

**GEOLOGIC & DRILLING PROGNOSIS**

Prepared: 18-Feb-21 DC

**WELL NAME:** RG 544-7-297  
Directional from the pad RG 41-18-297

**API:** 05-103-12466-00  
**STATE:** CO  
**COUNTY:** RIO BLANCO  
**BOTTOM HOLE LOCATION:** Sec. 7 T 2S R 97W  
**TYPE OF UNIT:** FED  
**FEDERAL EA:** Yes  
**HARDLINE:** No

Unspaced

**ELEVATION (ft):**  
**PAD (ft):** 6621  
**GROUND (ft):** 6620  
**KELLY BUSHING (ft):** 6651

**RIG INFORMATION:**  
**RIG NAME:** HP 329  
**KB HEIGHT (ft):** 30

**ESTIMATE TOPS:**

Formation	TVD	MD	Formation Resource Notes
Green River	956	968	Potentially Useable Water
A Groove	1116	1133	Potentially Useable Water
B Groove	1301	1325	Potentially Useable Water
Dissolution Surface	1616	1651	Possible Lost Circ Zone
Orange Marker	2526	2594	Potentially Useable Water
Wasatch	2731	2806	Potentially Useable Water
Top of "G" Sand	5161	5323	Possible Lost Circ Zone
Fort Union	5491	5665	Gas and Limited Use and Quality Water
Ohio Creek	6871	7094	Possible Lost Circ Zone
Mesaverde	6871	7094	Gas and Limited Use and Quality Water
Approx. Top Gas	7961	8199	Gas and Limited Use and Quality Water
Cameo Coals	10311	10549	Gas, Coal, and Limited Use and Quality Water
Rollins SS	10891	11129	Gas and Limited Use and Quality Water
Cozzette	11041	11279	Gas and Limited Use and Quality Water
Corcoran	11261	11499	Gas and Limited Use and Quality Water
Upper Segro	11621	11859	Gas and Limited Use and Quality Water
Lower Segro	11921	12159	Gas and Limited Use and Quality Water
<b>TD</b>	<b>12041</b>	<b>12279</b>	

**MUD LOGGING:** Type: (Optional) Remote Gas Unit  
Interval: Base of surface casing to TD with total gas only

**OPEN HOLE LOGS:** Specifics: (Optional) Triple-Combo (DIL-GR-SP-Neutron Density)  
Interval: GR from TD to surface, DIL-SP and Neutron Density from TD to 100' inside surface casing

**CASED HOLE LOGS:** Specifics: Pulsed Neutron Log (e.g. RMTE, RPM, or RST)  
Processing: Emulation Triple Combo Using OH logs and training well  
Cement Evaluation: CBL

**CSG & CEMENT PROGRAM: SHOE TEST REQUIRED**

	Csg Size (in)	Depth Set (tvd)	Depth Set (md)	Hole Size (in)	Approx. Cmt Tail (ft3)	Tail Yield (ft3/sx)	Approx. Sx Tail	Approx. Cmt Lead (ft3)	Lead Yield (ft3/sx)	Approx. Sx Lead	WOC (hrs)
Conductor:	20	89.5	89.5	30	243	212					
Surface	13.375	1416	1451	17.5	N/A	N/A	N/A	1109	2.34	474	
Intermediate	9.625	3231	3306	12.25	172	2.10	82	172	2.40	72	
Liner or Production:	4.5	12041	12279	8.75/7.875	1446	1.85	784	373	2.00	187	
					<b>Surface (sacks): 474</b>		<b>Intermediate (sacks):</b>	<b>154</b>	<b>Prod. (sacks): 970</b>		

**ANTICIPATED PRESSURES (psi)**

MASP	Prod Csg Test Pressure	Anticipated BHP	Prod. Csg. Grade
2,950	8,500	5,599	P-110

**MUD PROGRAM:** (Do not deviate from mud engineer's recommendation without prior consent from Parachute office)

FROM (md)	TO (md)	TYPE MUD	#/GAL	VIS	WL	CHEMICALS
0	3306	WBM	8.33-9.0	45-50	7-15	Bentonite/PHPA
3306	12279	LSND	8.7-10.0	40-80	6-10	PHPA/Barite

(Write mud added to system on tour sheets and report all mud mixed and daily cost in morning report)

**LOST CIRCULATION:** Report depth and bbls of mud lost on morning report and tour sheet. Any severe lost circulation problems should be reported immediately to well supervisor.

**SURVEYS:** Run every 100' on surface hole and trips unless otherwise instructed.

**TEP GEOLOGIST:** Office Cell  
Stephen Sunnenberg 281-936-0361 303-918-4327 [ssunnenberg@terraep.com](mailto:ssunnenberg@terraep.com)

(note: if there are questions concerning TD or logging, please call Geologist)

**CASING & CEMENTING PLAN**

Operator: Terra Energy Partners  
 Well Name & Number: RG 544-7-297  
 Location: Ryan Gulch

Casing Design Calculations											
Type of Casing	Size of Hole (inches)	Size of Casing (inches)	Weight per Foot (lbs/ft)	Grade	Thread	Interval (ft)	(ft - Length (feet)	Setting Depth (TVD feet)	Collapse (psi)	Burst (psi)	Tension (lbs)
Surface	17.5	13.375	54.5	J-55	BTC	0-1451	1,451	1,416	1130	2735	853,000
Intermediate	12.250	9.625	36.0	J-55	LTC	0-3306	3,306	3,231	2,020	3,520	453,000
Production	8.750	4.500	11.6	P-110	DWC/C	0-12279	12,279	12,041	8,860	12,150	417,000

Surface Casing Shoe	Intermediate Casing Shoe	Production Casing Shoe
Max MW = 9.2 ppg HP = 677 psi	Max MW = 9.2 ppg HP = 1,546 psi	Max MW = 10.0 ppg HP = 6,261 psi

True Vertical Depth = 12,041  
 Bottom Hole Pressure = 5,599  
 Pore Pressure Gradient = 0.465  
 Max. Sur. Pressure = 2,950  
 BOP Required = 3M  
 5M system will be used as per A

Bottom Hole Temperature = 230 degrees Fahrenheit

Casing Safety Factors			
Surface Casing	Pb = 3.46	Min = 1.100	Pass
	Pc = 1.67	Min = 1.125	Pass
	Sj = 10.79	Min = 1.500	Pass
Intermediate Casing	Pb = 1.19	Min = 1.100	Pass
	Pc = 1.31	Min = 1.125	Pass
	Sj = 3.81	Min = 1.500	Pass
Production Casing	Pb = 4.12	Min = 1.100	Pass
	Pc = 1.42	Min = 1.125	Pass
	Sj = 2.93	Min = 1.500	Pass

**Cement Design Calculations**

Estimating Cement for Ryan Gulch Wells (Permitting purpose only)

Critical Depths - Permitting Purposes Only	
Casing/Formation	Measured Depth
Surface Casing	1,451 ft
Intermediate Casing	3,306 ft
Top of Mesaverde	7,094 ft
Top of Gas	8,199 ft
Total Depth	12,279 ft

Production Cement Tops (Permitting Purposes Only)	
Cement Slurry	TOC - Measured Depth
Scavenger	3,106 ft
Lead	6,894 ft
Tail	7,999 ft

Surface Cement	Lead
<b>Cement Tops</b>	<b>Surface</b>
Volume, bbls	180
Annular vol w/ excess, ft <sup>3</sup>	1109
Volume, sacks	474
Slurry Weight, ppg	12.3
Slurry Yield, ft <sup>3</sup> /sk	2.340
Mixwater, gal/sk	13.40
Annular Capacity (BBJ)	0.1237
Annular Capacity (CF)	0.6947
Excess	0.1
<b>Total Sacks</b>	<b>474</b>
<b>Total Cubic Ft.</b>	<b>1,109</b>

Intermediate Cement	Lead	Tail
<b>Cement Tops</b>	<b>2,306</b>	<b>2,806</b>
Volume, bbls	28	28
Annular vol w/ excess, ft <sup>3</sup>	172	172
Volume, sacks	72	82
Slurry Weight, ppg	12.3	12.8
Slurry Yield, ft <sup>3</sup> /sk	2.400	2.100
Mixwater, gal/sk	13.30	11.30
Annular Capacity (BBJ)	0.0558	0.0558
Annular Capacity (CF)	0.3132	0.3132
Excess	0.1	0.1
<b>Total Sacks =</b>	<b>154</b>	
<b>Total Cubic Ft. =</b>	<b>345</b>	

Production Cement	Scavenger	Lead
<b>Cement Tops</b>	<b>3,106</b>	<b>6894</b>
Volume, bbls	207	60
Annular vol w/excess, ft <sup>3</sup>	1,280	373
Volume, sacks	416	187
Slurry Weight, ppg	11.0	12.7
Slurry Yield, ft <sup>3</sup> /sk	3.074	1.999
Mixwater, gal/sk	18.830	11.000
Annular Capacity (BBJ)	0.0547	0.0547
Annular Capacity (CF)	0.3072	0.3072
Excess	0.1	0.1
<b>Total Sacks =</b>		
<b>Total Cubic Ft. =</b>		

**NOTES:**

Surface Casing 17-1/2" hole to TD - Cement to surface.  
 54.5# 13-3/8" J-55, BTC surface casing will be ran.  
 10% excess is included in calculations.  
 Normal Surface excess is 40% over gauge hole  
 Normal Intermediate excess is 50% over gauge hole  
 Normal Production excess is 45% over gauge hole.

Casing Design Calculations

Surface Casing - 54.5#	Intermediate Casing - 36#	Production Casing
<p><b>Burst</b></p> <p>Bottom Hole Pressure = TVD * Pore Pressure Gradient                      = 3231 * 0.465                      = 1502.415 psi</p> <p>Pburst = Bottom Hole Pressure - (0.22 * TVD)                      = 1502.415 - (0.22 * 3231)                      = 791.595 psi</p> <p>Pb = Casing Burst Rating / Pburst                      = 2735 / 791.595                      = 3.46</p> <p>Pb ≥ 1.1                      3.46 ≥ 1.1</p> <p><b>Collapse</b></p> <p>If: Max MW * Setting TVD * 0.052 ≥ Pore Pressure Gradient * Setting TVD                      9.2 * 1416 * 0.052 ≥ 0.465 * 1416                      677.4144 ≥ 658.44</p> <p>Pcollapse = Max MW * Setting TVD * 0.052                      = 677.4144 psi</p> <p>Else:                      Pcollapse = Pore Pressure Gradient * Setting TVD                      = 658.44 psi                      Pcollapse = 677.4144 psi</p> <p>Pc = Casing Collapse Rating / Pcollapse                      = 1130 / 677.4144                      = 1.67</p> <p>Pc ≥ 1.125                      1.67 ≥ 1.125</p> <p><b>Tensile</b></p> <p>Tension = (Weight1 * Length1)                      = (54.5 * 1451)                      = 79079.5 lbs</p> <p>Sj = Casing Tension Rating / Tension                      = 853000 / 79079.5                      = 10.79</p> <p>Sj ≥ 1.5                      10.79 ≥ 1.5</p>	<p><b>Burst</b></p> <p>Bottom Hole Pressure = TVD * Pore Pressure Gradient                      = 12041 * 0.465                      = 5599.1 psi</p> <p>Pburst = Bottom Hole Pressure - (0.22 * TVD)                      = 5599.065 - (0.22 * 12041)                      = 2950 psi</p> <p>Pb = Casing Burst Rating / Pburst                      = 3520 / 2950.045                      = 1.19</p> <p>Pb ≥ 1.1                      1.19 ≥ 1.1</p> <p><b>Collapse</b></p> <p>If: Max MW * Setting TVD * 0.052 ≥ Pore Pressure Gradient * Setting TVD                      9.2 * 3231 * 0.052 ≥ 0.465 * 3231                      1545.7 ≥ 1502.415</p> <p>Pcollapse = Max MW * Setting TVD * 0.052                      = 1545.7 psi</p> <p>Else:                      Pcollapse = Pore Pressure Gradient * Setting TVD                      = 1502.4 psi                      Pcollapse = 1545.7 psi</p> <p>Pc = Casing Collapse Rating / Pcollapse                      = 2020 / 1545.7104                      = 1.31</p> <p>Pc ≥ 1.125                      1.31 ≥ 1.125</p> <p><b>Tensile</b></p> <p>Tension = (Weight1 * Length1)                      = (36 * 3306)                      = 119016 lbs</p> <p>Sj = Casing Tension Rating / Tension                      = 453000 / 119016                      = 3.81</p> <p>Sj ≥ 1.5                      3.81 ≥ 1.5</p>	<p><b>Burst</b></p> <p>Bottom Hole Pressure = TVD * Pore Pressure Gradient                      = 12041 * 0.465                      = 5599.1 psi</p> <p>Pburst = Bottom Hole Pressure - (0.22 * TVD)                      = 5599.065 - (0.22 * 12041)                      = 2950 psi</p> <p>Pb = Casing Burst Rating / Pburst                      = 12150 / 2950.045                      = 4.12</p> <p>Pb ≥ 1.1                      4.12 ≥ 1.1</p> <p><b>Collapse</b></p> <p>If: Max MW * Setting TVD * 0.052 ≥ Pore Pressure Gradient * Setting TVD                      10 * 12041 * 0.052 ≥ 0.465 * 12041                      6261.3 ≥ 5599.065</p> <p>Pcollapse = Max MW * Setting TVD * 0.052                      = 6261.3 psi</p> <p>Else:                      Pcollapse = Pore Pressure Gradient * Setting TVD                      = 5599.1 psi</p> <p>Pcollapse = 6261.3 psi</p> <p>Pc = Casing Collapse Rating / Pcollapse                      = 8860 / 6261.32                      = 1.42</p> <p>Pc ≥ 1.125                      1.42 ≥ 1.125</p> <p><b>Tensile</b></p> <p>Tension = Weight * Length                      = 11.6 * 12279                      = 142436 lbs</p> <p>Sj = Casing Tension Rating / Tension                      = 417000 / 142436.4                      = 2.93</p> <p>Sj ≥ 1.5                      2.93 ≥ 1.5</p>