National Cave & Karst Research Institute are all working together to assess horizontal and vertical movements to project any future subsidence. Work on a protective fence and keep-out signage began vesterday with completion expected on Friday.

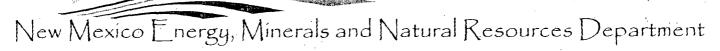
In a related issue, the Oil Conservation Division has also been closely monitoring a brine well operated by I & W, Inc located in Carlsbad, NM. Yesterday, following ongoing inquiries from OCD the operator decided voluntarily to stop operation of the well The division will work with I & W, Inc. to ensure that the well is properly plugged, permanently abandoned, and monitored for the long term.

Images provided on the brine well collapse are courtesy of National Cave and Karst Research Institute:



Morning, July 20, 2008 at 10:44 am. courtesy of National Cave and Karst Research Institute





Bill Richardson

Governor

Joanna Prukop Cabinet Secretary Reese Fullerton Deputy Cabinet Secretary Mark Fesmire
Division Director
Oil Conservation Division



OIL CONSERVATION DIVISION BRINE WELL INFORMATION REQUEST

GENERAL INFORMATION:		·				
Operator Name						
API Number						
Date Permit Expires?		· .				
Location: Section	Ts		Rg	 	<u></u> _	
Location: SectionFSLGPS of well(s): Lat:		FEL		FWL		
GPS of well(s): Lat:	Long:					
						
Have you reviewed and understan	d all of your p	ermit co	nditions?	? Yes □ No□		
Are you presently deficient of any					n't know□	
Do you operate below grade tanks					•	
Do all tanks, including fresh water						
Do you think you have the expert	ise, knowledge	and ger	neral und	erstanding of w	hat causes a	
brine well to collapse? Yes□ No					•	
Do you think OCD should provid	e guidelines on	ı subside	ence and	collapse issues?	? Yes□ No□	
SITING INFORMATION: Plea	ase provide the	e followi	ing infor	mation and dep	pict on 7.5	
minute (1": 2000") USGS Quad	Map. Limit se	e arch to	one mile	radius.		
Is the brine well located within a	municipality of	r city lin	nite? V	Vac II No II		
is the brine wen located within a	mumcipanty of	i City IIII	1116: 1	CSLI NOL	İ	
Distance and direction to nearest	permanent stru	cture, ho	ouse, scho	ool, etc. if less t	than one mile:	
	11 107	. 1	• 1			
Distance and direction to nearest	water well if le	'ss than o	one mile:			
Distance to nearest watercourse(s) floodplain n	lava lak	e(s) or m	nan-made canal	(s) or pand(s)	
if less than one mile:	,, moodplam, p	Tuyu Tuk	c(3), OI II	ian made canan	(3) of polici(3)	
if iess man one mue.						
Distance and direction to nearest	known karst fe	atures o	r mines it	flace than one x	mile:	
Distance and direction to hearest	anown kaist lo	atures Of	i iiiiics ij	iess man one n	тик.	
				•		



Oil Conservation Division August 1, 2008 Page 2

Distance and direction to nearest producing oil or gas well(s) if less than one mile: Provide API Number:
Distance and direction to nearest tank battery(ies) if less than one mile:
Distance and direction to nearest pipeline(s), including fresh water pipelines if less than one mile:
Distance and direction to nearest paved or maintained road or railroad if less than one mile:
Depth to ground water found above the Salado (salt section), regardless of yield:
Name of aquifer(s):
WELL CONSTRUCTION: Please provide the following information and attach a diagram depicting the brine well. Check box if attached: Copy of a current well diagram: Attached □ Copy of formation record with tops: Attached □ Copy of geophysical well logs if available: Attached □ If not, well logs within one mile □ Depth of the top of the salt below ground surface (feet):
Depth to the bottom of the salt below ground surface (feet):
Depth(s) to and thickness(es) of any anhydrite section(s) (located above the salt):
Depth of casing(s) shoe below ground surface (feet):
Do you suspect that your cavern has partially caved in? Yes□ No□ Don't know□
OPERATIONS: Please provide the following information.
Start date of brine well operation:
Total volume of fresh water injected into the brine well to date (bbls) and how determined:

Oil Conservation Division August 1, 2008 Page 3

Total volume of brine water produced (bbls) to date and how determined:
Have you ever lost casing or tubing? If yes, please provide details. Document attached
Do you maintain a surface pressure on your well during idle times? Yes□ No□
Have you noticed large amounts of air built up during cavity pressurization? Yes□ No□
Have you ever noticed fluids or air/gas bubbling up around the casing during testing or normal operations? Yes□ No□
MONITORING: Please provide the following information.
Are you currently monitoring ground water contamination from your brine well or system? Yes □ No□
Have you ever run a sonar log? Yes□ No□ If yes, please provide last date:
Provide cavern configuration (dimensions and volume) and method(s) used to estimate: If sonar report please attach \Box If other, please specify and provide a sketch of cavern: \Box
Do you have a subsidence monitoring program in place? Yes □ No□
Do you have any geophysical monitoring devices, such as a seismic device positioned near your brine well? Yes □ No□
Have you submitted all of your monthly, quarterly, or annual reports to the OCD? Yes □ No□
Have you failed a brine well mechanical integrity test (MIT)? If yes, please attach details and results. Attached □
Have you ever had a casing leak? Yes □ No□ Don't know □ Have you ever had a cavern leak? Yes □ No□ Don't know □ Don't know □ Do you know how to calculate your maximum pressure? Yes □ No□ Don't know □ Don't know □ Have you routinely looked for cracks or fissures in the ground surface around your brine well? Yes □ No□
Do you have any minor or major cracks, fissures, tank settlement, line breakage from settlement or any minor subsidence. Yes □ No□
During operations have you experienced any ground vibration, ground movement, or well movement after opening or shunting valves, pump start-up, shut-down, etc.? Yes No

Oil Conservation Division August 1, 2008 Page 4

Have you ever exper If Yes, was there a d				n? Yes□ No□ Yes□ No□
Anytime during the pwater volume pumper				rence between fresh No
Are you concerned a hole? Yes□ No□	bout pulling the	tubing due to the	fact it may be diffi	cult to re-enter the
Are you concerned a Yes□ No□	bout running a so	onar tool in fear o	f losing tool becau	se of debris in hole?
Have you ever conduphoto. □ Photo(s) attached	•	of your well site?	No□ Yes□ if ye	s, please provide
Calculation: Please	divide your esting mple: If you have	ve produced a tot	al of 18,000,000 bb	ols of brine in the life
	calculated number the depth (ft) fr		your casing shoe:	
Is the calculated nun	nber found in #1	above greater tha	n #2? Yes□ No	 D□
Comments or recom	mendations for C	OCD:	· · · · · · · · · · · · · · · · · · ·	
			•	
,	• •			• •
this document and all att	achments and that, b n, I believe that the i	based on my inquiry information is true, a	of those individuals im ccurate, and complete.	information submitted in mediately responsible for I am aware that there are d imprisonment."
	Company Name-p	orint name above	<u>. </u>	
•	Company Represe	entative- print name		
	Company Represe	entative- Signature		
	Title			
	Date:			

From:

Chavez, Carl J, EMNRD

Sent:

Friday, July 25, 2008 4:21 PM

To:

Hansen, Edward J., EMNRD; Price, Wayne, EMNRD

Cc:

Sanchez, Daniel J., EMNRD

Subject:

RE: PR-Secretary Prukop Proposes Stricter Conditions on Brine Wells State-wide

Attachments: image001.jpg; image007.jpg

Ed, Wayne, et. al:

Based on my records and knowledge of current activities at NMOCD BWs, my tally is as follows:

There are a total of 15 active UIC Class III Brine Well Permits (excluding BW-5 JWS & BW-6 I&W)

There are currently 13 active UIC Class III Brine Wells in operation (BW-2; BW-4; BW-9; BW-12; BW-13; BW-25; BW-27; BW-27; BW-28; BW-30; and BW-31)

There are currently 6 brine wells that have actually been PA'd including: BW-5 JWS Collapse w/ Site Closure; BW-6 Eugenie #2; BW-21 Loco Hills Well #1 recently PA'd: BW-26 Salado Brine Sales; BW-29 Marbob; & William Brininstool.

There are currently 3 pending PAs of BWs including: BW-6 Eugenie #1 w/ Site Closure; BW-18 Key w/ redrill; and BW-19 Key w/ redrill.

There are currently 5 inactive brine wells (BW-5 Collapse w/ Site Closure; BW-6 needs PA Eugenie #1 w/ Site Closure; BW-18 needs PA w/ redrill; BW-19 needs PA w/ redrill; and BW21 needs redrill)

Let me know how we need to straighten RBDMS out. Please contact me if you have questions. Thanks.

Carl J. Chavez, CHMM

New Mexico Energy, Minerals & Natural Resources Dept.

Oil Conservation Division, Environmental Bureau

1220 South St. Francis Dr., Santa Fe, New Mexico 87505

Office: (505) 476-3491 Fax: (505) 476-3462

E-mail: CarlJ.Chavez@state.nm.us

Website: http://www.emnrd.state.nm.us/ocd/index.htm (Pollution Prevention Guidance is under "Publications")

From: Hansen, Edward J., EMNRD

Sent: Wednesday, July 23, 2008 5:56 PM

To: Price, Wayne, EMNRD **Cc:** Chavez, Carl J, EMNRD

Subject: FW: PR-Secretary Prukop Proposes Stricter Conditions on Brine Wells State-wide

Wayne,

Jane and I tallied these numbers off of RBDMS (you may want to double check).

From: Hansen, Edward J., EMNRD

Sent: Wednesday, July 23, 2008 5:54 PM

To: Porter, Jodi, EMNRD

Subject: RE: PR-Secretary Prukop Proposes Stricter Conditions on Brine Wells State-wide

Jodi,

We counted (from our database: RBDMS):

16 Active Brine Wells

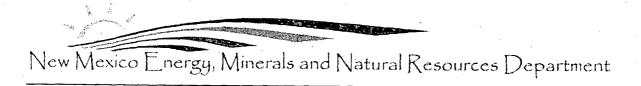
11 Plugged and Abandoned Brine Wells

2 Inactive Brine Wells

From: Porter, Jodi, EMNRD

Sent: Wednesday, July 23, 2008 5:00 PM

Subject: PR-Secretary Prukop Proposes Stricter Conditions on Brine Wells State-wide



Bill Richardson

Joanna Prukop Cabinet Secretary Reese Fullerton Deputy Cabinet Secretary

Mark Fesmire Division Director Oil Conservation Division



July 23, 2008

Contact: Jodi McGinnis Porter.

Public Information Officer 505.476.3226

Energy, Minerals and Natural Resources Cabinet Secretary Joanna Prukop Proposes Stricter Conditions on Brine Wells State-wide

Artesia brine well collapse prompts statewide review

SANTA FE, NM – Secretary Joanna Prukop has directed the Oil Conservation Division (OCD) to conduct a complete evaluation of the rules and regulations concerning brine wells, a method of creating saturated salt water used in oil and gas production. The OCD evaluation will include an internal audit and inspection of all existing brine wells in New Mexico. Secretary Prukop is considering strengthening oversight of brine wells to protect against well failures such as the recent collapse in Artesia that created a huge sinkhole and forced the closure of an Eddy County road.

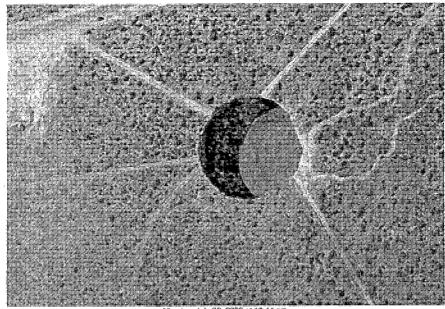
"There are several brine wells in New Mexico and we must ensure that they are all properly monitored to ensure safety and stability," stated Cabinet Secretary Joanna Prukop. "We have now seen that these wells can collapse and the extensive damage such a collapse can generate."

The Oil Conservation Division is continuing to monitor and investigate the collapse of the brine well, located on state trust land 17.3 miles southeast of Artesia, which is still active. The well is owned by Jim's Water Service. County Road 217 remains closed as a safety precaution, and a command center is on site. Division engineers estimate that the well is approximately 300 to 400 feet in diameter, 70 feet to the water level, and the actual depth to the bottom is unknown.

Scientists from the Oil Conservation Division, the Bureau of Land Management, State Land Office, the New Mexico Bureau of Geology and Mineral Resources, and the National Cave & Karst Research Institute are all working together to assess horizontal and vertical movements to project any future subsidence. Work on a protective fence and keep-out signage began yesterday with completion expected on Friday.

In a related issue, the Oil Conservation Division has also been closely monitoring a brine well operated by I & W, Inc located in Carlsbad, NM. Yesterday, following ongoing inquiries from OCD the operator decided voluntarily to stop operation of the well The division will work with I & W, Inc. to ensure that the well is properly plugged, permanently abandoned, and monitored for the long term.

Images provided on the brine well collapse are courtesy of National Cave and Karst Research Institute:



Mounting, July 20, 2000 of 10:44 item.

courtesy of National Cave and Karst Research Institute



Morning, July 22, 2008 courtesy of National Cave and Karst Research Institute

#30#

The Energy, Minerals and Natural Resources Department provides resource protection and renewable energy resource development services to the public and other state agencies.

Oil Conservation Division
1220 South St. Francis Drive • Santa Fe, New Mexico 87505
Phone (505) 476-3440 • Fax (505) 476-3462 • www.emnrd.state.nm.us/OCD



Jodi

Jodi McGinnis Porter Public Information Officer Energy, Minerals and Natural Resources Department (EMNRD) 1220 South St. Francis Drive Santa Fe, NM 87505 Phone: (505) 476-3226

Fax: (505) 476-3220 Cell: (505) 690-1689 E-mail: jodi.porter@state.nm.us Website: www.emnrd.state.nm.us