BW - 38

SURFACE SUBSIDENCE MONITORING PLAN

Chavez, Carl J, EMNRD

From: danny@pwllc.net
Sent: Tuesday, March 26, 2019 2:03 PM
To: Chavez, Carl J, EMNRD
Cc: Marvin Burrows
Subject: [EXT] Llano Disposal, LLC - State 27 BSW #1 (BW-38) COA Plan Submittal
Attachments: BW-38 COA Submittal Letter to OCD 032619.pdf; Surface Subsidence Monitoring Plan Submitted to OCD 032619.pdf; Solution Cavern Characterization Plan Submitted to OCD 032619.pdf

Carl,
Hope you are well. Attached are three files concerning plan submittals to complete the conditions of approval on BW-38.

* Cover letter
* Surface Subsidence Monitoring Plan
* Solution Cavern Characterization Plan

If you have any questions or need any additional information concerning these plans, please let me know.
Thank you,
Danny J. Holcomb
Cell: 806-471-5628
Email: danny@pwllc.net

Holcomb Consultants
6900 Spring Cherry Lane
Amarillo, Texas 79124

March 26, 2019

New Mexico Oil Conservation Division
Environmental Bureau
1220 South St. Francis Drive
Santa Fe, New Mexico 87505
Attn: Mr. Carl Chavez

Re: Discharge Plan Permit (BW-38)
Llano Disposal, LLC
UIC Class III Brine Well - State '27' BSW #1 (30-025-20592)
UL 'L', Sec 27, T16S, R33E, 1980 FSL x 660 FWL, Lea County, New Mexico

Dear Mr. Chavez,

Per Discharge Permit BW-38 approval conditions dated November 7, 2018, Llano Disposal, LLC is required to submit the following plans to the NMOCD Environmental Bureau within 180 days:

- Discharge Plan Approval Condition 2.B.1 - Surface Subsidence Monitoring Plan
- Discharge Plan Approval Condition 2.B.2 - Solution Cavern Characterization Plan

Llano previously submitted the initial surface subsidence monitoring plan in the original discharge permit application dated July 16, 2018. Please see pages 18– 19 and Attachment 'P'. Llano hereby submits supplemental information concerning the surface subsidence monitoring plan and subsequent monument installations.

Llano hereby submits the solution cavern characterization plan. This plan demonstrates that a 580 foot diameter salt solution cavern at the referenced well exceeds the NMOCD's safety factor guidelines for a stable cavern roof structure.

If you need any additional information concerning either the surface subsidence monitoring plan or the attached solution cavern characterization plan, please let us know. Thank you in advance for your consideration.

Sincerely,

DJ Holcomb

Danny J. Holcomb
Holcomb Consultants
Agent for Llano Disposal, LLC
Cell: 806-471-5628
Email: danny@pwllc.net

Attachments

Llano Disposal, LLC
State 27 BSW #1 (BW-38)
Surface Subsidence Monitoring Plan

Surface Subsidence Monitoring Plan
To insure public safety utilizing proper evaluation of potential surface subsidence, Llano will implement the following surface subsidence monitoring plan at the State 27 BSW #1.

Llano has installed three surface subsidence monuments suitable for three-dimensional surface monitoring over time in addition to establishing an X, Y, and Z position on the brine well wellhead. The three subsidence monuments are Berntsen's 9/16" stainless steel floating sleeved rod monuments (see Attachment "P") which are well suited for monitoring positional changes in the ground surface. The monuments are designed so that frost heave and swelling and shrinking soil conditions have no effect on the stainless-steel rod on which measurements will be made. Rod monuments were installed in a triangular configuration around the brine well at a maximum distance of 778 feet from the well as pre-approved by the NMOCD. See the attached survey contractor report of monument installation and initial survey results.

Monument Installation Procedure
A 12" diameter hole is augered to a depth of about 3-1/2 feet. The stainless-steel rod is manually driven into the ground, a section at a time, to a depth of 8 feet. The top of the rod would be about 6" below ground level. A finned floating sleeve (filled with NO-TOX grease) is placed over the rod and the datum point added on the rod end. A 6" diameter x 42" long PVC pipe conduit with access cover glued to top end is then placed over the finned sleeve. The inside of the PVC conduit is then filled with fine sand to a level about 3" below the top of the rod. The outside of the PVC conduit is filled with sand to about 1 foot below ground level, then concrete will be placed from 1-foot depth to ground level.

Annual Subsidence Surveys
The survey contractor will use modern survey equipment to establish X, Y, Z positions on the three surface subsidence monuments and the wellhead on an annual basis. Survey grade GPS equipment will be utilized to establish the horizontal position of each subsidence monument relative to the New Mexico Coordinate System North American Datum 1983 (2007) based on the nearest U. S. Coast & Geodetic Survey Benchmark set in concrete. Using Static and Fast Static observations the expected horizontal accuracy of the GPS equipment as established by the manufacturer for the subsidence monuments is ±0.01 ft. A digital level will be utilized to establish the vertical position of the surface subsidence monuments relative to the North American Vertical Datum of 1988 (NAVD88). Using differential leveling techniques the expected vertical accuracy of the equipment as established by the manufacturer for the subsidence monuments is ±0.01 ft.

Llano Disposal, LLC
State 27 BSW #1 (BW-38)
Surface Subsidence Monitoring Plan

The initial survey was conducted after monument installation on February 27, 2019. This survey established horizontal and vertical coordinate baseline values on the three monuments and the wellhead. Additional surveys will be performed annually in order to compare coordinate values checking for movement in the monuments and the wellhead.

After cease of operations of the brine well, annual surface subsidence surveys will be conducted for a minimum of five additional years. Reports of all annual surveys will be submitted to the NMOCD in both tabular and graphical form, as requested, or in the annual operating report.

Conclusions

The effective monitoring of surface ground movement (if any) is one method utilized to monitor cavern integrity. Comparing water injection volumes to brine production volumes is another method. Llano will be utilizing both methods to properly operate the brine well, cavern development and insure public safety.

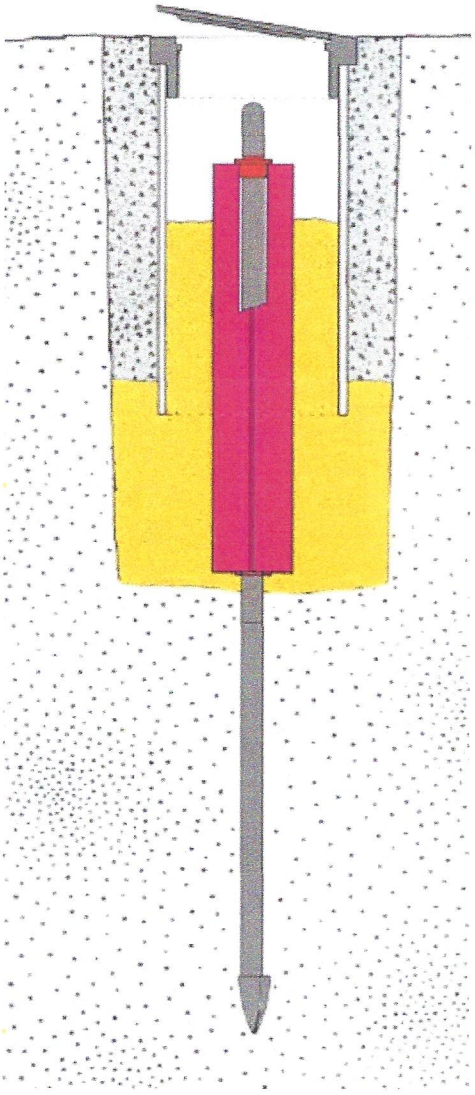
State '27' #1
API # 30-025-20592
Attachment P – Subsidence Monument Rod Design and Installation Procedure

Sectional Rod Monuments

Berntsen Survey Markers

Monument Design

SLEEVED ROD MONUMENT WITH FLOATING SLEEVE

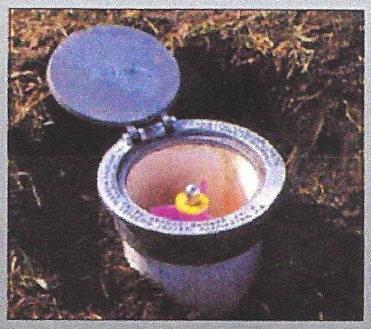


Monument Installation Procedure

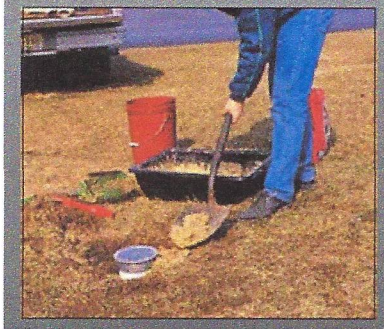
A 12 inch (300 mm) hole is augered to a depth of about 3 1/2 feet (1050 mm).

The rod monument is driven into the ground, a section at a time, to refusal*. The top of the last rod should be about 6 inches (150 mm) below the surface. **See page 15*

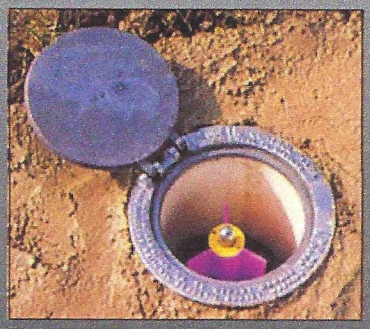
The finned sleeve (filled with grease) is placed over the rod and the datum point added (or filed onto the rod end).



A 6 inch (150 mm) diameter PVC pipe 3 feet (915 mm) long, with access cover glued on, is placed over the finned sleeve (pipe should not touch the fins). Back-fill (INSIDE the PVC Pipe) with sand.



The hole and pipe are carefully back-filled with sand. The top 12 inches (300 mm) of the hole (OUTSIDE of the PVC Pipe) are back-filled with concrete.



The finished mark - a well protected first-order benchmark.

PETTIGREW
& ASSOCIATES PA

ENGINEERING | SURVEYING | TESTING
DEFINING QUALITY SINCE 1965

Marvin Burrows
Llano Disposal LLC
Lovington, New Mexico, 88260
806-471-5628

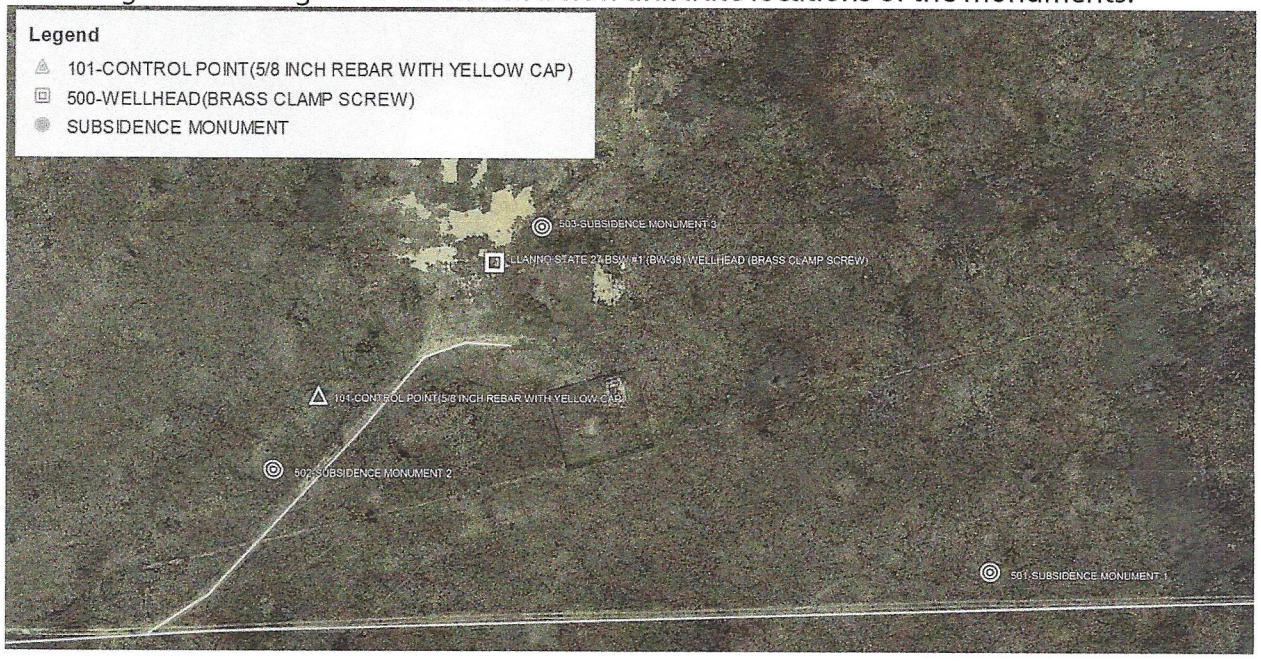
March 14, 2019

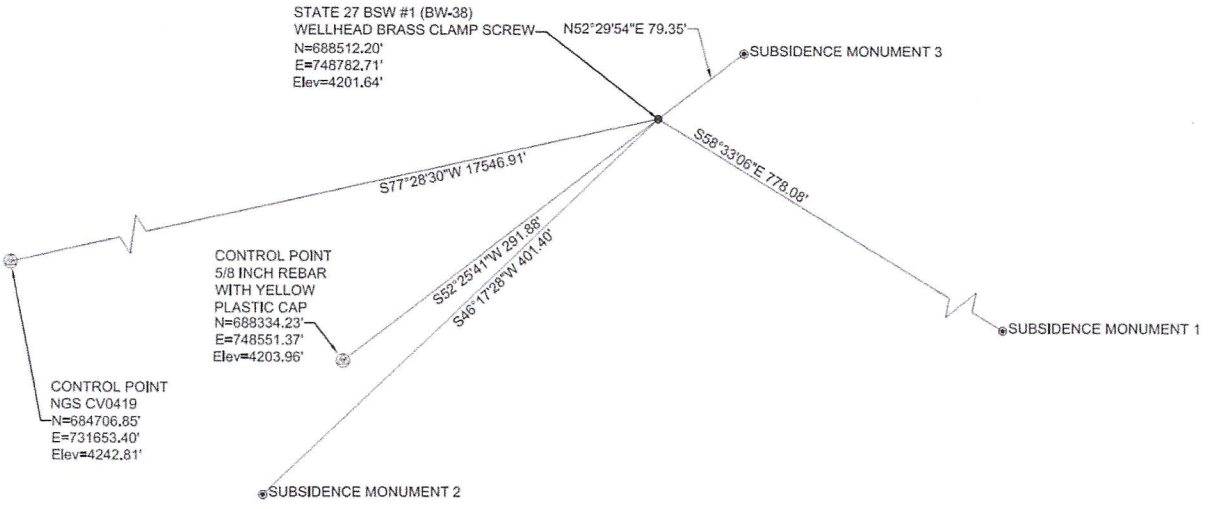
RE: Survey Report
Llano Disposal LLC'S State 27 BSW #1 (BW-38) Project
2019.1018

SUBSIDENCE MONUMENT SURVEY

On February 27, 2019 a field survey was conducted to set and observe positions of three new subsidence monuments for the State 27 BSW #1 (BW-38) Llano Wellhead located at: N33°13'21.03893", W103°18'55.69480". The well location and associated subsidence monuments can be accessed from Highway 82, approximately 6.5 miles East of Maljamar, NM in Lea County.

The Google Earth image and the sketch below illustrate locations of the monuments:





The discussion was to set at least three monuments at varying distances from the well head. The three monuments were set at differing distances in three separate directions.

This survey was conducted using Trimble R10 GNSS Receivers and a Trimble S6. The GNSS Receivers were used to establish the locations of the monuments and the well head through Differential GNSS observations. In an effort to tie into an existing published control point, the National Geodetic Survey website was reference to find the nearest published benchmark. Vertical Control point CV0419 is located approximately 17,546.91 feet or 3.31 miles southwest of the well site. A Control Point (10-A 5/8-inch rebar with a yellow plastic cap) was set close to the project's location. A GNSS base was setup over the point and static data was observed for nearly two hours. The data was then submitted to an online positioning service to firmly establish the horizontal coordinates:
Latitude: N32°53'25.53739", Longitude: W103°39'29.79702" with an elevation of 4203.96 feet. Once this position was established, the NGS Monument (CV0419) was verified for accuracy.

While, the accepted elevation for the point was used. The Trimble S6 was then used to accurately establish the elevation of the monuments and the wellhead in relation to the NGS control point featured above in the Google Maps screenshot. The data is stored onboard and may be transferred directly into the computer software at the office for analysis of results, ensuring greater accuracy.

SUBSIDENCE MONITORING PLAN

The NGS Control Point CV0419, with an observed elevation of 4242.79 feet above mean sea level (MSL), will be used as the Reference Control Point for determining the elevations of the newly placed Subsidence Monuments. The elevations of these monuments will be observed semi-annually by a level loop run with the DiNi level to ensure accuracy and precision.

Future observations made on all available points and tabulated to compare the elevations to the base elevations were established on February 27, 2019. The results will be graphically represented by trend lines representing measurements made on each monument. The continual change will be monitored by P.A. and presented to you semi-annually.

MONUMENT DESCRIPTIONS

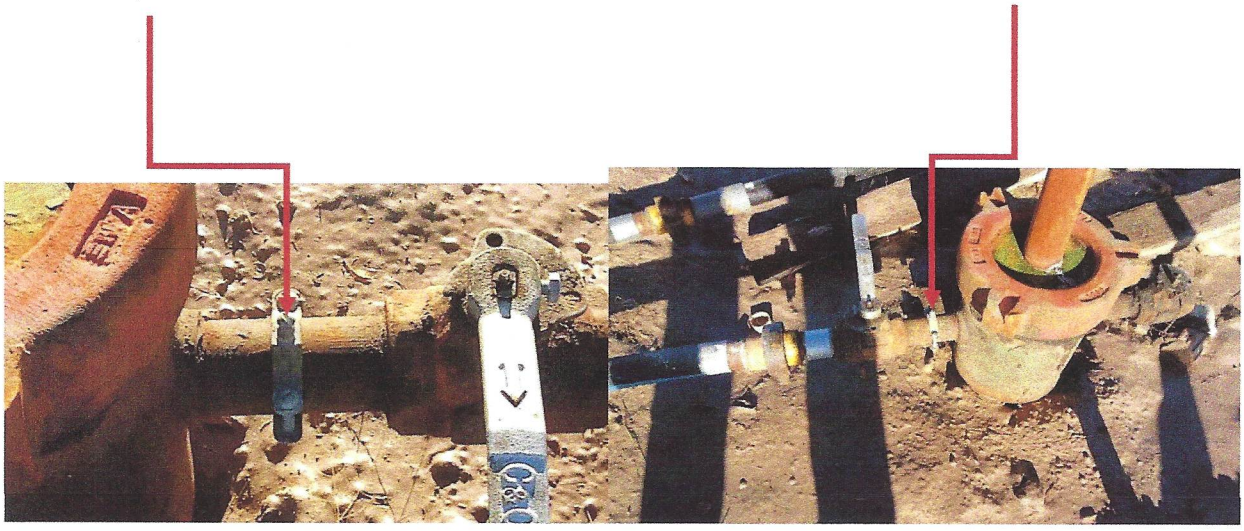
Each of the monuments set and observed are shown below with a description and images of the point.

CV0419

NGS Control Point CV0419 is a brass U.S. Coast & Geodetic Survey Benchmark set in concrete. It is stamped with an X and with the year it was set as shown below, followed by the NGS datasheet:

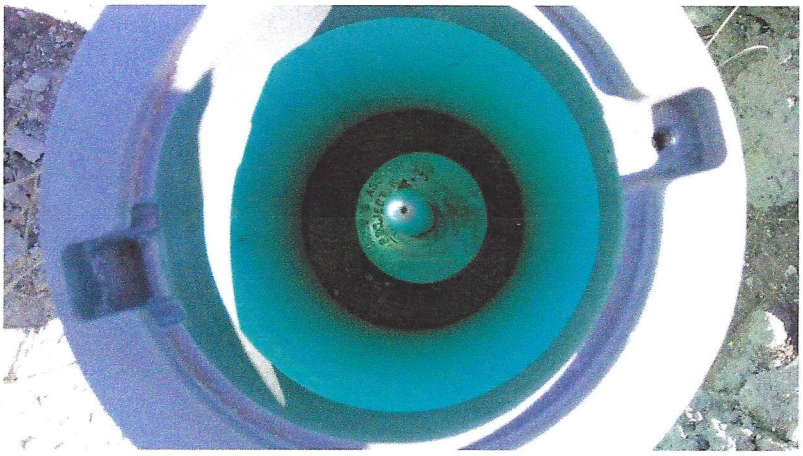
Llano Disposal LLC'S State 27 BSW #1 (BW-38)

The existing wellhead was measured on the top screw of a brass clamp; leaving the wellhead on a horizontal plane.



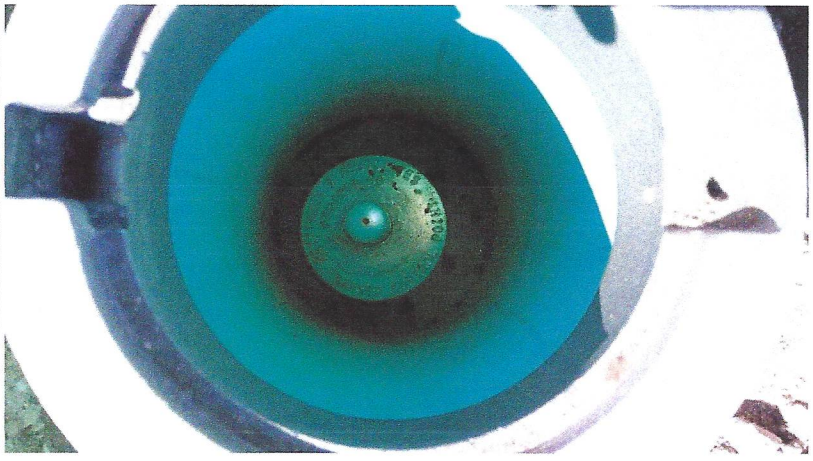
Subsidence Monument 1

A Berntsen three quarter inch Aluminum Top Security Sleeve Monument was set. It consists of a rod driven till refusal into a pre drilled three-foot deep hole with a twelve inch diameter. The sleeved rod is encased in six-inch PVC filled with sand, then topped with a Datum Point and an Aluminum Floating Datum Cap. It is then capped with an Access Cover that must be removed with a flathead screw driver or similar tool. The Monument is pictured below:



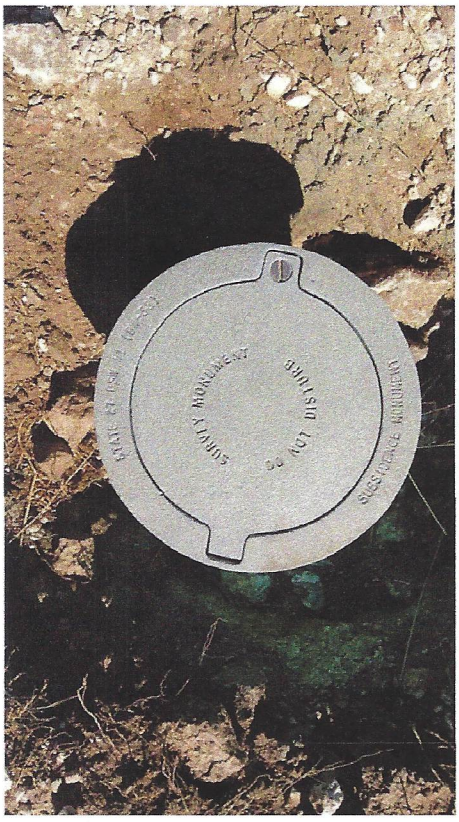
Subsidence Monument 2

A Berntsen three quarter inch Aluminum Top Security Sleeve Monument was set. It consists of a rod driven till refusal into a pre drilled three-foot deep hole with a twelve inch diameter. The sleeved rod is encased in six-inch PVC filled with sand, then topped with a Datum Point and an Aluminum Floating Datum Cap. It is then capped with an Access Cover that must be removed with a flathead screw driver or similar tool. The Monument is pictured below:



Subsidence Monument 3

A Berntsen three quarter inch Aluminum Top Security Sleeve Monument was set. It consists of a rod driven till refusal into a pre drilled three-foot deep hole with a twelve inch diameter. The sleeved rod is encased in six-inch PVC filled with sand, then topped with a Datum Point and an Aluminum Floating Datum Cap. It is then capped with an Access Cover that must be removed with a flathead screw driver or similar tool. The Monument is pictured below



STATE PLANE POINT REPORT FROM TRIMBLE BUSINESS CENTER

Project file data		Coordinate System	
Name:	Z:\2019.1018\Field Data \LianoDisposal_BSW#1.vce	Name:	United States/State Plane 1983
Size:	74 KB	Datum:	NAD 1983 (Conus)
Modified:	3/12/2019 8:08:14 AM (UTC:-6)	Zone:	New Mexico East 3001
Time zone:	Mountain Standard Time	Geoid:	GEOID12B (Conus)
Reference number:		Vertical datum:	
Description:		Calibrated site:	Default
Comment 1:			
Comment 2:			
Comment 3:			

Additional Coordinate System Details

Local Site Settings			
Project latitude:	N32.89043	Ground scale factor:	1.00023945679565
Project longitude:	W 103.65826	False northing offset:	0.000
Project height:	4131.494	False easting offset:	0.000

Point List

ID	Northing (US survey foot)	Easting (US survey foot)	Elevation (US survey foot)	Feature Code
1	684706.851	731653.399	4242.814	CV0419
500	688512.204	748782.710	4201.637	WELLHEAD BRASS CLAMP SCREW
501	688106.256	749446.501	4198.647	SUBSIDENCE MONUMENT 1
502	688234.839	748492.553	4205.138	SUBSIDENCE MONUMENT 2
503	688560.510	748845.660	4201.367	SUBSIDENCE MONUMENT 3

LAT/LONG POINT REPORT FROM TRIMBLE BUSINESS CENTER

Project file data		Coordinate System	
Name:	Z:\2019.1018\Field Data \LianoDisposal_BSW#1.vce	Name:	United States/State Plane 1983
Size:	74 KB	Datum:	NAD 1983 (Conus)
Modified:	3/12/2019 8:08:14 AM (UTC-6)	Zone:	New Mexico East 3001
Time zone:	Mountain Standard Time	Geoid:	GEOID12B (Conus)
Reference number:		Vertical datum:	
Description:		Calibrated site:	Default
Comment 1:			
Comment 2:			
Comment 3:			

Additional Coordinate System Details

Local Site Settings			
Project latitude:	N32.89043	Ground scale factor:	1.00023945679565
Project longitude:	W 103.65826	False northing offset:	0.000
Project height:	4131.494	False easting offset:	0.000

Point List

ID	Latitude (Local)	Longitude (Local)	Height (Local) (US survey foot)	Feature Code
1	N32.88074	W103.71338	4170.055	CV0419
500	N32.89091	W103.65752	4129.175	WELLHEAD BRASS CLAMP SCREW
501	N32.88978	W103.65537	4126.189	SUBSIDENCE MONUMENT 1
502	N32.89015	W103.65847	4132.669	SUBSIDENCE MONUMENT 2
503	N32.89104	W103.65731	4128.905	SUBSIDENCE MONUMENT 3

NATIONAL GEODETIC SURVEY DATA SHEET:

The information used in this report was obtained using the benchmark search engine http://benchmarks.scaredycatfilms.com/index.php## to locate the benchmark and the https://www.geocaching.com/play website to generate a pdf copy of the original datasheet shown below.

The NGS Data Sheet

See file dsdata.pdf for more information about the datasheet.

```
PROGRAM = datasheet95, VERSION = 8.12.5.2
1        National Geodetic Survey,   Retrieval Date = JANUARY 24, 2019
 CV0419
***********************************************************************
 CV0419  DESIGNATION -  S 34
 CV0419  PID         -  CV0419
 CV0419  STATE/COUNTY-  NM/LEA
 CV0419  COUNTRY     -  US
 CV0419  USGS QUAD   -  BUCKEYE NW (1985)
 CV0419
 CV0419                        *CURRENT SURVEY CONTROL
 CV0419
______________________________________________________________________
 CV0419* NAD 83(2011) POSITION- 32 52 50.67906(N) 103 42 48.16824(W)
ADJUSTED
 CV0419* NAD 83(2011) ELLIP HT-  1271.020 (meters)         (06/27/12)
ADJUSTED
 CV0419* NAD 83(2011) EPOCH   -  2010.00
 CV0419* NAVD 88 ORTHO HEIGHT -  1293.204 (meters)     4242.79   (feet)
ADJUSTED
 CV0419
______________________________________________________________________
 CV0419  GEOID HEIGHT    -        -22.177 (meters)
GEOID12B
 CV0419  NAD 83(2011) X  - -1,271,316.646 (meters)                    COMP
 CV0419  NAD 83(2011) Y  - -5,209,862.727 (meters)                    COMP
 CV0419  NAD 83(2011) Z  -  3,443,549.027 (meters)                    COMP
 CV0419  LAPLACE CORR    -          1.99  (seconds)
DEFLEC12B
 CV0419  DYNAMIC HEIGHT  -       1291.396 (meters)     4236.85   (feet) COMP
 CV0419  MODELED GRAVITY -    979,194.1   (mgal)                        NAVD
88
 CV0419
 CV0419  VERT ORDER      -  FIRST     CLASS II
 CV0419
 CV0419  Network accuracy estimates per FGDC Geospatial Positioning Accuracy
 CV0419  Standards:
 CV0419         FGDC (95% conf, cm)      Standard deviation (cm)      CorrNE
 CV0419            Horiz  Ellip           SD_N   SD_E   SD_h       (unitless)
 CV0419  ------------------------------------------------------------------
 CV0419  NETWORK     0.65   1.76           0.28   0.25   0.90      -0.06077748
 CV0419  ------------------------------------------------------------------
```

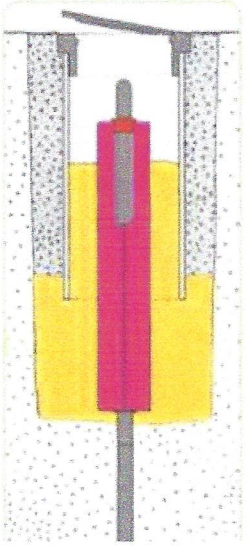
Top Security Sleeve Rod Monuments

9/16" Stainless Steel Top Security Sleeve Monument	3/4" Aluminum Top Security Sleeve Monument
	
More Info	More Info

Berntsen Sectional Rod Monument with Floating Sleeve

Berntsen's exclusive Top Security™ Sleeve 3-Dimensional Rod Monument System is specifically designed for high-precision geodetic and GPS surveys. Its patented design helps protect against excessive movements in the control monument. The Berntsen extendible rods, when driven to refusal, provide excellent vertical stability. The unique Y-shaped design of the Top Security Sleeve adds the second and third dimension to provide the most stable 3-D survey monument available.

Eliminate most common and unexpected shifts in stability by eliminating most of the direct transfer of shifts in movement from ground level or surface movement. Here's how: Rod markers (driven to refusal) have good vertical stability but can be disturbed by the natural phenomenon known as frost heave. Rod markers, installed with a greased-filled PVC pipe surrounding the upper three or four feet (900 or 1200 mm) (or more) of rod, are known to be effective in combating movement caused by frost heave but offer little protection against possible horizontal movement of surrounding earth (another major cause of differences in readings on rod markers). For the first time, Berntsen's Top Security Sleeve™ with the horizontal stability of the original Berntsen Top Security™ finned rod marker system, this is now available in a commercially available survey monument.



It's even extendible! 3' (914mm) lengths of Top Security Sleeves can also be connected together by Berntsen's exclusive End Cap Alignment Bushings and a little PVC Cement. When used in combination(s), nearly any even-foot length over six feet long (1.83m) of support for the rod marker is possible. That's innovative and flexible design at work for you.

More good news! The Top Security Sleeves' greatest advantage at installation time is speed. Simply drive standard Berntsen round rods to refusal, slip on the grease-filled finned Top Security Sleeve (recommended sleeve length greater than maximum recorded local frost depth), back-fill around the fins with sand, tamp firmly. The color coded End Cap Alignment Bushings follow Berntsen's long established universal color codes for rod marker systems and tell other surveyor's at a glance what size rod is installed - 9/16" (14 mm) Yellow; 3/4" (19 mm) Blue. We recommend NO-TOX lubricating grease to fill the Top Security Sleeve. It is specially formulated to be non-toxic and environmentally safe. It is available in an easy to use cartridge that fits a standard "grease gun". One cartridge should be used for each 36" (915mm) long Top Security Sleeve.