

**Investigation of Loss of Well Control
South Timbalier Block 188, Well CA-3
OCS-G 1899
22 April 2003**

**Gulf of Mexico
Off the Louisiana Coast**



**U.S. Department of the Interior
Minerals Management Service
Gulf of Mexico OCS Regional Office**

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Jack Williams – Chair
John McCarroll
Jerry Freeman

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Investigation and Report

Authority

In April 2003, the Pride Offshore Drilling, Inc. (hereinafter referred to as “Contractor” or “Pride”) jack-up rig *Pride Kansas* (hereinafter referred to as the “Rig”) was engaged in drilling operations for Chevron Exploration & Production Inc. (hereinafter referred to as “Operator”) on South Timbalier (ST) Block 188 Well CA-3. The Rig was in place next to the ST-188 “CA” platform (hereinafter referred to as the “Platform”). Drilling operations were being conducted with the Rig cantilevered over the Platform and the well was being drilled using a pre-installed drive-pipe.

Throughout the drilling of the conductor casing hole and the setting of the conductor casing, significant drilling fluid losses were experienced, and drilling and cementing returns were erratic in nature or entirely absent due to unexpectedly permeable morphology. After the conductor casing was set, the Operator continued to face severe lost circulation problems during drilling of the surface casing hole. Anomalous, thick sand deposits continued to be encountered to a depth of 4,800 ft where the Operator planned to set surface casing.

While the crew was tripping to prepare to set surface casing, the hole first went on vacuum, then ceased taking fluid, and then began flowing. The annular was closed, the diverter system opened, and the flow, mostly water, was placed into the downwind diverter line. After eight hours, flow ceased and the well again began taking fluid. Normal lost circulation operations were initiated and surface casing was run, sealing off the thief zone and the zone of influx. No indication of solids and only minimal gas was found in the diverted stream; and no sheen or pollution was observed.

The event occurred 22 April 2003 at approximately 2245 hrs on the surface location in the Operator’s Lease OCS-G 1899, South Timbalier Block 188, in the Gulf of Mexico, offshore the State of Louisiana. Pursuant to Section 208, Subsection 22 (d), (e), and (f), of the Outer Continental Shelf (OCS) Lands Act, as amended in 1978, and Department of the Interior Regulations 30 CFR 250, Minerals Management Service (MMS) is required to investigate and prepare a public report of this accident. By memorandum dated 26 April 2003, the following personnel were named to the investigative panel:

Jack Williams, Chairman – Office of Safety Management, GOM OCS Region

John McCarroll – Houma District, Engineering and Field Operations, GOM OCS Region

Jerry Freeman – Houma District, Field Operations, GOM OCS Region

Procedures

On the morning of 23 April 2003, personnel from the MMS visited the site of the incident to assess the situation. On 24 April 2003, representatives of the Operator met with Houma District personnel to review the incident. From 6 to 20 May, 2003, members of the panel interviewed and/or collected statements from eight Operator and Rig personnel about the loss of control event. On 20 May 2003, members of the panel reviewed the incident by telephone with personnel of the Operator. On 10 November 2003, members of the Panel discussed the incident by phone with drilling engineering and reviewed the company report on the incident. On 22 November 2003, members of the panel interviewed drilling engineering and other Operator personnel. In addition to the interviews, Operator personnel answered specific questions by e-mail on 9 June, 12 June, 10 November, 15 December and 16 December. Other information was gathered at various times from a variety of sources. This information included the following reports and statements:

- Daily Drilling Reports, 16 April 2003 – 30 April 2003 for Well CA-3
- Daily Drilling Reports, 16 April 2003 – 30 April 2003 for Well CA-4
- Daily Drilling Reports, 16 April 2003 – 30 April 2003 for Well CA-7
- Operator's Drilling Plan, Well No. CA-3
- Operator's Drilling Plan, Well No. CA-4
- Operator's Application for Permit to Drill, Well No. CA-7
- Operator's ST-188 CA-3 Incident Investigation Report
- Operator's TDT-K log, Well CA-3
- Electric Log, Induction/Gamma Ray, Well CA-7
- Operator's schematics of Wells CA-3, CA-4, CA-7
- Interviews with Operator drilling management and engineering and operational personnel, Contractor drilling management, operational supervisors, and operational personnel
- MMS records for all wells previously drilled from the Platform including logs, plans, drilling summaries

Introduction

Background

The surface and bottom-hole location for Well CA-3 is within lease OCS-G 1899, which covers approximately 5,000 acres and is located in South Timbalier Block 188 (ST-188) Gulf of Mexico, offshore Louisiana (*for lease location, see Attachment 1*). The lease OCS-G 1899 was issued to Chevron, who became the operator effective 28 March 1974. The lease is owned by the Operator 100 percent.

In 1981, following the successful drilling of the ST-Block 188 Well #1 (renamed CA-1) the CA platform was set in ST-188 in 146 ft of water. The platform is a six-pile, six-slot platform and, per Operator procedure, when the platform was set, drive-pipe was installed by the construction crews for at least five of the six slots. All drive-pipe was apparently driven to a pre-selected depth, approximately 150 ft to 200 ft below the mud line. Subsequently, two additional productive wells were drilled in 1982 from the CA platform and production was initiated in 1983.

In 2002, three additional wells were planned for the platform. The first well, the CA-7 well, was permitted to be drilled from the Platform to a bottomhole location (BHL) within adjacent Lease OCS-G 1572. The CA-7 was spudded in November 2002 and was successfully completed in April 2003. When the Application for Permit to Drill (APD) for the second well of the program, the CA-3 well, was filed with the MMS in September 2002, the Operator requested a waiver of the requirement to set conductor casing. To support the application, Operator cited the successful drilling of the three original wells. In December 2002, after the CA-7 well had logged the surface formations and the results of those logs were forwarded to the MMS, the MMS verbally waived the requirement for conductor casing in the CA-3.

Following the completion of the CA-7, the Rig was skidded and the CA-3 was spudded, 10 April 2003.

Brief Description, Loss of Well Control

The CA-3 well had been permitted with the requirement of a conductor casing string waived because (1) four previous wells drilled from the platform had encountered only routine sand-shale sequences to the depths projected for surface casing, (2) a log of the CA-7 surface hole had shown no resistivity, and (3)

the original shallow hazard seismic survey indicated no shallow zones potentially productive of hydrocarbons.

However, once the CA-3 drive pipe was drilled out, an anomalous, thick sand deposit was immediately encountered that initially caused large seepage losses and finally complete loss of drilling fluid returns. The drilling plan was subsequently modified and a string of conductor casing was run to 913 ft and cemented. Because no cement returns were received at the surface, a top cement job was performed. When the conductor casing was subsequently drilled out, the anomalous sand deposit continued to be encountered to a depth of 4,800 ft where surface casing was to be set, with significant seepage losses continuing (*see Attachment 2 for casing and cement schematic of Well CA-3*).

At 4,800 ft, a short trip was made to prepare to set surface casing. During tripping, returns were totally lost with the bit at 3,985 ft. After the bit was pulled back into the shoe, the hole ceased taking fluid and then began flowing. The annular was closed and the diverter lines opened, and after a slight belch of gas, the diverter flowed water. The flow from the well fluctuated in cycles for eight hours, alternately flowing/unloading and then taking fluid. After eight hours, flow ceased and the well began taking fluid. Normal lost circulation operations were initiated and surface casing was finally run to 3,883 ft, apparently sealing off the thief zone and zone of influx. No indication of solids was found in the diverted stream and only minimal gas; no sheen and no pollution were observed.

Findings

Preliminary Activities – Preparation of the Well Plan

The ST 188 “CA” platform of the ST-176 Field sits in 146 ft of water. The six-legged, six-slot Platform was set in 1981 and three wells were drilled by the operator, Chevron, in 1979 and 1982. Production was initiated from the Platform in 1983.

In 2003, the Operator planned additional drilling from the “CA” Platform with the CA-3 planned as the second of a three-well program that included the CA-7 and CA-4 wells. No new shallow-gas hazard surveys were run and none of the previously drilled wells had been logged in the upper portion of the hole.

When the platform was set in 1981, drive-pipe for some of the platform slots was installed. From documents, it was determined that in 1981, concurrent with the setting of the Platform, the Operator’s construction department oversaw the installation of drive-pipe for at least five of the six slots. This drive-pipe was apparently driven to a standard depth determined by company policy. In this case the depth for the drive-pipe for these slots was approximately 150 ft to 200 ft below the mud line. Some records for the CA Platform, including the records for the drive pipe of the CA-3 well slot, were subsequently lost in a re-organization, except for a single note that indicated the CA-3 drive-pipe was driven 164 ft below mud-line penetration. In the planning for the drilling of the CA-3 well, the Operator assumed the specification of the drive pipe used in the CA-2, which was known, was the same as the type of pipe driven in the slots for the CA-3 and the third well of the program, the CA-4.

The 2002 well program scheduled the C-7 well first. This well was permitted to be drilled from the Platform to a bottomhole location (BHL) within adjacent Lease OCS-G 1572. The CA-7 was spudded on 3 November 2002 and completed as planned with no abnormal drilling incidents. The casing program for the CA-7 utilized new drive-pipe (the CA-7 was drilled from a pre-existing slot with no previously installed drive-pipe) driven to 626 ft, conductor casing set at about 971 ft, and surface casing set at 4,988 ft (*see attachment 3 for casing plan of CA-7*).

According to testimony, review of the original shallow-gas hazard survey indicated no zones that might contain hydrocarbons. None of the original three wells drilled from this location had logged the formations encountered in the surface holes; therefore, after the surface hole of the CA-7 well was drilled,

a full suite of electric logs including sonic, etc., was run. According to testimony, the logs showed no resistivity in the shallow formations. The interpretation of a normal sequence of sand-shale layers, with shale predominating from the shoe of the drive-pipe through the depth of the surface casing setting, was inferred by the Operator.

The original Application for Permit to Drill (APD) for the second well in the program, the CA-3, requested a waiver of the requirement to set conductor casing. The waiver application was supported by the lack of problems encountered in the three original wells despite the fact that none of those wells had logged the surface hole. After the logging of the surface hole in the CA-7, the waiver was approved verbally by the MMS District office on 24 December 2002.

The plan for the CA-3 Well noted that because of the lack of records and some loss of returns during drilling of one of the first wells (the CA-2), some uncertainty was associated with the integrity of the shoes of the drive pipe originally installed when the platform was set. The well plan recommended control drilling to limit cuttings loading and prevent possible loss of returns from the drive pipe shoe to the setting point of the surface casing at 4,800 ft. In the Operator's well plan, note was taken of the possible need for a top (cement) job if full returns were not received during cementing of the surface casing.

Drilling Activities — Spud, Loss of Control, Regain Control

(From drilling morning reports and interviews)

12 Apr. – 17 Apr. – Skid Rig from CA-7 to CA-3 slot. Rig up, install and test diverter system, wash out 26-inch drive pipe to 400 ft, spud well, control drill to avoid collision with other wells. Operations lost returns while drilling from 449 ft to 520 ft. Continue to control drill while sliding, without returns from 520 ft to 800 ft. Pumping gel and lost circulation material (LCM) in sweeps, failed to regain returns. Drilled ahead to 925 ft, pulled into shoe after circulating sea water, spotted LCM pill.

18 Apr. – Control drill/slide without returns from 800 ft to 925 ft. Spotted LCM pill, pulled into shoe, allow hole to heal. Open hole to 22 inches from 449 ft to 769 ft with no returns. Change casing plan because of continued lost circulation, prepare to set conductor casing.

19 -20 Apr. – Open hole to 925 ft. Circulate and spot gel sweep, LCM pill. Rig up (RU) and run conductor casing, 18 5/8-inch, to 913 ft. Pump 15 barrels (bbls) seawater, 48 bbls superflush, 25 bbls seawater followed by 280 sacks (sx) 11.5 pounds per gallon (ppg) cement and 500 sx 16.4 ppg cement. Drop and bump plug. No returns were received during cementing. Crew opened well, found hole to be on vacuum. Held cement in place for 4 hours, performed top job using 26-inch casing valve. Mix and pump 400 sx 16.4 ppg cement. Wait on cement (WOC) for 4 hours, tag top of cement @ 900 ft. Drill out of conductor pipe shoe from 900 ft to 913 ft, drill ahead pumping sweeps and circulating out each stand.

21 Apr. – Drill ahead pumping 50 bbl sweeps each connection. Hole taking 50-60 barrels per hour (bph) seepage, varying to 10-12 bph.

22 Apr. - Drill to 4,800 ft (planned surface casing set depth),

1900 hrs - begin to pull out of the hole (pooh) to shoe. Returns totally lost with bit @ 3,985 ft, fill hole with 220 bbls 9.4 ppg mud. Hole taking 10-12 bph, continue pooh to shoe.

2200 hrs – Monitoring hole while building 9.4 ppg mud. Hole taking 10-12 bph, then became static.

2230 hrs - Well began flowing, crew closed annular and opened the downwind diverter line. Crew pumped a cap of seawater and diverted the flow while building 9.4 ppg mud. Crew monitored flowing well; displaced seawater w/9.4 ppg mud. The flow slowed and varied, decreased, then began unloading well. Pumped seawater, circulated through diverter line, flow remained constant.

23 – 24 Apr. – At 0700, 23 April, shut down, monitored well, found to be static, checked annular, found hole to be taking fluid. Filled the annular with seawater and monitored losses, well taking 130-260 bph. Pumped LCM pill down annulus, losses decreased to 175 bph and continued attempting to control the loss to the formation. Washed and reamed to 3,924 ft, continued to lose circulation, received hole-fill when the pumps were shut down. Displaced 9.2 mud with 10 ppg mud, pooh to 1,394 ft pumping LCM and continued to try to control lost circulation.

25 - 26 Apr. – Rigged up to run casing, ran 13 3/8-inch surface casing to approximately 3,883 ft. Cemented w/1530 sx, 12.5 ppg, 560 sx 16.4 ppg. Partial returns were received at surface while

cementing. Performed 13 3/8-inch top job on surface casing, with 5 sx, 16.4 ppg, cement. Divers checked CA platform area and Rig stern area but found no signs of washout or broaching.

27 Apr. – Ran through-casing logs from 4,800 ft to 642 ft. RIH with measurement while drilling device (MWD) and bit and drilled ahead, followed by normal drilling operations.

Drilling Activities – CA-4 and CA-7

As chronicled above, the CA-3 Well experienced extensive problems with fluid losses, which led to the diverter incident. The events experienced drilling the CA-3 well can be compared to the drilling events experienced in the CA-7 Well, which preceded the CA-3 in the 2002-03 program, and the CA-4 Well, which immediately followed the CA-3 in 2003. A brief summary of the events experienced while conducting operations on the CA-7 and CA-4 Wells follows:

Drilling activities of CA-7 through setting surface casing

1-5 Nov. – Moved on CA platform, rigged up on CA-7 slot, drove new drive-pipe to 626 ft, spudded well. Drilled to 1,050 ft, circulated well clean, logged from 1,032ft to 626 ft with gamma ray (GR)-sonic-induction tool, ran 20-inch conductor casing to 935 ft, cemented with 385 sx 12.5 ppg and 585 sx 16.4 ppg cement, good cement returns received at surface.

6-9 Nov. – Normal drilling operations, drilled ahead to 5,015 ft. RIH with electric line to 4,700 ft, logged with GR/Induction/sonic/caliper 4,700 ft to 971 ft. Prepared and ran 16-inch surface casing to 4,988 ft, cemented with full returns to surface.

Drilling activities of CA-4 through setting surface casing (see Attachment 4 for schematic).

2-9 June - Skidded rig to CA-4 slot from CA-3. Picked up hammer, drove 22-inch pipe to 635 ft, then washed inside 22-inch drive-pipe to shoe at 635 ft. Spudded well CA-4, drilled to 1,270 ft, pumped gel sweep, pooh. Hole began taking 100 bph.

9 June - RIH, under-reamed, loss of fluid climbed to 250 bph. Spotted 300-bbl LCM pill, attempted to fill hole with no success. Kept backside full of seawater, RIH w/conductor casing to 1,234 ft, landed

hanger, circulated 1 casing capacity with partial returns. Mixed and pumped cement, set conductor casing @ 1,234 ft with 310 sx 12.5 ppg, 460 sx 16.4 ppg cement, with partial returns received at surface. The plug did not bump.

10 June – Mixed and pumped 300 sx 16.4 ppg cement top job, displaced with 10 bbls seawater. WOC 15 hrs. and then proceeded to drill ahead.

11-13 June – Normal slide-and-control drilling operations commenced with normal fluid losses.

14 June – Set surface casing to 4,580 ft with full returns to surface.

Findings – History of Surface Hole Operations and Morphology

The first wells for the CA platform were the CA-1, spudded 12 August 1979, the CA-6, spudded 1 May 1982, and the CA-2, spudded 8 September 1982. None of these wells logged the surface hole, though according to testimony, the mud logs of each well indicated a normal shallow shale-sand sequence. Only the CA-2 experienced lost circulation problems of any note and the CA-2 records attributed the circulation problems to a stray sand that was isolated by using normal mud technology.

Because the drilling in the area had not encountered shallow-gas deposits or other significant surface hole problems, the Operator requested a waiver of the need to set conductor casing on the CA-3 well. This waiver was verbally granted after the CA-7, first well of the 2002-2003 program, had logged the shallow formations.

During the drilling of the CA-3, however, severe fluid losses were encountered immediately upon spudding the well. The losses and associated control problems were of such a nature that the Operator opted to install the waived conductor pipe at the first opportunity, at 993 ft. However, cementing the conductor was accomplished with little or no returns and a top cement job was finally required. According to testimony, because of the severe circulation problems, the conductor pipe was run unexpectedly and the conductor shoe was set in an unknown geologic layer. The bottom of the conductor casing was later found to be within the anomalous sand deposit, thus reducing the integrity of the conductor shoe.

According to testimony, during drilling of the surface hole, loss circulation continued to be an ongoing and severe problem that ultimately exhausted the supplies of lost circulation control materials and gel on the rig. During tripping to set surface casing, a complete loss of fluid returns followed by the well going on vacuum immediately led to the shallow kick and diverter incident. To determine the cause of the unexpected lost circulation problems in the CA3, the Operator ran a suite of through-casing logs after the surface casing of the CA-3 was finally installed. These logs revealed that unexpectedly thick sand deposits were encountered in the CA-3 throughout the interval of the surface hole. According to testimony, the track of the CA-3 was within 100 ft of the track of the previously drilled CA-7, as designed, to the depth of the surface casing. Therefore, the Operator attributes the radical change in the morphology encountered in the CA-3 to a geologic anomaly undetected by shallow hazard surveys.

The Operator's engineering and geosciences personnel reported the through-casing logs of the CA-3 indicated a section of hole at approximately 1,200 ft had suffered deep invasion during drilling and cementing operations. According to the Operator, this highly permeable sand section is suspected of being the primary thief zone that caused the hydrostatic loss preceding the well kick, as well as the location of formation breakdown, which limited returns during cementing operations. The Operator was unable to determine if the zone of influx was also the 1,200 ft permeable sand streak, or if other permeable zones also contributed to the inflow.

The chronology of events during the drilling of the CA-4, after the completion of the CA-3, indicates that the well did not experience the drilling problems to the extent encountered in the CA-3, though the CA-4 did encounter lost circulation and no returns during cementing of the conductor pipe. However, the design of the CA-4 was significantly different than that of the CA-3. In the CA-4, the Operator drove new drive-pipe 188 ft deeper than that which had been installed for the CA-3. According to testimony, the deeper drive-pipe enabled the Operator to set the conductor casing at 1,331 ft rather than the 931 ft in the CA-3. In the CA-4, after the setting of the conductor casing at 1,331 ft, presumably isolating the primary thief zone encountered at approximately 1,200 ft in the CA-3, the surface hole for the CA-4 was drilled with normal fluid loss and the surface casing was cemented with full returns.

Conclusions

The loss of control and diverter incident consisted of a systemic loss of drilling fluids and severe circulation problems encountered while drilling the conductor and surface hole. During preparation to set surface casing, the well experienced a sudden, complete loss of circulation, followed by a vacuum that could not be stemmed by surface fill-up. This led to loss of differential pressure, followed by subsequent influx of water and a light cut of gas from a shallow, thick, geologically anomalous sand deposit found to be present throughout the depth of the conductor and surface hole of the CA-3 Well.

Cause of Loss of Control

The loss of control of the subject well was caused by loss of drilling fluids to a highly permeable, geologically anomalous, thick sand deposit encountered while drilling the conductor and surface hole of the CA-3 well. This sand zone had not been identified in four wells previously drilled from the Platform, and was encountered by the CA-3 well less than 100 ft from the nearest location of those wells.

Probable Cause of Loss of Control

The primary zone responsible for the loss of drilling fluid was probably the highly permeable sand encountered at approximately 1,200 ft as logged in the CA-3. The log showed that this zone was not only deeply invaded by drilling fluids, but was also the zone that likely broke down during cementing the conductor and surface casing strings.

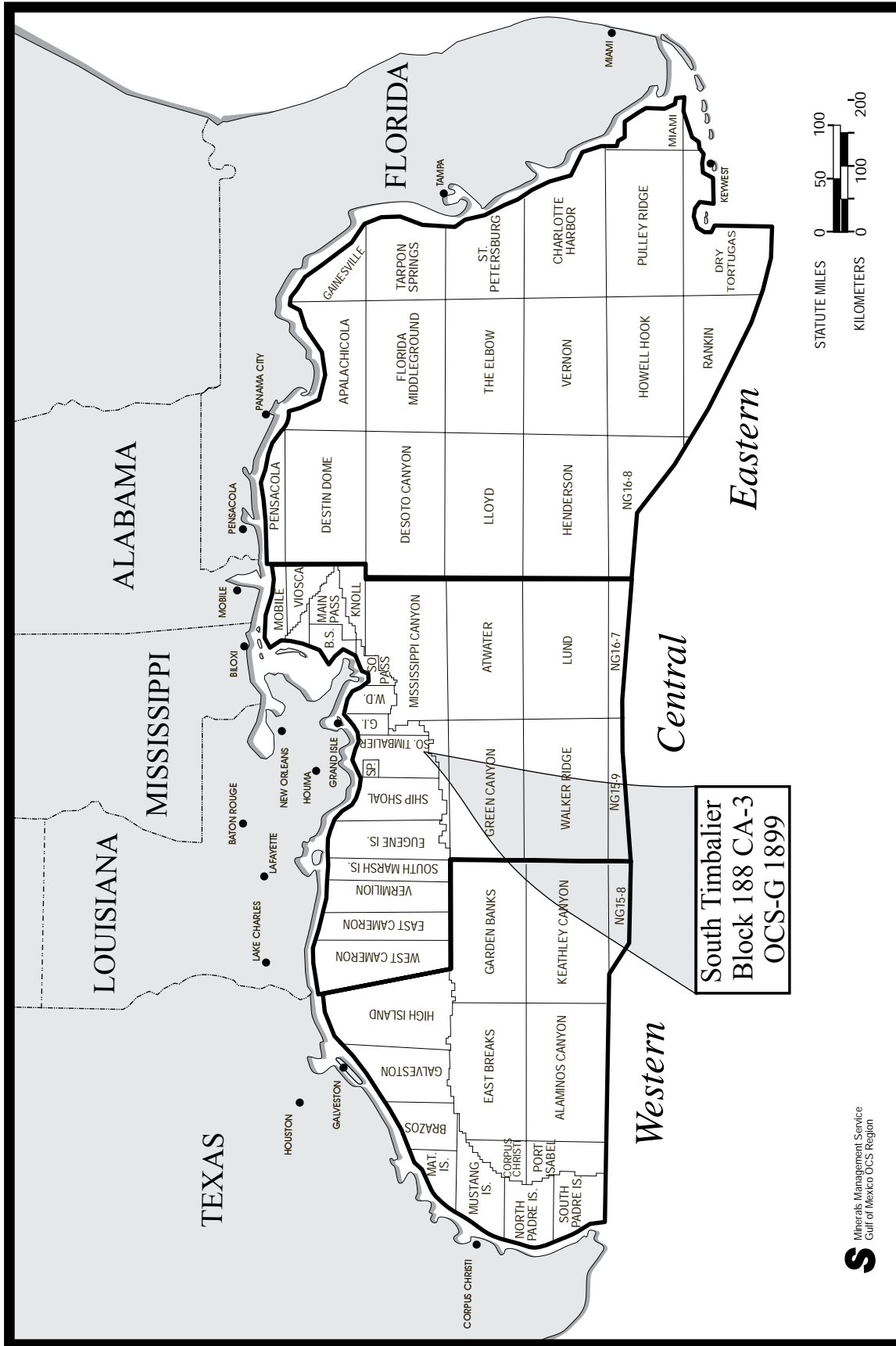
It is probable that the failure or inability to forecast the presence of the thick anomalous sand through use of sparker and shallow gas hazard surveys contributed to the incident. The lack of forewarning of the odd morphology probably contributed to the failure to plan for the difficult circulation problems encountered. The failure to anticipate the problems probably precluded adopting a drilling and casing plan that minimized the impact of the anomaly, such as the addition of new, deeper drive-pipe as used in the CA-4 well.

Possible Contributing Cause of Loss of Control

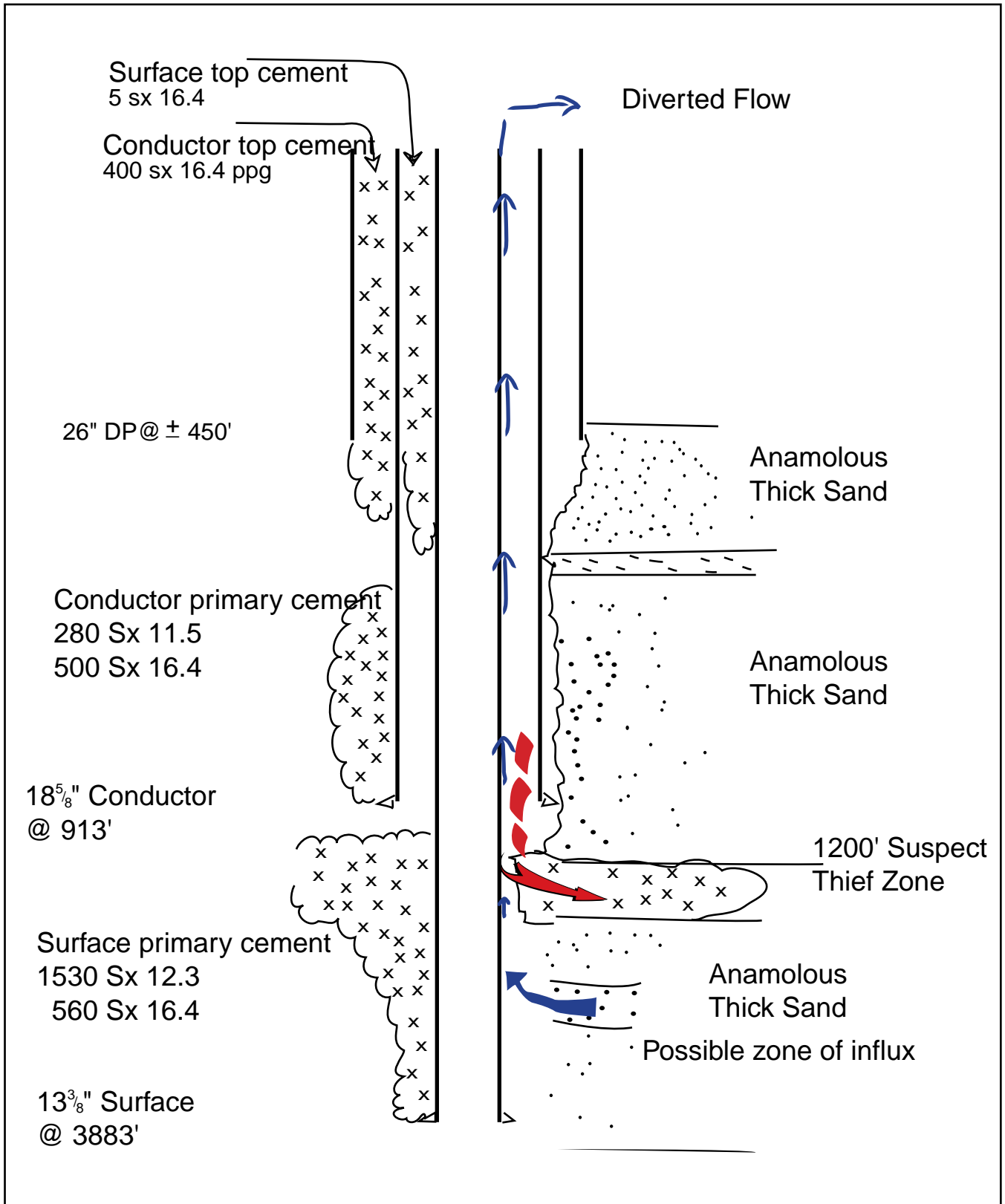
It is possible that the generic setting depth of drive-pipe for the CA-3 well at 150 ft – 170 ft below the mudline prevented the emergency isolation of the thief zone with conductor casing when the initial lost circulations problems were encountered. The drive-pipe of the subject well was possibly set by the Operator's construction department at a generic depth, rather than at a depth tailored to actual well-specific requirements determined by the Operator's drilling operations. It is possible that a thorough review by the drilling department of the setting of the original drive-pipe may have led the drive-pipe to be driven deep enough to allow the isolation of the main thief zone with conductor casing. This could have eliminated drilling the surface hole interval with the main thief zone exposed and may have reduced the risk of the loss of circulation that led to the diverter incident.

Recommendations

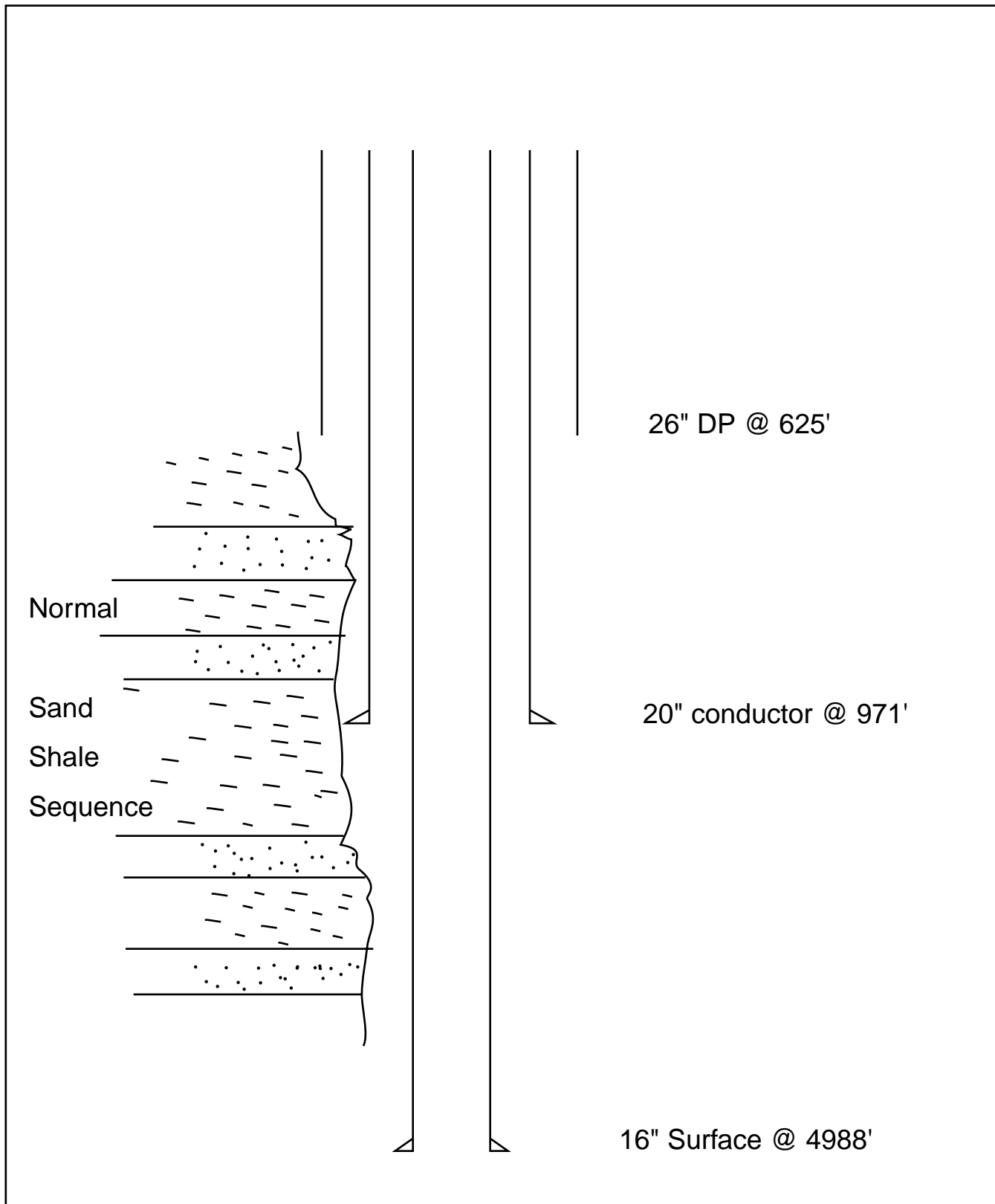
It is recommended that MMS issue a Safety Alert emphasizing the need for thorough geologic review of the shallow hazards, including morphologic ones, encountered in wells drilled from previously drilled locations.



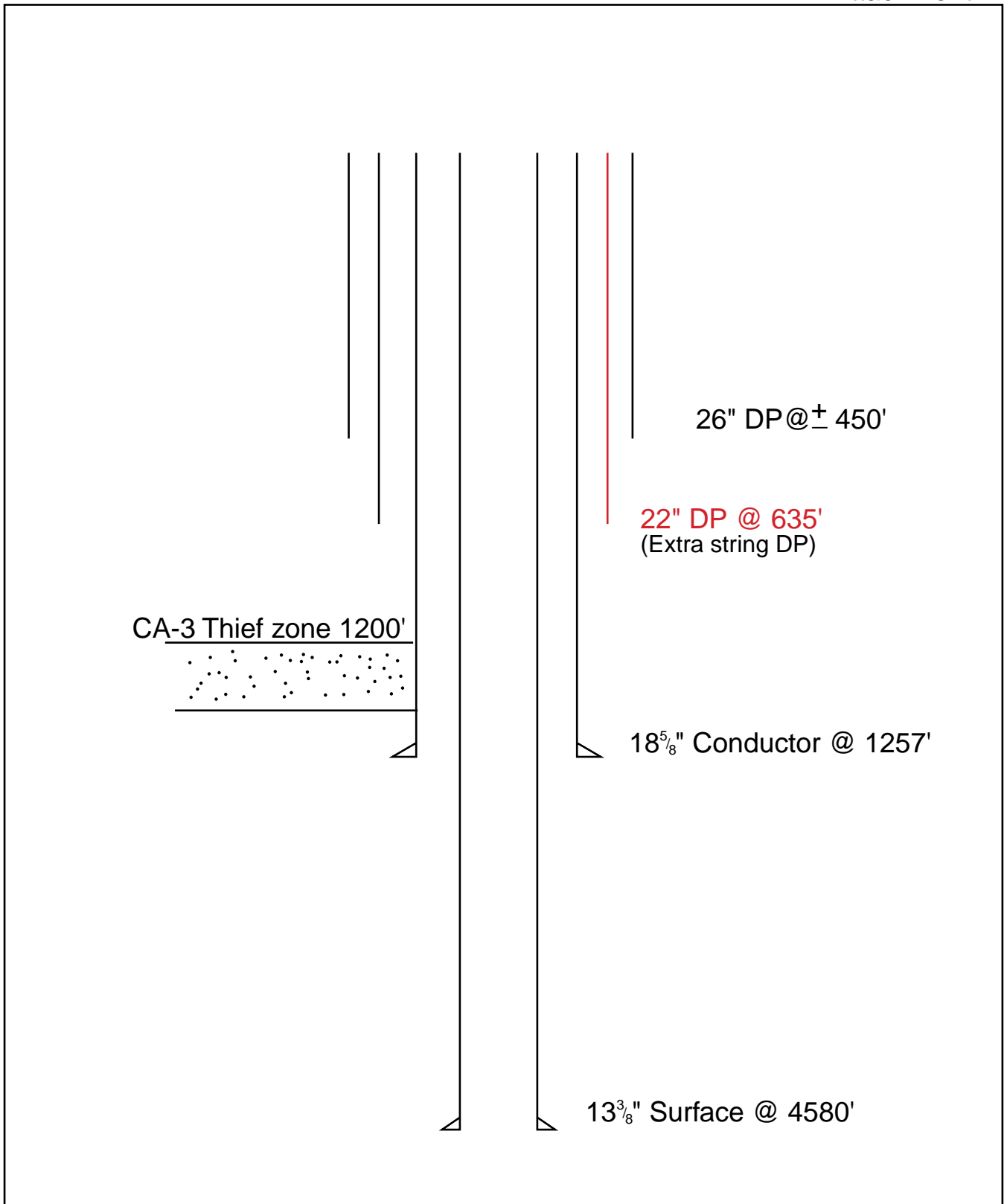
Location of Lease OCS-G 1899, South Timbalier Block 188 CA-3



South Timbalier Block 188 CA-3: to surface casing installation



South Timbalier Block 189 CA-7: to surface casing installation



South Timbalier Block 189 CA-4: to surface casing installation



The Department of the Interior Mission

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering sound use of our land and water resources; protecting our fish, wildlife, and biological diversity; preserving the environmental and cultural values of our national parks and historical places; and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to ensure that their development is in the best interests of all our people by encouraging stewardship and citizen participation in their care. The Department also has a major responsibility for American Indian reservation communities and for people who live in island territories under U.S. administration.



The Minerals Management Service Mission

As a bureau of the Department of the Interior, the Minerals Management Service's (MMS) primary responsibilities are to manage the mineral resources located on the Nation's Outer Continental Shelf (OCS), collect revenue from the Federal OCS and onshore Federal and Indian lands, and distribute those revenues.

Moreover, in working to meet its responsibilities, the **Offshore Minerals Management Program** administers the OCS competitive leasing program and oversees the safe and environmentally sound exploration and production of our Nation's offshore natural gas, oil and other mineral resources. The MMS **Minerals Revenue Management** meets its responsibilities by ensuring the efficient, timely and accurate collection and disbursement of revenue from mineral leasing and production due to Indian tribes and allottees, States and the U.S. Treasury.

The MMS strives to fulfill its responsibilities through the general guiding principles of: (1) being responsive to the public's concerns and interests by maintaining a dialogue with all potentially affected parties and (2) carrying out its programs with an emphasis on working to enhance the quality of life for all Americans by lending MMS assistance and expertise to economic development and environmental protection.