



Measuring Results Improves Devon's Closed Loop Operations

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The Barnett Shale play is both an unlikely place and a perfect place to analyze “closed loop” operations

- It is an unusual place because few of the usual economic drivers for drilling waste management exist in the Barnett
- It is a perfect place because the scale of operations enables lots of data collection
- Devon has 38 rigs in near proximity, and all are drilling similar wells

1) Surface Hole [Drilled < 12 hours]

- a) Bit Diameter: 12¹/₄"
- b) Casing Shoe: 1000 feet for 9-5/8"
- c) Mud Type: Native/Gel Sweeps
- d) ROP: 60 to 350 ft/hr
- e) Circulation rate: 400 to 600 gpm
- f) Maximum Rate Cuttings (wet)
 - 20 to 30 yards/hour
- g) Total Cuttings (wet) for interval
 - 90 cubic yards (450 bbl)

2. Vertical Section [Drilled in < 2 days]

- a) Bit Diameter: 8-3/4"
- b) KOP Depth: 5000 feet
- c) Mud Type: LSND w/ Sweeps
- d) ROP: 60 to 200 ft/hr
- e) Circulation rate: 300 to 450 gpm
- f) Maximum Cuttings Rate:
 - 5 to 10 yards/hour
- g) Total Cuttings Volume
 - 230 cubic yards (1100 bbl)

3. Curve/Lateral [Drilled in < 12 days]
 - a) Bit Diameter: 8-3/4 to 8¹/₂"
 - b) Total Depth (TD): 10500 feet
 - c) Mud Type: LSND w/ Sweeps
 - d) ROP: 30 to 200 ft/hr
 - e) Circulation rate: 300 to 450 gpm
 - f) Maximum Cuttings Rate
 - 5 to 10 yards/hour
 - g) Total Cuttings Volume
 - 220 cubic yards (1050 bbl)

“Dewatering” or “Closed Loop” poorly describes the work required when a well is drilled without a reserve pit.

The work entails:

- Coordinating haul-off of solids and spent fluids
- Recovering rig wash/rain water from ditches
- Handling all fluids and cuttings that normally report to a reserve pit.

Devon anticipated many benefits from closed loop operations in comparison to drilling with a reserve pit:

- Smaller locations (no reserve pits)
- Cleaner drilling fluids
- Less water usage
- Decreased disposal costs
- Minimizing long term liability
- Bundled Service from one vendor to simplify invoicing & tracking

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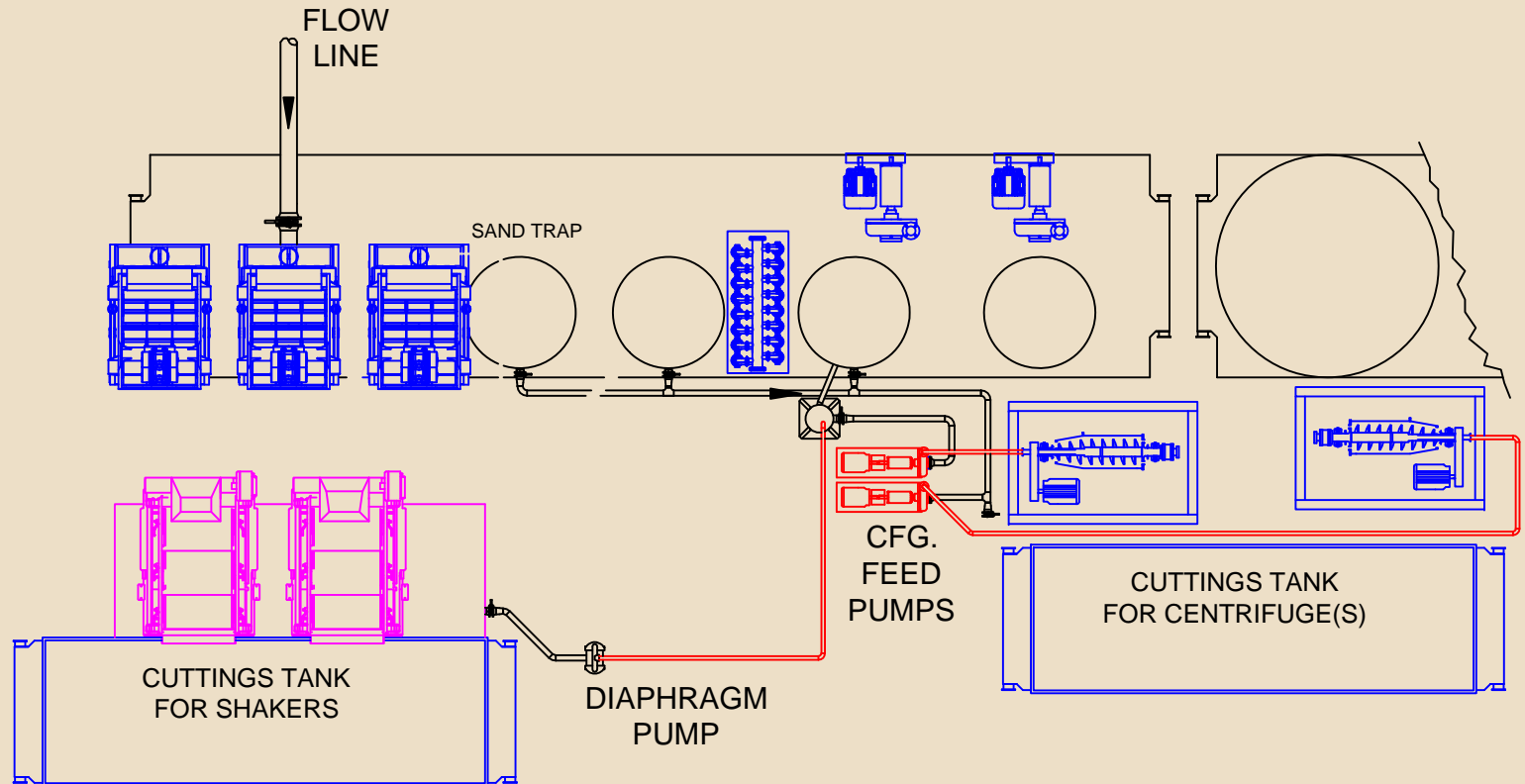


Figure 1: Typical Closed Loop Equipment Installation

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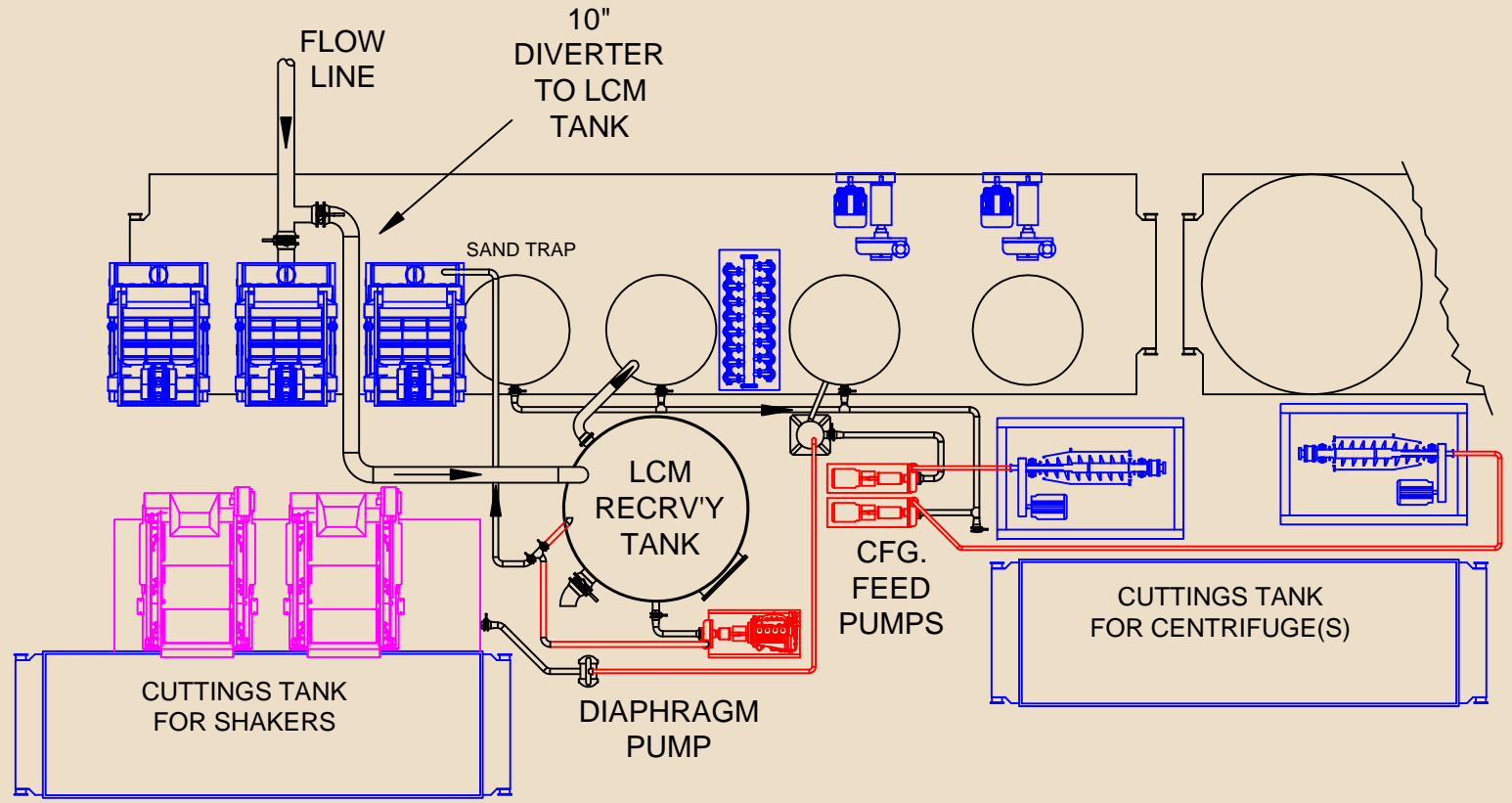


Figure 2: Closed Loop Equipment w/ LCM Tank

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Figure 3: Field Rig-up of LCM Recovery Tank

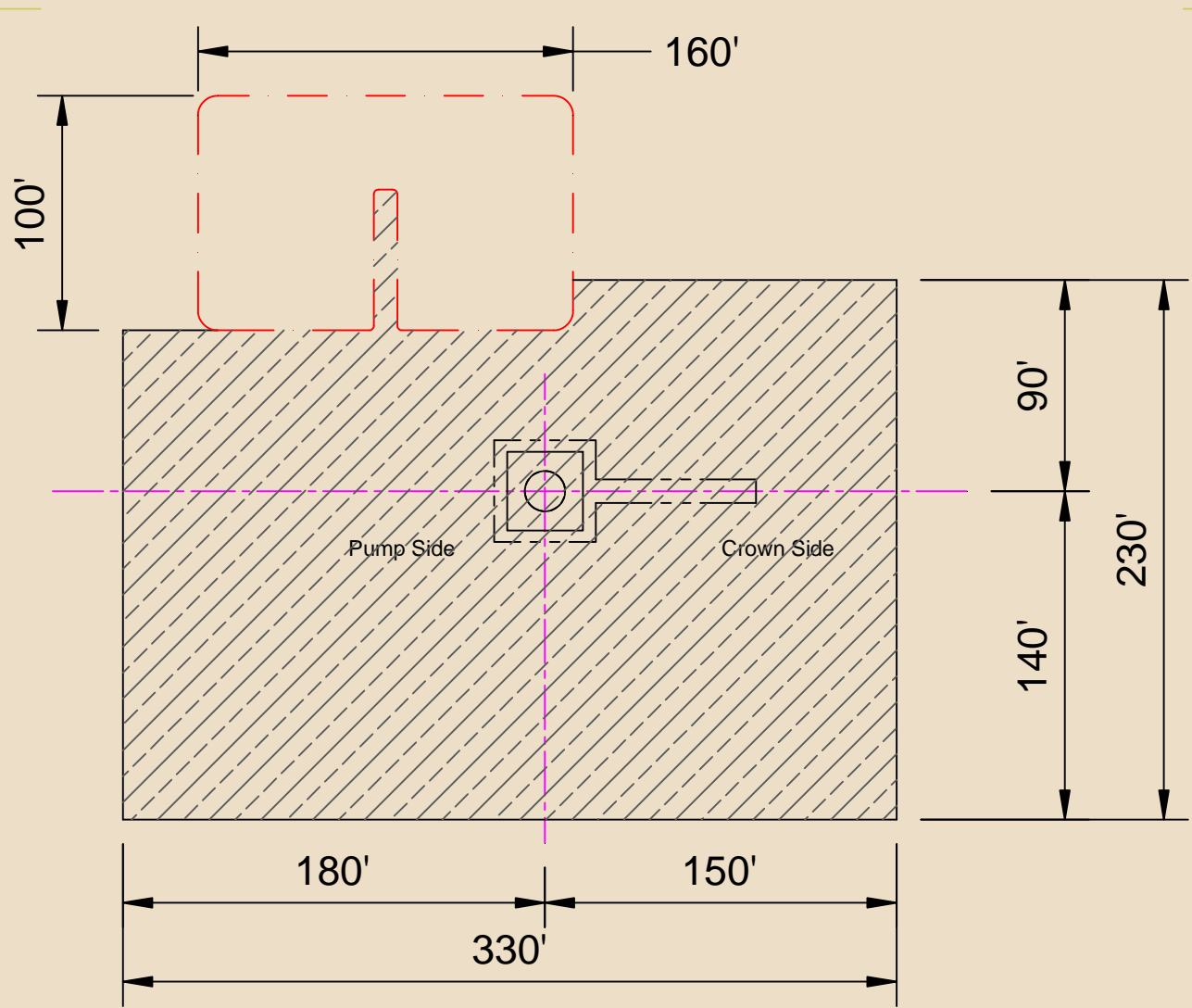
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The list of benefits was shortened after six months of measuring and recording closed loop operations.

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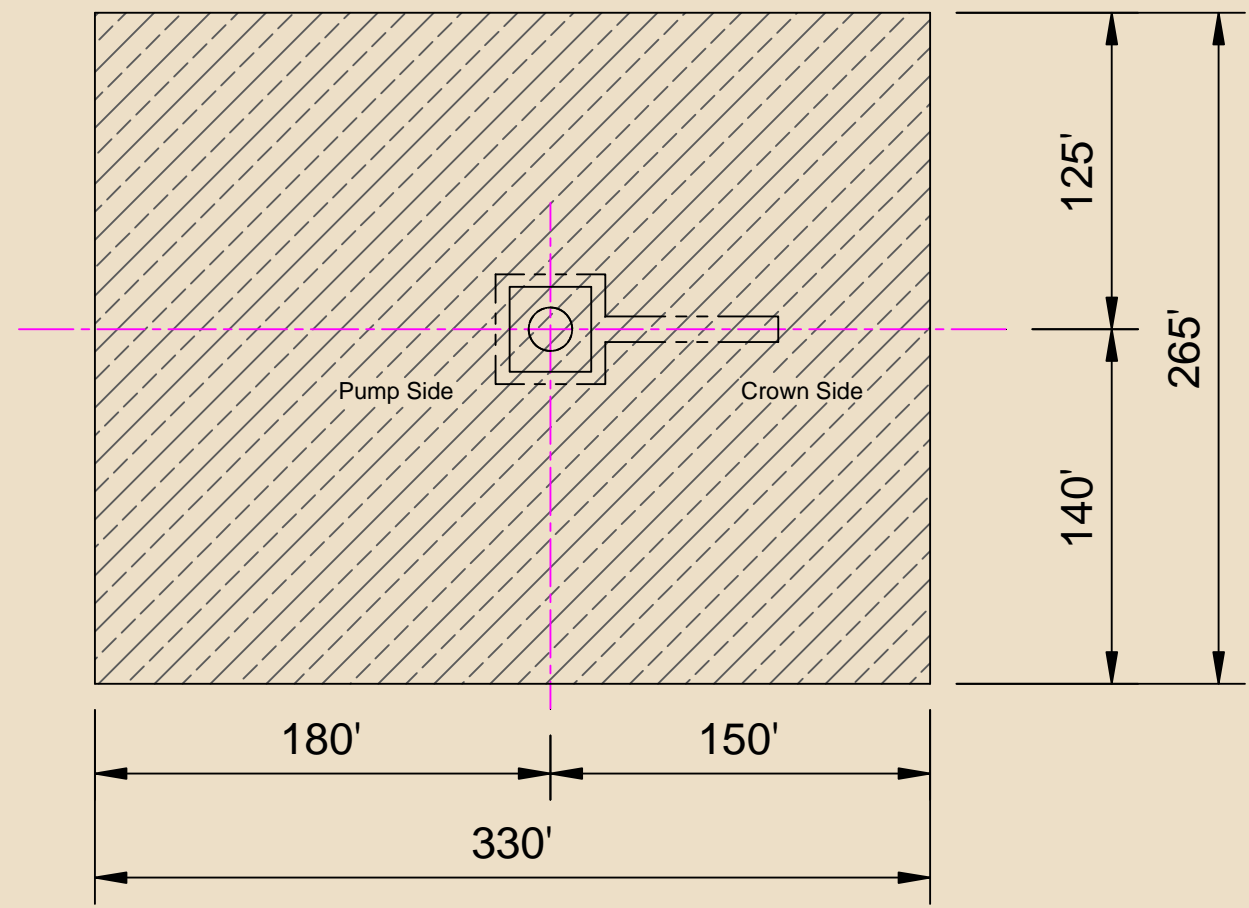
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UNIVERSAL RIG PAD WITH RESERVE PIT
 TOTAL LOCATION SIZE = 87,900 SQ. FT. (72,000 GRAVEL)

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UNIVERSAL RIG PAD WITHOUT RESERVE PIT
LOCATION SIZE = 87,450 SQ. FT. (ALL GRAVEL)

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1. One of the original goals of Devon's closed loop study was maximum Low Gravity Solids (LGS) of 5%
 - Closed loop providers were encouraged to flocculate as much as necessary to achieve 5% LGS early in the study
 - The 5% was unachievable and the goal was raised to 7%

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Dewatering Service Company	No. of Wells Analyzed	Average Maximum LGS Concentration	Avg. Ratio Cuttings Haul-off to Gauge Hole x 3
X	14	6.7%	57%
Y	11	7.2%	67%
Z	19	7.4%	97%
W	19	7.1%	62%

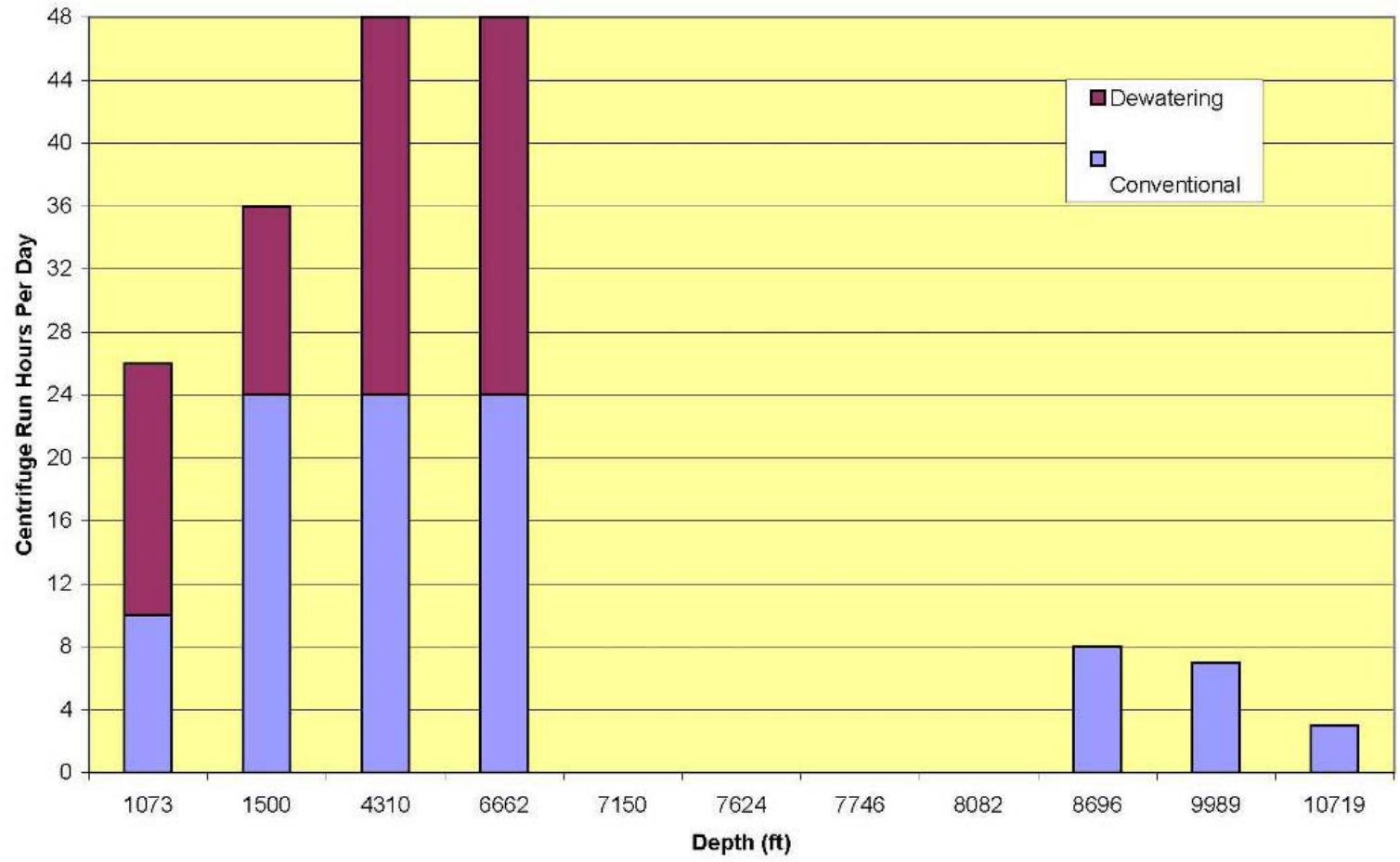
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Minimum Sacks of Bar to Weight Up a 1000 bbl of Fresh Water Mud									
Initial Mud Wgt.	Final Mud Weight in Topmost Row								
	9.2	9.3	9.4	9.5	9.6	9.7	9.8	9.9	10
8.8	253	318	383	448	514	581	648	715	784
8.9	190	254	319	384	450	516	583	650	718
9.0	127	191	255	320	386	452	518	585	653
9.1	63	127	191	256	321	387	453	520	588
9.2		64	128	192	257	323	389	455	522
9.3			64	128	193	258	324	390	457
9.4				64	129	194	259	325	392
9.5					64	129	194	260	326
9.6						65	130	195	261

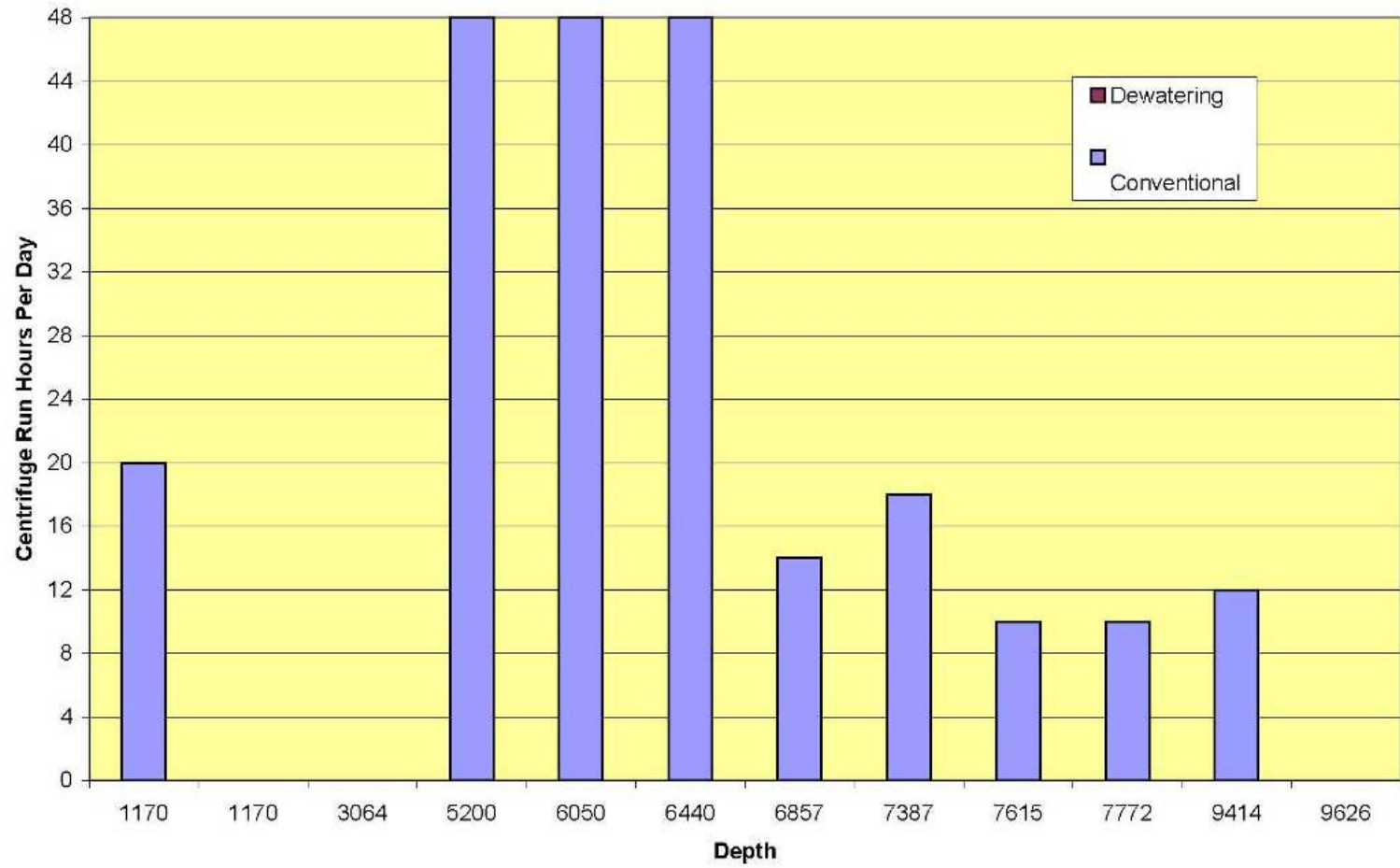
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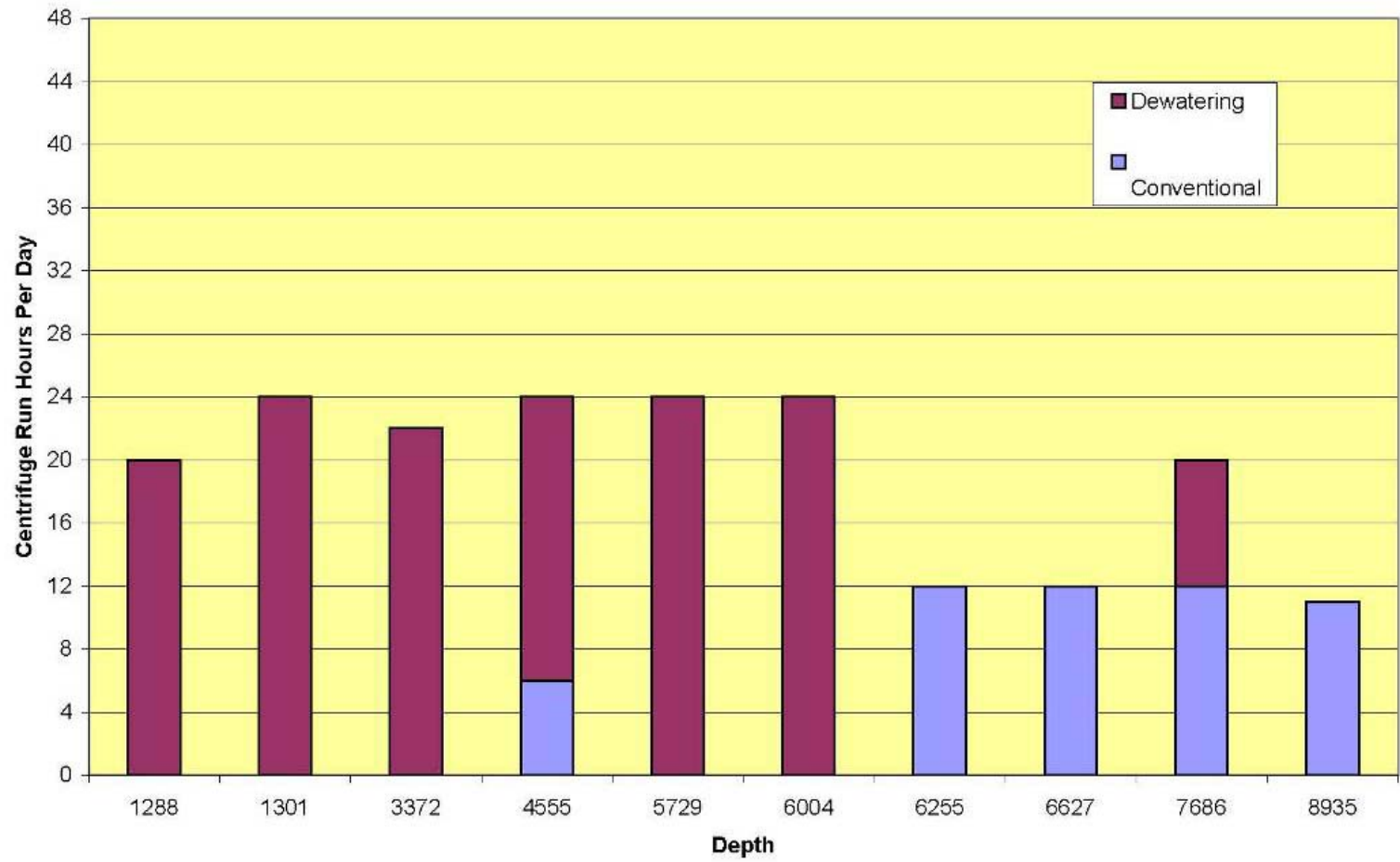
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Well No.	Water Usage (bbl)	Total Days		Well No.	Water Usage (bbl)	Total Days
3	2235	7		15	5100	10
4	2299	12		16	5119	15
5	2364	12		17	5249	7
6	2600	7		18	5940	12
7	2600	20		19	5950	12
8	2700	17		20	6000	15
9	3438	13		21	6900	15
10	3844	16		22	7150	13

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Land Farming of Spent Water Base Mud and Drill Cuttings is prevalent in Fort Worth Basin

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- The permit and land farming is paid for in one lump sum
- Cuttings are transported by End Dump (typically 15 cubic yard capacity) at a fixed price per load.
- Spent fluids are transported by Vac Truck to land farm location.
- Each land farm is well specific and covered by a minor permit from RRC.

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Well Name, Rig Activity, & Mud Info	
Template 61	
Company Providing Closed Loop Service:	SC/DWM Company
Well Name:	Buford 1
Devon Energy AFE No.	xxxxxxx
Rig Name & No.:	H&P 007
Spud Date <i>[mm/dd/yy]</i>	10/1/2008
Days from Spud	12
Report Date <i>[mm/dd/yy]</i>	10/13/2008
Report Completed by:	Mike M.
Rig Activity at Report Time	Drilling
Bit Diameter	8.50
Depth at Report Time (feet)	11111
Actual Mud Weight at Shakers	9.9

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Target Mud Weight (ppg)	9.9
Funnel Viscosity (seconds)	57
Sand Content in Suction Pit (v%)	0.25%
Reported Low Gravity Solids (v%)	7%
Chloride Content on Mud Report	1300
Shakers & Screens	
Number of Rig Shakers in Use	3
API No. for screens on Rig Shakers	140
API No. for Screens on Mudcleaner	
API No. for screens on Drying Shakers	200

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Desander	
Mud Weight - Desander Overflow (ppg)	0.0
Mud Weight - Desander Underflow (ppg)	0.0
Desander Hours of Operation	0.0
Desilter	
Mud Weight- Desilter Overflow (ppg)	9.9
Mud Weight - Desilter Underflow (ppg)	10.1
Desilter Hours of Operation	12.0

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Centrifuge Conventional Operation (without Coagulants or Flocculants)	
Centrifuge #1 Hours of Operation	12.0
Centrifuge #1 Mud Feed Rate (gpm)	75.0
Centrifuge #1 Dilution Water (gpm)	5.0
Centrifuge #2 Hours of Operation	
Centrifuge #2 Feed Rate (gpm)	0.0
Centrifuge #2 Dilution Water (gpm)	

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Drill Solids Out	
Total Wet Cuttings to disposal (yds)	15
No. End Dumps for reporting period	1
Fluids Out	
Spent Mud/Water/Cement to Disposal (bbl)	100
Whole Mud Trucked Out to other Rig (bbl)	0
Whole Mud Lost Downhole (bbl)	0
No. Vac Trucks for reporting period	1
Fluids In	
Dilution Water Rate on Mud Tanks (gpm)	8.0
Number of Hours Dilution was Run	12
Drill Mud Rec'd by Vac Truck (bbl)	0
Drill Water added to Active System	0

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Tank Management	
Drill Mud stored in Tanks (bbl)	350
Centrate stored in Tanks (bbl)	0
Fresh/Gray Water (bbl)	150
No. of Tanks for Closed Loop	2
Mud Products and Chemicals	
Bentonite Used (sacks)	100
Barite Used (sacks)	80
Polymer Usage	
Polymer Units of Measure	
Type of Polymer	
Coagulant Usage	
Coagulant Unit of Measure	
Type of Coagulant	

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Tank Management	
Drill Mud stored in Tanks (bbl)	350
Centrate stored in Tanks (bbl)	0
Fresh/Gray Water (bbl)	150
No. of Tanks for Closed Loop	2
Mud Products and Chemicals	
Bentonite Used (sacks)	100
Barite Used (sacks)	80
Polymer Usage	
Polymer Units of Measure	
Type of Polymer	
Coagulant Usage	
Coagulant Unit of Measure	
Type of Coagulant	

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Rig Name & No.:	H&P 234	
Spud Date & Time	5/17/08 6:00	
Dewatering Company Last Report Date	6/7/08 5:00	
Days on Well	21	
Measured Depth @ TD	10500	
Highest Reported Sand Content	0.15%	
Highest Reported LGS	5.90%	
Highest Reported Mud Weight (ppg)	10.3	
Desander		
Hours of Operation - Desander	0	
Desilter		
Hours of Operation - Desilter	145	
Centrifuge	Conventional	Dewatering
Centrifuge #1 - Total Hours of Operation	72	0
Centrifuge #2 - Total Hours of Operation	89	4
Total Volume of Fluid Centrifuged (bbl)	21514	229
Total Chemical Consumption		
Total Polymer Usage	11	Gallons
Total Coagulant Usage	13	gallons HCl Acid
Total Drill Cuttings Out from Spud to Final Tank Cleanout		
Total Wet Cuttings Haul-off (yd)	453	
Calculated Yards based on 3x Gauge Hole	507	
Cumulative Loads Out by End Dump	25	
Total Fluids Out from Spud to Final Tank Cleanout		
Spent Mud, Gray Water, or Cement to Disposal (bbl)	675	
Total fluids trucked to Other Rig (bbl)	875	
Total Rainwater/Rig Wash Hauloff (bbl)	0	

Highest reported LGS can be checked by comparing maximum mud weight versus the cumulative amount of barite mixed.

Wet cuttings haul-off can be compared to theoretical 3x gauge hole to determine the amount of solids being rejected by solids control equipment.

Figure 4: Summary Well Data from CL Daily Reports

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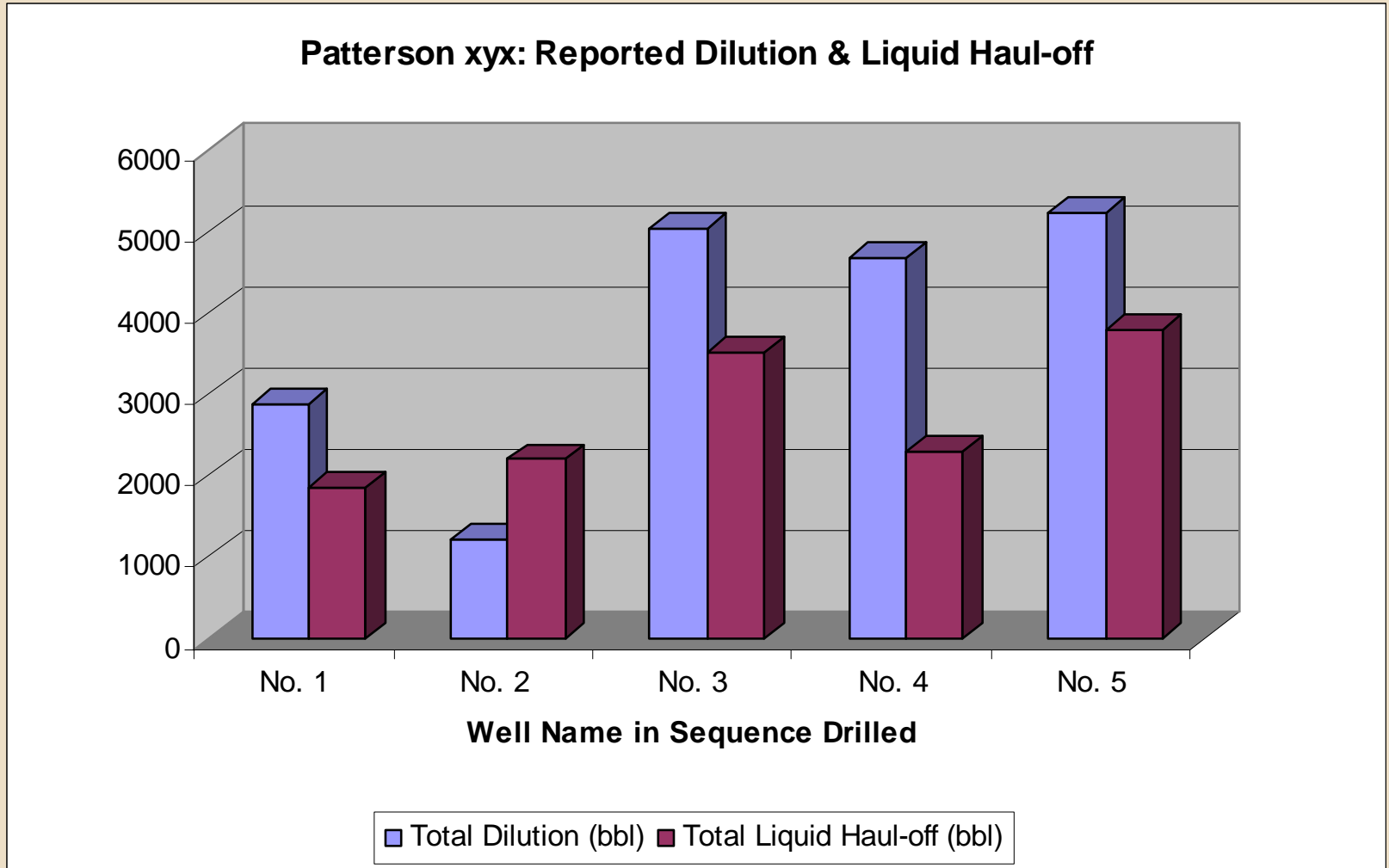


Figure 5: Analysis of Wells Ops from CL Reports

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Implementation of a uniform closed loop daily report by the service companies contracted by Devon improved performance and enabled Devon to analyze cost versus benefits.

Reporting enables:

- Comparison of quality of services being provided by different vendors
- Standardization of performance across the rig fleet
- Training of Company Men about the solids control & waste management process.

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Acknowledgement is due to many within Devon. In particular, I gratefully acknowledge the help and insight received from:

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- Fred Kellow
Drilling Engineer
- Mark Kramer
Drilling Supervisor Central Division