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BRINGING FORWARD DISCOVERY
IN AUSTRALIA'S NORTHERN TERRITORY
MAGELLAN PETROLEUM AUSTRALIA LIMITED
DRILLING FLUID RECAP
GOSSES BLUFF NO. 2

Prepared By : P McNaughton
Dated : March 1989
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WELL SUMMARY

Operator: Magellan Petroleum Australia Ltd
Well Number: Gosses Bluff No. 2
Location: OP-175, Amadeus Basin, NT
Contractor: Century Drilling
Rig: 14
Rig on Location: 23rd December 1988
Spud Date: 26th December 1988
RKB Elevation: 22.5 ft
Total Depth: 8700 ft
Date Reached TD: 21st March 1989
Total Days Drilling: 27 days

Drilling Fluid Type | Interval | Hole Size | Cost
--- | --- | --- | ---
Air | 0 - 65 ft | 26" | $
Air/Stiff Foam/Freshwater/Gel | 65 - 1364 ft | 171/2" | 15,579.79
Air/Foam/Freshwater/Gel/Polymer | 1364 - 5422 ft | 121/4" | 64,074.65
Air/Foam/Freshwater/Gel/Polymer | 5422 - 8700 ft | 81/2" | 166,933.90
KCl/Polymer

MUD MATERIALS CHARGED TO DRILLING: $246,588.34

Engineer on Location from: 27/12/88 to 05/01/89
18/01/89 to 21/03/89
Mud Engineering: 72 days @ $350.00/day
TOTAL DRILLING COST MATERIALS & ENGINEERING SERVICE: $271,788.34

Mud Materials not charged to Drilling: $
Engineering not charged to Drilling: $

Casing Program:
20" @ 65 ft
13 3/8" @ 1363 ft
9 5/8" @ 5400 ft

Drilling Supervisors: Phil Allwood, Trevor Hughes
Baroid Mud Engineers: Peter McNaughton, Alan Searle
DISCUSSION BY INTERVAL

26" HOLE

0 - 65 ft (RKB Elevation - 22.5 ft)
20" Casing set at 65 ft

Gosses Bluff No. 2 was spudded on 26th December 1988 using Century Drilling Rig 14. 17 1/2" hole was drilled from surface to 70 ft using air. The hole was then opened to 26" to 65 ft. The well was spudded in the Stokes Siltstone and 20" casing was cemented at 65 ft in the top of the Stairway Sandstone.

17 1/2" HOLE

65 - 1364 ft
13 3/8" Casing set at 1363 ft

After installing the 20" rotating head and blooie line, air was used to drill out the casing shoe and to begin drilling 17 1/2" hole. Drilling continued to 379 ft when the bit was tripped due to high torque. A stabilizer was laid out and drilling continued with air. Tight hole occurred at 525 ft and 541 ft. Slugs of foam were used to clean the hole. Tight hole occurred again at 590 to 605 ft and the hole packed off at 644 ft. 15 ft of fill occurred on a connection at 675 ft. Slugs of foam were used on connections to 798 ft. Tight hole occurred at 527 to 525 ft on a bit change trip at 706 ft.

60 ft of fill occurred on a connection at 798 ft. The hole was blown clean and drilling with stiff foam was commenced. The stiff foam mix used was 5 - 7 ppb Aquagel and 0.3 ppb Celpol. Quikfoam and Surflo H35 scale inhibitor were added prior to injection into the air stream. 5 gallon batches of Diesel/Foam Corrosion Inhibitor were added on connections once per tour.

Drilling continued using stiff foam from 798 ft. A ledge at 1200 ft had to be reamed. No further problems occurred till 1359 ft where fill was found. The hole was then displaced to Freshwater/Gei mud before drilling to 13 3/8" casing depth at 1364 ft. After a wiper trip, a viscous pill was spotted on bottom before pulling out to run casing.
13\(\frac{3}{8}\)" casing was run and cemented at 1363 ft. The entire 17\(\frac{1}{2}\)" interval was drilled in Stairway Sandstone.

**12\(\frac{1}{4}\)" HOLE**

1364 - 5422 ft
9\(\frac{5}{8}\)" Casing set at 5400 ft

After nippling up and testing BOP's and installing the rotating head, a 12\(\frac{1}{4}\)" bit was used with air to drill out the casing shoe. Drilling progressed rapidly using air and foam injected at 10 - 12 bbl/hour. Bit change trips were made at 1721 ft and 1923 ft. Drilling continued using air/foam at 2600 cfm and 160 - 185 psi. The next bit change was made at 2727 ft and 2687 to 2727 ft was reamed.

Fast drilling continued with air/foam to 3320 ft when tight hole occurred. The well was displaced to Freshwater/Gel mud and the interval 3120 to 3190 ft was reamed, with high torque occurring at 3190 ft. The roller reamer was laid out and the interval 3190 to 3320 ft was extensively reamed. Drilling then continued from 3320 ft using mud.

A bit change trip was made at 3337 ft and the interval 3198 to 3337 ft had to be washed and reamed to bottom. Drilling continued to 3404 ft. A wiper trip to 2993 ft was washed and reamed from 3249 ft to bottom. After drilling to 3415 ft, the hole was washed and reamed from 3243 ft to bottom. A bit change trip was made at 3415 ft and the hole was unloaded to air on the trip in.
DISCUSSION BY INTERVAL

12 1/4" HOLE (Contd)

After washing and reaming from 3404 to 3415 ft, drilling continued with air and stiff foam to 3654 ft. After a trip to change the reamer at 3654 ft, a bridge was hit at 3181 ft. The interval 3181 to 3250 ft was repeatedly reamed without success and the hole was then displaced to mud. The interval 3181 to 3221 ft was repeatedly reamed again with large quantities of black, blocky, carbonaceous, shaly siltstone cavings coming over the shakers. At this point the Baroid Engineer was recalled to the rig.

A trip was made to lay out the reamer and change the bit. A bridge was again hit at 3182 ft. After extensive reaming with continual cavings to 3263 ft, a 100 sack cement plug was pumped through the bit. The bit was then changed and after waiting on cement, the plug was drilled from 3191 to 3243 ft. The rathole was then reamed to bottom at 3654 ft. The amount of black siltstone cavings decreased significantly and the cement plug appeared to be successful. Drilling then continued with 9.7 - 9.8 ppg Freshwater/Gel mud. This mud was mixed before the Baroid Engineer arrived on the rig and had become highly aerated, presumably due to foaming agent left in the hole. Overtreatment with defoamer then compounded the aeration problem, which persisted for the duration of the 12 1/4" interval.

While drilling the cement, the mud became highly flocculated and aerated. While drilling the rathole beneath the cement plug, the hardness and chlorides levels increased markedly. The water loss also increased dramatically. Drilling continued without hole problems from 3654 ft. A ten stand wiper trip at 3863 ft showed no drag or fill and a bit change trip at 3927 ft was also good.
Drilling continued with aerated mud. Slight drag occurred during a wiper trip at 4129 ft. The pipe was tripped for repairs to the rotary table at 4334 ft and at 4393 ft for a washout in the drill collars. Drilling continued to 4593 ft where a bit change trip was made. A fishing trip was then made to retrieve a roller reamer locking block. The junk was not found, but 1 ft of core was recovered in the junk basket. The core showed the formation to be steeply dipping with overturned beds.

A new bit was run in and drilling continued from 4595 ft. A wiper trip at 4775 ft showed no drag or fill. Drilling continued with aerated 9.7 - 9.8 ppg mud. Q-Broixin was added to reduce mud flocculation. A trip was made at 4957 ft due to another washout in the 8" drill collars. A new bit was run in and after washing 60 ft to bottom, drilling continued without further problems. A wiper trip at 5141 ft was good.

From 5120 ft onwards, heavy dilution was ordered in an attempt to reduce the amount of mud aeration. Surface foam was dumped. The mud weight and viscosity were reduced to 9.2 ppg and 30 sec/qt respectively by 5267 ft although mud aeration continued. A bit change trip at 5200 ft showed no drag or fill. Drilling continued to 5346 ft, where a ten stand wiper trip was made with no drag or fill.

Drilled ahead with 9.2 ppg and 30 sec/qt viscosity to 5408 ft. At this point it was decided to run logs and set 95/8" casing.

Tight hole occurred at 3889 ft during the wiper trip and singles were pumped out through 3889 to 3071 ft on the trip out. A washed joint was replaced and the interval 3071 to 3639 ft was reamed. The viscosity was increased to ± 45 sec/qt and the mud weight was increased to 9.9 - 10.0 ppg. CMC was added to reduce the filtrate loss from 20 to less than 10 cc/30 min.
DISCUSSION BY INTERVAL

12 1/4" HOLE  (Contd)

Drilling was continued to casing point at 5422 ft. After pumping a viscous sweep and only minor drag on the wiper trip, a viscous sweep and viscous pill were pumped before pulling out to log. The following logs were run:

SLS-WFT-GR, SHDT-GR, DLL-MSFL-GR and LDL-CNGL-GR.

One logging run hit a ledge at 3170 ft.

After logging and a wiper trip, 9 5/8" casing was successfully run and cemented at 5400 ft.

8 1/2" HOLE  5422 - 8700 ft (TD)

While nipping up the BOP's, it was found that the wrong size casing slips had been supplied. After eventually installing, testing and repairing the BOP's, an 8 1/2" bit was run in the hole. Every 1400 ft, the hole was unloaded with air. As much as possible of the Freshwater/Gel/Polymer mud was salvaged for possible reuse. Cement was drilled from 5374 ft.

New 8 1/2" hole was drilled rapidly using air and Quik Foam. Incident-free bit change trips were made at 5710 ft and 6248 ft. Survey data showed rapidly increasing hole deviation from 2 3/4° at 5543 ft to 11° at 6606 ft.

After a survey at 6617 ft, the bit could not be run back to bottom. A five stand wiper trip was made but the hole would not unload. After a ten stand wiper trip, the bit was found to be plugged. 50 bbls of mud was used to try to unplug the bit, but without success, so the pipe was tripped.
A new bit was run in to 6506 ft and the hole was reamed to 6617 ft. Drilling continued with foam to 6704 ft. Steady formation caving persisted and the hole required blowing for 1 - 1 1/2 hours before making connections. It was learnt that the caving formation was the same Middle Stairway Siltstone which had caused severe caving problems in the 12 1/4" interval. A junk basket core in 12 1/4" hole had shown overturned bedding, which is why the same formation had been found in the 8 1/2" hole.

During a connection at 6617 ft, the pipe became stuck at 6675 ft. After working the pipe with air and foam, the hole was displaced to mud. During the displacement, the annulus became packed off with cavings and the hole was then filled down the annulus. Intermittent returns occurred as the pump pressure fluctuated. At one point, a large air bubble which had been trapped beneath the pack-off "blew out" and cleared the obstruction, allowing full circulation. The flowline then plugged with cuttings and the pipe remained stuck. Additional mud was mixed when it was found that 700 bbl of mud was needed to fill the hole with a theoretical volume of 485 bbl. Some mud losses appeared to occur, probably when high pump pressures were used when attempting to clear the pack-off.

The pipe was worked unsuccessfully. A viscous pill and a SAPP (detergent) pill were tried, then a 25 bbl Diesel/EZ Spot pill was spotted on bottom. The pipe moved about 3 ft and a second Diesel/EZ Spot pill was pumped. The pipe remained stuck so a free-point log was run and the pipe was backed off. A fishing string was made up and the stuck pipe was jarred free. At this stage, the mud weight was 9.1 ppg and the viscosity was 32 - 34 sec/qt.
A new bit was run in and caving shaly siltstone was reamed from 6520 ft. While reaming, the mud weight was increased to 10.0 ppg the viscosity was increased to ± 45 sec/qt. Some mud losses occurred to blooie line blockages. Drilling continued slowly to 6801 ft. After a trip to change the bit and 2 washed drill collars, drilling continued slowly.

A reduction in cavings and a trouble-free trip encouraged the reduction in mud weight to 9.5 ppg in order to improve penetration rates. However very tight hole occurred again on a trip at 6866 ft and the mud weight was increased to 9.7 ppg. Very tight hole again occurred on a wiper trip at 6970 ft with 8 singles having to be pumped out. A second wiper trip was also tight with moderate quantities of blocky black siltstone cavings seen at the shakers.

The mud weight was increased to 9.9 ppg and drilling continued slowly to 6990 ft, where a trip was made because of lost jet. The trip was good and a new bit was run in with a junk sub. Drilling continued slowly to 7108 ft. Tight hole occurred at 6400 to 6470 ft during a wiper trip and this section was heavily reamed. A bit change was made and a PDC bit was run in.

After reaming several sections below 6370 ft, drilling continued at a rapid 30 ft/hour from 7108 ft. A pipe washout occurred at 7130 ft and the damaged joint was laid out without requiring a full trip out. The mud weight was increased to 10.1 ppg below 7108 ft. Drilling continued at 30 - 40 ft/hour and a 14 stand wiper trip at 7637 ft showed the hole condition was good. A 30 bbl viscous sweep was circulated every 4 hours to ensure good hole cleaning. Slight mud flocculation with increasing gel strengths occurred in this interval, possibly due to thin evaporite beds.
At 7817 ft, a survey recorded a deviation of 14°. A wiper trip to the casing shoe was good. A viscous sweep was circulated out, another wiper trip was made to the casing shoe, a viscous sweep and a viscous pill were pumped and the pipe was tripped for DST No. 1. A packer seat failure occurred during DST No. 1, probably due to the serrated borehole wall damaging the packer.

Drilling then continued with the PDC bit at ±20 ft/hour into the Horn Valley siltstone. KCl/Polymer/Baracarb mud was mixed at this stage for imminent displacement into the well. 1050 bbls of KCl mud and KCl brine were mixed. Not enough whole mud could be mixed due to the limitations of pit volume capacity on site. The new mud was formulated with 12% KCl at the geologists request to provide sufficient salinity for optimum log interpretation. The KCl/Polymer mud was then weighted to 10.0 ppg with acid-soluble Baracarb.

Drilling continued with Freshwater/Gel/Polymer mud while new KCl/Polymer/Baracarb mud was being prepared. The drill rate slowed and after a 15 stand wiper trip, the bit was tripped at 8119 ft. A new bit was run in and after washing 50 ft to bottom, drilling continued at 4 - 5 ft/hour. New 10.0 ppg KCl/Polymer/Baracarb mud was displaced into the well while drilling from 8171 to 8190 ft. Some mud losses occurred at the shakers when the new polymer mud was circulated since only one shaker was operational.

At 8190 ft, a 15 stand wiper trip was made the bit was tripped. A new PDC bit was run in, however this bit failed to drill anywhere near as fast as the previous PDC bit. The displacement to KCl mud showed the hole to be greatly over-gauge and new mud was continually mixed to build surface pit volume. The viscosity and yield point were increased to assist hole cleaning and the KCl concentration was increased to 14% by weight.
DISCUSSION BY INTERVAL

8 1/2" HOLE (Contd)

Drilling continued to 8231 ft where tight hole on a connection had to be worked. Viscous sweeps were circulated every 4 hours. At 8291 ft, a 40 bbl viscous sweep was pumped and the bit was tripped. Tight hole occurred at 7626 ft. A new bit was run in and tight hole was reamed at 8130 to 8291 ft. Drilling then continued from 8291 ft and the mud weight was allowed to drop to 9.8 ppg.

A survey at 8385 ft showed a hole deviation of 150° and a bit change trip recorded one tight spot at 8266 ft. Potassium Nitrate tracer was added while drilling ahead from 8385 ft. Drilling continued into the upper Pacoota Formation and a bit change trip was made at 8533 ft. Some foaming occurred in the high salinity KCl mud in this section and oxygen scavenger treatment was increased.

A bridge was hit on the trip in and the interval 8411 to 8533 ft was reamed. After drilling to 8555 ft, another bit change trip was made and the hole was washed from 8392 ft to bottom. Drilling continued with a mud weight of 9.9 ppg and the viscosity was maintained at 42 - 45 sec/qt with XCD Polymer and Baravis.

After drilling to 8700 ft, a wiper trip was made to the casing shoe. The interval 8578 to 8700 ft was reamed and washed. After another ten stand wiper trip, 60 bbls of viscous mud was spotted on bottom and the pipe was tripped for DST No. 2. The test tools had to be worked through a bridge at 8547 ft.

After performing DST No. 2, the drill string could not be circulated and the test tool was found to be stuck. The string was jarred and eventually circulated. The string eventually parted at the Howco safety joint, leaving 255 ft of test tools and drill collars in the hole. An overshot was run in but was unable to free the fish. Another overshot was run which engaged, but jarring continued to be unsuccessful. Several more fishing trips were made but the grapple kept slipping off the fish.
A trip was made with a bit to clean the hole and after two wiper trips, a viscous sweep and a viscous pill were pumped. The pipe was then tripped for logging. An SLS-GR log was run which hit a bridge at 7665 ft. After logging back to the casing shoe, a bit was run in and the hole was reamed from 7658 to 7720 ft. After a wiper trip, a 50 bbl viscous sweep and a 60 bbl viscous pill were pumped. The pipe was then tripped to continue logging. SLS-GR, FMS, DLL-MSFL-GR, LDL-CNL-GR and WST logs were run.

After logging, a bit was run in. After reaming a bridge at 8345 ft, the hole was circulated clean. The bit was tripped and a fishing trip was made, but the fish could not be engaged. The trip out was tight for 3 singles. Another fishing trip was made, but the overshot kept pulling off the fish. When trying to trip out, the hole was very tight. The mud weight was increased from 10.0 ppg to 10.5 ppg, then after a tight wiper trip, to 10.7 ppg with all available weighting material onsite (Barite, Baracarb and KCl). The viscosity, yield point and gel strengths were also increased with XCD Polymer to improve hole cleaning and suspension of Barite.

Another wiper trip was good and the bit was tripped. Inflatable test tools were run in and DST No. 3 and DST No. 4 were performed. The test string was tripped out without problems and an overshot with 6" grapple was run in. After washing through tight hole at 8340 ft and washing 100 ft to bottom, the fish was engaged. Jarring moved the fish some 3 - 4 ft, but no further. The overshot could not then be disengaged and efforts to do so caused the drill string to twist off. After two attempts could not locate the top of the fish in a washed out section of hole, it was decided to plug and abandon the well.

The Baroid Mud Engineer was released from the site on 20th March 1989.
Gosses Bluff No. 2 proved a very difficult hole to drill. This was almost entirely due to the very steep bedding angles and highly fractured formations caused by the original meteorite impact. In particular, siltstones of the Middle Stairway and Horn Valley Formations were highly fractured and tended to cave into the hole. The Middle Stairway siltstone was drilled twice, in both the 12 1/4" and 8 1/2" sections, and caused severe hole problems on both occasions. The Horn Valley siltstone caused the DST test tool to become stuck, resulting in premature abandonment of the well.

Due to meteoric impact, these formations are highly fractured and stressed. Consequently, the usual remedies for controlling sloughing shaly/argillaceous formations did not appear to work. Increased mud density and viscosity and tighter filtration control were used with little success. In future Gosses Bluff wells, polymers which restrict water invasion along microfractures could be trialled e.g. Quik Mud, Microlube Plug or Soltex. An alternative could be to set cement plugs in these formations, especially the Middle Stairway siltstone, as soon as caving or tight hole become excessive.

Mudding up and relatively high mud weights were used to control the caving formations and this resulted in high mud costs. Additional costs were due to the high KCl concentration requested by the geologists for mud used to drill the Pacoota Formation and acid-soluble Baracarb used to weight up the mud. A final mud weight of 10.7 ppg and KCl concentration of 14% were used. In future Gosses Bluff wells, sodium chloride (NaCl) and Barite would be more cost effective in exploration drilling. Baracarb and Potassium Chloride (KCl) could then be used in production wells or completion fluids to prevent reservoir damage.

Many wet trips were made through tight caving hole and this caused unusually high mud losses due to spillage on the rig floor.
Mudding up in the 12\(\frac{1}{4}\)" and 8\(\frac{1}{2}\)" hole intervals because of bridges and caving hole also caused another unusual problem - mud foaming. This occurred when large slugs of foam were injected into the air stream to clean out cavings from the hole. When this proved unsuccessful, the hole was mudded up. However, a significant quantity of foam was left at the bottom of the hole and when mud was displaced into the hole, Quik Foam foaming agent became incorporated into the mud system. This resulted in severe mud aeration in both the 12\(\frac{1}{4}\)" and 8\(\frac{1}{2}\)" hole intervals, resulting in reduced pump efficiency, variable mud densities, the inability to run the desander or desilter effectively and higher mud costs. If this occurs in future wells, the hole should be first blown clean of foam before mudding up, or if this is not possible, a large water spacer should be pumped ahead of the mud and then dumped when it reaches the surface.
Baroid Australia PTY. LTD./NL INDUSTRIES INC.

MATERIAL RECAP

COMPANY: MAGELLAN PETROLEUM
WELL: COGLES BLUFF #2
LOCATION: DP-175, NT

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FRESH WATER
SEA WATER
TOTAL MUD MADE: 950 bbl
COST LESS BARYTES: 950 bbl
COST WITH BARYTES: $15579.79

COMMENTS

1. DRILL WITH AIR TO 798'. DRILL WITH AIR & STIFF FOAM TO 1359'. DISPLACE TO MUD. DRILL TO 1364'.
2. BARADEFOAM USED TO CONTROL EXCESSIVE FOAMING IN FLARE PIT.
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<td>200 lt</td>
<td>543.67</td>
<td>21</td>
<td>11417.07</td>
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<tr>
<td>SAPP</td>
<td>35 kg</td>
<td>118.30</td>
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<td>354.90</td>
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<tr>
<td>SODA ASH</td>
<td>25 kg</td>
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<tr>
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</tr>
<tr>
<td>BARITE</td>
<td>50 kg</td>
<td>18.03</td>
<td>1175</td>
<td>21185.25</td>
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</tbody>
</table>

FRESH WATER 2120 BBL
SEA WATER 2120 BBL
TOTAL MUD MADE 2120 BBL
COST LESS BARYTES $42889.40
COST WITH BARYTES $64074.65

COMMENTS
1. DRILLED WITH AIR/FOAM TO 3320 FT. DISPLACED TO MUD TO DRILL TO 5422 FT.
2. BARIITE USED TO WEIGHT SYSTEM TO CONTROL CAVING.
3. MUD CONSUMPTION BASED ON WATER USAGE OVER INTERVAL 3320 - 5422 FT.
COMPANY: HAGELLAN PETROLEUM  
WELL: GOSSES BLUFF #2  
LOCATION: OP-175, NT  
COST/FT: $50.93  
COST/BBL: $44.69  
RECAPPED BY: P. McNaughton  
DATE: 21 MARCH 1989

MATERIAL RECAP

- **HOLE SIZE**: 8"  
- **INTERVAL TO** 8700'  
- **FEET DRILLED**: 3278  

<table>
<thead>
<tr>
<th>MATERIAL</th>
<th>UNIT</th>
<th>UNIT COST</th>
<th>ACTUAL</th>
<th>TOTAL COST</th>
<th>UNIT COST</th>
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<td>ACTICIDE AZ</td>
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<td>AQUACEL</td>
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<td>CAUSTIC POTASH</td>
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<tr>
<td>CAUSTIC SODA</td>
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</table>

**FRESH WATER**  
**SEA WATER**  
**TOTAL MUD MADE**  
**COST LESS BARYTES** $131,829.43  
**COST WITH BARYTES** $166,933.90

**COMMENTS**

1. DRILLED WITH AIR/FOAM TO 6704 FT. DISPLACED TO FRESHWATER/GEL/POLYMER MUD AFTER CAVING MIDDLE STAIRWAY SILSTONE STUCK DRILL PIPE.  
2. DISPLACED TO KCl/POLYMER/BARACARB MUD AT 8175 FT, PRIOR TO DRILLING PATUTA FORMATION.  
3. LIME USED FOR SEPTIC TANKS (NOT USED FOR DRILLING).