



December 31, 2016

Arjuna Weragoda, P.E.
Capital Projects Manager
IRC Department of Utility Services
1801 27th Street Building A
Vero Beach, FL 32960

**RE: *Indian River County Utilities Department
South County WTP Floridan Well Rehabilitation Project
Production Well S-4 Condition Assessment
Contract #2016031***

Dear Mr. Weragoda,

There follows a summary of our findings and observations of the condition of the South Oslo Road production well S-4, and the recommendations to restore and/or replace the well to full service conditions. Well S-4 was intended to be rehabilitated, along with three other wells under contract IRC-2016031, currently being performed by All Webbs Enterprises (AWE), Inc. Well S-4 was selected first to be rehabilitated because of its low capacity and apparent elevated turbidity. Silt Density Indices (SDI) were also elevated and the membrane plant pretreatment filters fouled rapidly when this well was placed into operation with other wells, suggesting suspended material was entering the well or being produced within the well borehole. Elevated suspended material in the raw water is detrimental to membranes and can foul them irreversibly.

The first step to rehabilitate the well was to take it out of service and remove the pump from the well casing. The existing pump is a vertical turbine pump with column pipe nearly 100 ft deep. The initial attempts to remove the pump were unsuccessful due to extreme resistance during lifting of the pump column pipe and apparent binding and lodging of the pump within the well casing. The contractor, AWE, then remobilized with a larger capacity 50 ton crane to dislodge the pump and column pipe. Following pump and column pipe removal AWE performed geophysical and video logging of well S4, on October 18, 2016 and October 24, 2016. During the well video, damage to the well casing was observed at depths between 7 feet and 279 feet below pad level (BPL). Casing separations identified in the well video at depths of approximately 27 feet BPL, 46 feet BPL and a casing crack at 38 feet BPL are of particular concern because their size and the scale/growth features at these depths indicate a downward migration of water in the well casing and distinct sanitary seal failure. Given the fact that this well had a history of the well casing damage due to pump extractions, further review of historical videos and reports was conducted to confirm the more recent

extraction of the pump did not cause new or further damage to the well casing. JLA compared observations from the 2016 well video with a 2009 well video performed by Aquifer Maintenance and Performance Systems, Inc. (AMPS). The majority of observations made during the recent 2016 video were also present in the 2009 video, but the amount of scaling and growth was more substantial in the recent 2016 video. A comparison of observations made during both the 2016 and 2009 well videos is provided in the attached JLA Memorandum dated December 9, 2016.

Due to existing concerns over the S4 casing damage, a review of the 2002 and 2005 CDM IRCU South Wellfield Rehabilitation Phase I & II Reports outlining how the well S4 casing was originally damaged, was conducted. Key differences and similarities between the Phase I & II Reports include to following:

- As described in the Phase I Report (2002) the well S4 pump and column pipe (45 feet length) had become lodged in the well and required the use of a vibratory hammer and 100 ton crane for removal. The PVC well casing was separated at 26 feet below pad level (BPL) and was raised up approximately 3-4 inches above the concrete pump pedestal as a result of this effort.
- As described in the Phase II Report (2005), repairs were made to the S4 wellhead but not to the cracked well casing. At the time, the cracked well casing was not considered a sanitary hazard because the larger outer 24 inch diameter steel surface casing was assumed to provide a sanitary seal between shallow groundwater and the well production interval. From the current 2016 video, there is clearly infiltration of groundwater into the well casing.
- Phase II Report (2005) refers to a plumbness and alignment test (P&A) being performed to determine if the new pump would pass freely to the new pump setting depth of 100 feet BPL. The P&A test descriptions stated there were two locations where the well was not properly aligned and that the pump column pipe became lodged, but “not too tightly” during installation. (Refer to attached 2004 plumbness and alignment test exhibit)

SUMMARY AND RECOMMENDATIONS

Based on the work completed to date, the following conclusions are provided:

- Historically, well pump assemblies have been difficult to extract from well S4 due to an out of plumb PVC well casing.

- Pump removal efforts to date have caused visible damage to the S4 PVC well casing at depths between 7 feet and 46 feet BPL, exposing the well to groundwater infiltration and potential sanitary hazards.
- Damage to the S4 well casing has been present since the pump was removed using a vibratory hammer and crane as reported in the Phase I report (2002).
- Observations from the 2009 and 2016 well videos demonstrate growth of scale or organic material on the interior PVC well casing has increased. The downward growth of scaling observed in the 2016 well video from casing cracks and casing joint separations between 38 feet and 46 feet BPL indicates leakage of fluid from behind the PVC well casing and represents a sanitary seal hazard.
- Potential repairs needed to fix the well casing cracks including out of plumbness are cost prohibitive and not guaranteed to resolve the casing integrity and alignment issues.

Given the fact that there are numerous casing breaches and the well is extremely out of plumb in several areas, there are limited corrective actions available to restore the well to usable capacity. Most of these include the following:

1. Continue to rehabilitate the well and do nothing to the casing.

- a. Previously scheduled well acidization will be dangerous due to the casing failures and may not safely handle pressures generated during the procedure. Jetting and cleaning off the existing casing is all that could be performed.
- b. Pumping water levels would have to remain above the water table elevation to prevent further seepage into the existing PVC well casing. This would reduce the pumping rate of S4 to less than 500 gallons per minute (GPM) based on the current specific capacity of 16 GPM/Ft at 535 GPM measured during the pre-rehabilitation well video.
- c. A design rate of less than 500 GPM is not sufficient for the South Oslo Road WTP needs, and a reduction in capacity would require other wells to overproduce.
- d. NO COST (Rehabilitation already budgeted)

2. Line the well casing to seal off sanitary hazards and install a smaller/different type pump.

- a. Installation of a stainless steel liner should be completed to the total depth of the existing PVC well casing and should include squeeze grouting behind the

existing PVC well casing and in the annular space between the existing PVC casing and liner.

- b. The existing cement grout lodged in the well S4 completion interval should be drilled out and acidized.
- c. The liner installation is not guaranteed to be successful and would reduce the effective diameter of the well casing to less than 10-inches, which is equivalent to the current pump column pipe diameter.
- d. The proposed liner may not pass the entire length of the well casing due to plumbness and alignment issues identified in the 2005 CDM Phase II report and observed each time the well S4 pump assembly was removed and/or installed.
- e. A reduction in well capacity will likely result
- f. Due to the high costs and unforeseeable complications associated with the stainless steel liner installation, it is not recommended.
- g. \$150,000 to \$250,000 COST

3. Over drill the top of the well casing down to 100 feet and replace damaged casing with new PVC casing.

- a. Over drilling and replacing the existing PVC well casing with new PVC well casing to a depth of 100 feet in an experimental approach that would have similar costs as constructing a new well.
- b. The approach is not guaranteed to work effectively and complications that arise during the process may render the well unsalvageable and is not recommended.
- c. COST NOT DETERMINED

4. Plug & abandon the well, drill new well and install new pump on same site.

- a. This approach would provide IRCUD the opportunity for having a properly constructed UFA water supply well for the South Oslo Plant.
- b. IRCUD already has competitively bid pricing for new well construction, and mobilization costs are minimized.
- c. New well construction is recommended.
- d. \$500,000 - \$800,000 COST, depending on use of existing or new equipment (See attached opinion of probable replacement costs, including well casing replacement with existing equipment and new equipment)

Based on our observations and evaluation of the existing production well S-4 condition, we recommend option 4 to drill a new well and plug and abandon the existing well. Either option

of utilizing existing equipment or installing new equipment could be implemented with a new well casing, but construction of a new well casing is strongly recommended.

If you have questions or require additional information, please let us know if you would like to discuss further.

Sincerely,

KIMLEY-HORN AND ASSOCIATES, INC.



Mark D. Miller, P.E.
Vice President

CC: Vincent Burke, P.E., Utility Director
Terry Southard, Treatment Superintendent
Mike Vernon, Treatment Plant Chief
Jon Friedrichs, P.G., JLA Geosciences, Inc.
Jim Andersen, P.G., JLA Geosciences, Inc.

Attachments:

JLA Geosciences, Inc. Tech Memo – Well S-4 Condition Assessment Dec 9, 2016
Well S-4 Upper Floridan Well Opinion of Probable Replacement Costs
2004 Plumbness and Alignment Test Data Exhibit

K:\WPB_Civil\044572029 - Well 7 Construction_Construction\Well 4 Issues\Well S-4 cover letter Recommendation rev1.docx

TECHNICAL MEMORANDUM

To: Mark Miller, P.E.
Kimley Horn & Associates, Inc.

From: Jon Friedrichs, P.G.

RE: Summary of Work Completed to Date and Recommendation for
South Oslo Road Water Treatment Plant, Upper Floridan Aquifer Well S4

Date: December 9, 2016

As part of JLA Geosciences Inc. (JLA) existing Purchase Order (Job No. 044572026) with Kimley-Horn and Associates (KHA), JLA's scope of work included Rehabilitation Phase Services for four (4) existing Floridan Aquifer supply wells (S3, S4, S5, & S6) located at the Indian River County Utilities Department (IRCUD) South Oslo Road Water Treatment Plant (WTP) in Vero Beach, Florida. Well S4 was selected to be the first well for rehabilitation since it was not regularly used due to poor performance, sand production noted by IRCWUD WTP Staff, and historical records which indicated the well casing was out of alignment and damaged during earlier rehabilitation efforts. This technical memorandum provides a summary of pre-rehabilitation investigation work completed to date and a recommendations based on those findings.

SUMMARY OF WORK

All Webb's Enterprises (AWE) was contracted by IRCUD to perform rehabilitation services on well S4 and began work by removing the existing well pump, column pipe, and motor on 10/13/16. The S4 pump became lodged in the well casing during removal and required the use of a 50-ton crane to dislodge and remove the pump and column pipe.

Following pump and column pipe removal AWE performed geophysical and video logging of well S4, on October 18, 2016 and October 24, 2016. During the well video, JLA observed damage to the well casing at a depths between 7 feet and 279 feet below pad level (BPL). Casing separations identified in the well video at depths of approximately 27 feet BPL, 46 feet BPL and a casing crack at 38 feet BPL are of particular concern because their size and the scale/growth features at these depths indicate a downward migration of water in the well casing and potentially a sanitary seal failure.

JLA also compared observations from the 2016 well video with a 2009 well video performed by Aquifer Maintenance and Performance Systems, Inc. (AMPS). Overall, the majority of observations made during

IRCUD Well S-4 Technical Memorandum

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the 2016 video were also present in the 2009 video, but the amount of scaling and growth was more substantial in the 2016 video. A comparison of observations made during both the 2016 and 2009 well videos are presented in the table below:

Depth (Feet BPL)	Observation	2016 Well Video	2009 Well Video
7	Top of casing joint is cracked and separated	X	X
27	Top of casing joint is cracked and separated	X	X
26	Bottom of casing joint is cracked and separated. Grout is visible behind casing.	X	X
38	Visible crack in casing. Vertical scaling/growth on casing is extending downward. Growth on the casing is more substantial in the 2016 video.	X	X
46	Casing joint appears separated with grout visible behind casing. Vertical scaling/growth visible on casing extending downward. Growth on the casing is more substantial in the 2016 video.	X	X
52	Casing is visually cleaner looking with less scaling/growth	X	X
279	Approximately 1 feet above a casing joint a scaling/growth feature is visible extending upward around the entire circumference of the well casing. Well Casing below the ring appears to be irregular and broken. Growth on the casing is more substantial in the 2016 video.	X	X
280	Casing joint appears to be in good condition.	X	X
391-369	Vertical scaling/growth visible on casing extending upward. Growth on the casing is more substantial in the 2016 video.	X	X
415	Base of PVC Casing	X	X
419-425	Large chunks of grout lodged in the borehole. Grout appears to have fallen out from behind the base casing	X	X
640	Water in the borehole is visually less clear	X	X
711	Total Depth	X	X

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Selected photographs comparing features from the 2016 and 2009 well videos are included as Attachment A. Geophysical logging performed by AWE included caliper, dual induction, gamma ray, and static and dynamic fluid conductivity and flow logs. PDF Copies of the geophysical logs are included as Attachment B.

Due to existing concerns over the S4 casing damage, JLA reviewed the 2002 and 2005 CDM IRCWUD South Wellfield Rehabilitation Phase I & II Reports which outlined how the well S4 casing was originally damaged. Key points from the Phase I & II Reports are summarized below:

- As described in the Phase I Report (2002) the well S4 pump and column pipe (45 feet length) had become stuck in the well and required the use of a vibratory hammer and 100 ton crane for removal. During the pump removal process the S4 PVC well casing was separated at 26 feet below pad level (BPL) and was raised up approximately 3-4 inches above the concrete pump pedestal as a result of this effort.
- As described in the Phase II Report (2005) repairs were made to the S4 wellhead but not to the cracked well casing. At the time the cracked well casing was not considered a sanitary hazard because the 24 inch diameter steel surface casing provided a sanitary seal between shallow groundwater and the S4 production interval.
- Phase II Report (2005) also mentions a plumbness and alignment test (P&A) was performed to determine if the new pump and column pipe would pass freely to the new pump setting depth of 100 feet BPL. The P&A test descriptions stated there were two locations where the well was not properly aligned and that the pump column pipe became lodged, but “not too tightly” during installation.

SUMMARY AND RECOMMENDATION

Based on the work completed to date, the following conclusion and recommendations are being presented for IRCWUD UFA Well S4:

- Historically, well pump assemblies have been difficult to extract from well S4 due to an out of plumb PVC well casing.
- Pump removal efforts to date have caused visible damage to the S4 PVC well casing at depths between 7 feet and 46 feet BPL.
- Damage to the S4 well casing has been present since the pump was removed using a vibratory hammer and crane as reporting in the Phase I report (2002).
- Observations from the 2009 and 2016 well videos shows growth on the S4 PVC well casing has increased.

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- The downward growth of scaling observed in the 2016 well video from casing cracks and casing joint separations between 38 feet and 46 feet BPL indicates leakage of fluid from behind the PVC well casing and represents a sanitary seal hazard.
- Potential repairs needed to fix the S4 well casing cracks including are cost prohibitive and not guaranteed to resolve the casing integrity and alignment issues.

Based information gathered to date as outlined in this technical memorandum, JLA recommends IRCWUD plug and abandon the existing well S4 and replace with a new well S4 instead of pursuing additional rehabilitation work.

If there are any questions, please don't hesitate to contact me directly at (561) 746-0228.

Respectfully submitted,

JLA Geosciences, Inc.

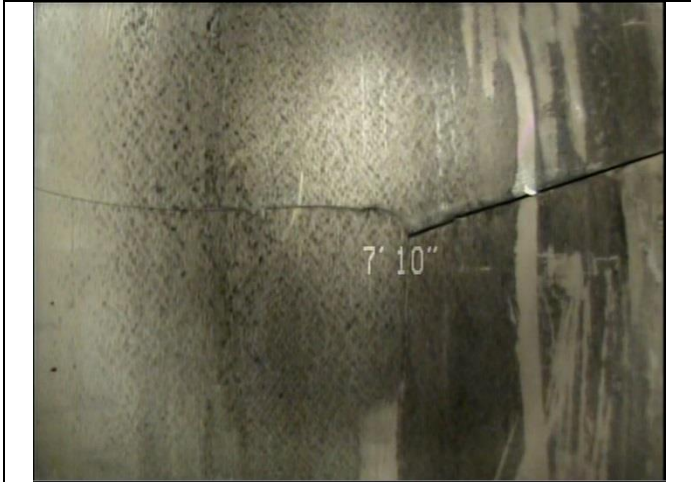


Jon Friedrichs, P.G.
Senior Hydrogeologist
State of Florida Prof.
Geologist Registration No. 2709

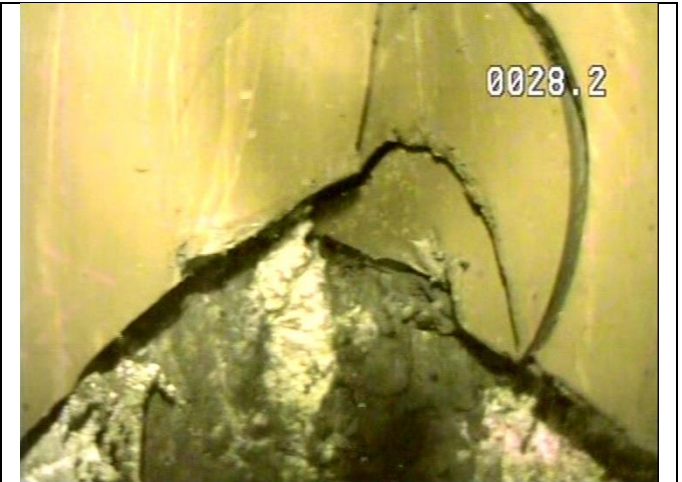
ATTACHMENT A

ATTACHMENT A

2009 AMPS Video



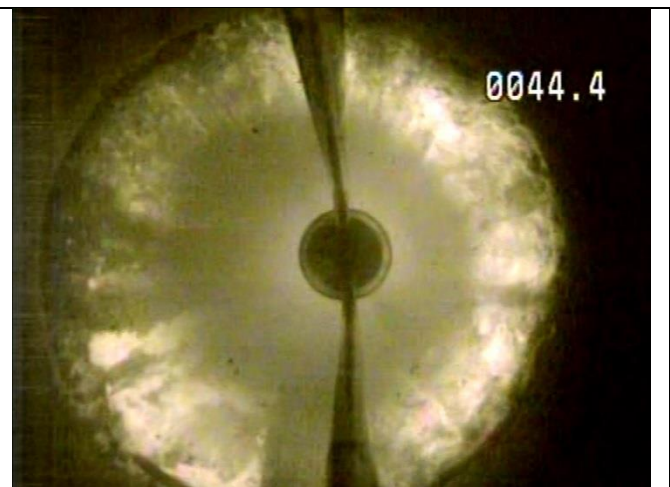
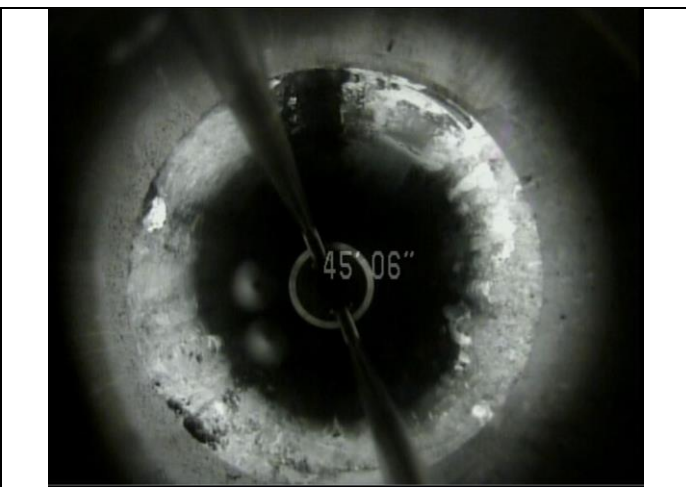
2016 AWE Video



ATTACHMENT A

2009 AMPS Video

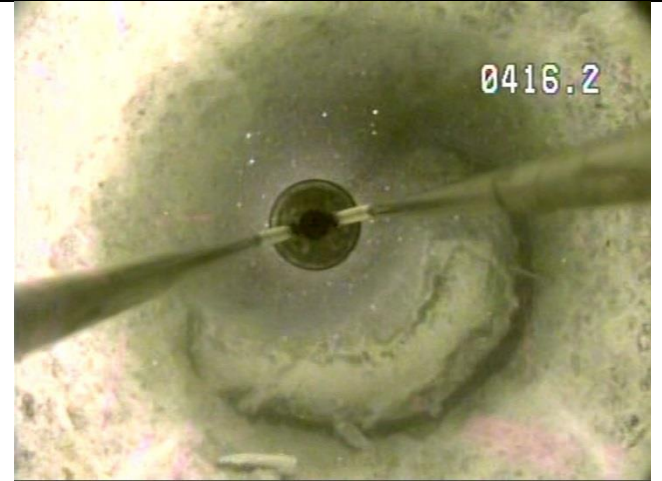
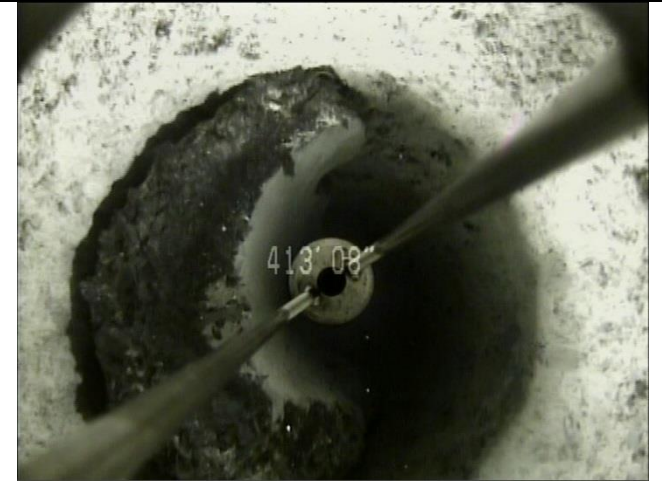
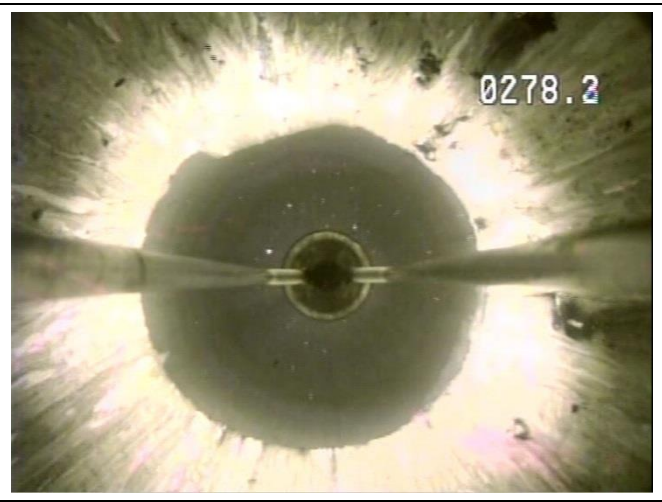
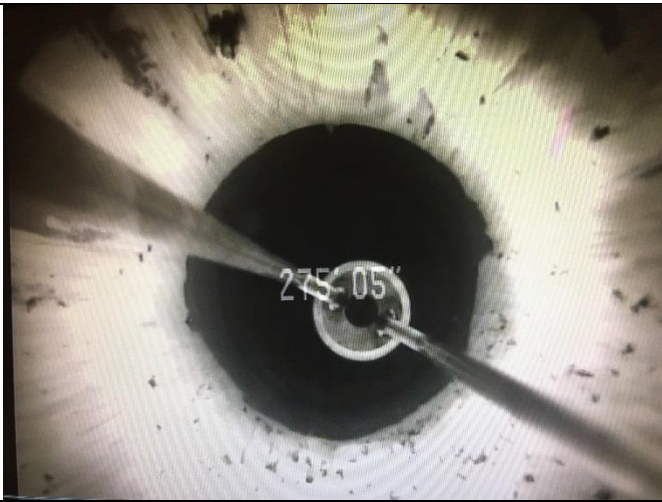
2016 AWE Video



ATTACHMENT A

2009 AMPS Video

2016 AWE Video



ATTACHMENT B



X-Y CALIPER
GAMMA RAY
LOG

Company INDIAN RIVER COUNTY SOUTH RO W
Well S-4
Field SOUTH OSLO ROAD
County INDIAN RIVER
State FLORIDA

Company INDIAN RIVER COUNTY SOUTH RO W.T.P
Well S-4
Field SOUTH OSLO ROAD
County INDIAN RIVER State FLORIDA

Location: API #:

SEC	TWP	RGE	Elevation
	PAD		K.B.
	PAD		D.F.
	PAD		G.L.

Other Services
SEE
COMMENTS

Date	18-OCT-2016		
Run Number	ONE		
Depth Driller	710'		
Depth Logger	710'		
Bottom Logged Interval	710'		
Top Log Interval	CASING		
Open Hole Size	NA		
Type Fluid	WATER		
Density / Viscosity	NA		
Max. Recorded Temp.	75.5 DEGF		
Estimated Cement Top	NA		
Time Well Ready	0000		
Time Logger on Bottom	0000		
Equipment Number	VA-202		
Location	JUPITER		
Recorded By	LEE		
Witnessed By	J. FRIEDRICHS		

	Borehole Record		Borehole Record	
	Bit	From	Bit	To
Run Number				
Casing Record				
Surface String	Size	Wgt/Ft	Top	Bottom
Prot. String				
Production String				
Liner				

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All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

FLOWMETER
DIL/LL3/SP
FCT
DHTVS



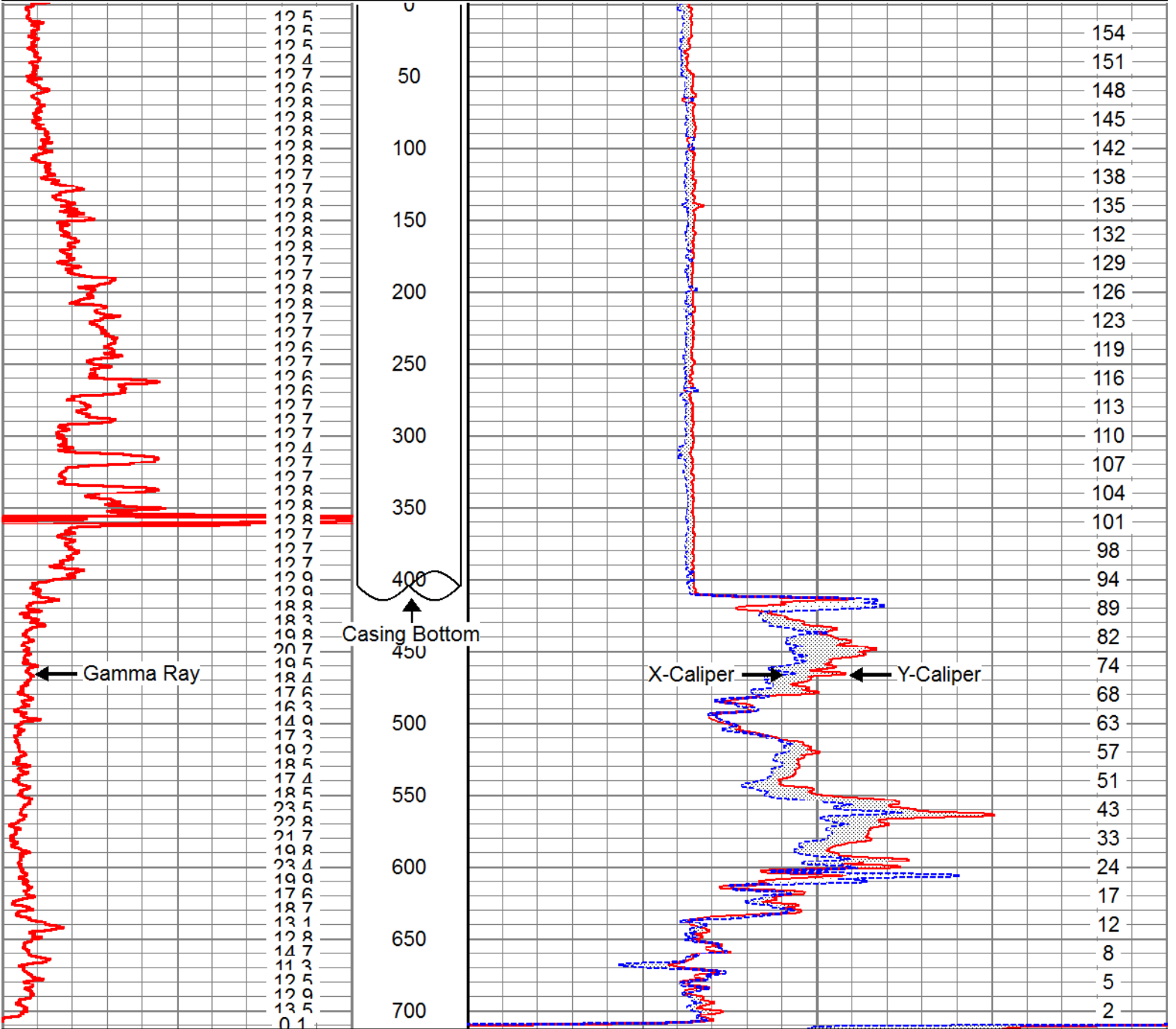
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 Charted by: Depth in Feet scaled 1:1200

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	CALA (in)	

0	X-Caliper (in)	40
0	Borehole ID (in)	40
0	YCAL (in)	40

TBHV
(bbl)



0	GR (GAPI)	100
	CALA (in)	

0	X-Caliper (in)	40
0	Borehole ID (in)	40
0	YCAL (in)	40

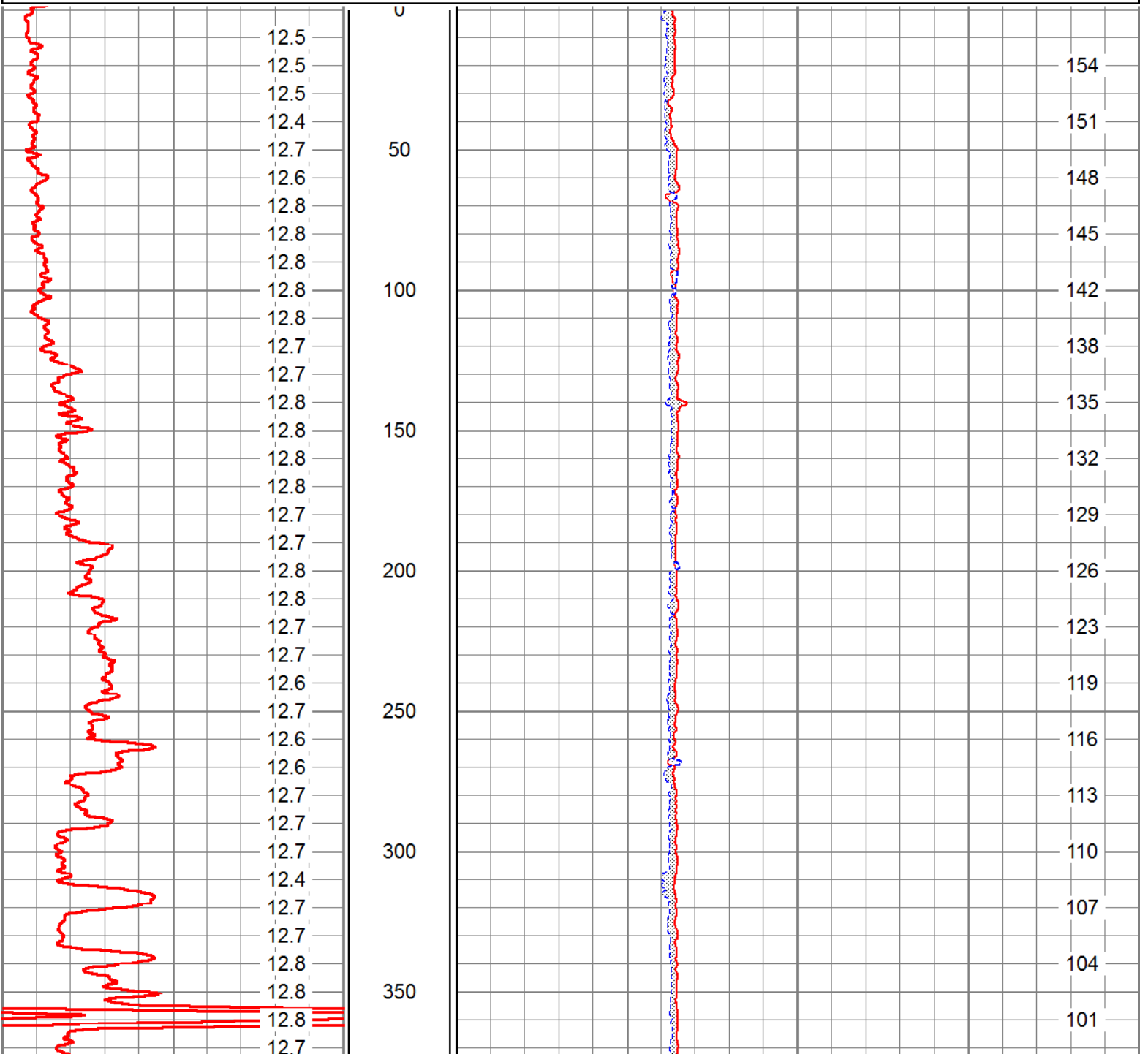
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(bbl)

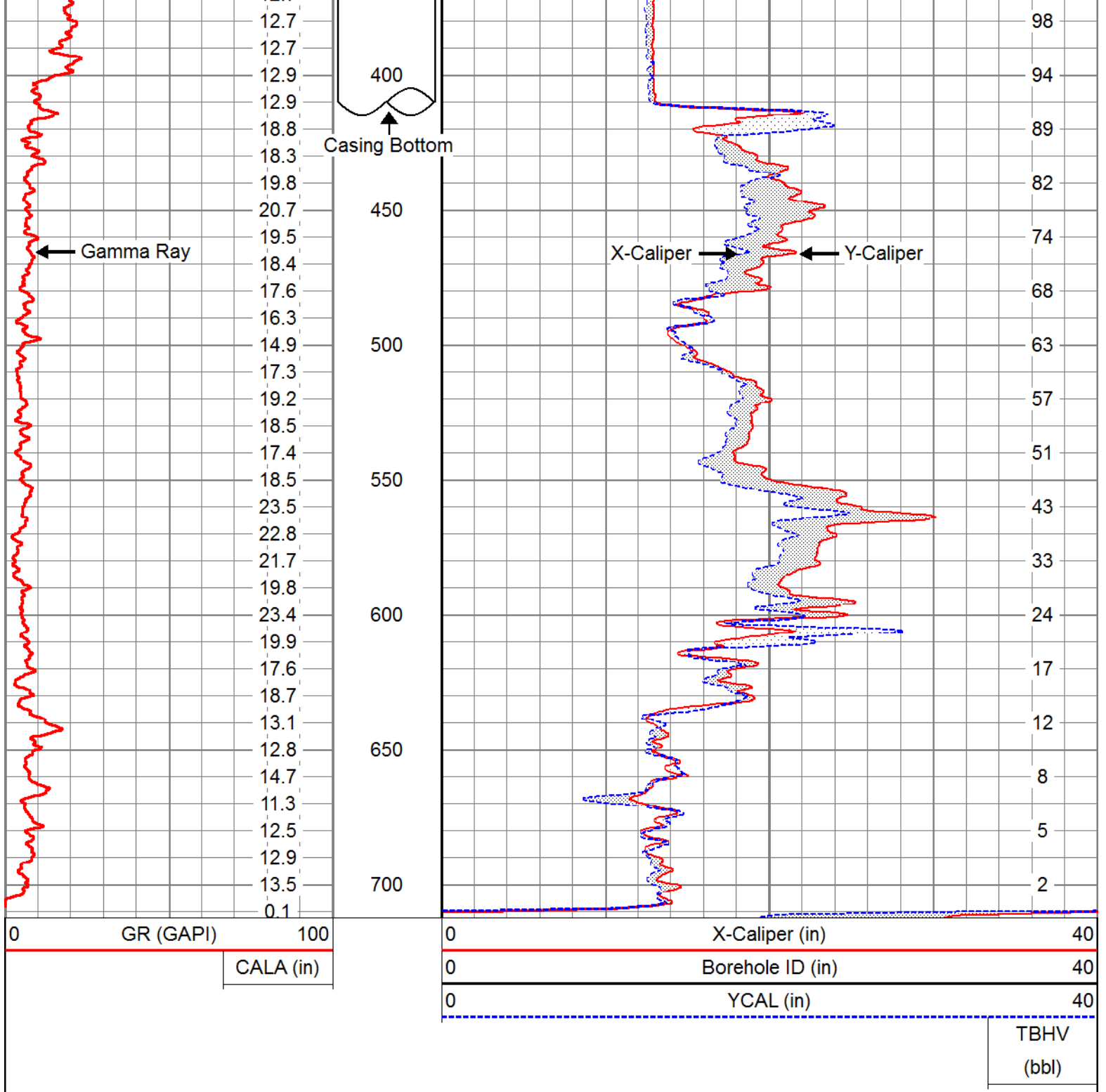


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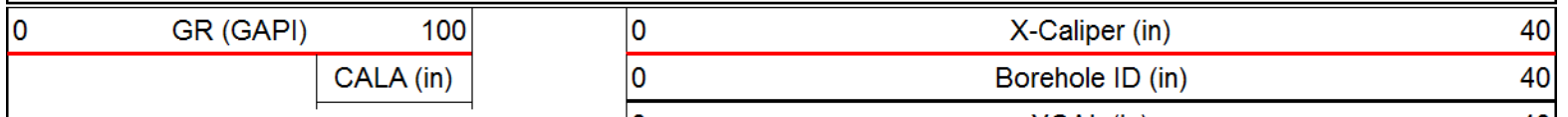
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	CALA (in)		0	Borehole ID (in)	40
			0	YCAL (in)	40
					TBHV (bbl)





MAIN PASS

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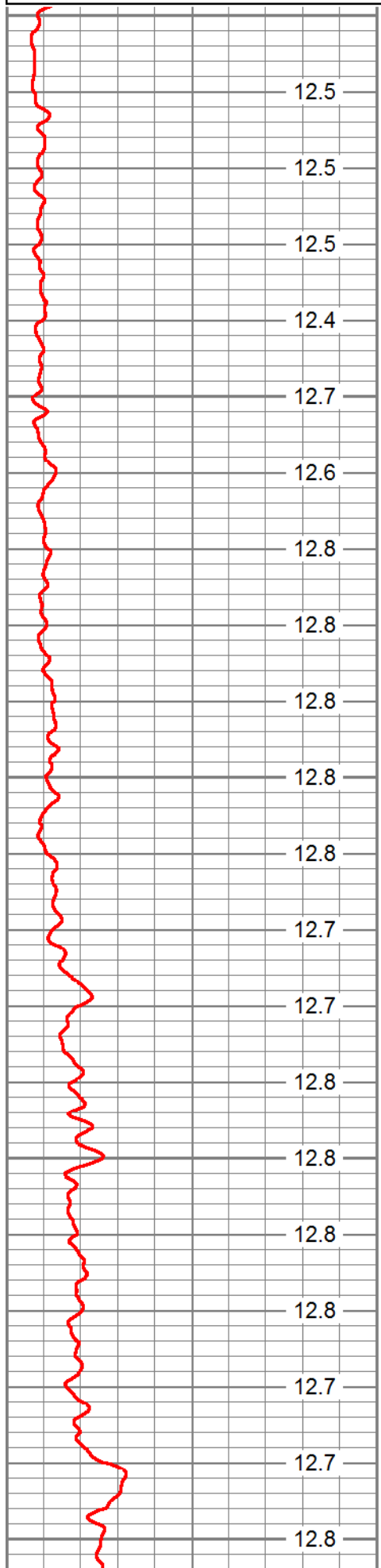


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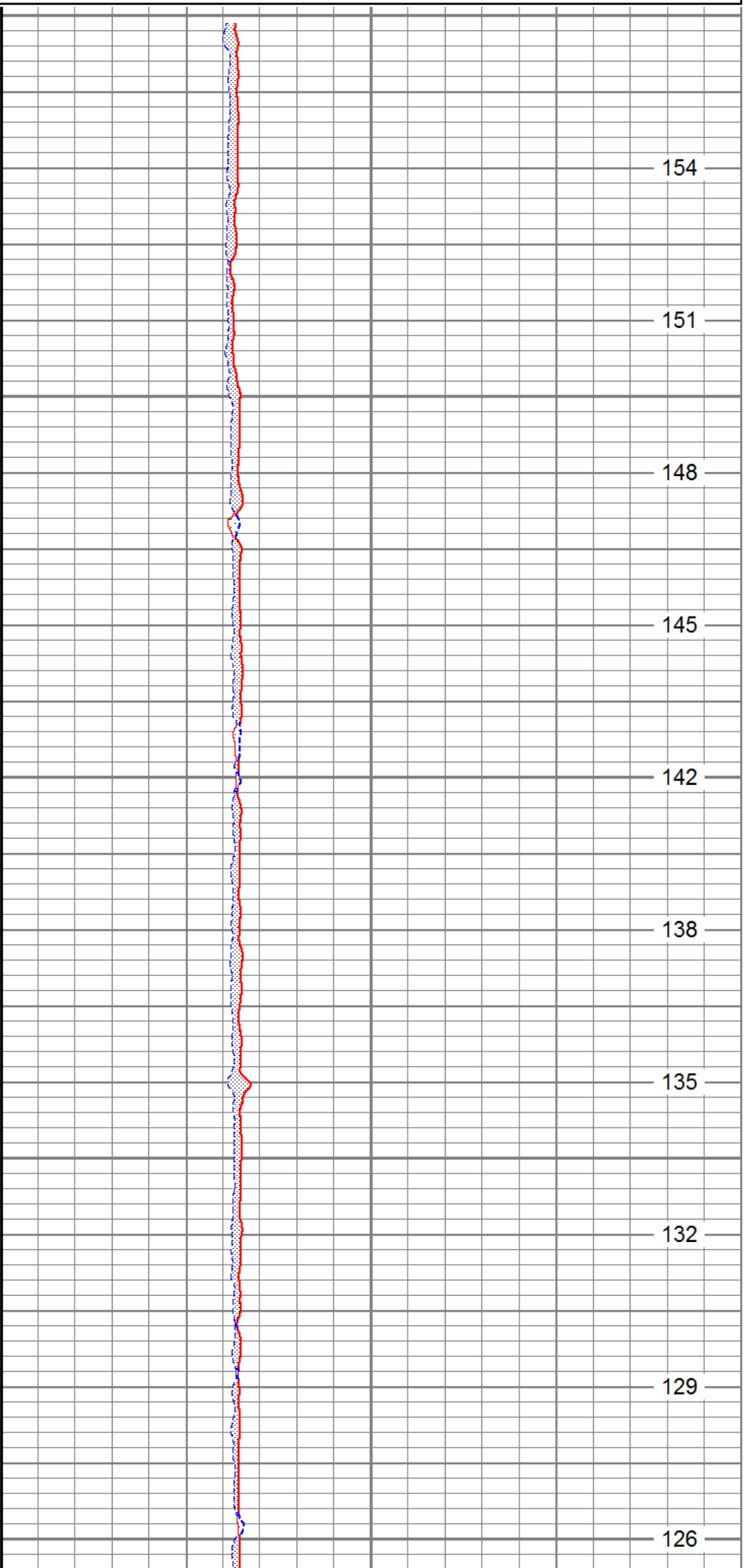
YCAL (in)

40

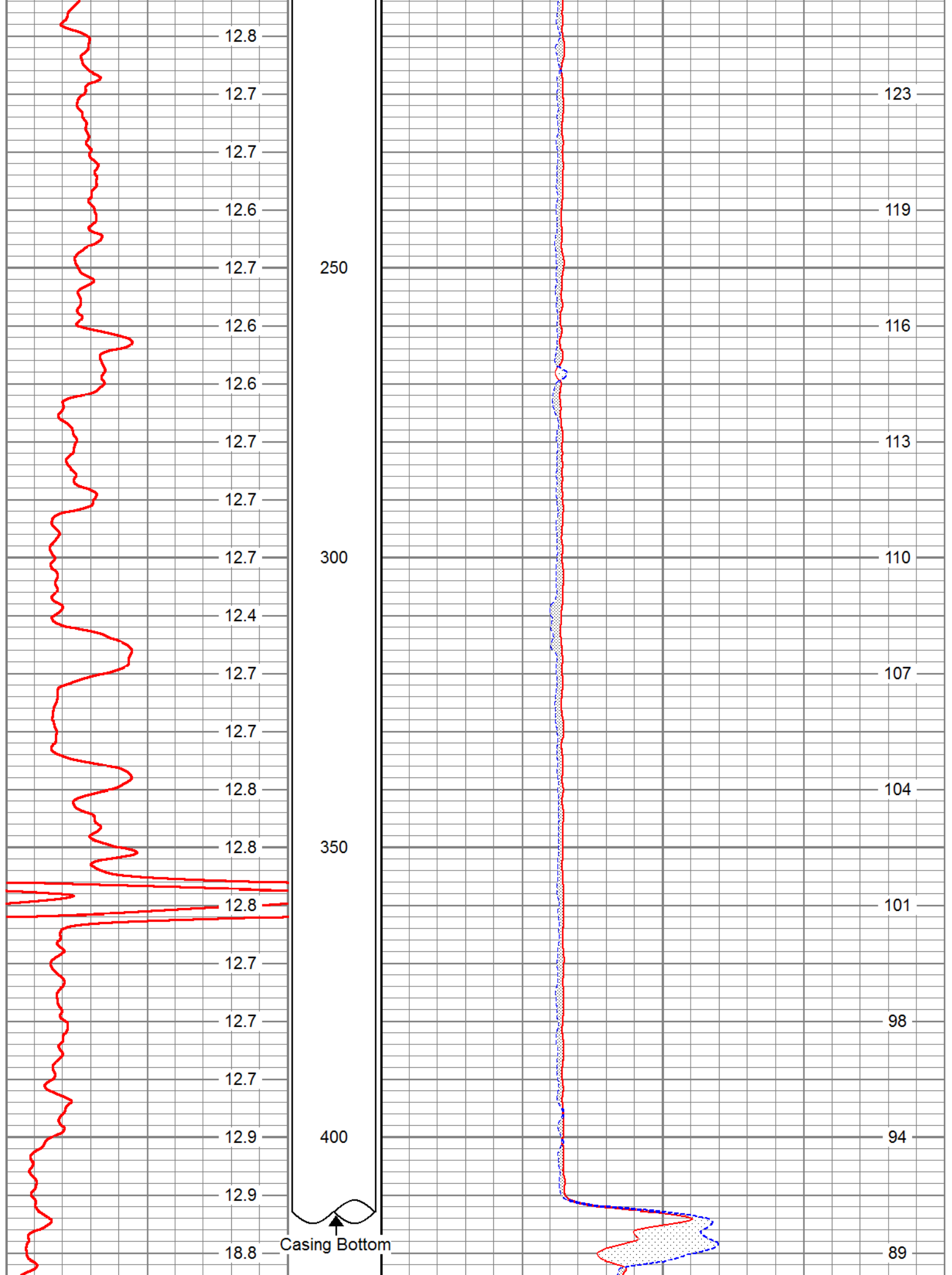
TBHV
(bbl)

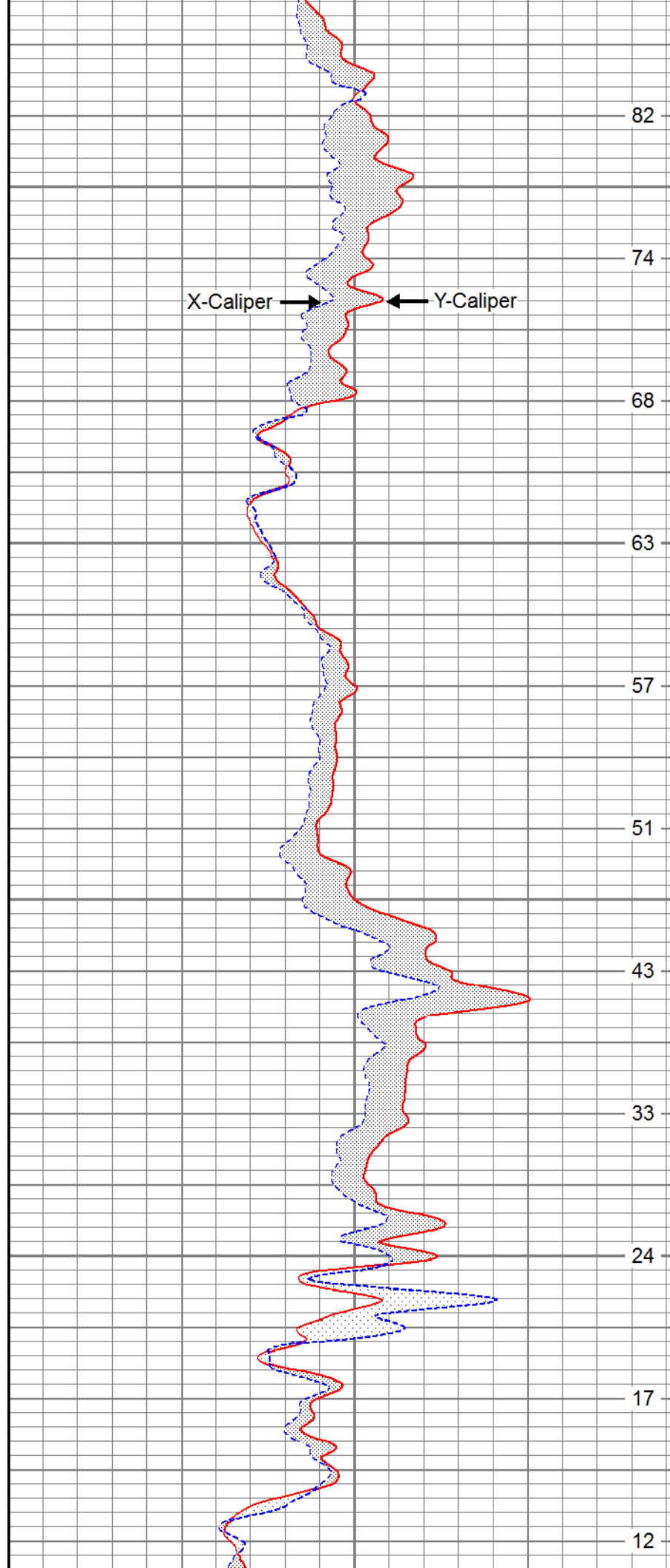
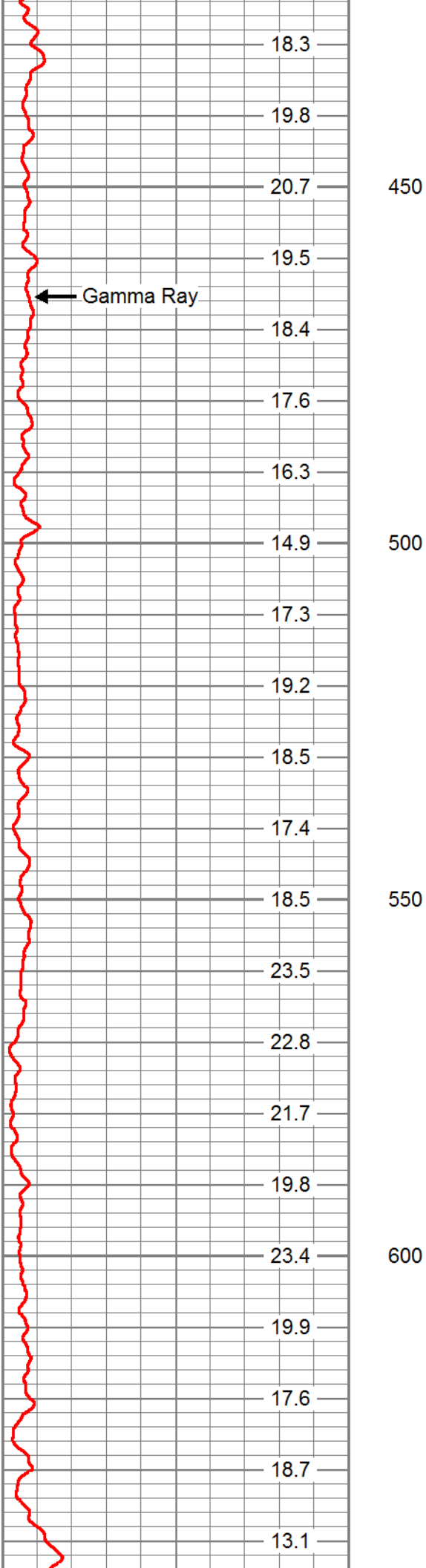


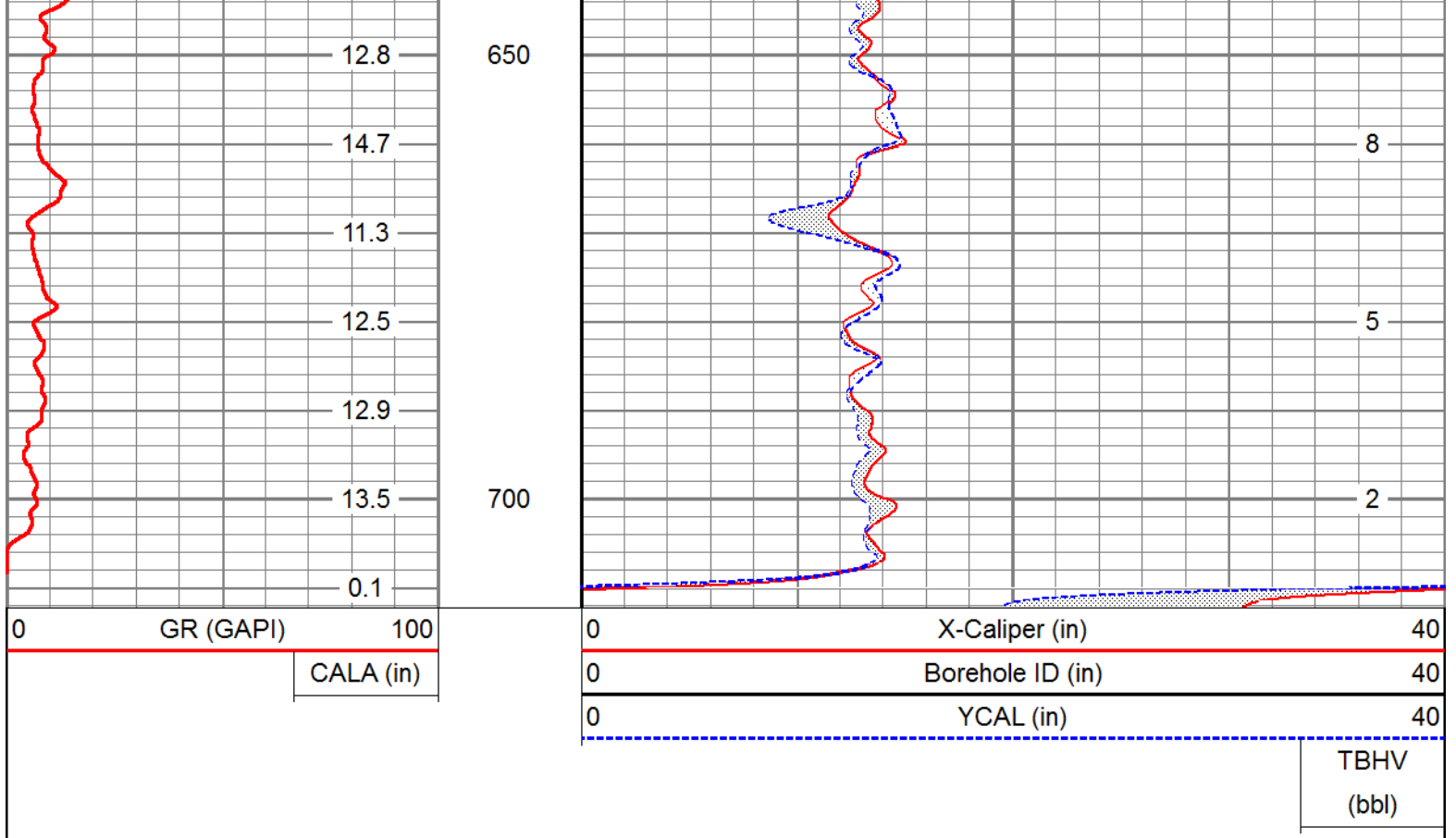
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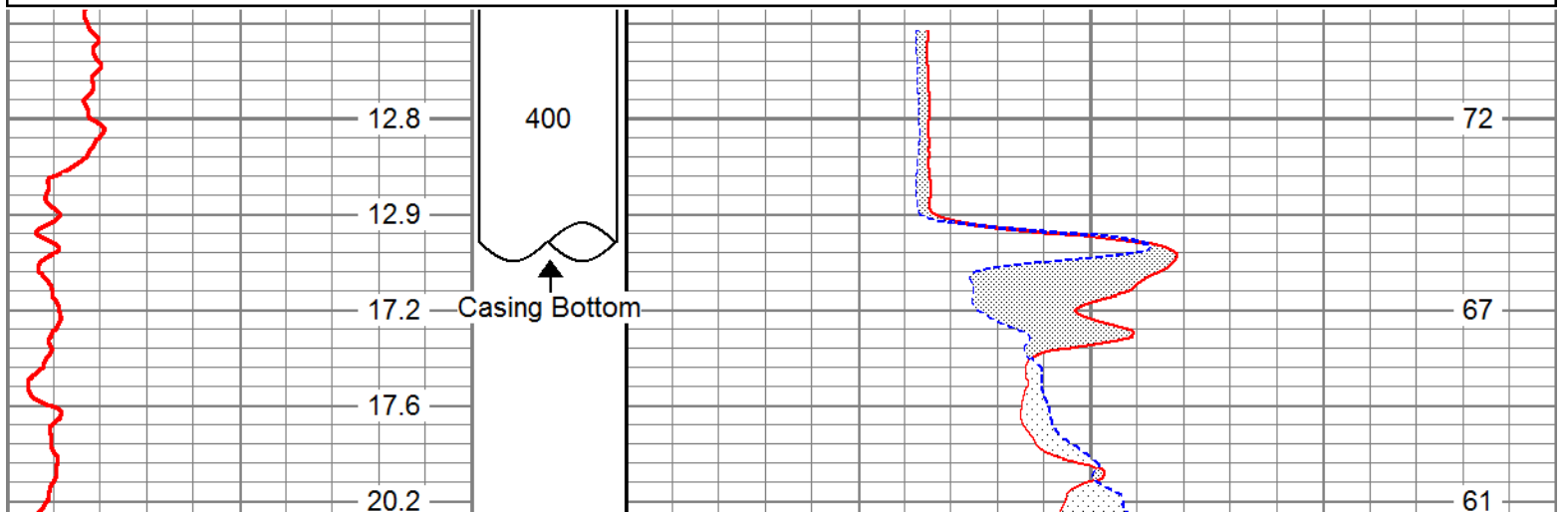
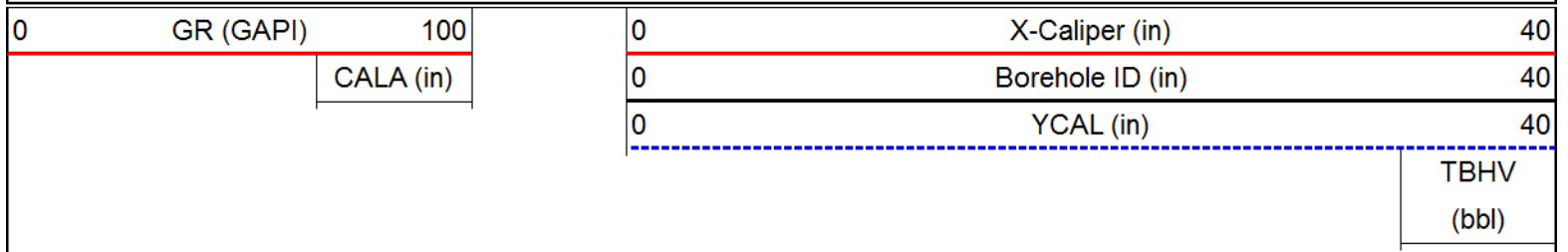


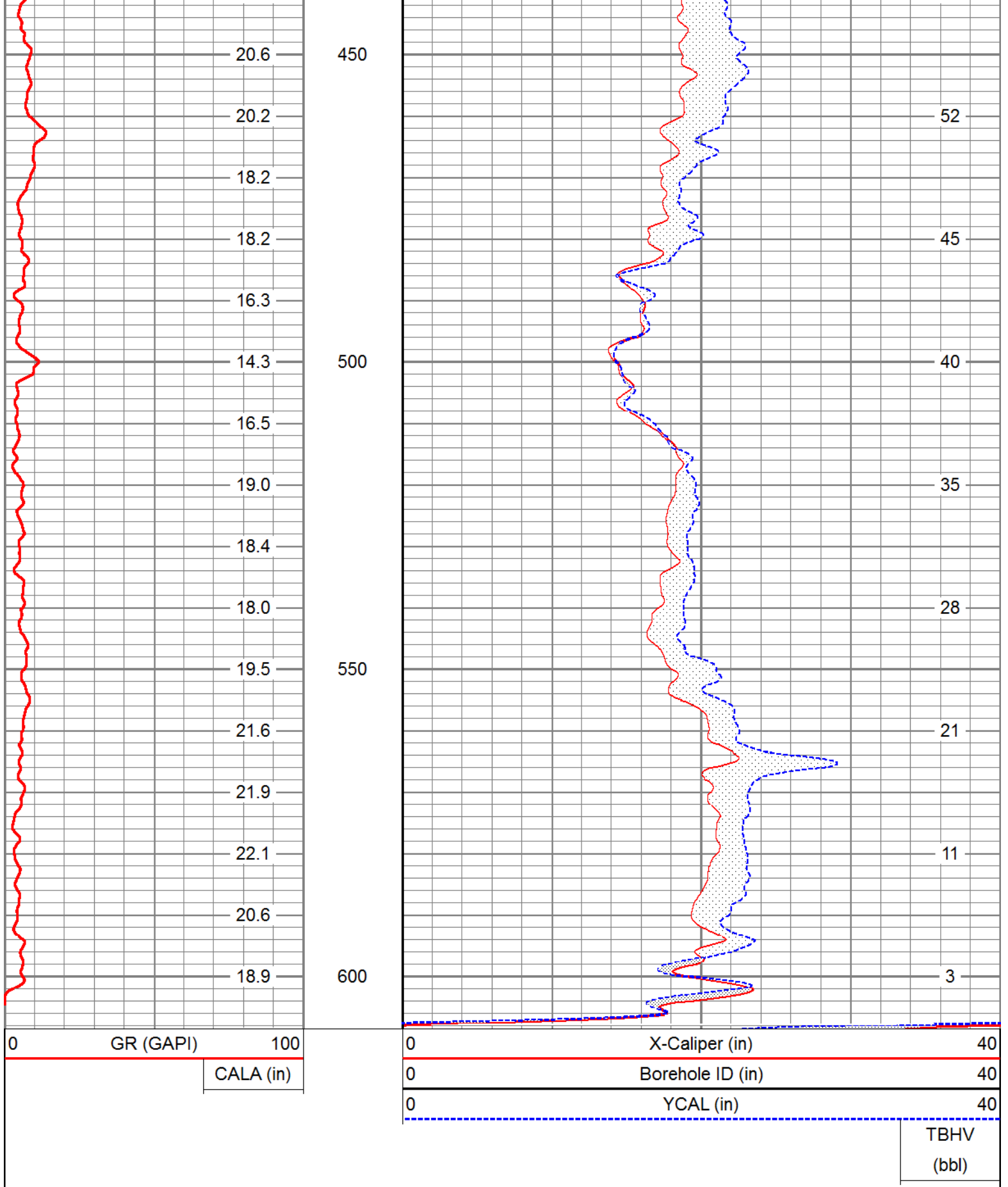




REPEAT PASS

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 Charted by: Depth in Feet scaled 1:240





Calibration Report

Database File: verosouth4.db
 Dataset Pathname: XYC
 Dataset Creation: Tue Oct 18 10:47:43 2016 by Log Open-Cased 071220

Serial Number/Model:
Performed:

Probe1-Probe
Tue Sep 20 12:08:25 2016

	Ring		X Caliper		Y Caliper	
	-----		-----		-----	
1:	10	in	1226.2	cps	1494.67	cps
2:	19.25	in	1809	cps	1947	cps
3:	20	in	1865.65	cps	1989.02	cps
4:	30	in	2590.43	cps	2628.7	cps
5:		in		cps		cps
6:		in		cps		cps

Gamma Ray Calibration Report

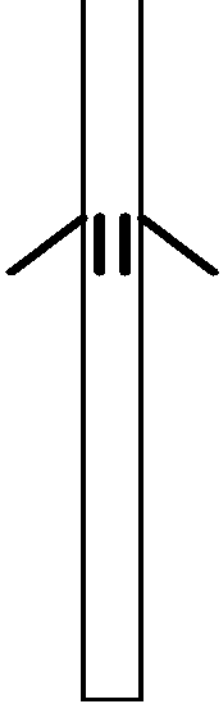
Serial Number: SDS
 Tool Model: SDSGR
 Performed: Tue Jun 28 15:58:31 2016

Calibrator Value: 120.0 GAPI

Background Reading: 117.8 cps
 Calibrator Reading: 585.1 cps

Sensitivity: 0.2568 GAPI/cps

Sensor	Offset (ft)	Schematic	Description	Len (ft)	OD (in)	Wt (lb)
			CHD-SDSCHD (SDS) Cable Head	1.00	1.50	5.00
GR	6.17		GR-SDSGR (SDS) GR	3.00	1.69	20.00

<p>XCAL YCAL</p>	<p>0.75 0.75</p>		<p>XYC-Probe (Probe1) Probe_AWE-XY Caliper SM</p>	<p>5.17</p>	<p>3.50</p>	<p>99.00</p>
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Dataset: verosouth4.db: field/well/run1/XYC
Total Length: 9.17 ft
Total Weight: 124.00 lb
O.D. 3.50 in



FLUID CONDUCTIVITY TEMPERATURE LOG

Company INDIAN RIVER COUNTY SOUTH RO W
 Well S-4
 Field SOUTH OSLO ROAD
 County INDIAN RIVER
 State FLORIDA

Company INDIAN RIVER COUNTY SOUTH RO W.T.P
 Well S-4
 Field SOUTH OSLO ROAD
 County INDIAN RIVER State FLORIDA

Location: API # :
 Other Services SEE COMMENTS
 Elevation

SEC	TWP	RGE	Elevation
Permanent Datum	PAD		PAD
Log Measured From	PAD		PAD
Drilling Measured From	PAD		PAD

Date	24-OCT-2016		
Run Number	ONE		
Depth Driller	710'		
Depth Logger	710'		
Bottom Logged Interval	710'		
Top Log Interval	CASING		
Open Hole Size	NA		
Type Fluid	WATER		
Density / Viscosity	NA		
Max. Recorded Temp.	75.5 DEGF		
Estimated Cement Top	NA		
Time Well Ready	0000		
Time Logger on Bottom	0000		
Equipment Number	VA-202		
Location	JUPITER		
Recorded By	LEE		
Witnessed By	J. FRIEDRICHS		

Borehole Record				Borehole Record			
Run Number	Bit	From	To	Run Number	Bit	From	To

Casing Record	Size	Wgt/Ft	Top	Bottom
Surface String				
Prot. String				
Production String				
Liner				

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All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

XYC/GR
DIL/LL3/SP
FLOWMETER
DHTVS

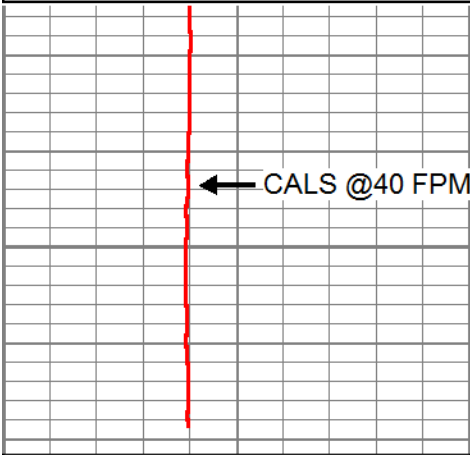


CALS @ 40 FPM

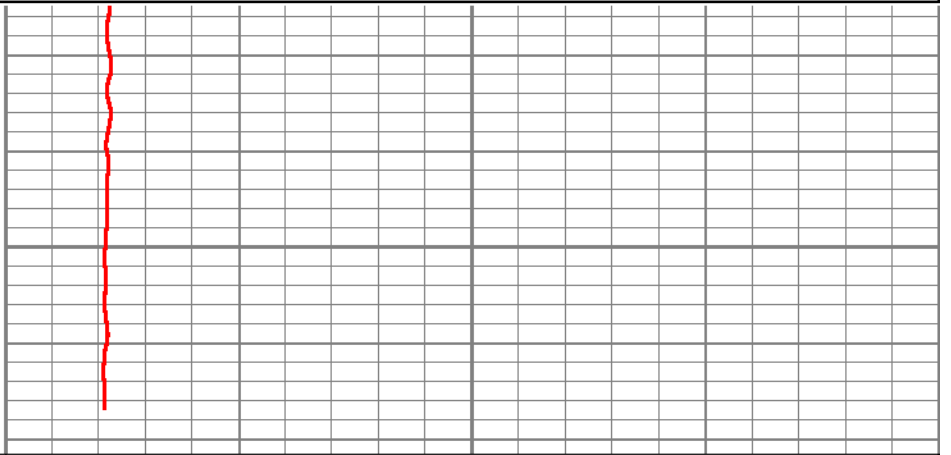
Database File: verosouth4.db
Dataset Pathname: FMCALS40
Presentation Format: flow
Dataset Creation: Mon Oct 24 12:16:06 2016 by Log Open-Cased 071220
Charted by: Depth in Feet scaled 1:240

0 LSPD_DOWN (ft/min) 100

0 FLOWP_DOWN (cps) 100



350



0 LSPD_DOWN (ft/min) 100

0 FLOWP_DOWN (cps) 100

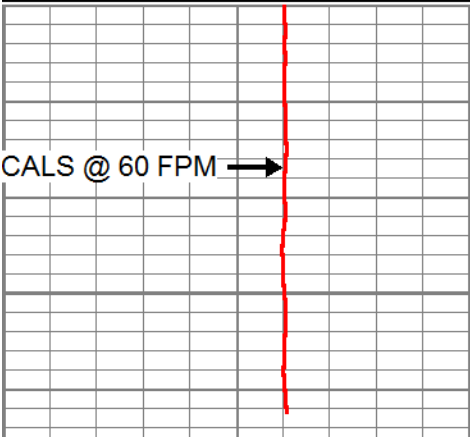


CALS @ 60 FPM

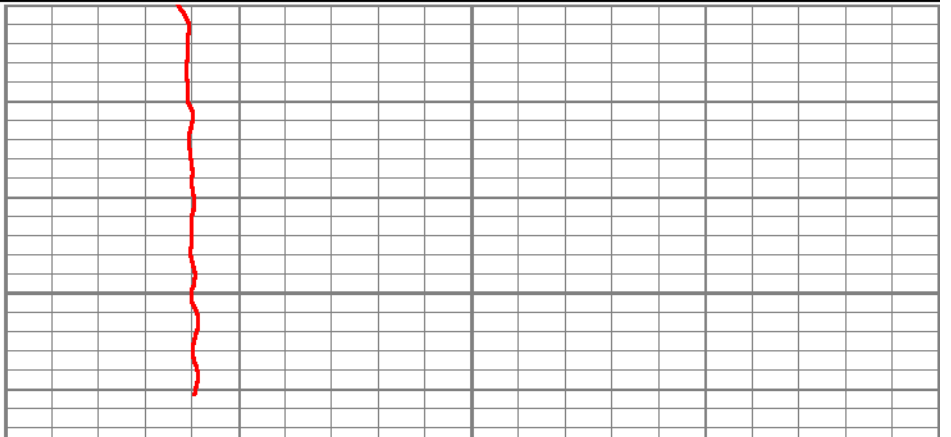
Database File: verosouth4.db
Dataset Pathname: FMCALS601
Presentation Format: flow
Dataset Creation: Mon Oct 24 12:21:44 2016 by Log Open-Cased 071220
Charted by: Depth in Feet scaled 1:240

0 LSPD_DOWN (ft/min) 100

0 FLOWP_DOWN (cps) 100



350



0 LSPD_DOWN (ft/min) 100

0 FLOWP_DOWN (cps) 100

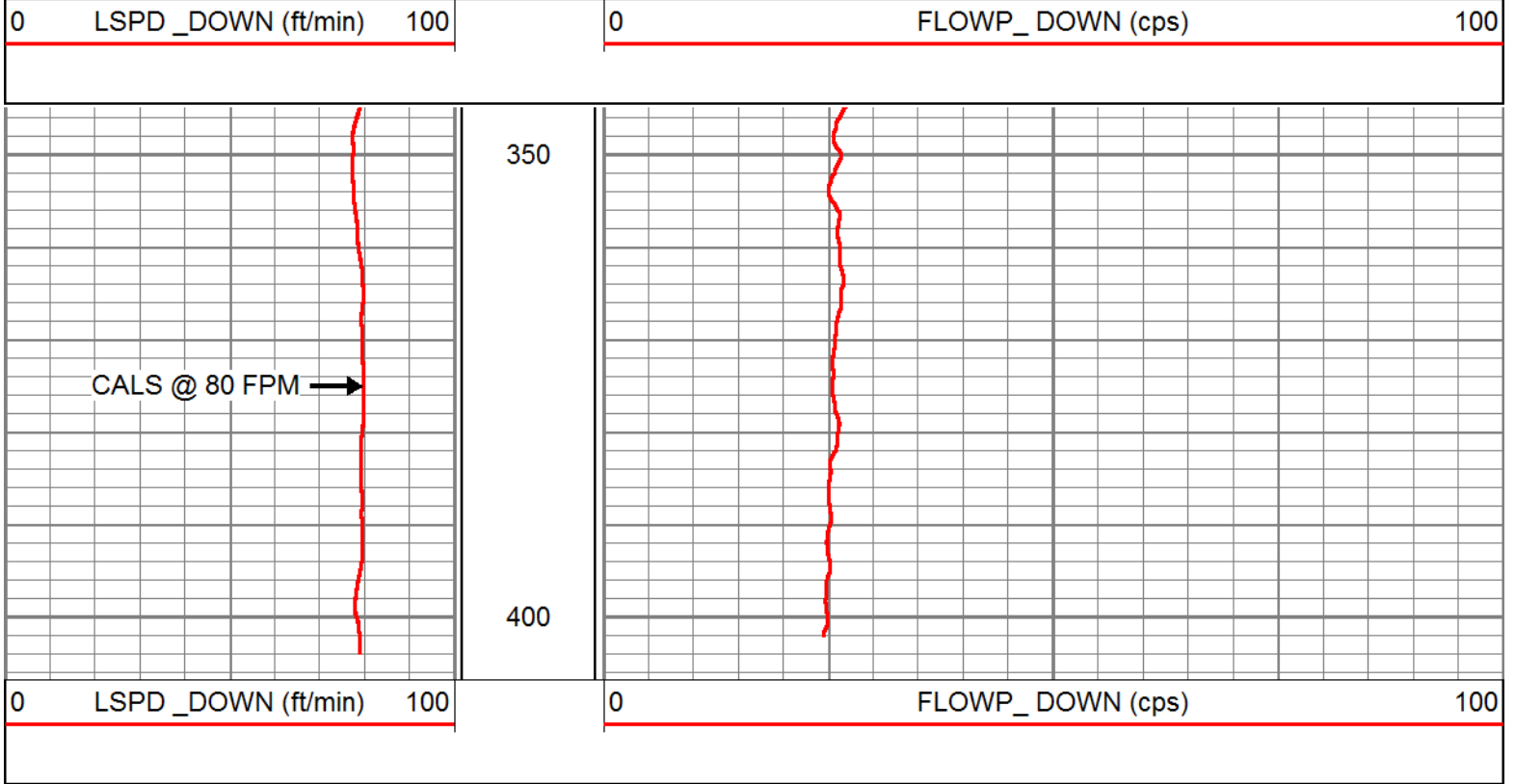


CALS @ 60 FPM



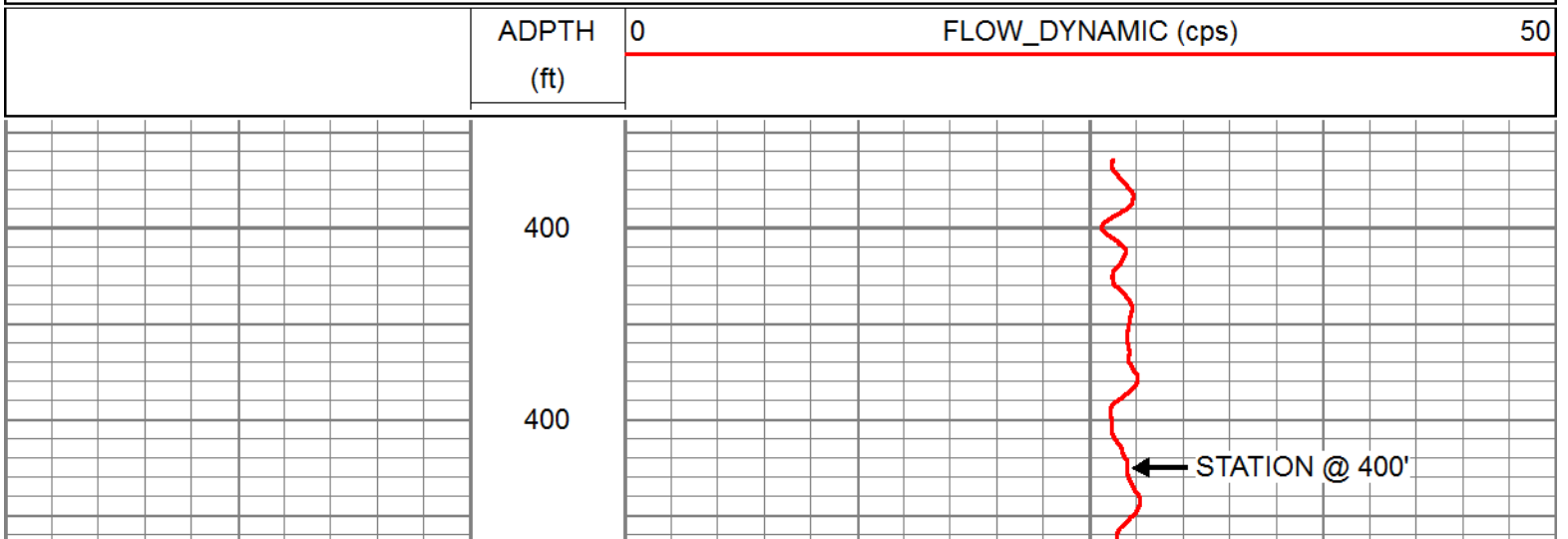
CALS @ 80 FPM

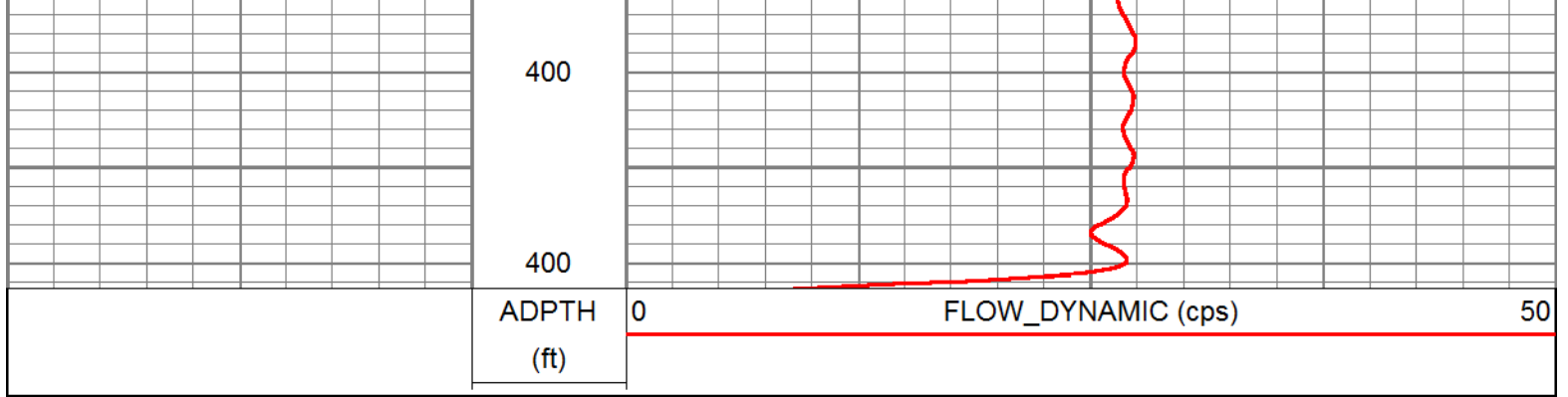
Database File: verosouth4.db
 Dataset Pathname: FMCALS80
 Presentation Format: flow
 Dataset Creation: Mon Oct 24 12:25:52 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240



STATION @ 400'

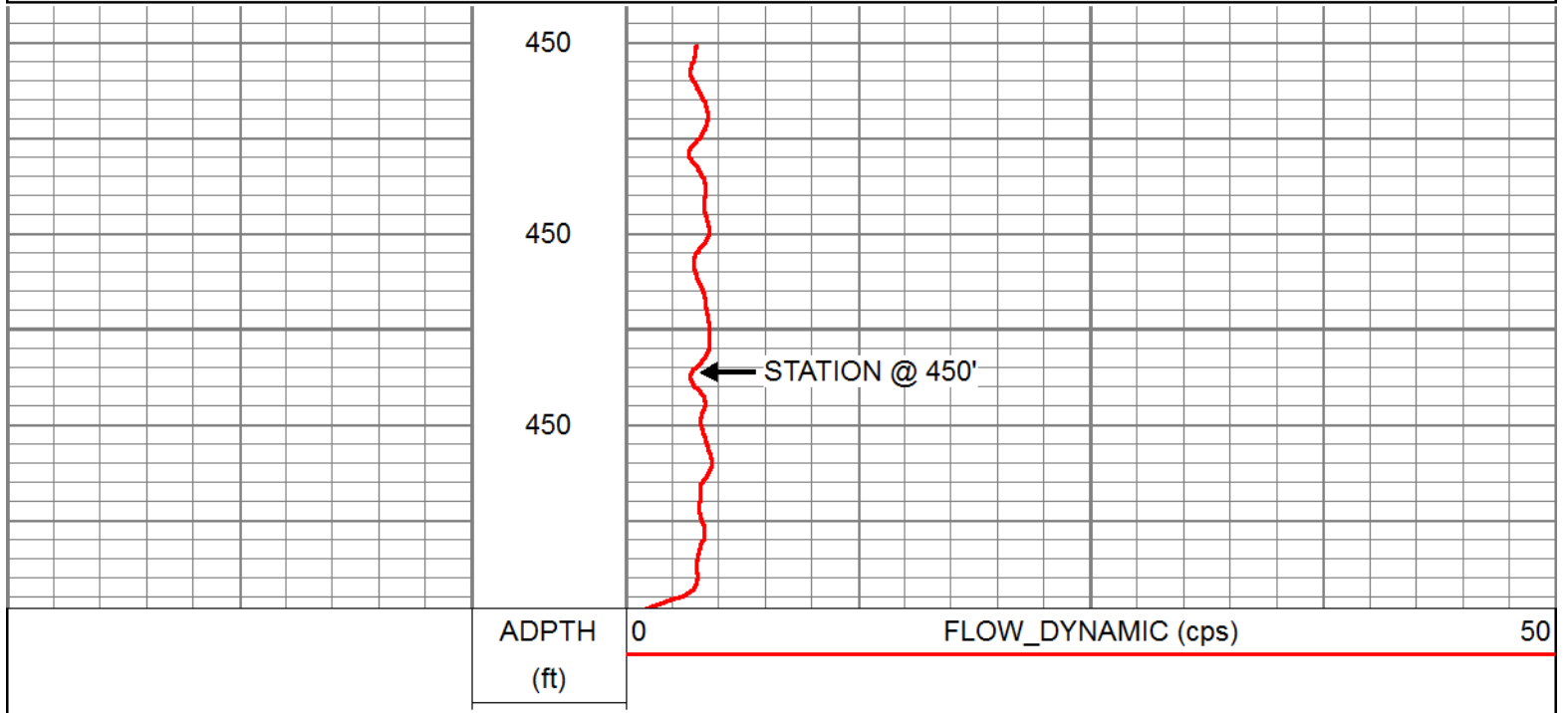
Database File: verosouth4.db
 Dataset Pathname: STA400
 Presentation Format: flow_sta
 Dataset Creation: Mon Oct 24 14:26:42 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240





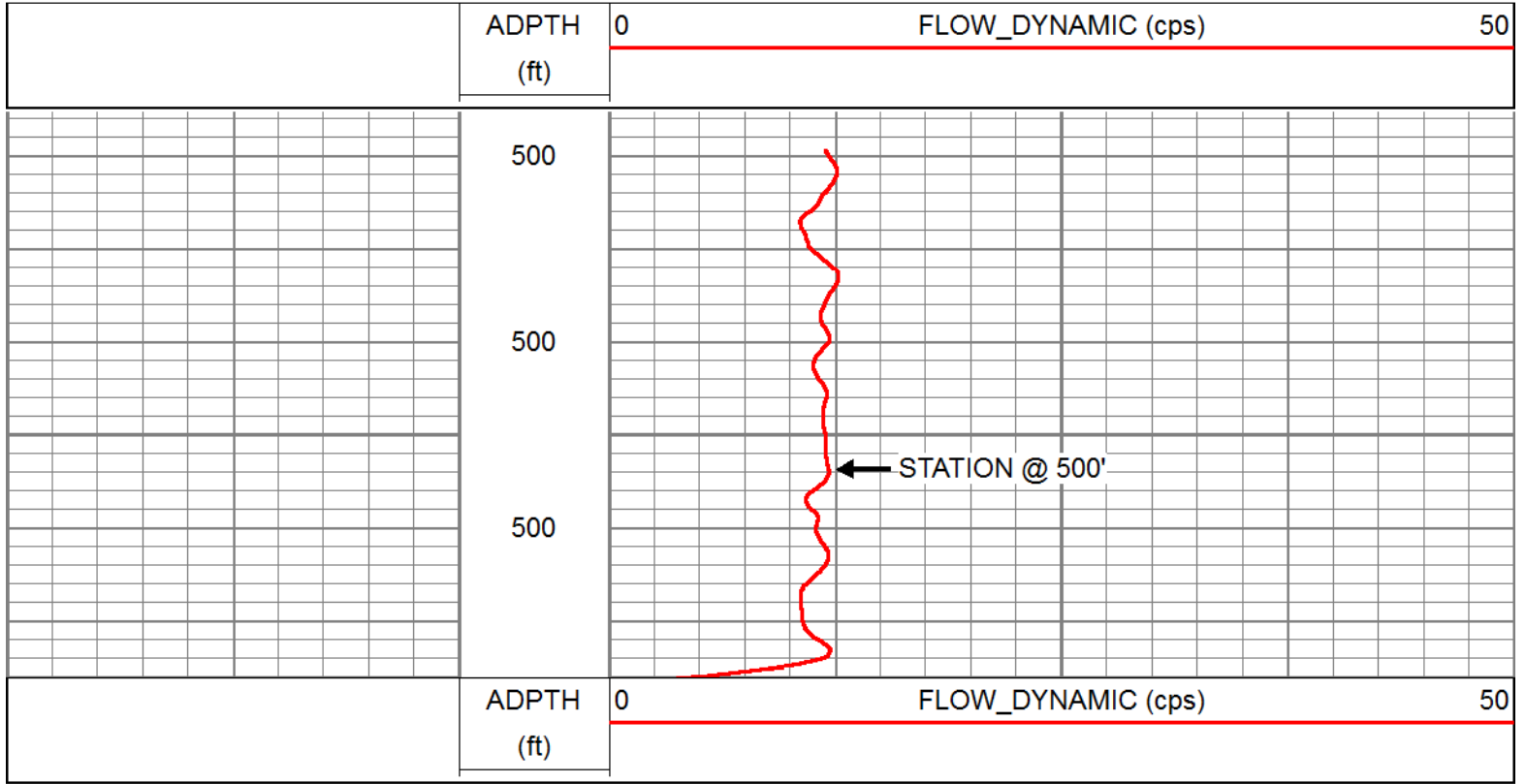
STATION @ 450'

Database File: verosouth4.db
 Dataset Pathname: STA450
 Presentation Format: flow_sta
 Dataset Creation: Mon Oct 24 14:24:23 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240



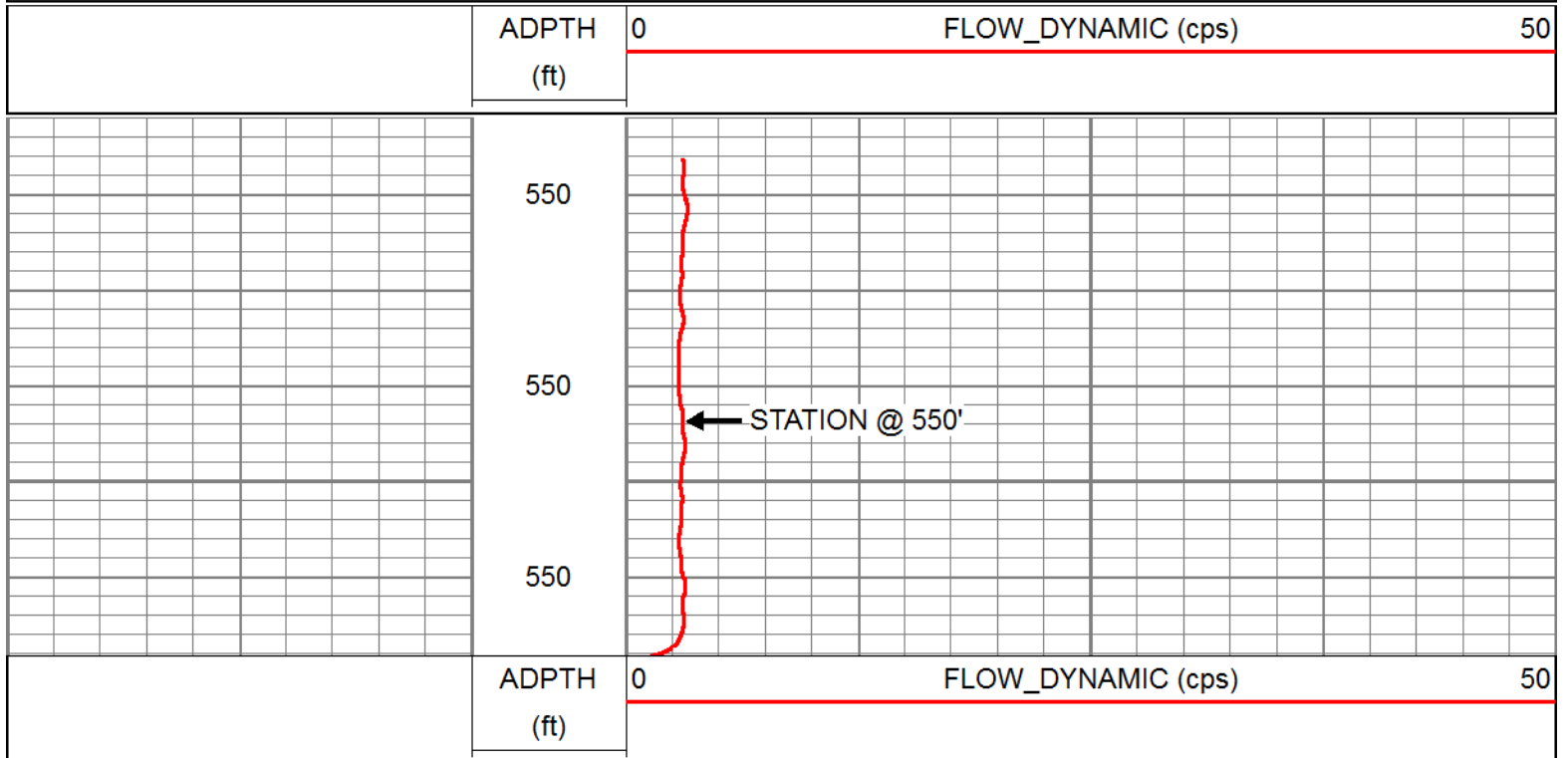
STATION @ 500'

Database File: verosouth4.db
 Dataset Pathname: STA500
 Presentation Format: flow_sta
 Dataset Creation: Mon Oct 24 14:22:26 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240



STATION @ 550'

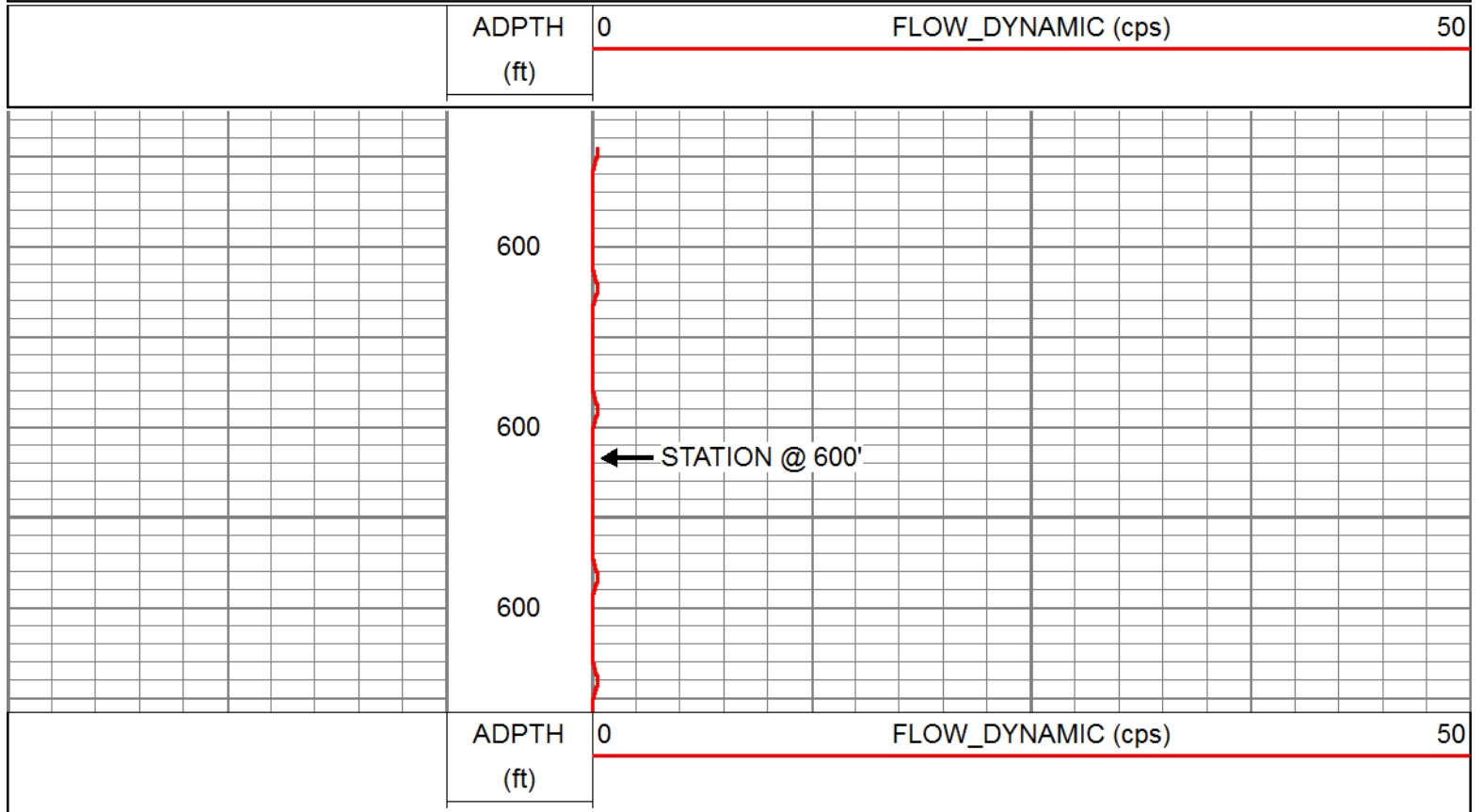
Database File: verosouth4.db
 Dataset Pathname: STA550
 Presentation Format: flow_sta
 Dataset Creation: Mon Oct 24 14:20:36 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240





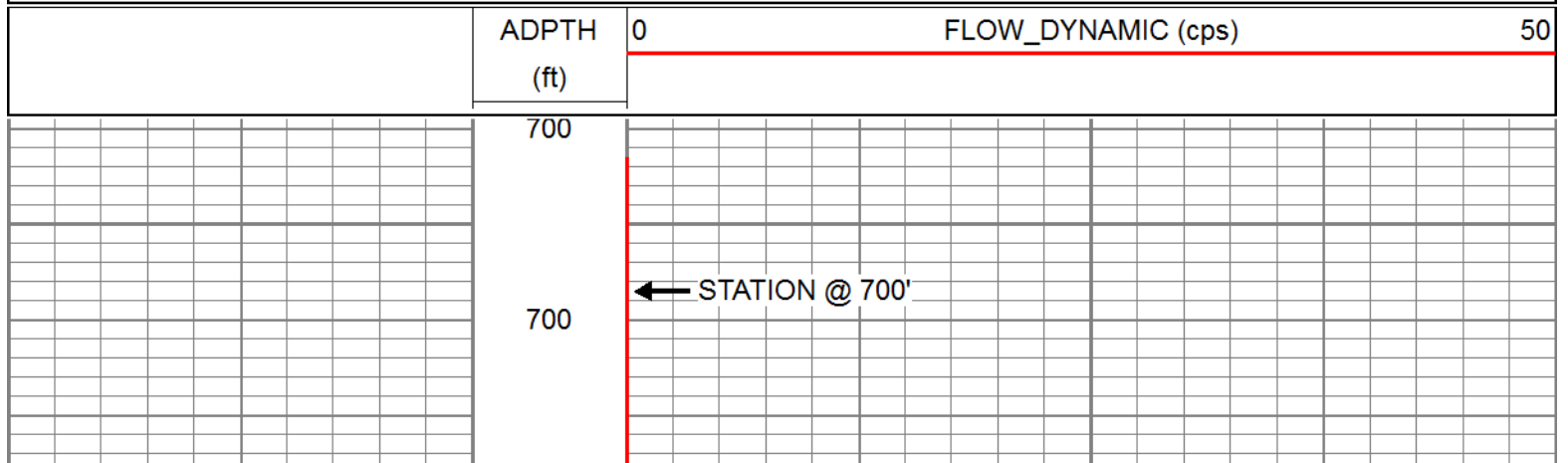
STATION @ 600'

Database File: verosouth4.db
 Dataset Pathname: STA600
 Presentation Format: flow_sta
 Dataset Creation: Mon Oct 24 14:18:32 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240



STATION @ 700'

Database File: verosouth4.db
 Dataset Pathname: STA700
 Presentation Format: flow_sta
 Dataset Creation: Mon Oct 24 14:12:02 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240



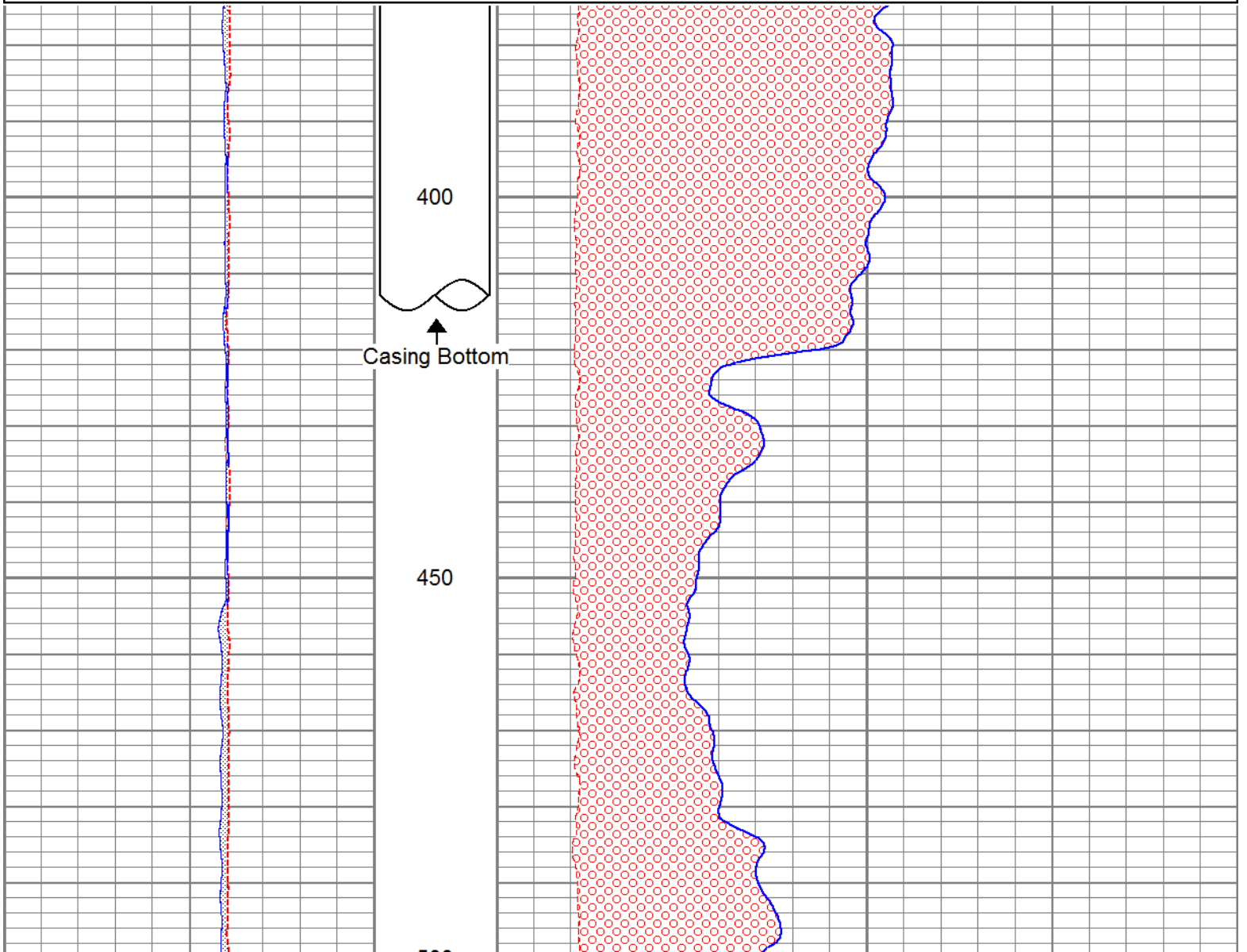
	700				
ADPTH (ft)	0	FLOW_DYNAMIC (cps)			50

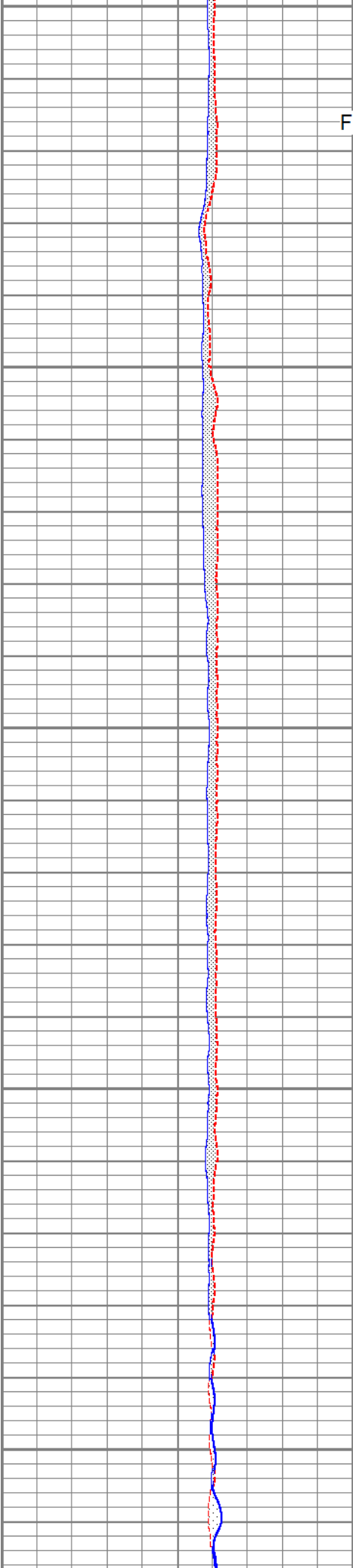


FLOWRATE = 585 GPM

Database File: verosouth4.db
 Dataset Pathname: FMDY
 Presentation Format: flow_mg
 Dataset Creation: Mon Oct 24 13:58:56 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240

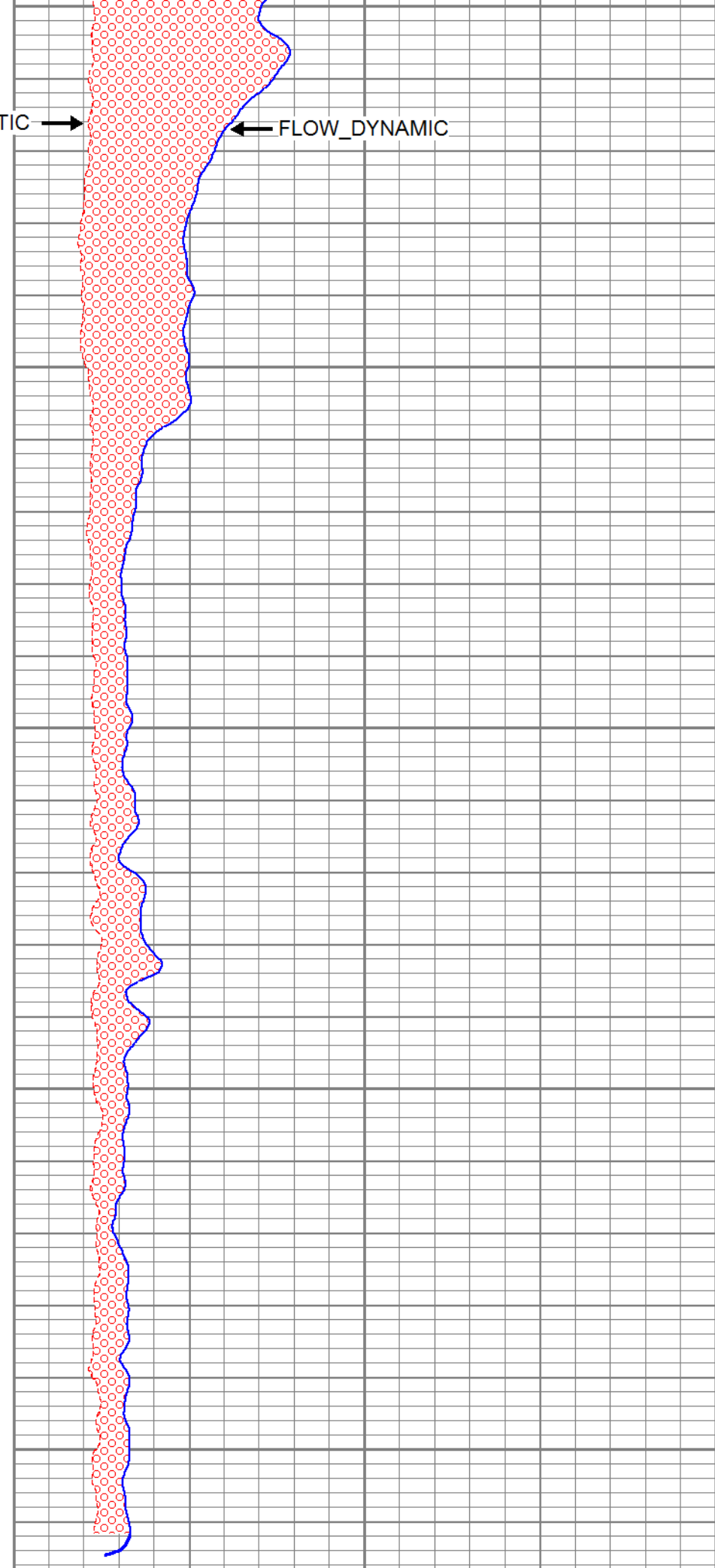
0	LSPD_STATIC (ft/min)	100	0	FLOW_STATIC (cps)	100
0	LSPD_DYNAMIC (ft/min)	100	0	FLOW_DYNAMIC (cps)	100





FLOW_STATIC →

← FLOW_DYNAMIC



0	LSPD_STATIC (ft/min)	100
0	LSPD_DYNAMIC (ft/min)	100

0	FLOW_STATIC (cps)	100
0	FLOW_DYNAMIC (cps)	100

Sensor	Offset (ft)	Schematic	Description	Len (ft)	OD (in)	Wt (lb)
			CHD-SDSCHD (SDS) Cable Head	1.00	1.50	5.00
			CBLINLINE	3.00	1.50	10.00
			FLOWMETER-TITAN (TITAN_3") TITIN_3'	3.00	1.69	25.00
FLOWP FLOWN	0.25 0.25					

Dataset: verosouth4.db: field/well/run1/FMDY
 Total Length: 7.00 ft
 Total Weight: 40.00 lb
 O.D.: 1.69 in



**FLUID
CONDUCTIVITY
TEMPERATURE
LOG**

Company	INDIAN RIVER COUNTY SOUTH RO W	Company	INDIAN RIVER COUNTY SOUTH RO W.T.P
Well	S-4	Well	S-4
Field	SOUTH OSLO ROAD	Field	SOUTH OSLO ROAD
County	INDIAN RIVER	County	INDIAN RIVER
State	FLORIDA	State	FLORIDA
Date	24-OCT-2016	Location:	API #:
Run Number	ONE	SEC	TWP
Depth Driller	710'	RGE	Elevation
Depth Logger	710'	Permanent Datum	PAD
Bottom Logged Interval	710'	Log Measured From	PAD
Top Log Interval	CASING	Drilling Measured From	PAD
Open Hole Size	NA		
Type Fluid	WATER		
Density / Viscosity	NA		
Max. Recorded Temp.	75.5 DEGF		
Estimated Cement Top	NA		
Time Well Ready	0000		
Time Logger on Bottom	0000		
Equipment Number	VA-202		
Location	JUPITER		
Recorded By	LEE		
Witnessed By	J. FRIEDRICHS		

	Borehole Record				Borehole Record			
	Run Number	Bit	From	To	Run Number	Bit	From	To
Casing Record								
Surface String								
Prot. String								
Production String								
Liner								

<<< Fold Here >>>

All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

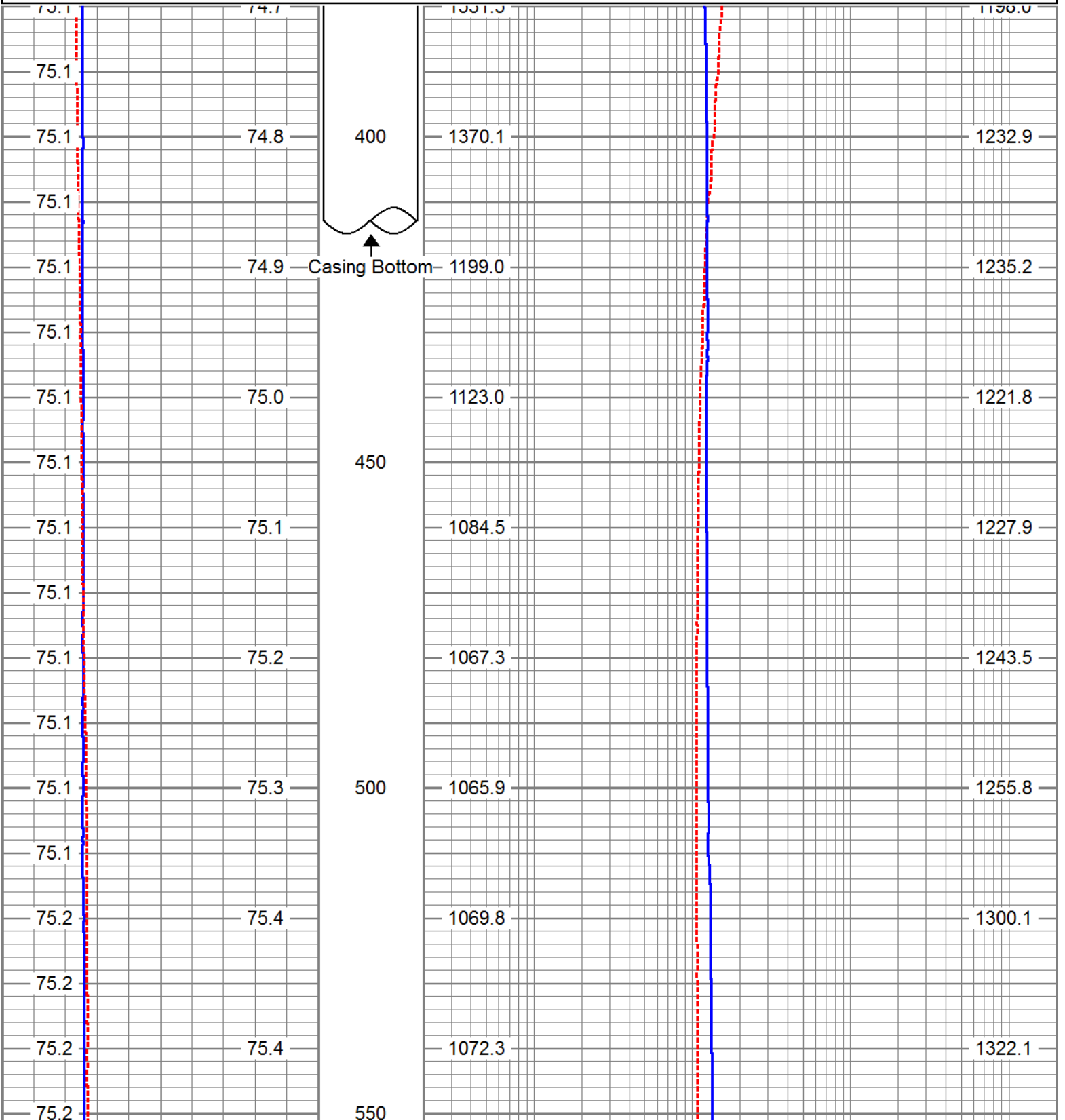
XYC/GR
DIL/LL3/SP
FLOWMETER
DHTVS

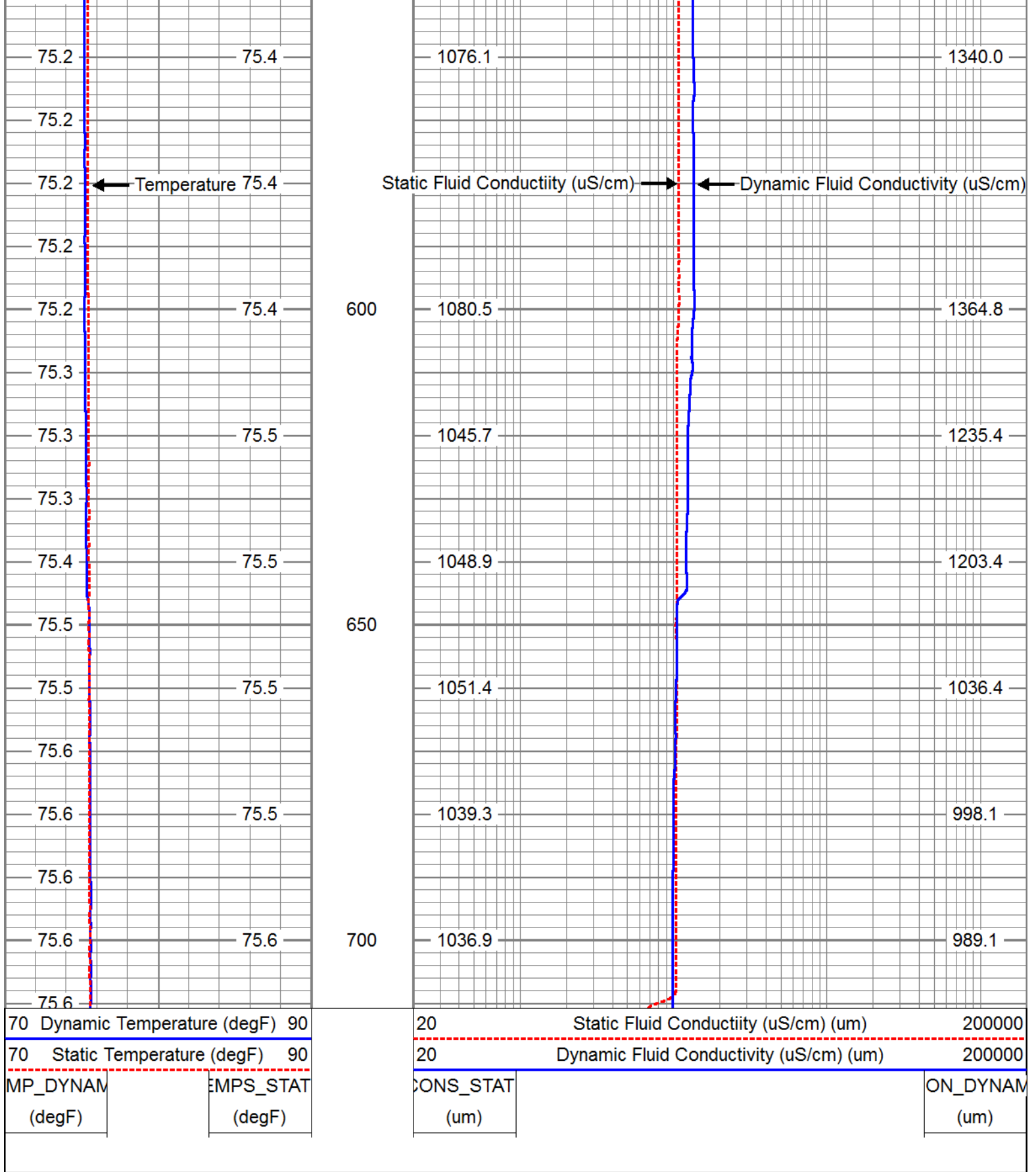


FLOWRATE = 535 GPM

Database File: verosouth4.db
 Dataset Pathname: FCTDY
 Presentation Format: fct
 Dataset Creation: Mon Oct 24 15:12:18 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240

70	Dynamic Temperature (degF)	90	20	Static Fluid Conductivity (uS/cm) (um)	200000
70	Static Temperature (degF)	90	20	Dynamic Fluid Conductivity (uS/cm) (um)	200000
MP_DYNAM		EMPS_STAT	CONNS_STAT		ON_DYNAM
(degF)		(degF)	(um)		(um)





Tool Model: RG
 Performed: Tue Feb 03 12:15:15 2015
 Calibrator Value: 120.0 GAPI
 Background Reading: 16.8
 Calibrator Reading: 90.5
 Sensitivity: 1.6275 GAPI/

Temperature Calibration Report

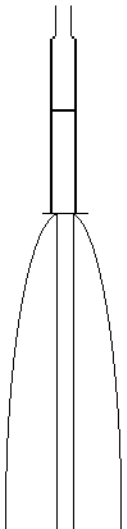
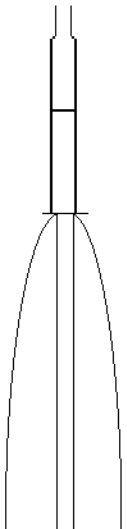
Serial Number: 1234
 Tool Model: RG
 Performed: Tue Feb 03 12:15:16 2015

Point #	Reading	Reference	
1	2641.30	36.10	degF
2	6158.48	70.50	degF
3	8638.29	83.80	degF
4	11950.30	114.30	degF
5			degF
6			degF
7			degF
8			degF
9			degF
10			degF

Calibration Report

Serial Number: 1234
 Tool Model: RG
 Performed: Tue Feb 03 12:15:18 2015

Reference (um)	Reading ()
1000.000	1081.220
10000.000	9313.330
25000.000	24070.300
50000.000	45133.200

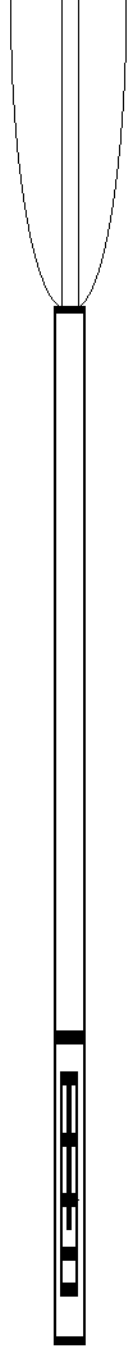
Sensor	Offset (ft)	Schematic	Description	Len (ft)	OD (in)	Wt (lb)
			CHD-SDSCHED (SDS) Cable Head	1.00	1.50	5.00
			CBL IN LINE	3.00	1.50	10.00

OBELINE

0.00

1.00

10.00



FRTG-RG (1234)

5.00

1.50

25.50

GR

1.22

FCON
TEMP

0.50
0.33

Dataset: verosouth4.db: field/well/run1/FCTDY
 Total Length: 9.00 ft
 Total Weight: 40.50 lb
 O.D.: 1.50 in



**DUAL
INDUCTION
LL3
LOG**

Company INDIAN RIVER COUNTY SOUTH RO W Well S-4 Field SOUTH OSLO ROAD County INDIAN RIVER State FLORIDA	Company INDIAN RIVER COUNTY SOUTH RO W.T.P Well S-4 Field SOUTH OSLO ROAD County INDIAN RIVER State FLORIDA
Location: _____ API #: _____ SEC TWP RGE Permanent Datum PAD PAD Elevation Log Measured From PAD PAD Drilling Measured From PAD PAD	Other Services SEE COMMENTS Elevation K.B. D.F. G.L.

Date	18-OCT-2016			
Run Number	ONE			
Depth Driller	710'			
Depth Logger	710'			
Bottom Logged Interval	710'			
Top Log Interval	CASING			
Open Hole Size	NA			
Type Fluid	WATER			
Density / Viscosity	NA			
Max. Recorded Temp.	75.5 DEGF			
Estimated Cement Top	NA			
Time Well Ready	0000			
Time Logger on Bottom	0000			
Equipment Number	VA-202			
Location	JUPITER			
Recorded By	LEE			
Witnessed By	J. FRIEDRICHS			

	Borehole Record		Borehole Record	
	Run Number	Bit	Run Number	To
Casing Record				
Surface String				
Prot. String				
Production String				
Liner				

<<< Fold Here >>>

All interpretations are opinions based on inferences from electrical or other measurements and we cannot and do not guarantee the accuracy or correctness of any interpretation, and we shall not, except in the case of gross or willful negligence on our part, be liable or responsible for any loss, costs, damages, or expenses incurred or sustained by anyone resulting from any interpretation made by any of our officers, agents or employees. These interpretations are also subject to our general terms and conditions set out in our current Price Schedule.

Comments

FLOWMETER
XYC/GR
FCT
DHTVS

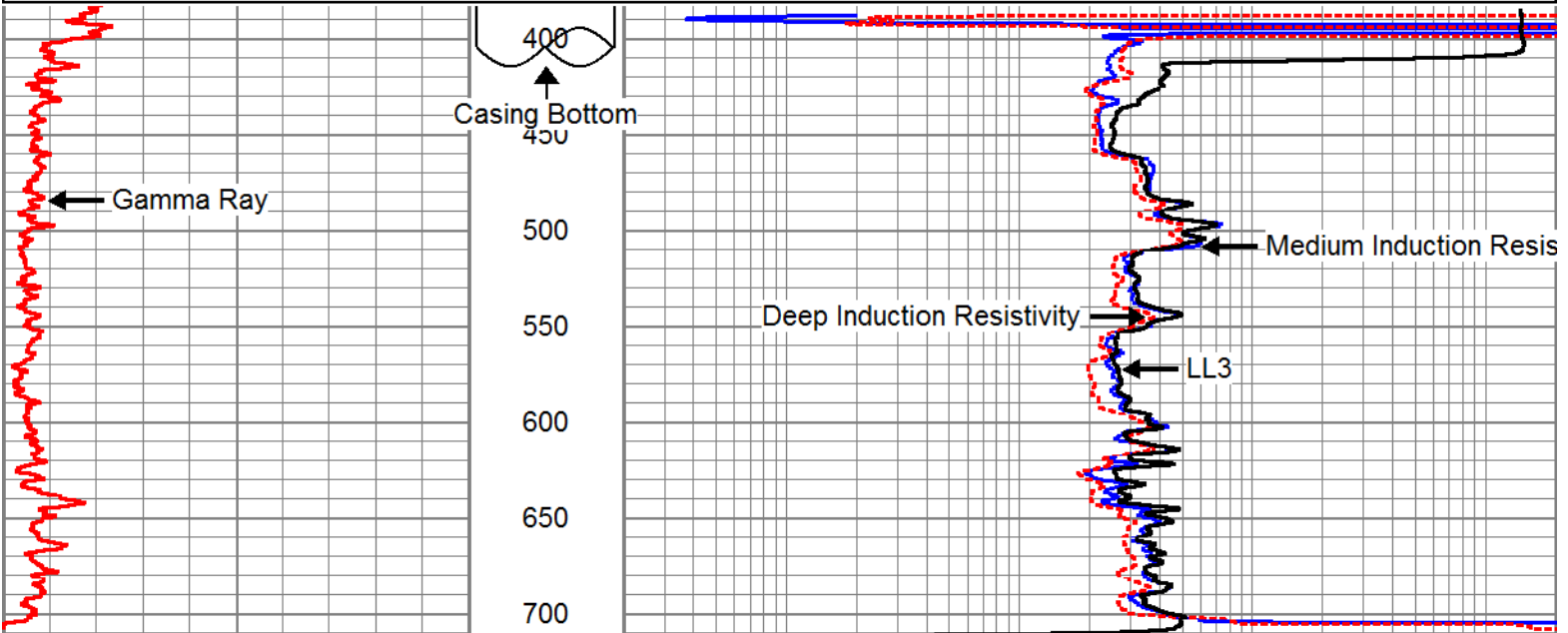


MAIN PASS

Database File: verosouth4.db
 Dataset Pathname: DILMP
 Presentation Format: dil
 Dataset Creation: Tue Oct 18 11:48:10 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:1200

0 Gamma Ray (GAPI) 100

0.2 Medium Induction Resistivity (Ohm-m) 2000
 0.2 Deep Induction Resistivity (Ohm-m) 2000
 0.2 LL3 (Ohm-m) 2000



0 Gamma Ray (GAPI) 100

0.2 Medium Induction Resistivity (Ohm-m) 2000
 0.2 Deep Induction Resistivity (Ohm-m) 2000
 0.2 LL3 (Ohm-m) 2000

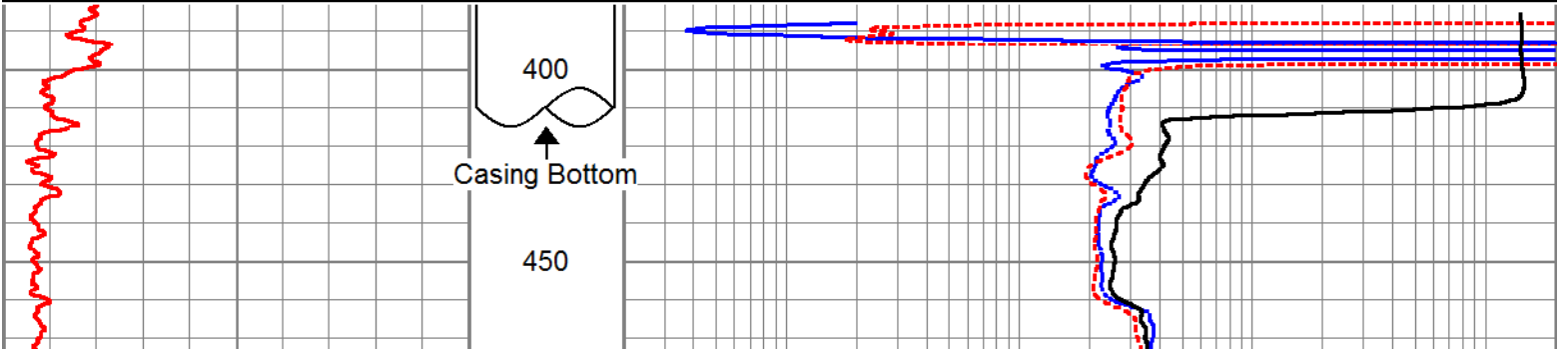


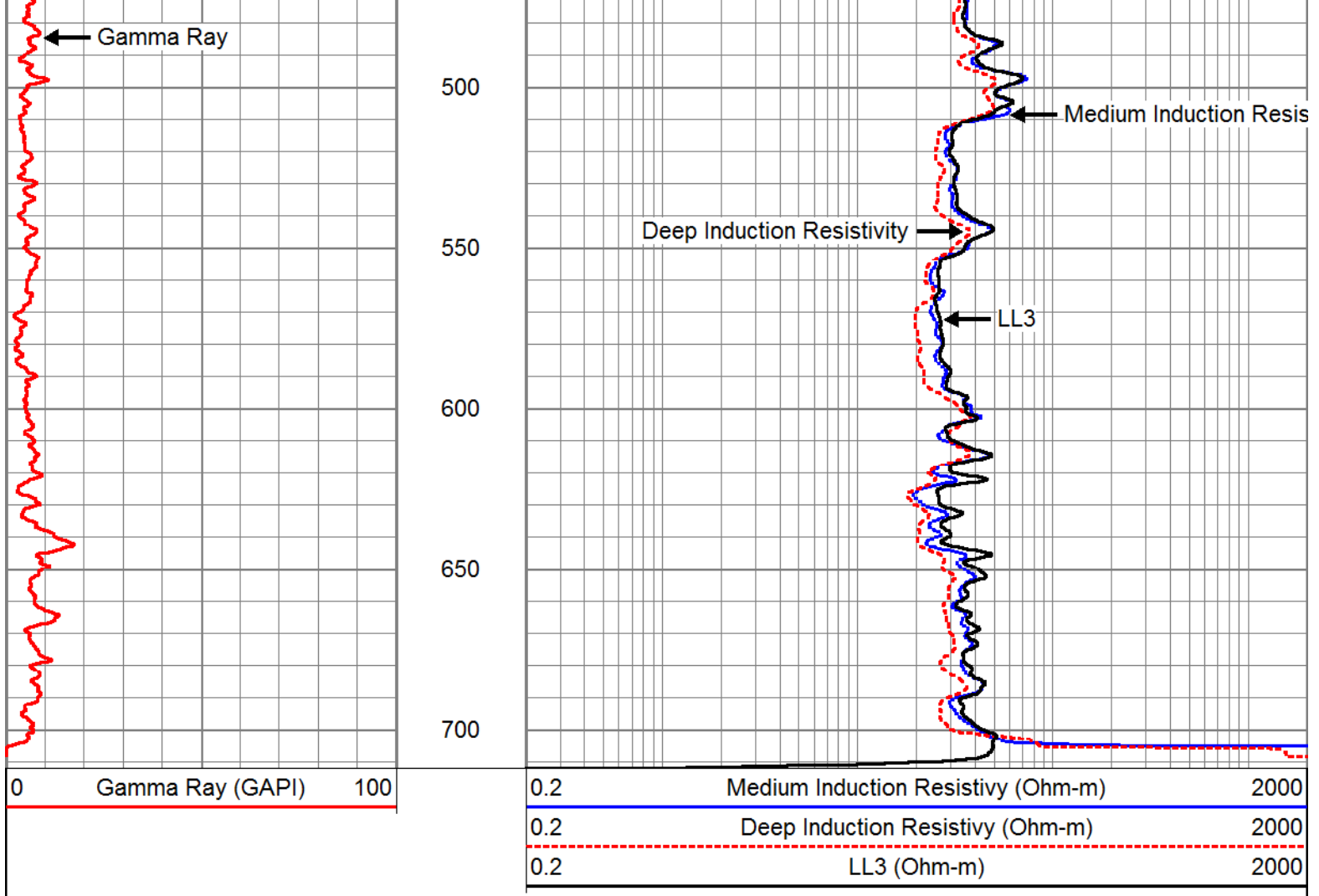
MAIN PASS

Database File: verosouth4.db
 Dataset Pathname: DILMP
 Presentation Format: dil
 Dataset Creation: Tue Oct 18 11:48:10 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:600

0 Gamma Ray (GAPI) 100

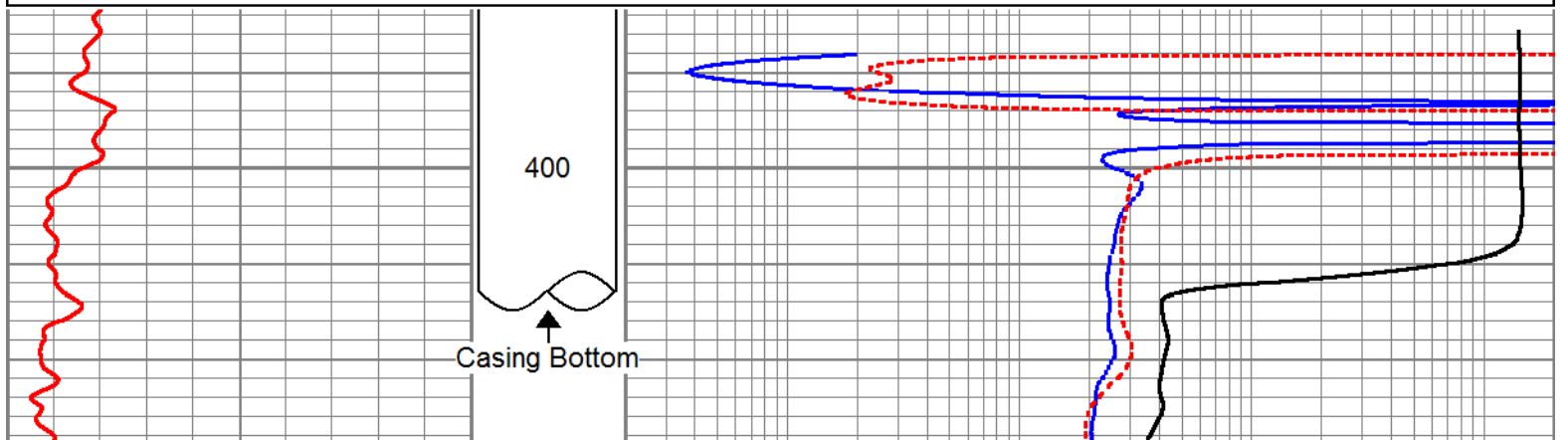
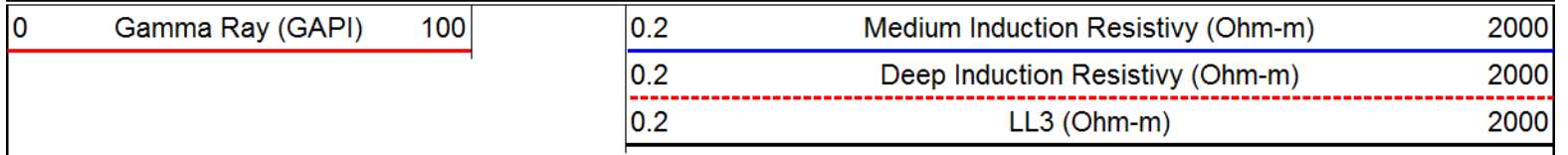
0.2 Medium Induction Resistivity (Ohm-m) 2000
 0.2 Deep Induction Resistivity (Ohm-m) 2000
 0.2 LL3 (Ohm-m) 2000

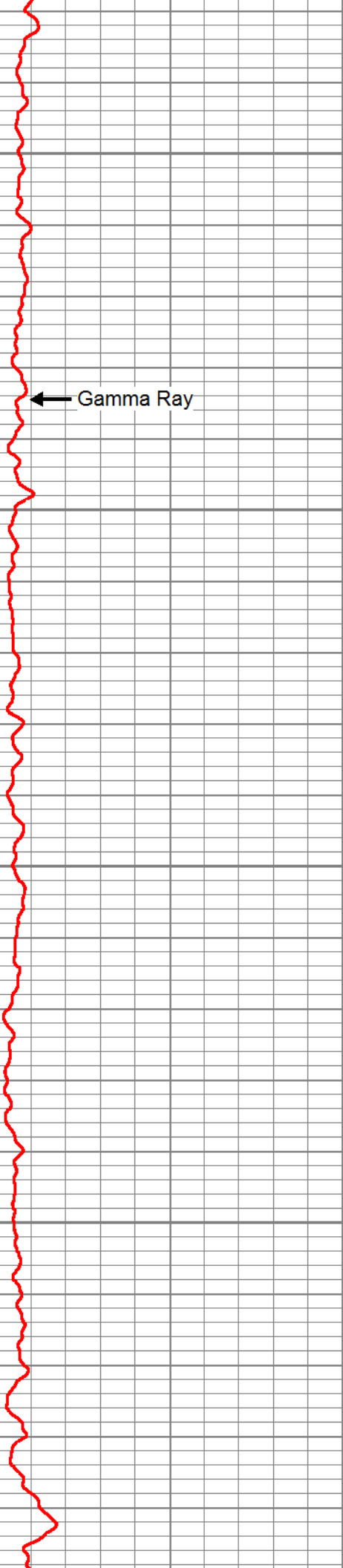




MAIN PASS

Database File: verosouth4.db
 Dataset Pathname: DILMP
 Presentation Format: dil
 Dataset Creation: Tue Oct 18 11:48:10 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240





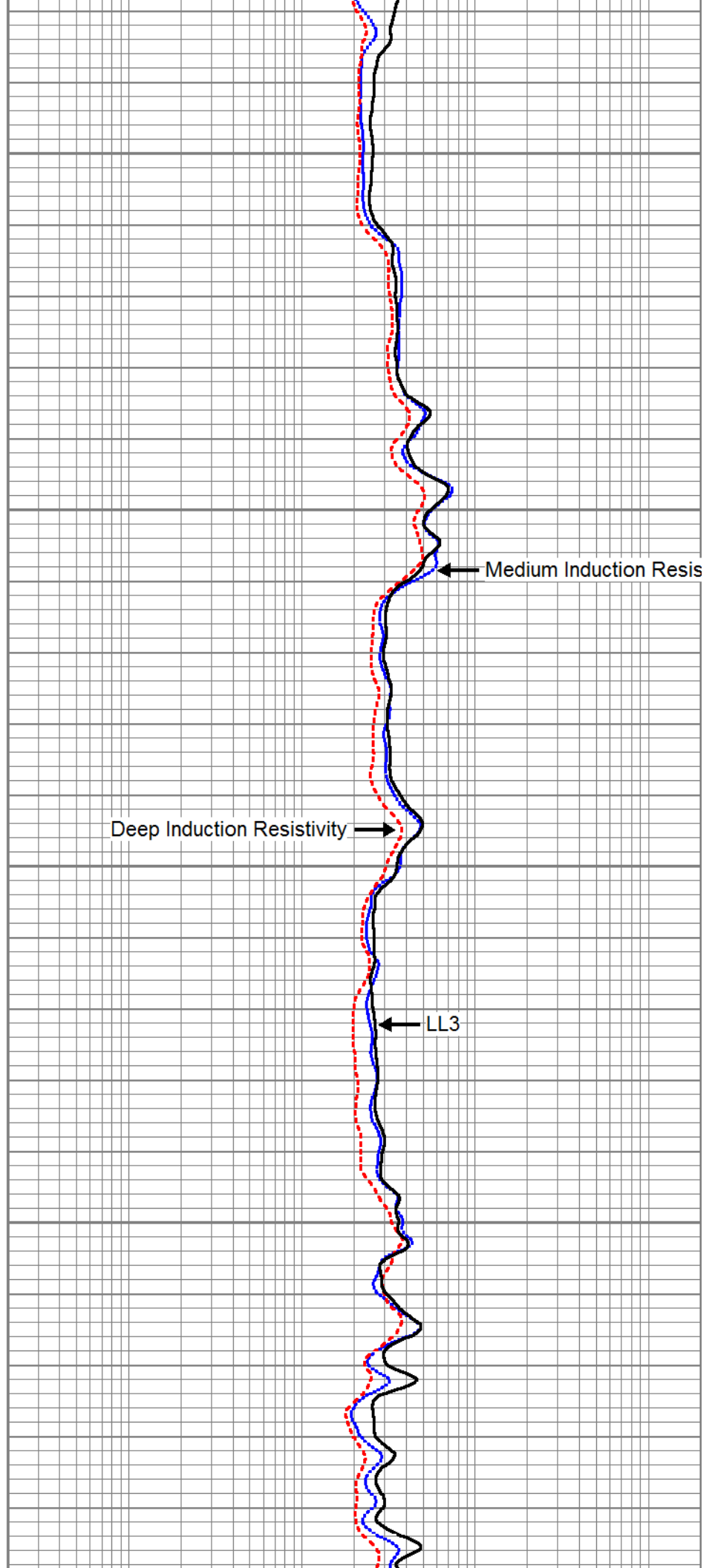
← Gamma Ray

450

500

550

600



← Medium Induction Resis

Deep Induction Resistivity →

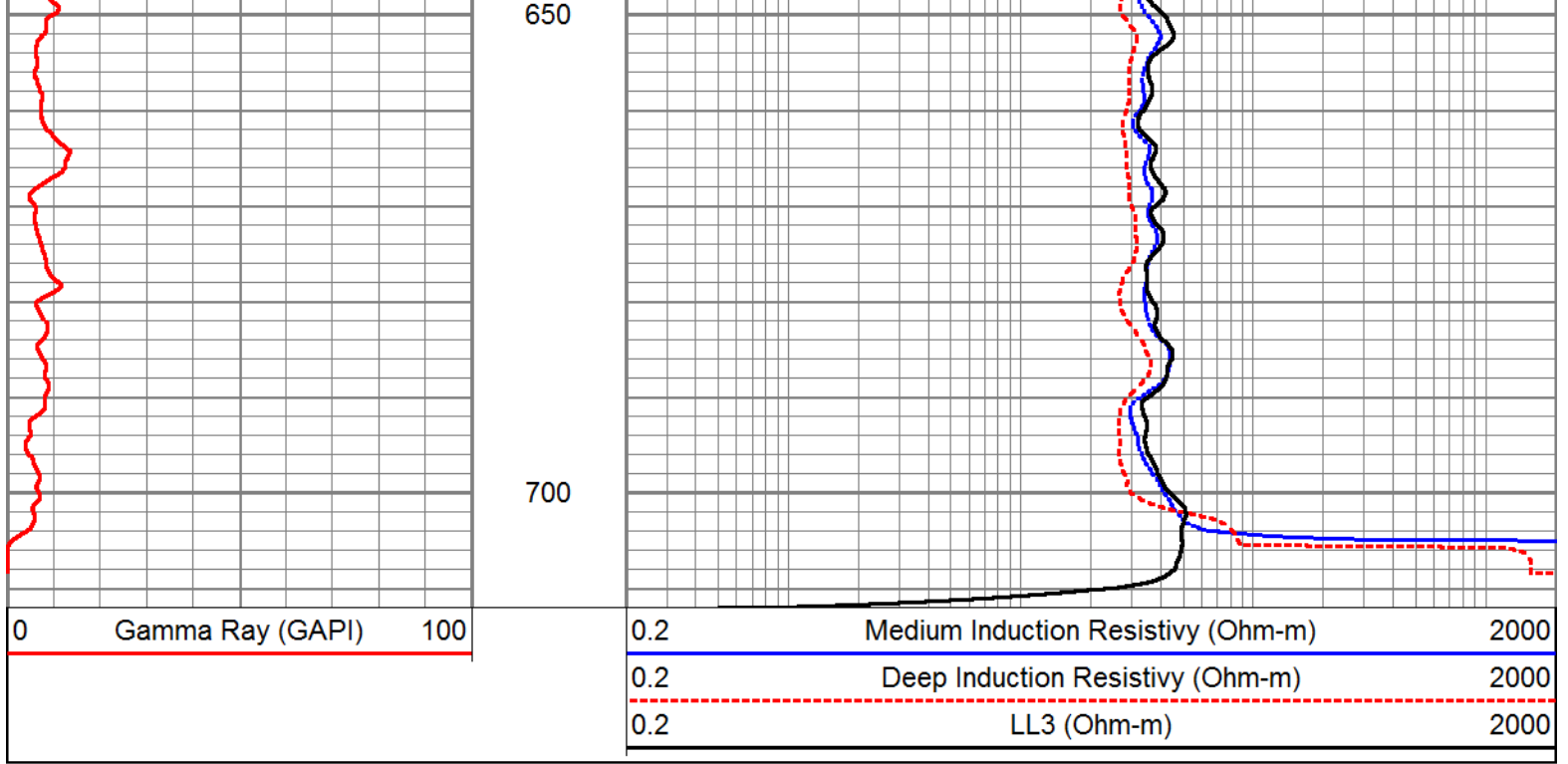
← LL3

450

500

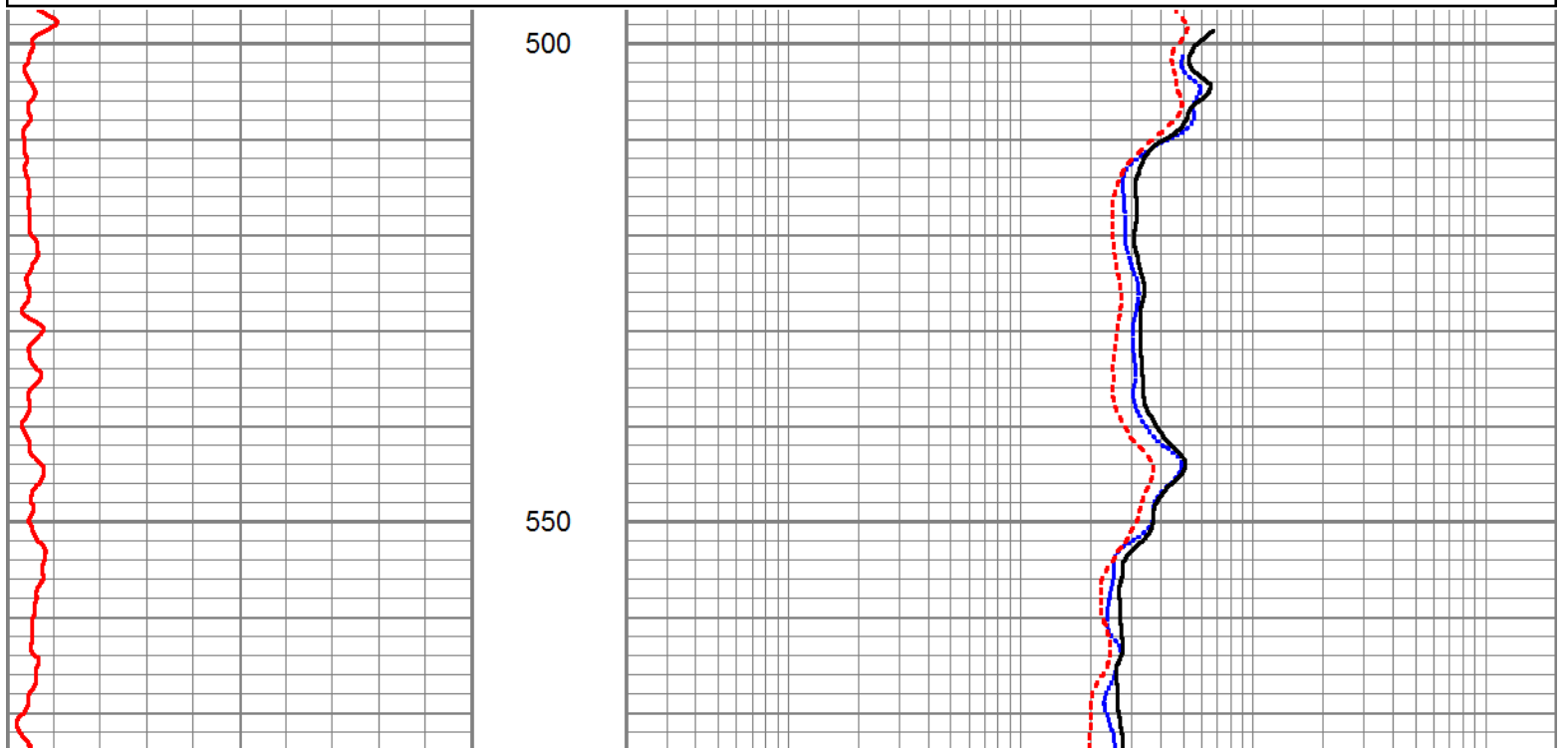
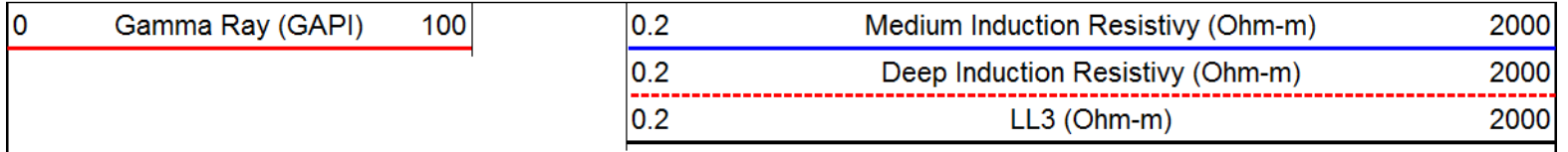
550

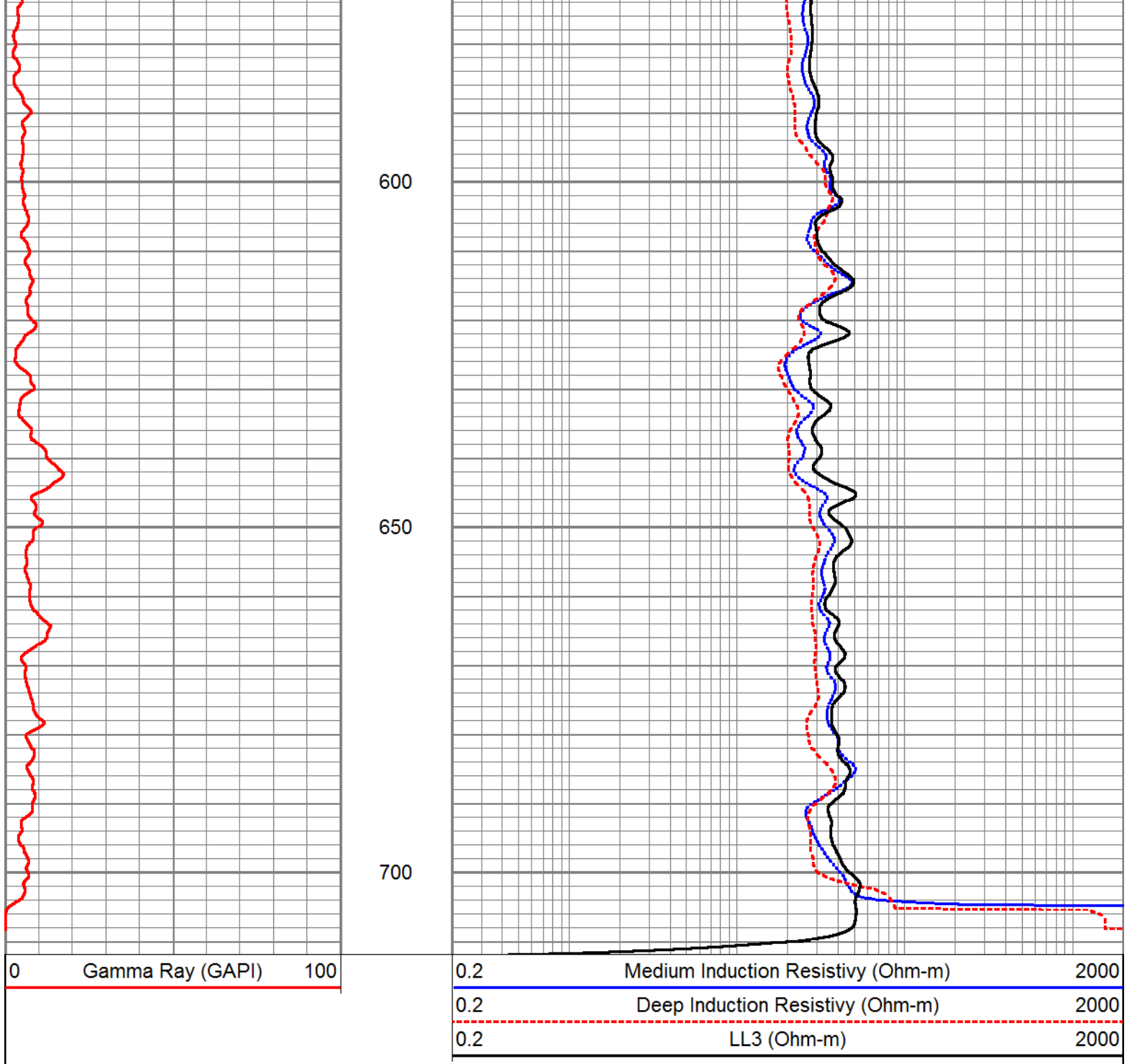
600



REPEAT PASS

Database File: verosouth4.db
 Dataset Pathname: DILRP
 Presentation Format: dil
 Dataset Creation: Tue Oct 18 11:39:50 2016 by Log Open-Cased 071220
 Charted by: Depth in Feet scaled 1:240





Calibration Report

Database File: verosouth4.db
 Dataset Pathname: DILMP
 Dataset Creation: Tue Oct 18 11:48:10 2016 by Log Open-Cased 071220

Dual Induction Calibration Report

Serial-Model: DIL2-GEAR
 Surface Cal Performed: Thu Apr 17 15:09:38 2014
 Downhole Cal Performed: Tue Sep 20 13:42:03 2016
 After Survey Verification Performed: Tue Sep 20 13:42:03 2016

Surface Calibration

		Readings		References		Results	
Loop:	Air	Loop	Air	Loop	m	b	

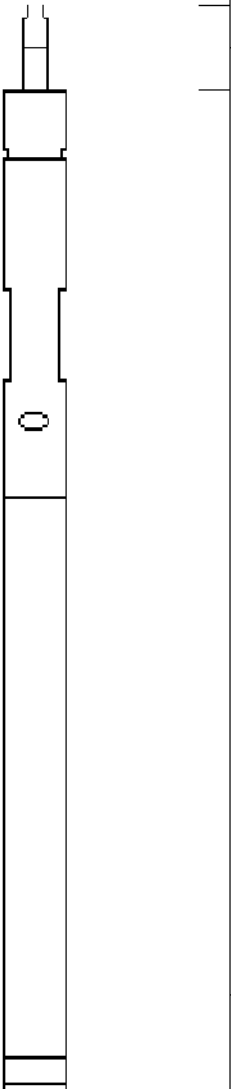
Deep	-0.015	0.569	V	0.000	400.000	mmho-m	684.688	10.270
Medium	0.010	0.723	V	0.000	465.000	mmho-m	652.254	-6.523
Internal:	Zero	Cal		Zero	Cal		m	b
Deep	0.007	0.635	V	0.000	400.000	mmho-m	637.070	-4.479
Medium	0.010	0.750	V	0.000	465.000	mmho-m	628.185	-6.138

Downhole Calibration

Internal:	Readings			References			Results	
	Zero	Cal		Zero	Cal		m	b
Deep	7.521	440.173	mmho-m	7.717	445.844	mmho-m	1.013	0.102
Medium	6.850	489.567	mmho-m	-4.578	482.836	mmho-m	1.010	-11.494
Shallow	2.503	0.012	V	500.000	2.000	Ohm-m	199.996	-0.494

After Survey Verification

Internal:	Readings			Targets			Results	
	Zero	Cal		Zero	Cal		m'	b'
Deep	0.000	0.000	mmho-m	7.521	440.173	mmho-m	1.013	0.102
Medium	0.000	0.000	mmho-m	6.850	489.567	mmho-m	1.010	-11.494
Shallow	0.000	0.000	Ohm-m	500.000	2.000	Ohm-m	1.000	0.000

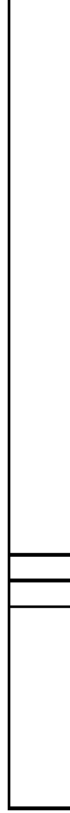
Sensor	Offset (ft)	Schematic	Description	Len (ft)	OD (in)	Wt (lb)
			CHD-SDSCHD (SDS) Cable Head	1.00	1.50	5.00
SP CILD	11.00 10.50		DIL-GEAR (DIL2) GO_DIL/LL3/SP	21.25	3.50	150.00

CILM

7.00

RLL3

2.00



Dataset:	verosouth4.db: field/well/run1/DILMP
Total Length:	22.25 ft
Total Weight:	155.00 lb
O.D.:	3.50 in

OPINION OF PROBABLE CONSTRUCTION COSTS - South County Oslo Rd Water Treatment Plant - Upper Floridan Aquifer Production Well #4			New Well Casing/ New Equipment			New Well Casing / Existing Equipment		
Item	Description	UOM	Quantity	Unit Rate	Total	Quantity	Unit Rate	Total
1	General							
a	Well Construction Permit	LS	1	\$ 5,040	\$ 5,040	1	\$ 5,040	\$ 5,040
2	Site Preparation and Restoration							
a	Sediment and Erosion Control	LS	1	\$ 4,200	\$ 4,200	1	\$ 4,200	\$ 4,200
b	Site Restoration	LS	1	\$ 16,000	\$ 16,000	1	\$ 16,000	\$ 16,000
3	UFA Well S-4							
a	Mobilization/Demobilization (Cannot exceed 10% of the total well construction costs)	LS						
b	Drill 12" pilot borehole to 120'±	FT	120	\$ 85	\$ 10,200	120	\$ 85	\$ 10,200
c	Perform geophysical logging (caliper, gamma and electric)	LS	1	\$ 3,500	\$ 3,500	1	\$ 3,500	\$ 3,500
d	Ream 32" nominal diameter borehole	FT	120	\$ 220	\$ 26,400	120	\$ 220	\$ 26,400
e	Furnish, install and grout in place 26" OD .375" steel surface casing	FT	120	\$ 260	\$ 31,200	120	\$ 260	\$ 31,200
f	Drill 12" pilot borehole (from 120' to 400'±)	FT	280	\$ 85	\$ 23,800	280	\$ 85	\$ 23,800
g	Perform geophysical logging (caliper, gamma and electric)	LS	1	\$ 3,500	\$ 3,500	1	\$ 3,500	\$ 3,500
h	Ream 25" nominal diameter borehole (from 120'-400'±)	FT	280	\$ 150	\$ 42,000	280	\$ 150	\$ 42,000
i	Perform geophysical logging (caliper and gamma)	LS	1	\$ 3,000	\$ 3,000	1	\$ 3,000	\$ 3,000
j	Furnish, install and grout in place 16-inch ID .375" wall fiberglass or 17.4 OD SDR 17 1.024" wall PVC final casing	FT	400	\$ 130	\$ 52,000	400	\$ 130	\$ 52,000
k	Drill nominal 15-inch borehole (from 400'-700'±)	FT	300	\$ 110	\$ 33,000	300	\$ 110	\$ 33,000
l	Perform well development	HR	12	\$ 350	\$ 4,200	12	\$ 350	\$ 4,200
m	Perform static and dynamic geophysical and video logging (full logging suite per Section 02853)	LS	1	\$ 8,500	\$ 8,500	1	\$ 8,500	\$ 8,500
n	Conduct step drawdown test	LS	1	\$ 3,000	\$ 3,000	1	\$ 3,000	\$ 3,000
o	Collect Primary and Secondary water samples	LS	1	\$ 6,200	\$ 6,200	1	\$ 6,200	\$ 6,200
p1	Furnish and install 100 HP vertical turbine pump assembly including flanged column pipe, spider bearings and discharge head	LS	1	\$ 155,000	\$ 155,000			
p2	Remove and reinstall well pump assembly	LS				1	\$ 10,000	\$ 10,000
q1	Furnish and install 10" stainless steel discharge piping and appurtenances (including expansion joint, blowoff valve, pressure sustaining valve, flow meter, etc.)	LS	1	\$ 40,000	\$ 40,000			
q2	Remove and reinstall wellhead piping, valve and appurtenances	LS				1	\$ 5,000	\$ 5,000
r1	Furnish and install 12" PVC discharge piping (as shown, below grade)	LS	1	\$ 25,000	\$ 25,000			
r2	Remove and reinstall discharge piping (below grade)	LS				1	\$ 25,000	\$ 25,000
s1	Furnish and install well pedestal, housekeeping pad and pipe supports	LS	1	\$ 26,000	\$ 26,000	1	\$ 26,000	\$ 26,000
s2.2	Remove and reinstall well pipe supports	LS				1	\$ 15,000	\$ 15,000
t	Furnish and install electrical panel (VFD & CONTROL PLC PANEL)	LS	1	\$ 48,000	\$ 48,000			
u	Furnish and install Fiber Optic Communication	LS	1	\$ 80,000	\$ 80,000			
v1	Furnish and install 6' green vinyl coated chain link fence with vinyl privacy slats	LF	120	\$ 40	\$ 4,800			
v2	Remove and reinstall fence and swing gate	LS				1		
w	Furnish and install 12' Swing Gate	LS	1	\$ 1,500	\$ 1,500			
x	Complete Setup & Removal for Acidization Including Removal	LS	1	\$ 5,000	\$ 5,000	1	\$ 5,000	\$ 5,000
y	Well Acidization	GAL	4,000	\$ 4.00	\$ 16,000	4000	\$ 4	\$ 16,000
z	Furnish and install electric service from existing S-4 control panels to new well Replace flexible elastomeric expansion joint (Mercer or equal)	LS	1	\$ 12,000	\$ 12,000	1	\$ 48,000	\$ 48,000
aa	Pump mechanical seal replacement Motor rework including winding bake, bearing replacement and recoating Replacement of all pressure gages and sample valves with 316 SS Cla-Val diaphragm replacement and strainer screen replacement Replace level probes and transmitters Painting, including preparation of all ferrous metallic components (no stainless to be painted) Replace all electrical fittings and flexible conduits when disassembling electrical conduits Refurbish pump spider bearing/couplings and replace o-ring/gaskets Replace all pipe gaskets, elastomeric components modified as part of the well rehabilitation, and pipe hardware (nuts, bolts, washers, etc.)	LS				1	\$ 20,000	\$ 20,000
	GENERATOR	LS	1	\$ 80,000	\$ 80,000	1	\$ 5,000	\$ 5,000
4	Allowance							
a	Contractor's provision for equipment standby time	Hour	24	\$ 80	\$ 1,920	24	\$ 80	\$ 1,920
b	Contractor's provision for equipment and crew standby time	Hour	24	\$ 150	\$ 3,600	24	\$ 150	\$ 3,600
c	Conduct single or straddle packer test	LS	1	\$ 7,000	\$ 7,000	1	\$ 7,000	\$ 7,000
d	Contingency Allowance	LS	1	\$ 20,000	\$ 20,000	1	\$ 20,000	\$ 20,000
New Well S-4 with New Equipment					\$ 801,560			
New Well S-4, Existing Equipment						\$ 483,260		

The Engineer has no control over the cost of labor, materials, equipment, or over the Contractor's methods of determining prices or over competitive bidding or market conditions. Opinions of probable costs provided herein are based on the information known to Engineer at this time and represent only the Engineer's judgment as a design professional familiar with the construction industry. The Engineer cannot and does not guarantee that proposals, bids, or actual construction costs will not vary from its opinions of probable costs.

**INDIAN RIVER COUNTY
UPPER FLORIDAN AQUIFER WELL S4
2004 PLUMBNESS AND ALIGNMENT TEST DATA
(DEFLECTION CALCULATED FROM 0 FT.)**

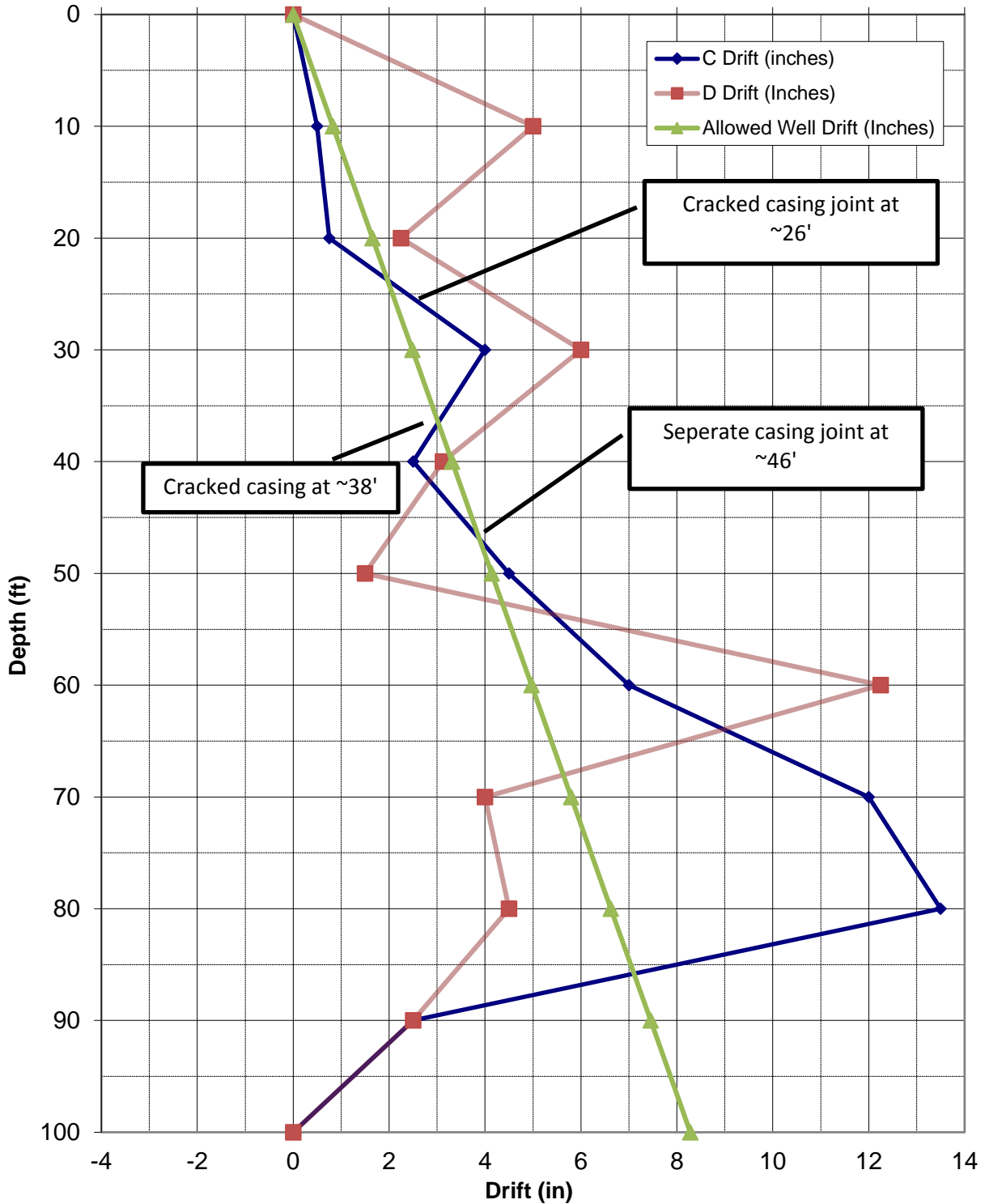


CHART
INDIAN RIVER COUNTY
UPPER FLORIDAN AQUIFER WELL S4
2004 PLUMBNESS AND ALIGNMENT TEST DATA
(DEFLECTION CALCULATED FROM 100 FT.)

