ELLISON
FLUID CALIPERS

A Case Study of the Application of a Fluid Caliper on a SWD Well

Permian Basin
Martin County, Texas

August 4, 2020

Prologue

This case study will show a well drilled in Martin County, Texas on August 4, 2020.

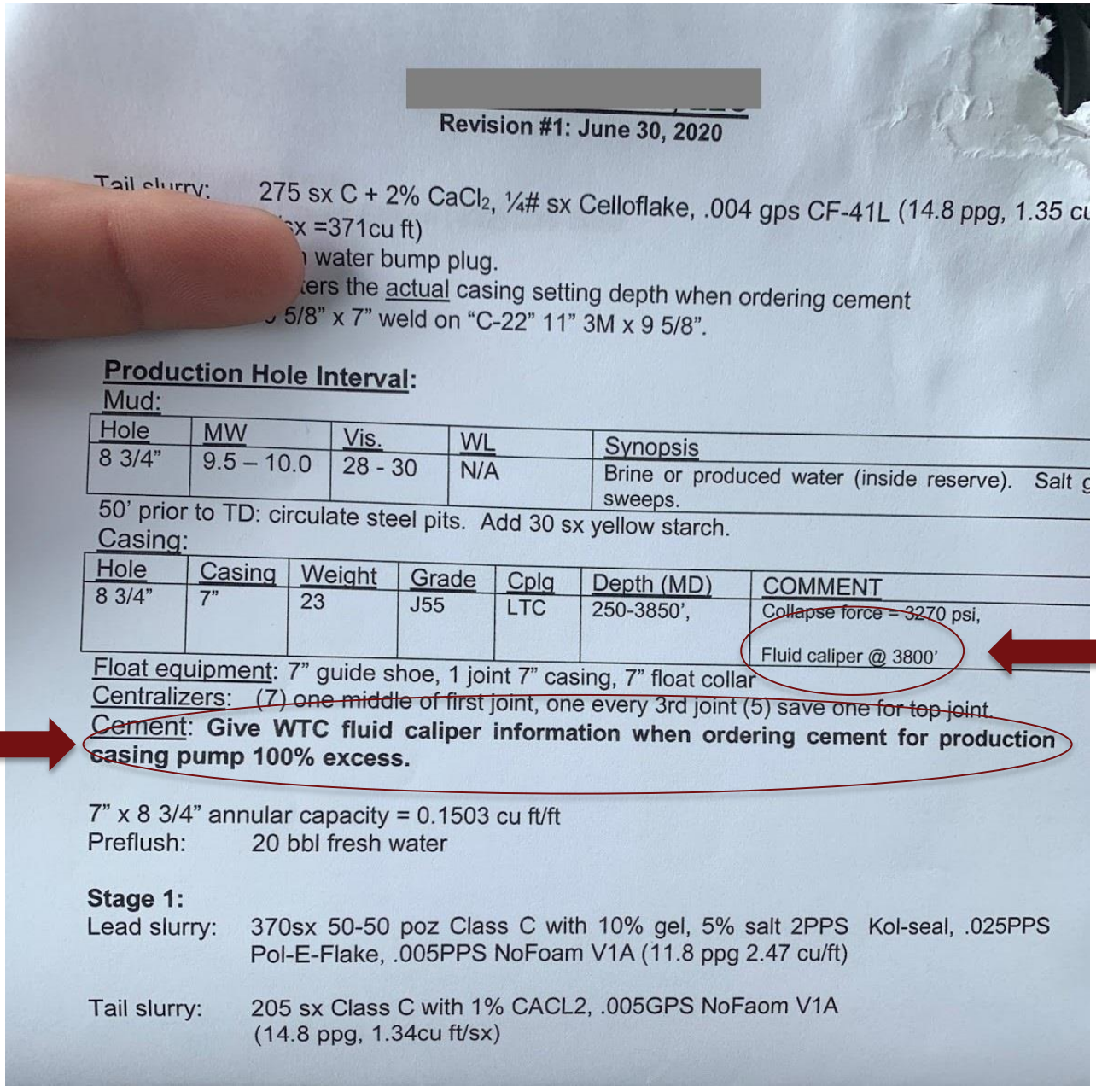
- The first photo will show the prognosis, which is the E&P's specific instructions on how to drill and cement the well.

- The second photo will show Ellison Fluid Calipers' fluid caliper report and invoice. This report was left on location with the E&P company man. The report was also emailed to the designated E&P employees, including the petroleum engineers.

- The third photo is the cement report from the cementer. It is important to note that this is not the W-15 cement report filed with the Texas Railroad Commission, as those aren't as detailed. Instead this is the actual cement report that the cementer provided to the E&P.

Because this is a Salt Water Disposal (SWD) well and because of the location of the well, the Texas Railroad Commission required cement circulation on this string. The Railroad Commission did not want any open hole where saltwater could come in contact with the casing. Failure to circulate would require the E&P to perform a costly remediation job to achieve satisfactory results.

E&P Well Prognosis



[redacted]

Revision #1: June 30, 2020

Tail slurry: 275 sx C + 2% $CaCl_2$, ¼# sx Celloflake, .004 gps CF-41L (14.8 ppg, 1.35 cu
x =371cu ft)
water bump plug.
ers the actual casing setting depth when ordering cement
5/8" x 7" weld on "C-22" 11" 3M x 9 5/8".

Production Hole Interval:

Mud:

Hole	MW	Vis.	WL	Synopsis
8 3/4"	9.5 – 10.0	28 - 30	N/A	Brine or produced water (inside reserve). Salt g sweeps.

50' prior to TD: circulate steel pits. Add 30 sx yellow starch.

Casing:

Hole	Casing	Weight	Grade	Cplg	Depth (MD)	COMMENT
8 3/4"	7"	23	J55	LTC	250-3850',	Collapse force = 3270 psi, Fluid caliper @ 3800'

Float equipment: 7" guide shoe, 1 joint 7" casing, 7" float collar
Centralizers: (7) one middle of first joint, one every 3rd joint (5) save one for top joint.
Cement: **Give WTC fluid caliper information when ordering cement for production casing pump 100% excess.**

7" x 8 3/4" annular capacity = 0.1503 cu ft/ft
Preflush: 20 bbl fresh water

Stage 1:
Lead slurry: 370sx 50-50 poz Class C with 10% gel, 5% salt 2PPS Kol-seal, .025PPS Pol-E-Flake, .005PPS NoFoam V1A (11.8 ppg 2.47 cu/ft)

Tail slurry: 205 sx Class C with 1% CACL2, .005GPS NoFaom V1A (14.8 ppg, 1.34cu ft/sx)

The E&P intended to run 100% excess cement over True Hole (Gauge)

Running the fluid caliper 50' from TD let EFC deliver cement calculations by the time TD was reached

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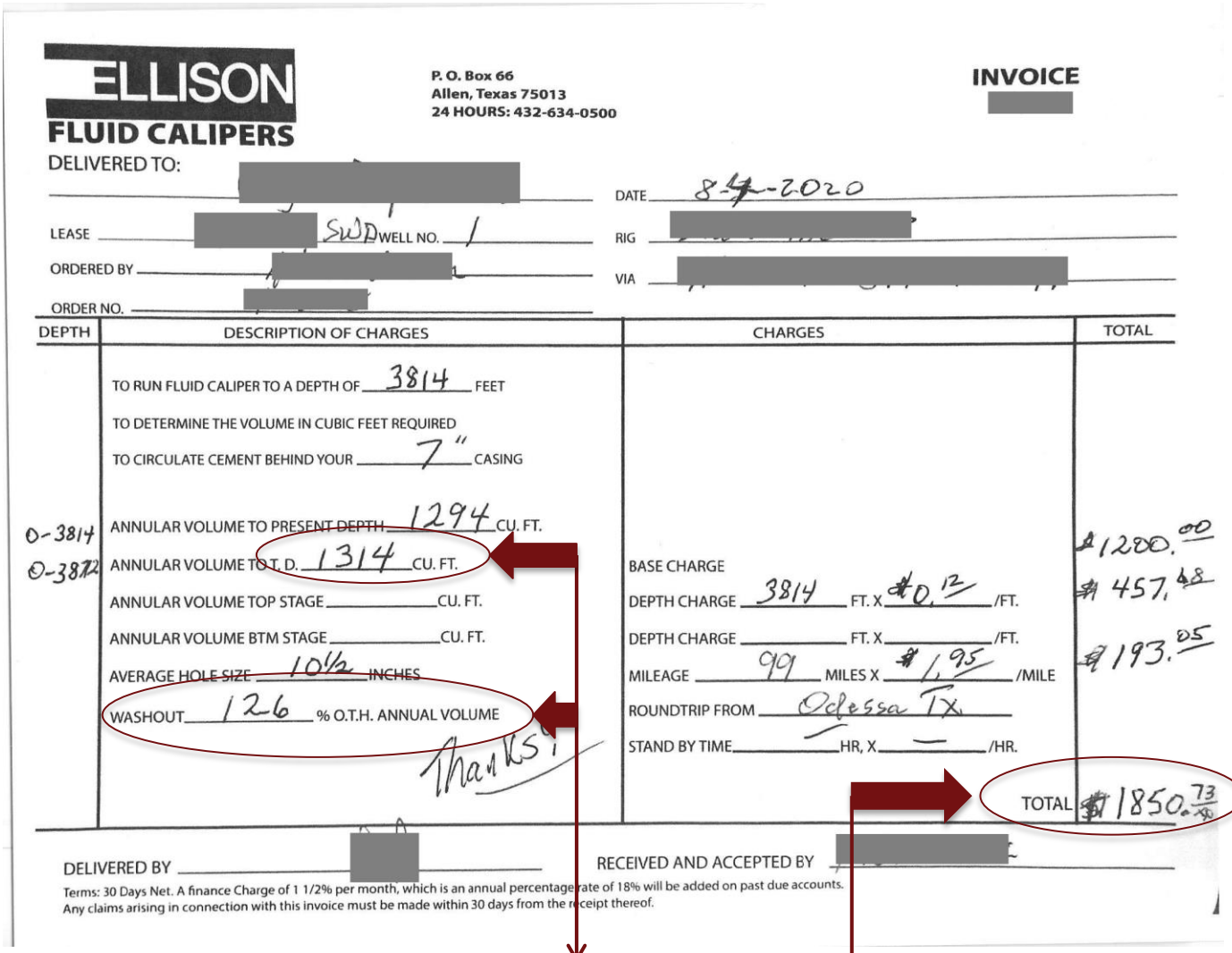
EFC Fluid Caliper Report



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FLUID CALIPERS

P. O. Box 66
Allen, Texas 75013
24 HOURS: 432-634-0500

INVOICE [redacted]

DELIVERED TO: [redacted]

DATE 8-4-2020

LEASE [redacted] SWD WELL NO. 1

RIG [redacted]

ORDERED BY [redacted]

VIA [redacted]

ORDER NO. [redacted]

DEPTH	DESCRIPTION OF CHARGES	CHARGES	TOTAL
	TO RUN FLUID CALIPER TO A DEPTH OF 3814 FEET		
	TO DETERMINE THE VOLUME IN CUBIC FEET REQUIRED		
	TO CIRCULATE CEMENT BEHIND YOUR 7" CASING		
0-3814	ANNULAR VOLUME TO PRESENT DEPTH 1294 CU. FT.		
0-3872	ANNULAR VOLUME TO T. D. 1314 CU. FT.	BASE CHARGE	$1200.00
	ANNULAR VOLUME TOP STAGE ____ CU. FT.	DEPTH CHARGE 3814 FT. X $0.12 /FT.	$457.68
	ANNULAR VOLUME BTM STAGE ____ CU. FT.	DEPTH CHARGE ____ FT. X ____ /FT.	
	AVERAGE HOLE SIZE 10½ INCHES	MILEAGE 99 MILES X $1.95 /MILE	$193.05
	WASHOUT 126 % O.T.H. ANNULAR VOLUME	ROUNDTRIP FROM Odessa TX	
	Thanks!	STAND BY TIME ____ HR, X ____ /HR.	
		TOTAL	$1850.73

DELIVERED BY [redacted]

RECEIVED AND ACCEPTED BY [redacted]

Terms: 30 Days Net. A finance Charge of 1 1/2% per month, which is an annual percentage rate of 18% will be added on past due accounts. Any claims arising in connection with this invoice must be made within 30 days from the receipt thereof.

EFC determined that the washout was 126%, meaning that the E&P prognosis would result in a failed cement job. True hole + 100% excess would have been only 1164 ft³. After getting this report, E&P changed cement volume to 1314 ft³ + 35% excess to get proper circulation.

Fluid Caliper cost $1,850. A cement remediation job would have cost ~$50,000-75,000!

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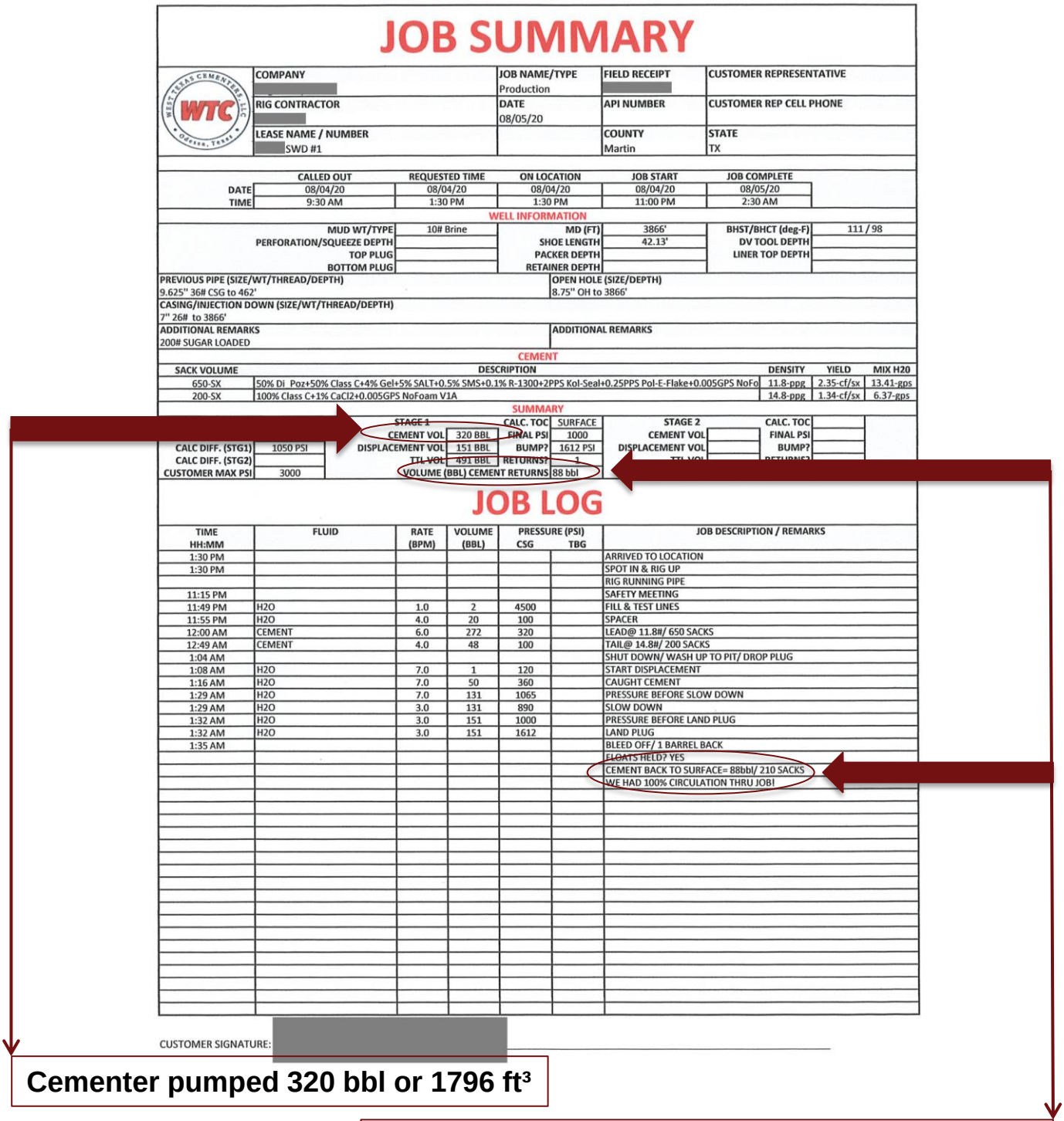
Cement Report



JOB SUMMARY

COMPANY [redacted]		JOB NAME/TYPE Production	FIELD RECEIPT [redacted]	CUSTOMER REPRESENTATIVE
RIG CONTRACTOR [redacted]		DATE 08/05/20	API NUMBER	CUSTOMER REP CELL PHONE
LEASE NAME / NUMBER [redacted] SWD #1			COUNTY Martin	STATE TX

	CALLED OUT	REQUESTED TIME	ON LOCATION	JOB START	JOB COMPLETE
DATE	08/04/20	08/04/20	08/04/20	08/04/20	08/05/20
TIME	9:30 AM	1:30 PM	1:30 PM	11:00 PM	2:30 AM

WELL INFORMATION

MUD WT/TYPE	10# Brine	MD (FT)	3866'	BHST/BHCT (deg-F)	111 / 98
PERFORATION/SQUEEZE DEPTH		SHOE LENGTH	42.13'	DV TOOL DEPTH	
TOP PLUG		PACKER DEPTH		LINER TOP DEPTH	
BOTTOM PLUG		RETAINER DEPTH			

PREVIOUS PIPE (SIZE/WT/THREAD/DEPTH)
9.625" 36# CSG to 462'

OPEN HOLE (SIZE/DEPTH)
8.75" OH to 3866'

CASING/INJECTION DOWN (SIZE/WT/THREAD/DEPTH)
7" 26# to 3866'

ADDITIONAL REMARKS
200# SUGAR LOADED

ADDITIONAL REMARKS

CEMENT

SACK VOLUME	DESCRIPTION	DENSITY	YIELD	MIX H20
650-SX	50% Di Poz+50% Class C+4% Gel+5% SALT+0.5% SMS+0.1% R-1300+2PPS Kol-Seal+0.25PPS Pol-E-Flake+0.005GPS NoFo	11.8-ppg	2.35-cf/sx	13.41-gps
200-SX	100% Class C+1% CaCl2+0.005GPS NoFoam V1A	14.8-ppg	1.34-cf/sx	6.37-gps

SUMMARY

		STAGE 1		CALC. TOC	SURFACE	STAGE 2		CALC. TOC	
		CEMENT VOL	320 BBL	FINAL PSI	1000	CEMENT VOL		FINAL PSI	
CALC DIFF. (STG1)	1050 PSI	DISPLACEMENT VOL	151 BBL	BUMP?	1612 PSI	DISPLACEMENT VOL		BUMP?	
CALC DIFF. (STG2)		TTL VOL	491 BBL	RETURNS?	1				
CUSTOMER MAX PSI	3000	VOLUME (BBL) CEMENT RETURNS		88 bbl					

JOB LOG

TIME HH:MM	FLUID	RATE (BPM)	VOLUME (BBL)	PRESSURE (PSI) CSG	PRESSURE (PSI) TBG	JOB DESCRIPTION / REMARKS
1:30 PM						ARRIVED TO LOCATION
1:30 PM						SPOT IN & RIG UP
						RIG RUNNING PIPE
11:15 PM						SAFETY MEETING
11:49 PM	H2O	1.0	2	4500		FILL & TEST LINES
11:55 PM	H2O	4.0	20	100		SPACER
12:00 AM	CEMENT	6.0	272	320		LEAD@ 11.8#/ 650 SACKS
12:49 AM	CEMENT	4.0	48	100		TAIL@ 14.8#/ 200 SACKS
1:04 AM						SHUT DOWN/ WASH UP TO PIT/ DROP PLUG
1:08 AM	H2O	7.0	1	120		START DISPLACEMENT
1:16 AM	H2O	7.0	50	360		CAUGHT CEMENT
1:29 AM	H2O	7.0	131	1065		PRESSURE BEFORE SLOW DOWN
1:29 AM	H2O	3.0	131	890		SLOW DOWN
1:32 AM	H2O	3.0	151	1000		PRESSURE BEFORE LAND PLUG
1:32 AM	H2O	3.0	151	1612		LAND PLUG
1:35 AM						BLEED OFF/ 1 BARREL BACK
						FLOATS HELD? YES
						CEMENT BACK TO SURFACE= 88bbl/ 210 SACKS
						WE HAD 100% CIRCULATION THRU JOB!

CUSTOMER SIGNATURE: [redacted]

Cementer pumped 320 bbl or 1796 ft³

Circulation returned 88 bbl or 494 ft³ of excess, meaning the fluid caliper was off by only 12 ft³!

Conclusion

As seen on the previous pages:

- True hole equaled 582 cubic feet (ft^3)
- The prognosis called for true hole plus 100% excess, which equals 1164 ft^3.
- The fluid caliper calculated the actual cement needed to circulate behind the 7” casing was 1314 ft^3. This equated to a 126% washout.
- Without running a fluid caliper, the E&P would not have had any possibility of circulating and would have been a failed job.
- Upon receiving the fluid caliper report, the E&P instructed the cementer to pump the fluid caliper volume plus 35% excess (1314 x 1.35 = 1774 ft^3). As is typical of cementing operations, it was rounded up, in this case to 320 bbl (320 bbl x 5.6146 ft^3 /bbl = 1796 ft^3).
- The cementer circulated 88 bbls back to the surface (88 bbl x 5.6146 ft^3 /bbl = 494 ft^3).
- Pumped: 1796 ft^3
  Circulated: 494 ft^3
  Actual Hole Volume: 1302 ft^3
- These results show the fluid caliper of 1314 ft^3 being off of the actual hole volume by only 12 ft^3 or 2.1 bbl.

Cement is the single best tool for reducing environmental problems and protecting groundwater aquifers. This case study serves as an example of the efficacy of fluid calipers and how they can have a positive effect on drilling operations & long-term wellbore integrity.