SANDIA REPORT

SAND2007-0483
Unlimited Release
Printed March 2007

Geologic Technical Assessment of the Chacahoula Salt Dome, Louisiana, for Potential Expansion of the U.S. Strategic Petroleum Reserve

Anna Snider Lord, Christopher A. Rautman and Karl M. Looff

Prepared by
Sandia National Laboratories
Albuquerque, New Mexico 87185 and Livermore, California 94550

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-AC04-94AL85000.
Approved for public release; distribution is unlimited.

Issued by Sandia National Laboratories, operated for the United States Department of Energy by Sandia Corporation.

Available to DOE and DOE contractors from
U.S. Department of Energy
Office of Scientific and Technical Information
P.O. Box 62
Oak Ridge, TN 37831

Telephone:(865)576-8401
Facsimile:(865)576-5728
E-Mail:reports@adonis.osti.gov
Online ordering: http://www.doe.gov/bridge

Available to the public from
U.S. Department of Commerce
National Technical Information Service
5285 Port Royal Rd
Springfield, VA 22161

Telephone:(800)553-6847
Facsimile:(703)605-6900
E-Mail:orders@ntis.fedworld.gov
Online order: http://www.ntis.gov/help/ordermethods.asp?loc=7-4-0#online

SAND2007-0483
Unlimited Release
Printed March 2007

Geologic Technical Assessment of the Chacahoula Salt Dome, Louisiana, for Potential Expansion of the U.S. Strategic Petroleum Reserve

Anna Snider Lord and Christopher A. Rautman
Sandia National Laboratories
P.O. Box 5800
Albuquerque, NM 87185

Karl M. Looff
Geologic Consultant
P.O. Box 546
Lovelady, TX 75851

ABSTRACT

The Chacahoula salt dome, located in southern Louisiana, approximately 66 miles southwest of New Orleans, appears to be a suitable site for a 160-million-barrel-capacity expansion facility for the U.S. Strategic Petroleum Reserve, comprising sixteen 10-million barrel underground storage caverns. The overall salt dome appears to cover an area of some 1800 acres, or approximately 2.8 square miles, at a subsea elevation of 2000 ft, which is near the top of the salt stock. The shallowest known salt is present at 1116 ft, subsea. The crest of the salt dome is relatively flatlying, outward to an elevation of –4000 ft. Below this elevation, the flanks of the dome plunge steeply in all directions. The dome appears to comprise two separate spine complexes of quasi-independently moving salt. Two mapped areas of salt overhang, located on the eastern and southeastern flanks of the salt stock, are present below –8000 ft. These regions of overhang should present no particular design issues, as the conceptual design SPR caverns are located in the western portion of the dome. The proposed cavern field may be affected by a boundary shear zone, located between the two salt spines. However, the large size of the Chacahoula salt dome suggests that there is significant design flexibility to deal with such local geologic issues.

Contents

Figures

Tables

Plates

INTRODUCTION

The Chacahoula salt dome is one of five salt domes that have been identified as possible candidates for an expansion site for the United States Strategic Petroleum Reserve (SPR). The SPR currently consists of four underground storage sites with a total capacity of 727 MBB of crude oil. The locations of the four active SPR sites are indicated on the regional index map of figure 1.

The Energy Policy Act of 2005 (P.L. 109-58) directs the U.S. Department of Energy (DOE) to investigate options for expanding the Reserve significantly, to its full Congressionally authorized capacity of one billion barrels. Although some of this expansion will be accommodated by the construction of additional storage capacity at one or more of the existing SPR sites, the magnitude of the required expansion dictates that at least one new site be considered.

The Chacahoula dome is located in northwestern Lafourche Parish, in southern Louisiana. The dome is positioned approximately 72 miles southeast of Baton Rouge and approximately 66 miles southwest of New Orleans. Specifically, the dome is located 8 miles southwest of the town of Thibodaux.

Chacahoula is one of the largest Gulf Coast salt domes. The dome measures approximately four miles from east to west and three miles from the north to south, within 10,000 ft of the surface (Magorian and Neal, 1990). Within the –2000 ft contour, the salt covers an area of approximately 1809 acres. Wells have encountered the shallowest caprock and salt at a sub-

Figure 1. Index map showing location of the four existing U.S. Strategic Petroleum Reserve facilities along the Gulf Coast of Texas and Louisiana, plus the location of the Chacahoula salt dome in southern Louisiana.

sea elevation of –875 and –1116 ft, respectively. The Chacahoula site ground surface is a swamp with an elevation of 6–7 feet (DOE, 1978).

This report describes the geology of the Chacahoula salt dome as it relates to potential selection of this site for SPR expansion. The description utilizes the best information available from the literature and petroleum industry sources.

GEOLOGY OF THE CHACAHOULA SALT DOME

Background

Gulf Oil Corporation discovered the Chacahoula salt dome in 1926 using refraction seismic data. In 1927, exploratory drilling penetrated caprock. The Gulf Oil Dibert Stark & Brown No. 25 well encountered salt in 1930. Sun Oil Company discovered petroleum in 1938, and production of oil and gas continued as of 1990 (Magorian and Neal, 1990).

The majority of oil production has been from the southern and eastern flanks of the dome. Most production on the north and west sides of the dome has been gas. Freeport Sulphur conducted sulfur mining operations, from 1955 to 1962, in the northeast-central region of the dome. Approximately 700 acres of the caprock were affected (DOE, 1978). Texas Brine Company still operates three brine caverns along the south-central flank of the dome (Magorian and Neal, 1990; Louisiana Dept. of Natural Resources website, sonris-gis.dnr.stae.la.us/gis/sonris/viewer.htm).

Previous Investigations

The geology of the Chacahoula salt dome has been documented by only a few sources in the open literature. The New Orleans Geological Society (NOGS) published a structure contour map of salt in 1961 (Spillers, 1962). The NOGS map has since been referenced by other authors, including Murray (1966) and the U.S. Department of Energy (DOE; 1978). An updated, visually simplified map was presented in 1990 by Magorian and Neal (1990). This reinterpretation incorporated a number of new wells drilled since 1961.

The current interpretation by Sandia National Laboratories, as described in this report, is similar to the original New Orleans Geological Society map of 1961 (Spillers, 1962). The Chacahoula dome is a shallow piercement dome. The dome has been described by Magorian and the DOE as a large elliptical structure with a rounded top and steeply dipping flanks. To the east, overhang is present below –8000 ft.

Most of the available well control is along the southern flank of the dome, where many wells have encountered salt at depths of approximately 4500 ft. The southern flank has been well defined as a consequence of intensive drilling, related to hydrocarbon production in this area. In comparison, the north flank of the dome has only poor well control. The massive dome is thought to be divided into several spine complexes.

The caprock is composed primarily of anhydrite with less abundant quantities of gypsum and calcite. A large number of faults are reported to cut through the caprock, and have created zones of lost circulation. The quality of the underlying salt is unknown (DOE, 1978).

Data

Data to support this assessment of the Chacahoula salt dome were acquired from a number of different sources. A database, containing locations and other basic data for historical oil & gas wells, was acquired from Tobin International, a commercial vendor of well-location data (www.tobin.com). Additional well-location information and basic well data were obtained from the Louisiana Depart-

ment of Natural Resources website (http://sonrisgis.dnr.state.la.us).

Geophysical well logs, oil-industry scout tickets, and well-completion cards were also obtained from commercial oil-industry sources. A large number of depths to the tops of caprock and salt were taken from table 1 of Magorian and Neil (1990). Some well information was extracted from the structure contour maps presented in the classical 1961 compilation of salt domes of Louisiana, published by the New Orleans Geological Society (Spillers, 1962)

A total of 587 documented wells have been drilled within approximately one mile of the Chacahoula salt dome. Of these wells, Sandia was able to acquire 290 electric/induction well logs and/or scout tickets and completion cards from oil-industry sources. Of the 290 available records, 37 wells document penetrating caprock, while 30 wells penetrate salt.

In addition to these verified intercepts of the salt dome, Magorian and Neal (1990) report an additional 27 wells that document the presence of salt. Another eight top-of-salt and 13 top-of-caprock depths were obtained directly from the 1961 structure-contour map (Spillers, 1962).

A comprehensive list of all the wells identified by this study is presented in Appendix A. Well locations in the immediate vicinity of the Chacahoula salt dome are plotted on the map which forms plate 1, located in the pocket in the back of this report. A smaller-scale version of this well-index map is presented as figure 2.

Notice on plate 1 that there is a small area in the east-central portion of the map for which the intensity of drilling is quite high. This area, shown in the red outline, was the principal location of past sulphur-mining activities. Mining was via the Frasch process, which involves injecting high-temperature steam and water into the formation, melting the crystalline sulphur, and extracting the molten material. An enlarged map of this local area is presented as plate 2. Note that the majority of these wells were drilled directionally. A smaller-scale version of this map is presented as figure 3.

A search for commercially available seismic data within the immediate vicinity of the Chacahoula salt dome was conducted by a broker of non-exclusive seismic data. Three seismic lines were identified that cross the Chacahoula field. The locations of these lines are shown in figure 4.

Of the three lines, only one line appears to be worth acquiring for potential reprocessing using current algorithms. The other two lines are of significantly lesser quality. The SEI 17/17A line was shot approximately from north to south, over the western portion of the dome. There are no records indicating the existence of 3-D seismic surveys in this area.

Caprock

Structure contours on top of caprock are presented as plate 3, in the pocket at the end of this report. A small-scale version of this map, slightly simplified to enhance readability, is presented as figure 5.

Caprock was mapped using only well control. The data are principally from scout tickets, and from wells drilled by Freeport Sulphur. The structure contour maps show that the dome is generally elongate from west to east. The caprock is shallowest in the south-central part of the dome, with intercepts at an elevation of –875 ft.

Overall, the caprock appears to be subdivided into two parts. The segment to the east exhibits the same trend as the overall dome, and it is elongate from west to east. The western portion of the caprock displays a different character: elongate from north to south. The

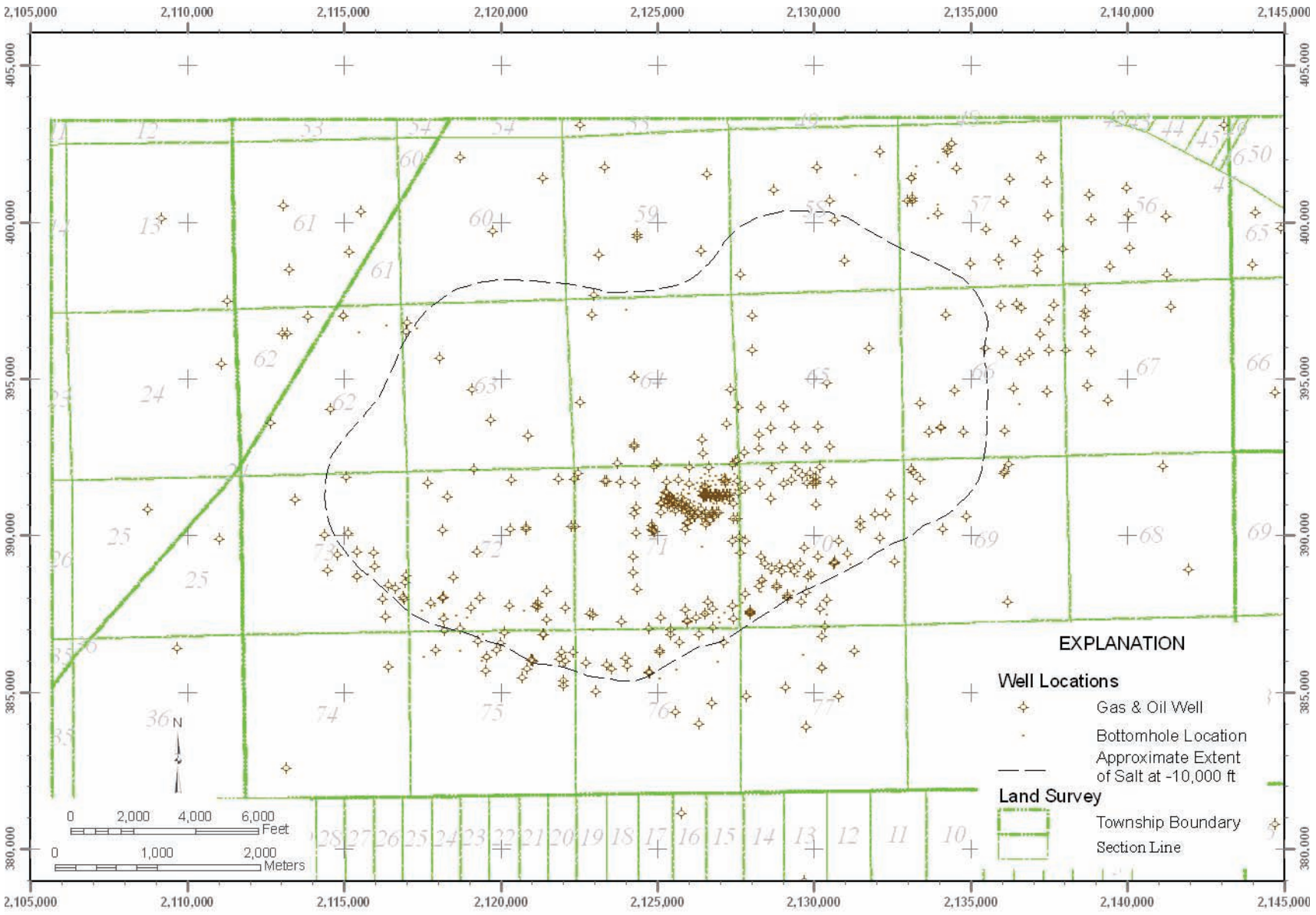


Figure 2. Map showing the locations of oil & gas well in the vicinity of the Chacahoula salt dome. This illustration is a small-scale version of Plate 1.

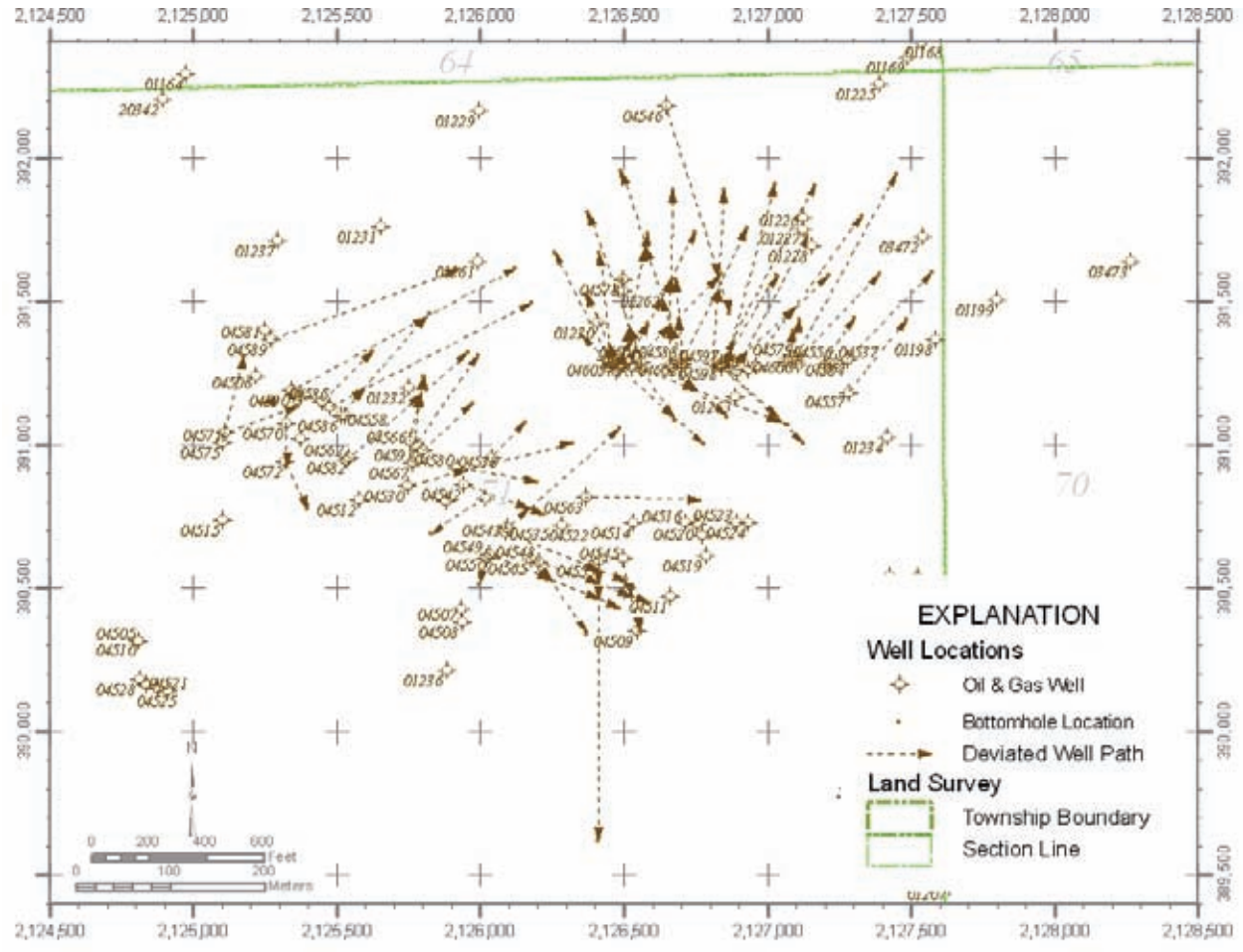


Figure 3. Location map showing well detail within the area affected by historical sulphur-mining activities.

top of caprock dips steeply towards the south, and in this area, it is well defined by drilling. The caprock to the north and west also dips at a rather steep angle, but the interpretation is defined by only sparse well control. Toward the northeast, the top of caprock appears to dip less steeply.

The structure contour map shown in figure 5 has been digitized and converted to a three-dimensional computer model, using the methodology of Rautman and Stein (2003). A top view of the model of the Chacahoula salt dome, showing the structure on the top of caprock, is presented in figure 6. In this visualization, the caprock surface is colored by its elevation below sea level. The flanks of the underlying salt stock, itself, are represented by the grey surface. Modeling of the salt is discussed later in this report.

Two perspective visualizations of this same 3-D model, showing the geometry of the salt dome caprock, are presented in figure 7. Figure 7(a) is a view from the southwest, and part (b) of the same figure is a view from the southeast. Visualization of the segmentation of the caprock is enhanced by both the perspective view and the use of a colored elevation scale.

Segmentation suggests the presence of two separate spine complexes. Differential movement of individual spines, with removal of

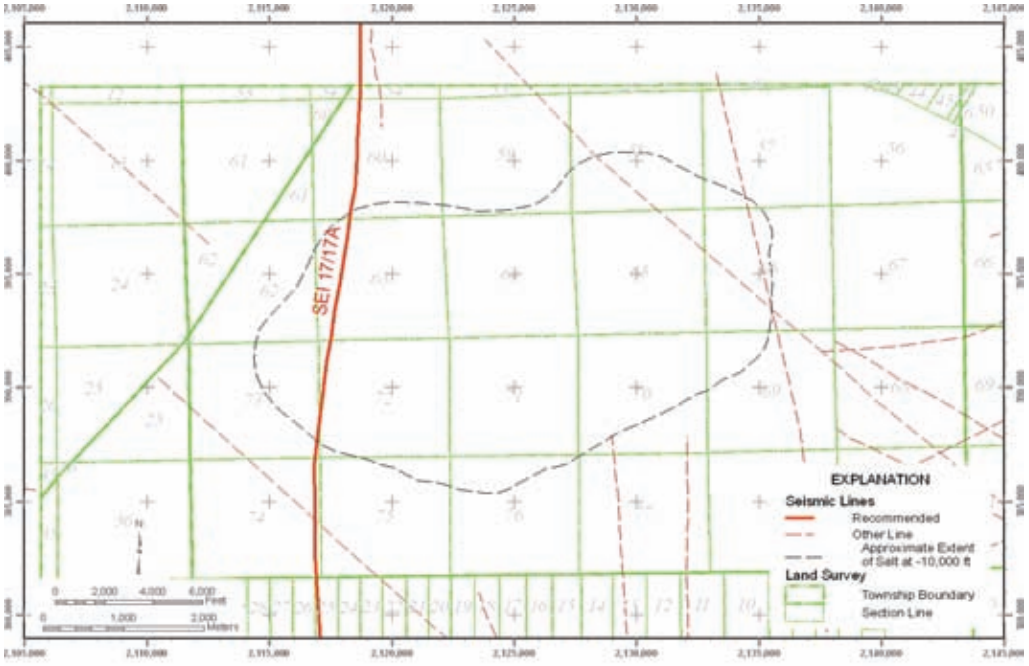


Figure 4. Index map showing approximate locations of 2-D seismic profiles identified in the vicinity of the Chacahoula salt dome.

varying amounts of upwelling salt by fresh ground waters, almost certainly took place in the underlying salt mass.

An isopach map, showing the thickness of the caprock unit is presented in figure 8. This 3-D computer model was created using data from both the top-of-caprock and top-of-salt and structure contour maps (the salt model is described below).

The elevations of grid nodes composing the model of the top of salt were subtracted from the elevations of the corresponding grid nodes constituting the top of caprock. These differences, representing the thickness at the node locations, are then modeled, contoured, and displayed using the color scheme indicated on the left-hand side of figure 8.

The modeled thicknesses indicate that the caprock unit is thicker beneath the two major structural culminations, shown in figures 5 to 7. The spatial correlation is quite pronounced. The north-south trending structural high, on the western side of the dome, is the location of the caprock exhibiting the greatest thickness: nearly 1000 ft.

The correlation of thick caprock with structurally high regions on the caprock surface is not unexpected. A greater thickness of caprock represents a greater accumulation of insoluble materials, from dissolution of slowly upwelling salt. As the top of the salt stock, itself, is continually dissolved at the base of ‘fresh” ground water, impurities accumulate and undergo diagenesis to form caprock anhydrite, gypsum, and/or limestone. Consequently, one can use thickened areas of caprock to identify the likely location of more rapidly moving salt. These semi-independently moving, semi-discrete portions of the salt dome are generally referred to as salt spines. The regions between different spines form what are termed boundary shear zones.

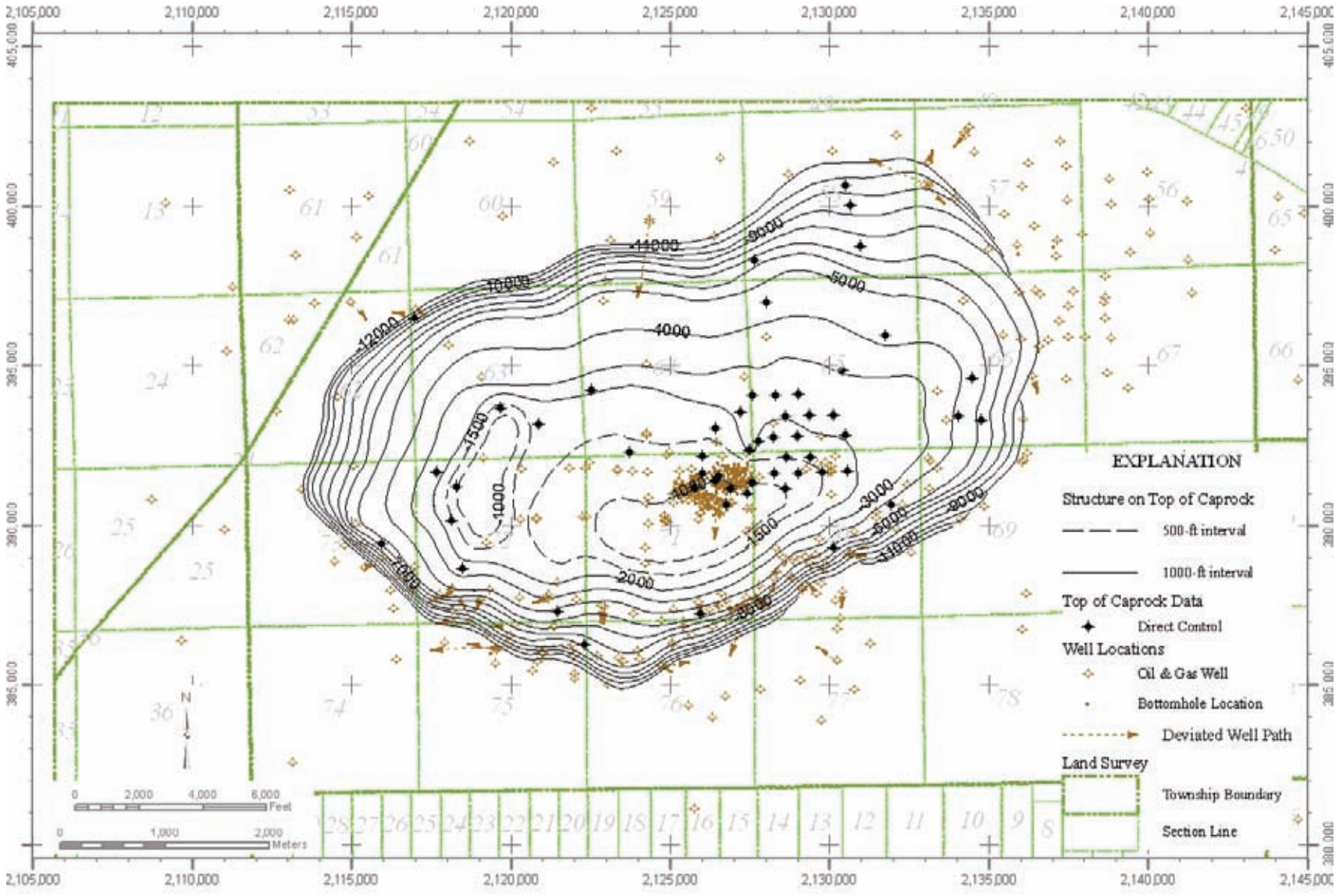


Figure 5. Structure contour map drawn on the top of the caprock.

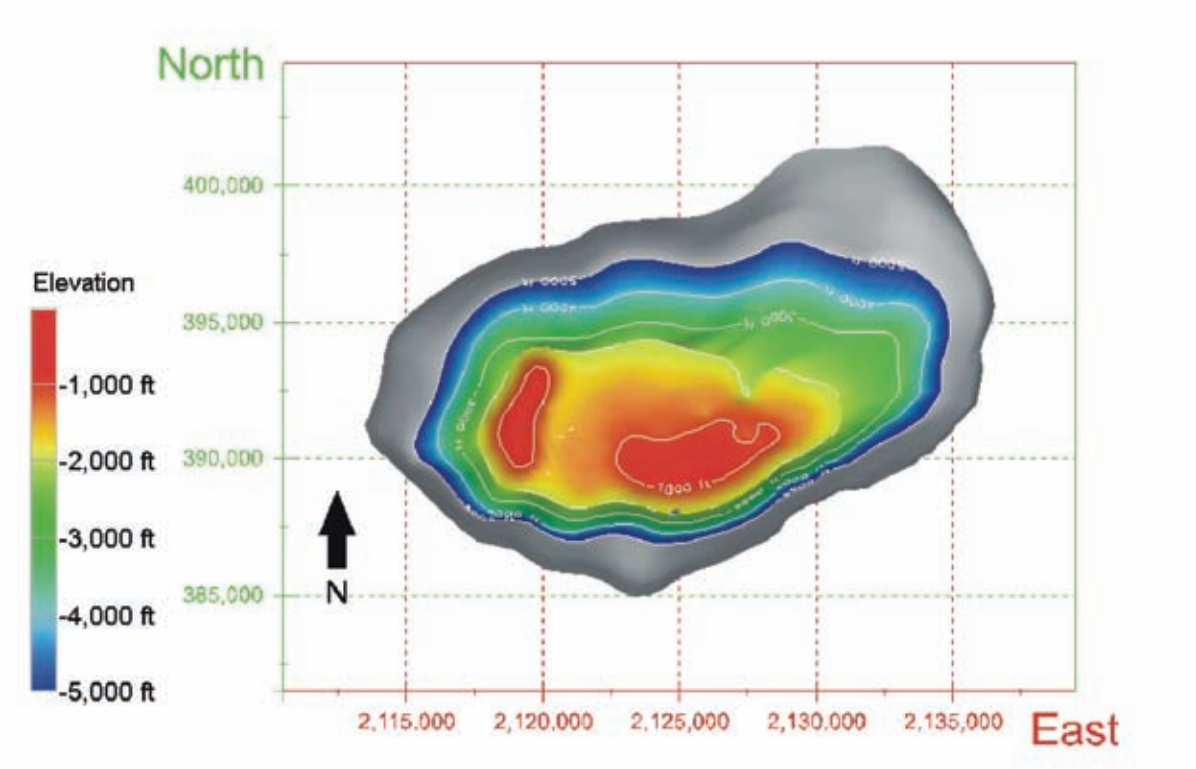


Figure 6. Map view of the three-dimensional computer model of the Chacahoula salt dome, showing geometry of the caprock. unit. Color scale represents elevation below sea level. Grey object represents the underlying salt stock.

In addition to the two regions of thicker caprock corresponding to the main structural high points of the top-of-caprock surface, there is a third prominent area of thicker caprock, located along the northern flank of the Chacahoula dome. This third area trends more or less east-west, and it appears to extend eastward from the northern terminus of the north-south-trending thick region on the western side of the dome (fig. 8). The origin of this third region of thick modeled caprock is obscure. However, we note that the structural form of the caprock in this northern-flank region is only poorly constrained by limited well control.

Salt

Structure contours drawn on the top of salt are presented on plate 4. A smaller-scale version of this map is presented as figure 9, only with the actual salt-intercept depths removed, in order to reduce visual clutter. The Chacahoula dome was mapped using only well control. The salt interpretation is similar to a map produced by the NOGS in 1961 (Spillers, 1962). The current map is refined, with the addition of new wells drilled during the past 45 or so years.

The salt stock is generally elongate from the west towards the east. The contours defining the dome form a crenulated pattern. The shallowest salt point, at an elevation of –1116 ft, is located in the central southwest region of the dome. The dome flank dips steeply to the south where there is good well control. The mapped salt flanks also dip steeply to the north and west, although well control is more sparse

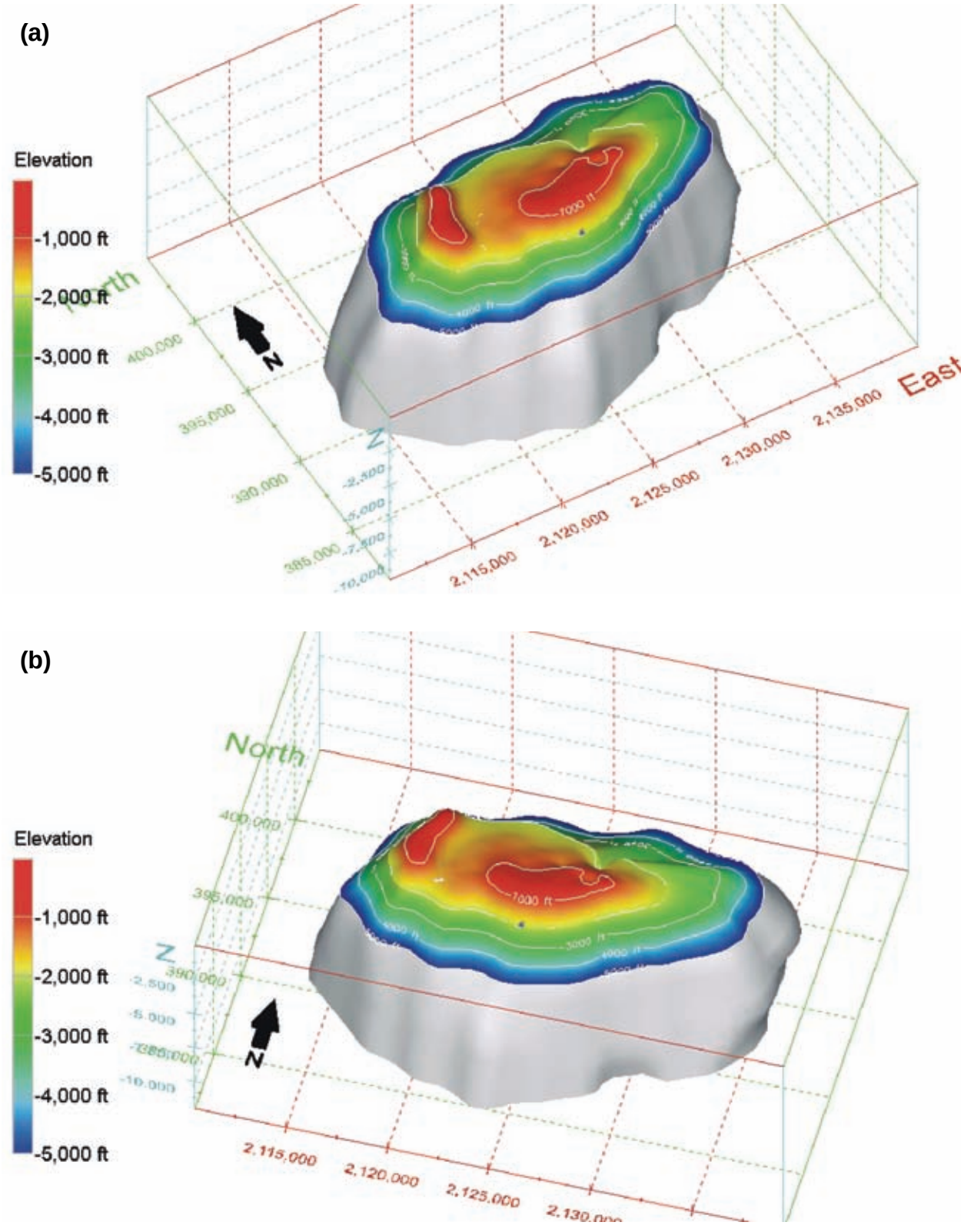


Figure 7. Perspective views of the 3-D model of the Chacahoula salt dome, emphasizing the structure of the caprock. Views are (a) from the southwest; (b) from the southeast. Color scale represents elevation below sea level. Grey object represents the underlying salt stock.

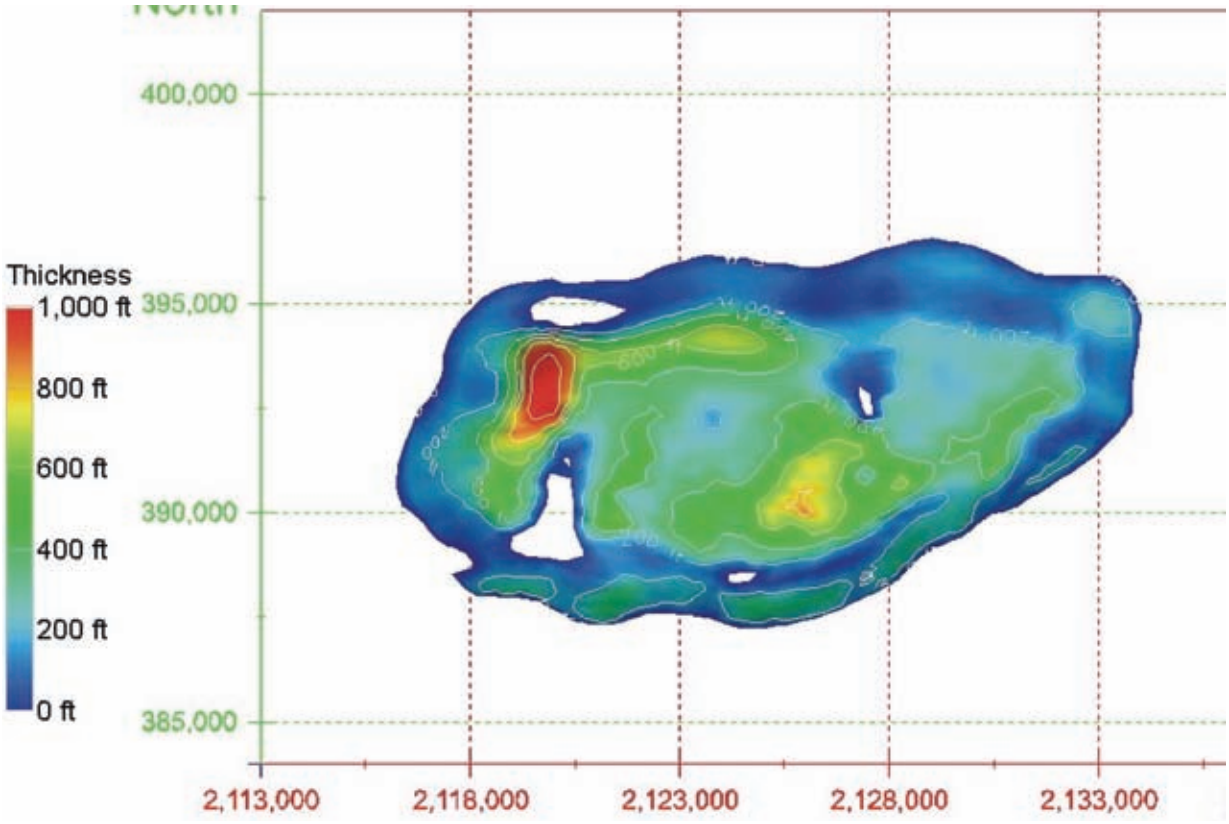


Figure 8. Map view showing the thickness model for the caprock unit at the Chacahoula salt dome. Color scale represents thickness, in feet.

in this area. Towards the northeast, the flank appears substantially less steeply plunging. This northeastern portion of the dome may represent the oldest salt.

Two regions of salt overhang have been mapped. The overhang to the east is the more severe, but it is present below –8000 ft elevation. The lesser overhang to the southeast is present below an even greater depth: –10,000 ft. Both of these areas of salt overhang are distinctly below proposed cavern depths, and thus they should be of little concern for SPR expansion activities.

Figure 10 represents the top view of the 3-D computer model developed from the structure contour map of figure 9. Conversion of the structure-contour map to a three-dimensional computer model used the methodology of Rautman and Stein (2003). Subsea elevations of the salt surface are colored by their elevation. The relatively flat upper surface of the salt mass, described previously on page 12, is quite evident in the uniform shades of red in this illustration.

Perspective visualizations of the three-dimensional model of the salt stock are presented in figure 11. Figure 11(a) is a view from the southwest, and part (b) of the same figure is a view from the southeast. The visualization of the overhangs at depth is more apparent. The two locations are marked by the arrows in figure 11.

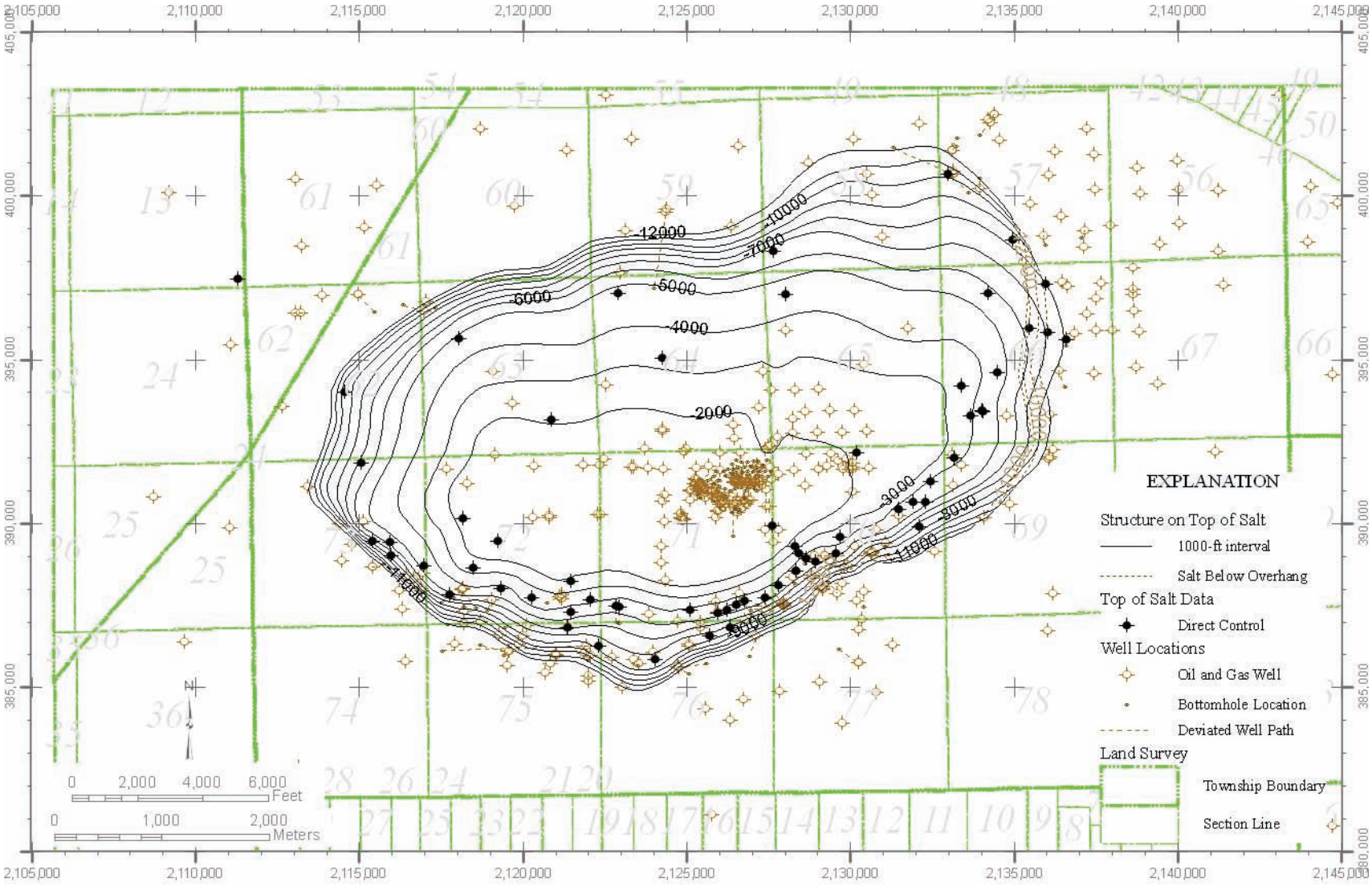


Figure 9. Structure contours drawn on the top of salt.

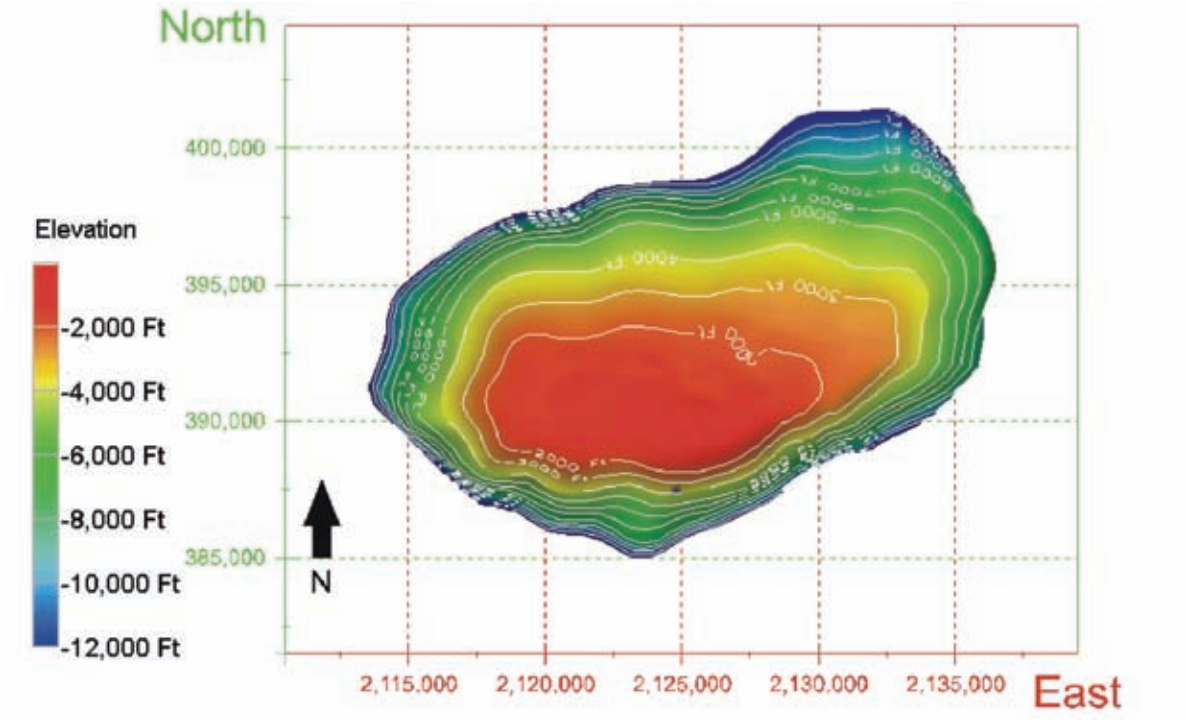


Figure 10. Map view of the three-dimensional computer model of the Chacahoula salt dome, showing the geometry of the top of salt. Color scale represents elevation of the salt surface below sea level.

The creation of a computer model also allows for three-dimensional visualization of well distribution with depth. This modeling tool allow a more comprehensive and intuitive presentation of how the well data control the dome interpretation. Figure 12 presents the distribution of well control over the Chacahoula dome, for both caprock and salt.

There is a large number of wells located along the southern flank. On top of the dome a group of wells are concentrated at previous sulfur mining area (plate 2; fig. 3). Well control is sparse along the northern flank. Figure 13 displays two different perspective views of the Chacahoula dome, showing locations and depths of available exploration wells and how those wells have influenced the interpretation of flank geometry, including the salt overhangs.

AREA AND VOLUME OF SALT AVAILABLE FOR DEVELOPMENT

The three-dimensional model of the Chacahoula salt dome have been used to generate quantitative estimates of the extent of salt nominally available for cavern development at this proposed site. We have produced estimates of both area and volume. These values are presented in table 1.

Table 1: Estimated Area and Volume of the Chacahoula Salt Dome

Area	ft^2	Acres	km^2
Caprock, at –2,000 ft	1.03×10^8	2,375	8.40
Salt, at –2,000 ft	7.88×10^7	1,809	7.32
Volume	**ft^3**	**m^3**	
Total Salt: 0–2,500 ft	4.53×10^{10}	1.28×10^9	
Total Salt: 0–4,500 ft	2.54×10^{11}	7.18×10^9	
Total Salt: 0–6,000 ft	4.93×10^{11}	1.40×10^{10}	
Interval 2,500–4,500 ft	2.08×10^{11}	5.90×10^9	

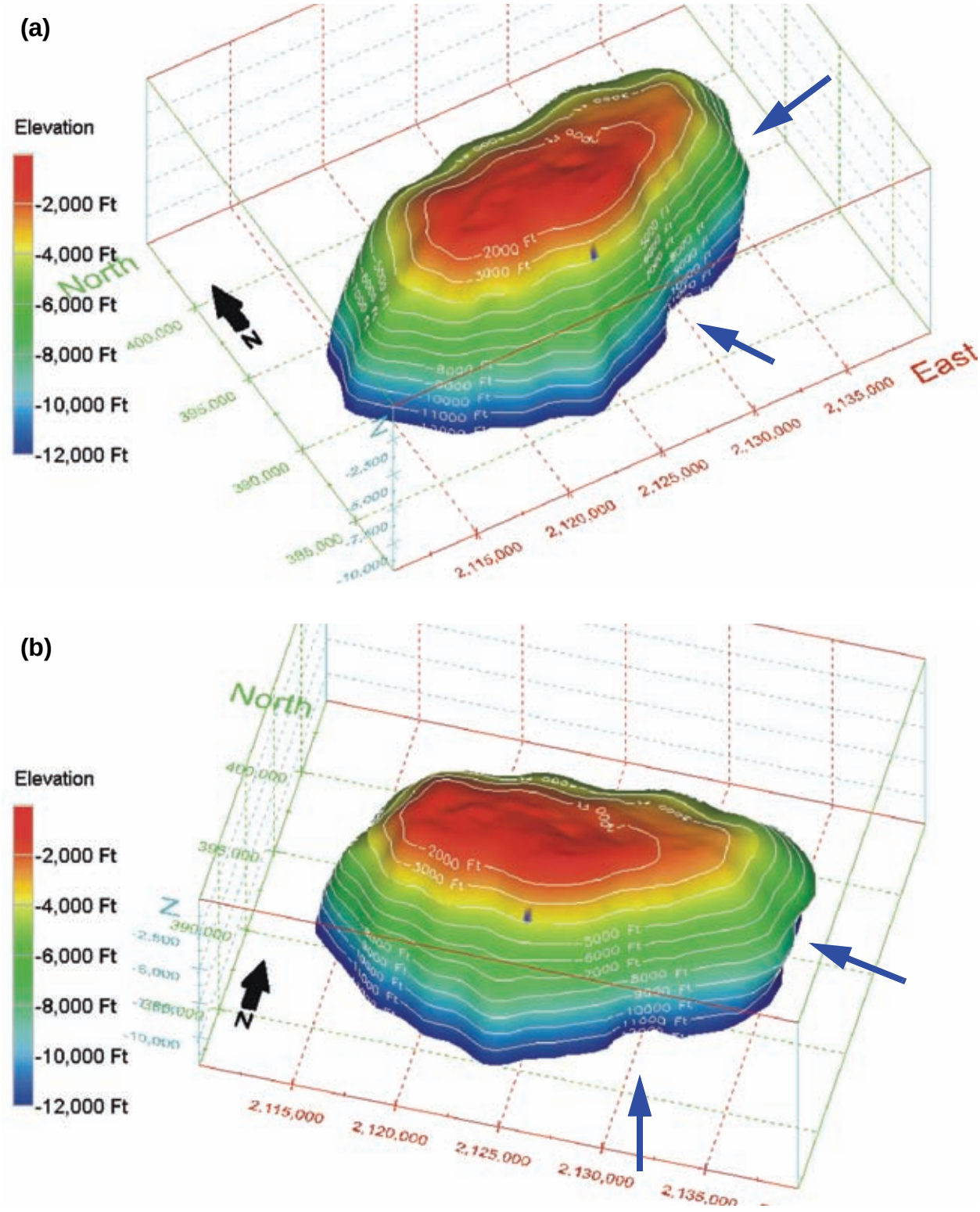


Figure 11. Perspective visualization of the three-dimensional computer model of the Chacahoula salt dome, emphasizing the structure on the top of salt. Views are (a) from the southwest; (b) from the southeast. Color scale represents elevation of the salt surface below sea level. Blue arrows mark the positions of the salt overhangs described in the text.

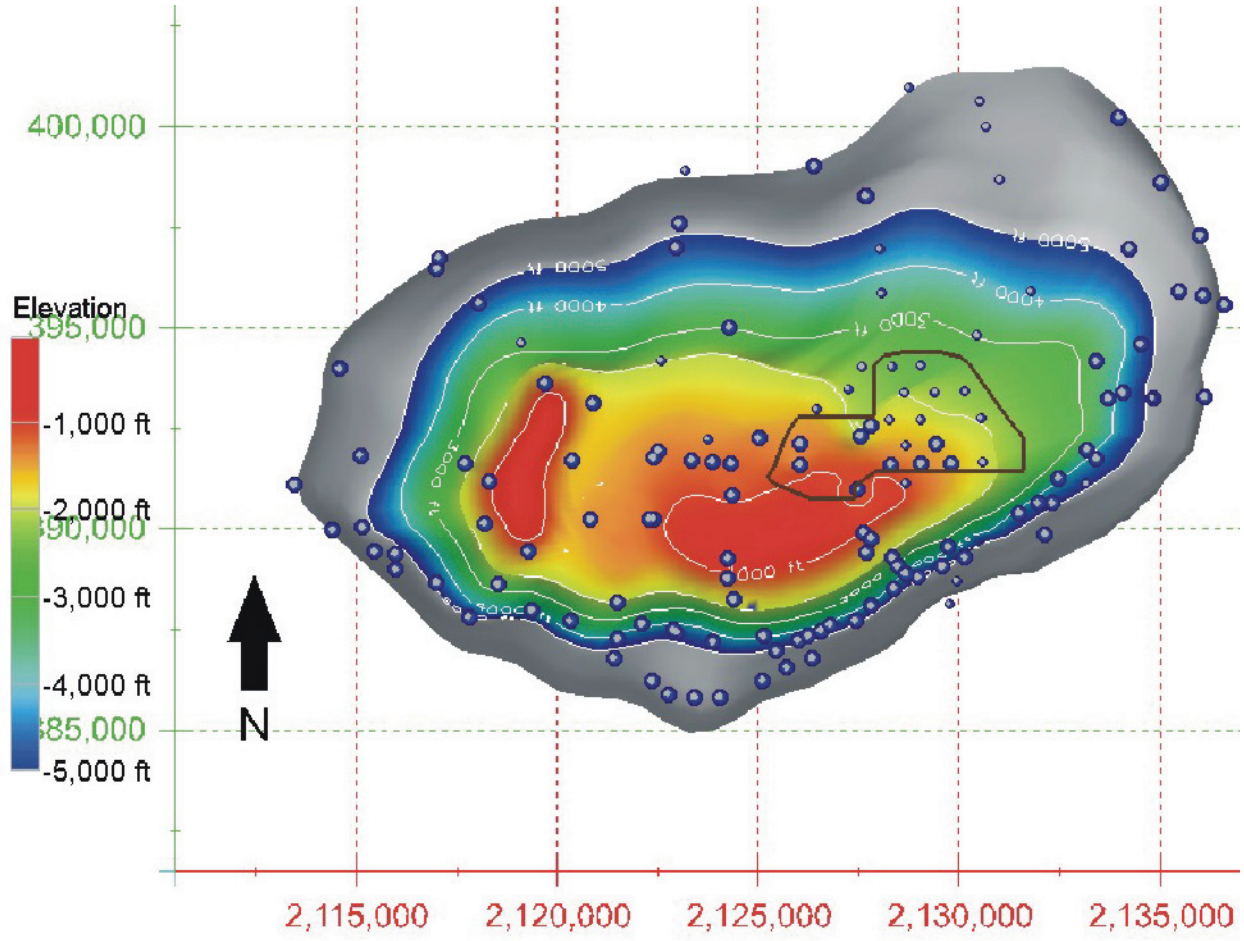


Figure 12. Top view of the model of the Chacahoula caprock and underlying salt stock, showing the distribution of the most relevant well control for mapping the salt dome (circles). The cluster of wells outlined by the irregular polygon in the eastern part of the dome is related to historical sulphur mining.

The area of the salt dome, at a subsea elevation of approximately 2000 ft, was roughly 1,809 acres, which is equivalent to approximately 2.8 square miles or 7.32 km^2. As suggested by examination of the geometric model of the salt stock (fig. 11) the area of salt increases somewhat with depth, to a depth of at least 8000 ft. The volume of the dome, from the salt crest to 6000 ft subsea, is estimated to be 4.93 x 10^{11} cubic feet (1.40 x 10^{10} m^3).

Current SPR cavern-design concepts specify construction of oil-storage caverns between depths of approximately 2500 and 4500 ft. Table 1 presents the volume estimates for the portion of the salt stock from the crest to subsea elevations of 4500 ft and 2500 ft. Differencing these two volume estimates yields the approximate volume of salt within the prime cavern interval. This volume is 2.08 x 10^{11} cubic feet or 5.90 x 10^9 cubic meters (table 1).

Conceptual Cavern Design

Figure 14 presents a conceptual-design layout of a 160-million barrel (MMB) SPR storage facility at the Chacahoula site (PBESS, 2006). The facility would consist of sixteen 11-MMB caverns, each with an oil capacity of 10 MMB. Figure 15 shows a perspective visu-

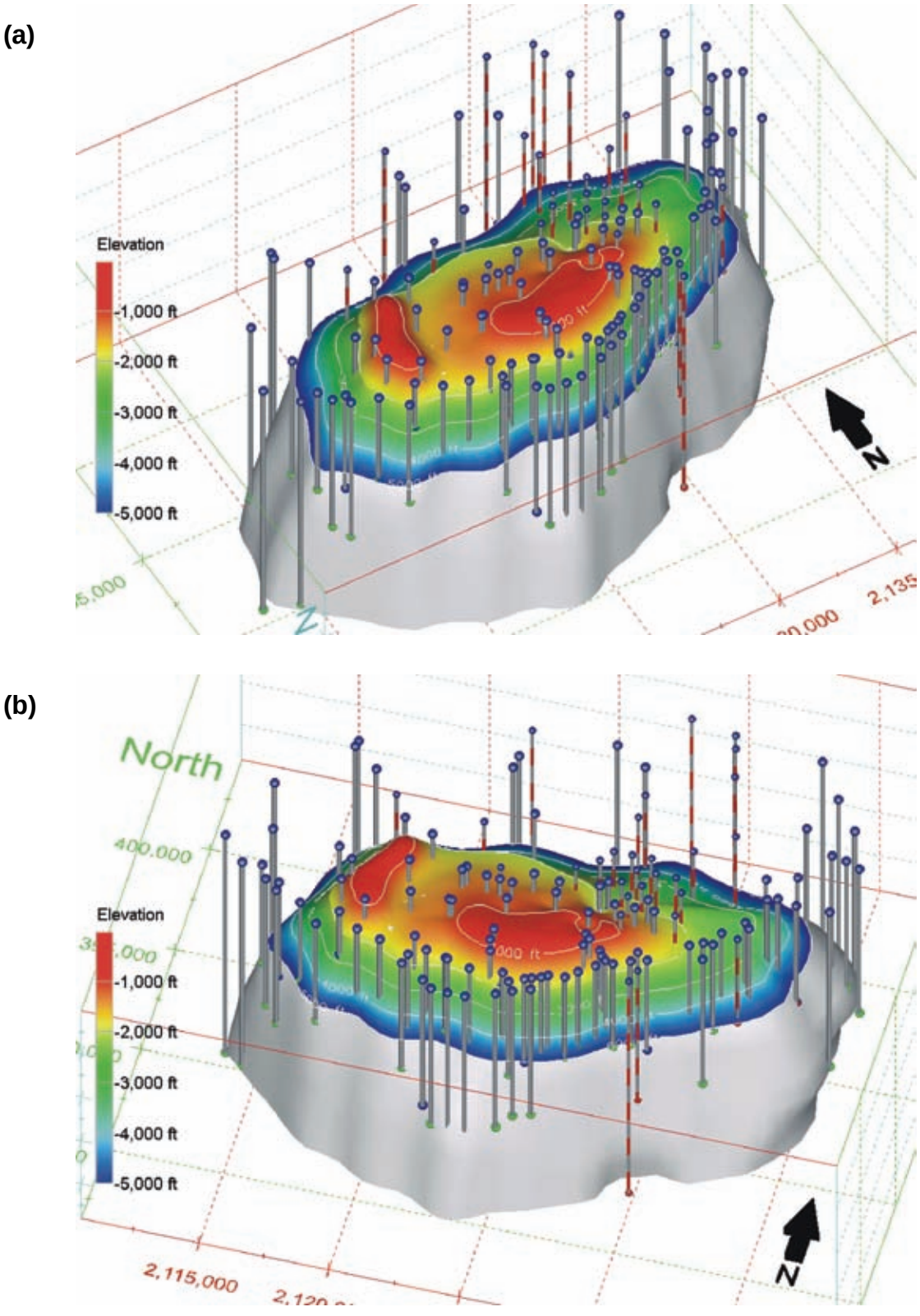


Figure 13. Perspective views of the model of the Chacahoula salt dome indicating the distribution of both direct and indirect well control. Views are from the (a) southwest and (b) southeast. Dark grey well paths indicate direct control; red-and-grey well paths represent indirect control points.

alization of the 16 caverns positioned within the salt stock. Note that the conceptual design was developed based upon pre-existing geologic descriptions of the Chacahoula salt dome, and was developed independently of this technical assessment study. Accordingly, the conceptual design has not been optimized.

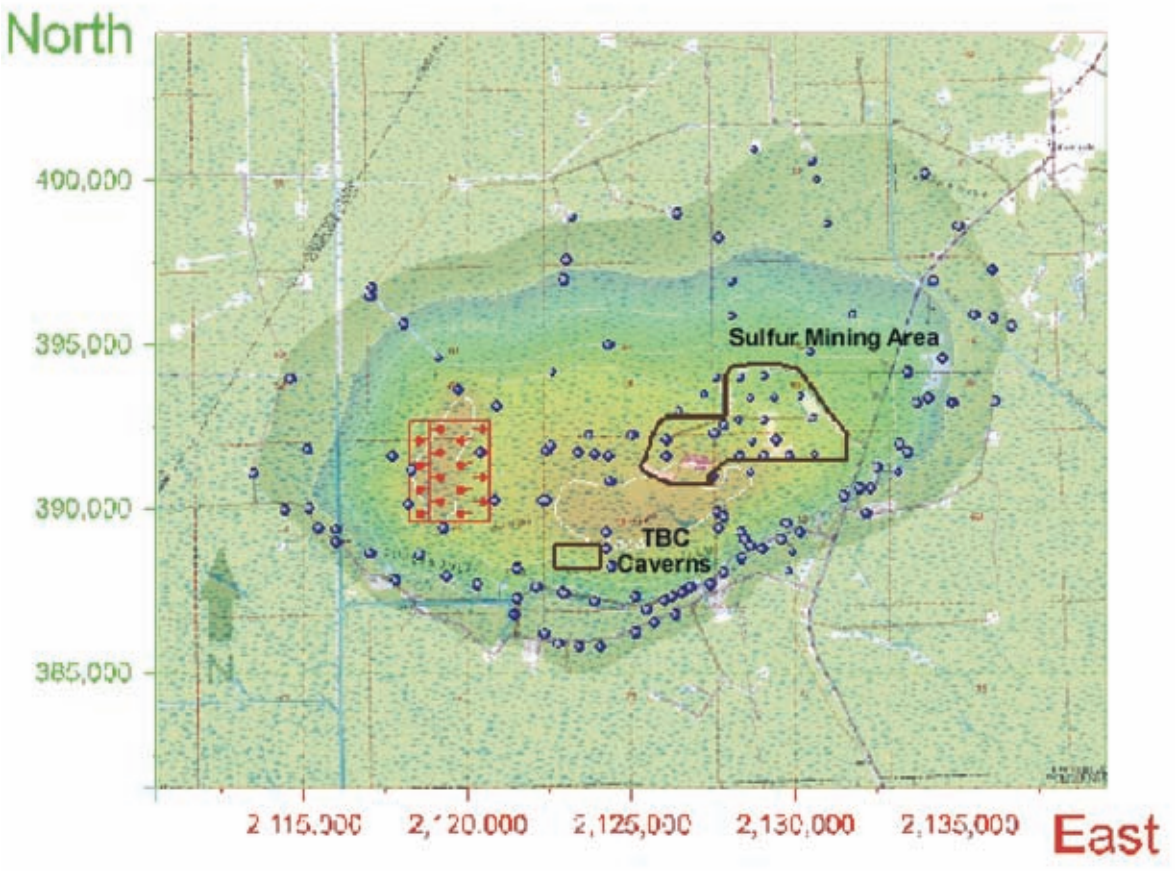


Figure 14. Conceptual design layout of a potential SPR expansion facility, in red, superimposed on the 3-D model of the Chacahoula salt dome (PBESS 2006). The locations of historical sulphur-mining activities and the approximate location of the Texas Brine Co. (TBC) brine caverns are also indicated.

The potential SPR expansion facility, as proposed by PBESS (2006), is positioned within the western portion of the Chacahoula dome. The western part of the salt stock appears generally suitable for cavern development. Reference to figures 14 and 15 indicates that the caverns, as proposed, would be located at substantial distances from the edge of the salt mass. There are no regions of meaningful salt overhang in this western part of the dome, as the flanks are currently mapped. Additionally, the overall large size of the Chacahoula dome suggests that significant flexibility of design exists, to accommodate any adverse geology revealed by more extensive geologic characterization.

The eastern part of the Chacahoula salt dome would appear, a priori, to be less favorable for development of a large underground storage facility. A non-trivial portion of this region was mined for sulphur deposits, within the caprock, using the Frasch process of injecting superheated water into the caprock to melt the sulphur.

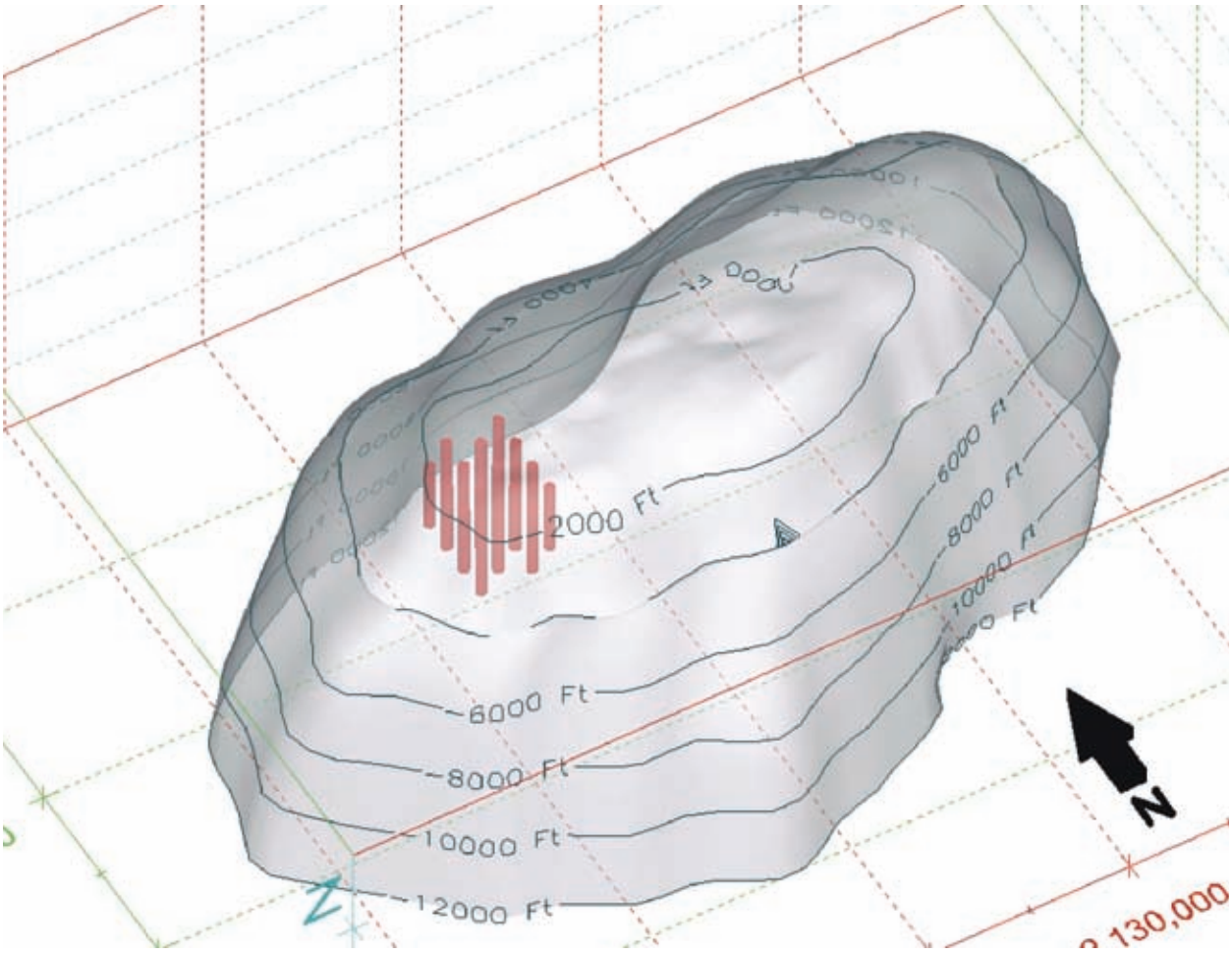


Figure 15. Perspective visualization of the conceptual-design SPR storage caverns (red), positioned within the partially transparent shell of the Chacahoula salt dome. View is from the southwest.

Very high residual temperatures, affecting a large area around the actual locus of mining, are known to persist for many decades after the cessation of such activities. In addition to exhibiting very significantly elevated temperatures, the caprock unit adjacent to historical sulphur-mining activities is likely to be pervaded by acidic and highly corrosive solutions. Corrosion of cavern well casings and consequent well failures are possible in the long term. Large expenses associated with continual monitoring of cavern wells are likely.

In addition to the restrictions imposed by the historical sulphur-mining activities, the Texas Brine Company owns and operates three brine caverns along the south central region of the dome. This area of brine caverns is shown in figure 14. The peripheral location of these caverns would not affect siting of the proposed SPR cavern field, as currently envisaged.

DISCUSSION

The Chacahoula dome is a very large salt mass that is elongate from west to east. Such large salt stocks are generally considered to

comprise several spine complexes (Kupfer, 1976). The two-part segmented geometry of the top of caprock, best illustrated in figures 6 and 7, suggests the presence of at least two, more-or-less distinctly separate, salt spines. The modeled presence of two discrete areas, within which the caprock thickness exceeds 800 ft, also suggests at least a two-fold subdivision.

The thickness of caprock may be taken as a first approximation of the quantity of slowly upwelling salt that has been dissolved, over time, by near-surface, relatively fresh ground waters. Thicker caprock represents a greater accumulation of anhydritic and other impurities within the dissolved salt, which in turn implies larger, and potentially faster, upward salt movement in such areas (Martinez, 1980).

Structurally low regions between such quasi-independently moving salt spines are considered to represent boundary shear zones, along which the differential movement of salt is accommodated. Boundary shear zones also may be suggested by contour reentrants, particularly on the top-of-salt surface, or by regions of substantially thinner caprock.

The isopach model of the Chacahoula salt dome, figure 8, indicates several regions (white) of thin to missing (?) caprock. These regions generally correspond to the geometrically low parts of both the caprock surface and the top of salt. They also appear to extend toward the locations of the stronger contour reentrants mapped on the top of salt.

Figure 16 presents an illustration of possible boundary shear zones, in relationship to the proposed caverns, as indicated by the preliminary conceptual design (PBESS, 2006). The figure indicates the likely presence of a boundary shear zone passing through, or along the eastern margin of, the proposed cavern field. This boundary shear zone would be the structural feature which divides the dome into the eastern and western segments, described previously.

In addition, it appears likely that there may be two additional boundary shear zones, of distinctly lesser relevance to the cavern field proposed by the conceptual design documents. One of these zones is located within the eastern part of the salt stock, and its presence is suggested by the very strongly reentrant structure contours on the north side of the east half of the dome. Interestingly, this contour reentrant trends essentially straight toward the area affected by historical sulphur-mining activites. Potentially, brecciation of the caprock that may have been part of the cause for localization of sulphur deposits in this area, may be related to this boundary shear zone.

The other possible boundary shear zone is suggested more by the thickness model of the caprock. In this model, shown in figure 8, there is a prominent, linear structural low trending from northeast to southwest, in approximate the center of the Chacahoula dome. This diagonally trending structural feature appears to originate, at both ends, at positions close to the southern and northern terminations, respectively, of the more north-south-trending western and eastern boundary shear zones. Should the Chacahoula salt dome be selected for actual expansion of the Strategic Petroleum Reserve, the locations of these boundary shear zones should be considered during advanced conceptual design.

Conclusions and Recommendations

The Chacahoula salt dome is one of five salt domes identified as a possible candidate for an expansion site for the Strategic Petroleum Reserve. A geologic assessment using only existing information has determined that Chacahoula is a suitable site for expansion. The salt dome at an elevation of –2000 ft extends across an area of approximately 2.8 square miles. The shallowest caprock intersect

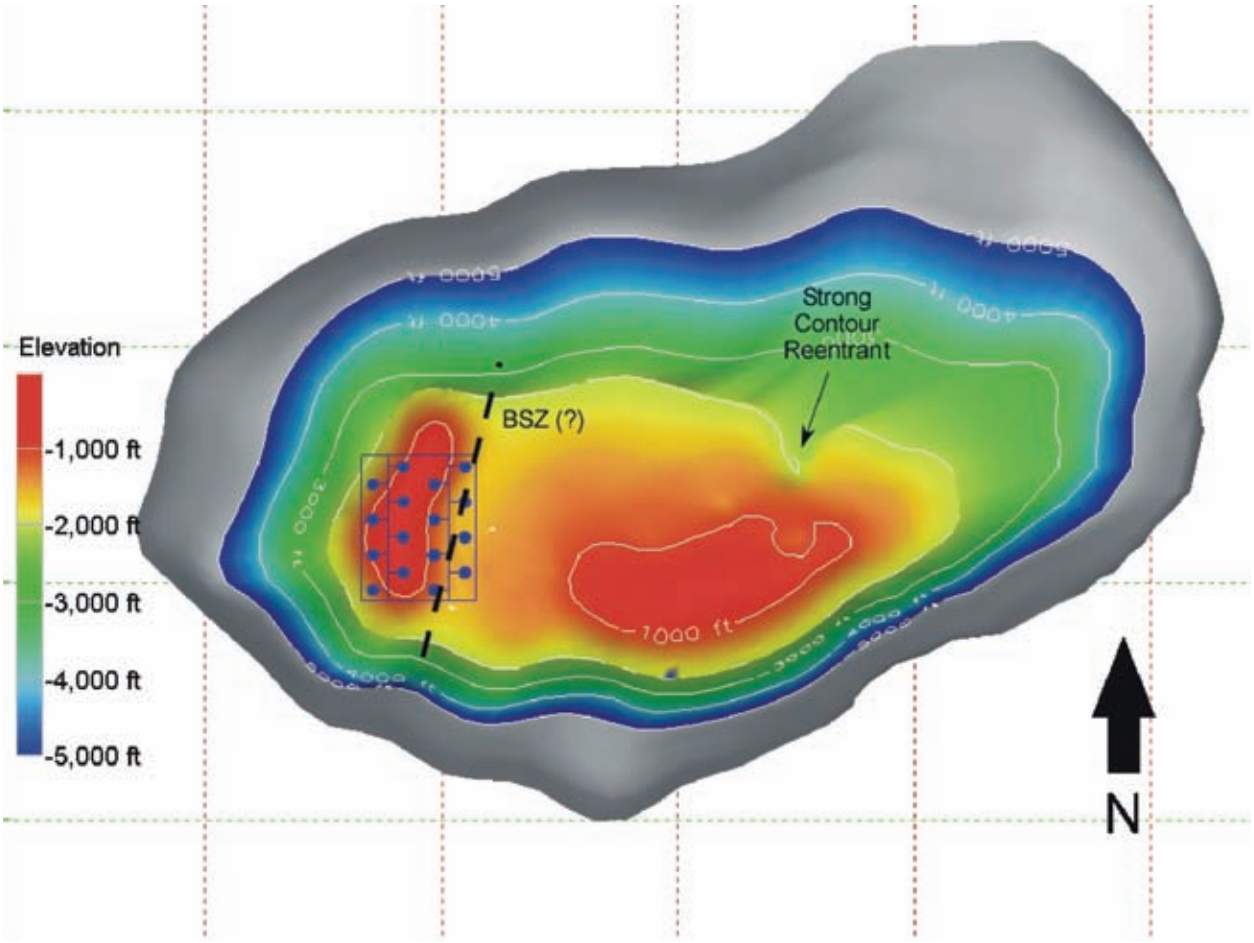


Figure 16. Top view of the Chacahoula salt dome and caprock. Proposed SPR cavern layout is indicated in blue. Potential boundary shear zones (BSZ) are represented by dashed black lines.

is at –875 ft. The shallowest salt reached was documented at –1116 ft. Chacahoula is a large dome that is fairly flat to the –4000 ft contour line. The flanks plunge steeply on all sides, particularly to the south were well control is relatively dense. The structure contours on top-of-caprock along with corresponding areas of caprock thickness exceeding 800 ft infer that Chacahoula consists of at least two spinal complexes. Contour reentrants mapped on top of salt suggest the presence of boundary shear zones that could affect cavern development. The Chacahoula dome has two overhangs one to the east and one over the southeast flank. Both overhangs occur below –8000 ft and should not impact cavern development.

The acquisition of seismic data would be desirable. In particular the acquisition of the 2D seismic line SEI 17/174, which runs across the northwest quadrant where the proposed site is to be located, would add more control to the western region of the dome. In addition, little can be said about the salt quality of the dome and the internal structure and fabric can only be postulated.

Based on the analysis presented in this report Sandia believes that the Chacahoula salt dome is a suitable site for expansion by the Strategic Petroleum Reserve. The dome could be developed as is, but as the project progresses and additional data are acquired the

information should be incorporated into the geologic model. The western region of the salt dome has sufficient area and volume available for cavern development. It is apparent that the proposed placement of caverns within the salt dome will not be affected by depth of salt and they have been placed a sufficient distance from edge of salt.

REFERENCES

DOE [U.S. Department of Energy], 1978. *Capline Group Salt Domes; Environmental Impact Statement,* Washington D.C., 4 volumes.

Kupfer, D.H., 1976. *Shear zones inside Gulf Coast salt stocks help to delineate spines of movement.* Am. Assoc. petrol. Geologists Bull., v. 60, no. 9, p. 1434–1447.

Magorian, T.R., and Neal, J.T., 1990. *Petroleum storage potential of the Chacahoula salt dome, Louisiana*. Sandia Report SAND89-2894, Sandia National Laboratories, Albuquerque, N. Mex., 28 p.

Martinez, J.D., 1980. *Salt dome caprock: a record of the geologic processes.* Fifth International Symposium on Salt, Northern Ohio Geological Society, Cleveland, O., v. 1, p. 143–151.

Murray, G.E., 1966. Salt structures of Gulf of Mexico Basin: A review. *American Association of Petroleum Geologists Bulletin,* v. 50, no. 3, p. 439–478.

PBESS [PB Energy Storage Services, Inc.], 2005. *Proposed Chacahoula SPR facility, Lafourche Parish, La., 160 MMB crude oil storage facility, Vicinity map.* AutoCAD drawing. 50534A-C-CH001, dated March 22, 2006. 1:6,000.

Spillers, J.D. (ed.), 1962. *Salt domes of south Louisiana*. New Orleans Geological Society, New Orleans, La., v. II., 107 p.

Rautman, C.A., and Stein, J.S., 2003. *Three-dimensional representations of salt-dome margins at four active Strategic Petroleum Reserve sites*. Sandia Report SAND2003-3300, Sandia National Laboratories, Albuquerque, N. Mex., 70 p.

APPENDIX A TABULATION OF WELL DATA FOR THE CHACAHOULA SALT DOME

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2143057	403088	00057	Texas Gas Expl. Corp.	Chacahoula Gas Unit	2	45	12798	-	-	-	-	-
2141209	400179	00060	Texas	Howell, R.B.	1	56	13460	-	-	-	-	-
2141226	398320	00061	Texas	Howell, R.B.	2	56	12932	-	-	-	-	-
2138748	400860	00062	Humble	Frost, A.G.	1	56	12852	-	-	-	-	-
2139962	401068	00063	Humble	Chacahoula Unit 9	1	56	12745	-	-	-	-	-
2140029	400214	00064	Humble	Coulon, C.J.	5	56	12760	-	-	-	-	-
2138830	400079	00065	Humble	Coulon, C.J.	6	56	12750	-	-	-	-	-
2140036	399156	00066	Humble	Coulon, C.J.	7	56	13122	-	-	-	-	-
2139416	398554	00067	Humble Oil & Refg. Co.	Coulon, C.J.	8	56	12543	-	-	-	-	-
2134541	401706	00068	Sun Oil	Levert Land Co.	1A	57	13713	-	-	-	-	-
2133092	401403	00069	Sun Oil	Levert Land Co.	2A	57	14284	-	-	-	-	-
2137211	402043	00070	Humble	Frost, A.G.	1B	57	13253	-	-	-	-	-
2136227	401371	00071	Markley T.G.	Guillot, L.	1	57	13020	-	-	-	-	-
2137426	401259	00072	Humble	Adams, C.J.	1	57	13456	-	-	-	-	-
2136029	400643	00073	Sun-Humble	Roger Unit	1	57	12497	-	-	-	-	-
2133117	400675	00074	Pan Am	Levert, J.B. Land	1	57	10914	-	-	-	-	-
2137443	400211	00075	Humble	Cletus, Adams	1B	57	12741	-	-	-		-
2134958	398671	00076	Markley & L. Russell T.G.	Mire, I.M.	1	57	11414	-	-	-	[a]8817	[a]9507
2136412	399371	00077	Alfred C. Glassell, Jr.	Rogers, J.	1	57	11500	-	-	-	-	-
2137127	398945	00078	Humble	Adams	3	57	12370	-	-	-	-	-
2137107	398436	00079	Humble	Chacahoula Oil Unit 10	1	57	12717	-	-	-	-	-
2128699	401012	00081	Cabot Oil & Gas Corp	Levert-Morvant	3	58	14260	-	-	-	[b]12080	-
2132099	402221	00082	Sun Oil	Levert-Morvant	4	58	15500	-	-	-	-	-
2130483	400659	00083	Sun Oil	Levert-Morvant Inc.	1	58	10743	-	10720	-	-	-
2130631	400052	00084	Sun Oil	Levert, J.B. Land	2	58	9795	-	-	9772	-	-
2130969	398744	00085	Sun Oil	Levert, J.B. Land Co.	1	58	8026	-	-	7106	-	-
2127639	398321	00086	Lucerne Corp.	Levert, J.B. Land Co.	1	58	6530	-	6277	-	6467	-
2126581	401507	00087	Sun Oil	Dibert, Stark & Brown	35	59	16027	-	-	-	-	-
2123119	398946	00088	Sun Oil	Dibert, Stark	43	59	15017	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2124338	399521	00089	Sun Oil	Dibert, Stark & Brown	46	59	14306	-	-	-	-	-
2126364	399059	00090	Sun Oil	Dibert, Stark & Brown	77	59	11906	-	-	-	[b]11880	-
2119724	399702	00091	Sun Oil	Dibert, Stark & Brown	37	60	16296	-	-	-	-	-
2116978	396500	00092	Sun Oil	Dibert, Stark & Brown	65	63	10609	-	-	-	[a]10527	-
2118027	395652	00093	Sun Oil	Dibert, Stark & Brown	76	63	7600	-	-	-	4908	-
2119072	394659	00094	Sun Oil	Dibert, Stark & Brown	78	63	3551	-	[b]3477	-	-	-
2122532	394234	00095	Freeport Sulphur	Dibert, Stark & Brown	5	64	2337	-	2097	2303	-	-
2124258	395062	00096	Gulf Refg. Co.	Starks, Dibert & Brown	25	64	5150	-	-	-	[a]3462	-
2127996	397010	00097	Chas. B. Wrightsman	Cypress, Lothman	2	65	4696	4457	-	-	-	-
2128022	395908	00098	Chas. B. Wrightsman	Cypress, Lothman	1	65	3615	-	-	-	-	-
2130406	394858	00099	Sun Oil	Dodge, Sundberry & Lothman	1	65	3222	-	3187	-	-	-
2131744	395961	00100	Sun Oil	Dodge, Sundberry & Lothman	2	65	4259	-		4217	-	-
2127559	394077	00101	Freeport Sulphur	Dodge, Sundberry & Lothman	10	65	2395	-	2237	2353	-	-
2128279	394094	00102	Freport Sulphur	Dodge, Sundberry & Lothman	12	65	2496	-	2342	2447	-	-
2129000	394108	00103	Freport Sulphur	Dodge, Sundberry & Lothman	9	65	2601	-	2427	2563	-	-
2134187	397017	00104	Oliphant A.G.	Frost, A.G.	1	66	5988	-	-	-	5922	-
2135943	397326	00105	Sun Oil	Lyric Realty & Parking Co.	5	66	11133	-	-	-	[a]8177	[a]8747
2137632	397332	00106	Sun Oil	Lyric Realty & Parking Co.	7	66	13402	-	-	-	-	-
2135435	395953	00107	Sun Oil	Lyric-Drexler Unit 1	1	66	10160	-	-	-	[a]6287	[a]9957
2136009	395853	00108	Sun Oil	Lyric Realty & Parking Co.	6	66	12003	-	-	-	7297	8667
2137207	396392	00109	Sun Oil	Lyric-Realty & Parking Co.	2	66	10200	-	-	-	-	-
2137488	395895	00110	Sun Oil	Lyric Realty & Parking Co.	1	66	11131	-	-	-	-	-
2137996	395894	00111	Sun Oil	Rob 3 Sand Unit 4	9	67	13010	-	-	-	-	-
2133382	394218	00112	Sun Oil	Drexler Unit	1	66	3878	-	-	-	[a]3637	-
2134465	394618	00113	Shoreline Drlg. Co.	Leray, O.	1	66	4483	-	4647	-	4687	-
2138629	397809	00115	Humble	Coulon, C.J.	4	67	9695	-	-	-	-	-
2138629	397143	00116	Humble	Coulon, C.J.	3	67	10045	-	-	-	-	-
2138620	397001	00117	Humble	Coulon, C.J.	9	67	13100	-	-	-	-	-
2138631	396485	00118	Humble	Coulon, C.J.	2	67	10159	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2138814	395878	00119	Humble	Coulon, C.J.	1	67	11748	-	-	-	-	-
2138704	394769	00120	Sun Oil	Lyric Realty & Parking Co.	3	67	9700	-	-	-	-	-
2141376	397292	00121	Sun Oil	Lyric Realty & Parking Co.	8	67	12870	-	-	-	-	-
2146158	401856	00147	Howell, Holloway & Howell	Energy Realty Inv. Co.	4	50	12723	-	-	-	-	-
2147943	400787	00148	Howell, Holloway & Howell	Energy Realty Inv. Co.	2	55	12717	-	-	-	-	-
2144055	400281	00150	Howell, Holloway & Howell	Energy Realty Inv. Co.	1	65	14643	-	-	-	-	-
2143950	398615	00151	Howell, Holloway & Howell	Energy Realty Co.	3	65	14823	-	-	-	-	-
2125741	381136	00173	Sun Oil	Lyric Realty & Parking	1B	16	15880	-	-	-	-	-
2120936	376825	00175	Oil & Gas Futures	Lyric Realty & Parking	1	21	12900	-	-	-	-	-
2113851	396955	00178	Superior	Dibert, Stark, Brown, Cypress	1	62	13004	-	-	-	-	-
2119655	393690	01159	Freeport Sulphur	Dibert, Stark & Brown	18	63	1626	-	1425	1598	-	-
2120850	393182	01160	Freeport Sulphur	Dibert, Stark & Brown	6	63	2126	-	1669	1801	2048	-
2123700	392286	01161	Freeport Sulphur	Dibert, Stark & Brown	11	64	1534	-	1409	1453	-	-
2124972	392290	01164	Freeport Sulphur	Dibert, Stark & Brown	2	64	1652	-	[b]1335	-	-	
2126407	393033	01165	Freeport Sulphur	Dibert, Stark & Brown	25	64	1910	-	1699	1872	-	-
2127186	393541	01167	Freeport Sulphur	D S & B	1	64	2377	-	-	2090	-	-
2127486	392350	01169	Freeport Sulphur	Dodge, Sundberry & Lothman	4	65	2176	-	2019	2132	-	-
2127761	392634	01170	Sun Oil	Dodge, Sundberry & Lothman	3	65	1783	-	1626	1760	-	-
2128238	393210	01171	Freeport Sulphur	Dodge, Sundberry & Lothman	11	65	630	-	-	-	-	-
2128227	392770	01172	Freeport Sulphur	Dodge, Sundberry & Lothman	2	65	1965	-	1751	1900	-	-
2128615	393434	01173	Freeport Sulphur	Dodge, Sundberry & Lotham	6	65	2228	-	2072	2189	-	-
2129364	393454	01174	Freeport Sulphur	Dodge, Sundberry & Lothman	5	65	2363	-	2222	2318	-	-
2128988	392788	01175	Freeport Sulphur	Dodge, Sunberry & Lathman	1	65	2042	-	1844	2002	-	-
2130112	393472	01177	Freeport Sulphur	Dodge, Sunberry & Lothman	8	65	2450	-	1266	2404	-	-
2130486	392826	01178	Freeport Sulphur	Dodge, Sundberry & Lotham	7	65	2394	-	2284	2347	-	-
2134762	393310	01179	Texas Gulf Prod.	Drexler Community	1	66	6263	-	-	5584	-	-
2141116	392215	01181	Sun Oil	Polmer	2	68	13070	-	-	-	-	-
2136181	392276	01182	Pure	Fee-Powell Unit	2	69	9134	-	-	-	-	-
2134845	390591	01183	Sun Oil	Leray, J. Pool	1	69	10422	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2133117	391159	01185	Sun Oil	Mire, O.J.	2	69	4821	-	-	-	-	-
2132434	391302	01186	Sun Oil	Dibert, Stark & Brown	74	70	4140	-	-	-	[a]4067	-
2132281	390679	01187	Sun Oil	Dibert, Stark & Brown	72	70	5151	-	-	-	[a]4897	-
2131912	390678	01188	Sun Oil	Dibert, Stark & Brown	57	70	4446	4397	-	-	-	-
2132093	389904	01189	Sun Oil	Dibert, Stark & Brown Cypress	9	70	7838	-	-	-	7149	-
2130554	391691	01190	Freeport Sulphur	Dibert, Stark & Brown	26	70	2191	-	1874	-	-	-
2131450	390436	01191	Sun Oil	Dibert, Stark & Brown	83	70	4225	-	-	-	[a]4197	-
2131466	390244	01192	Sun Oil	Dibert, Stark & Brown	55	70	4846	-	-	-	-	-
2130633	389124	01195	Sun Oil	Dibert, Stark & Brown Cypress	6	70	7295	-	-	-	-	-
2129390	392142	01196	Freeport Sulphur	Dibert, Stark & Brown	3	70	1869	-	1648	1846	-	-
2127584	391365	01198	Freeport Sulphur	Dibert, Stark & Brown	22	70	1291	-	1167	1268	-	-
2128613	391175	01200	Freeport Sulphur	Dibert, Stark & Brown	9	70	1481	-	1042	1437	-	-
2127589	389950	01202	Sun Oil	Dibert, Stark & Brown Cypress	1A	70	1518	-	-	-	1483	-
2129685	389597	01203	Sun Oil	Dibert, Stark & Brown Cypress	23	70	3893	-	-	-	3561	-
2130105	389330	01204	Sun Oil	Dibert, Stark & Brown Cypress	19	70	5199	-	5176	-	-	-
2128299	389320	01205	Sun Oil	Dibert, Stark & Brown Cypress	31	70	2893	-	-	-	2870	-
2128642	392125	01206	Freeport Sulphur	Dibert, Stark & Brown	13	70	1731	-	1523	1708	-	-
2127635	389456	01207	Union Oil & Gas of La.	Dibert, Stark & Brown	5	70	1715	-	-	-	[b]1662	
2128427	389106	01208	Sun Oil	Dibert, Stark & Brown	28	70	3509	-	-	-	3486	-
2129535	389110	01209	Sun Oil	Dibert, Stark & Brown Cypress	20	70	4784	-	-	-	[a]4737	-
2129217	389039	01210	Oryx Energy	Dibert, Stark & Brown	59	70	4730	-	-	-	-	-
2128936	388838	01211	Sun Oil	Dibert, Stark & Brown Cypress	22	70	4813	-	-	-	[a]4767	-
2129809	388696	01213	Sun Oil	Dibert, Stark & Brown	84	70	7511	-	-	-	-	-
2129722	388176	01214	Sun Oil	Dibert, Stark & Brown	85	70	12225	-	-	-	-	-
2129148	388083	01215	Oryx Energy Co.	Dibert, Stark & Brown	5	70	7550	-	-	-	-	-
2128334	388560	01217	Oryx Energy	Dibert, Stark & Brown	24ST1	70	4675	-	-	-	4341	-
2128334	388560	01217	Sun Oil	Dibert, Stark & Brown Cypress	24	70	4364	-	-	-	[a]4457	-
2127780	388125	01218	Sun Oil	Dibert, Stark & Brown Cypress	25	70	4408	-	-	-	[a]4237	-
2127953	387591	01219	Sun Oil	Dibert, Stark & Brown Cypress	10	70	7369	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2129139	387988	01220	Sun Oil	Dibert, Stark & Brown Cypress	3	70	7275	-	-	-	-	-
2129151	388021	01221	Sun Oil	Dibert, Stark & Brown Cypress	2	70	7312	-	-	-	-	-
2129564	387881	01222	Sun Oil	Dibert, Stark & Brown Cypress	4	70	8292	-	-	-	-	-
2125992	392163	01229	Freeport Sulphur	Dibert, Stark & Brown	14	71	1595	-	1330	1531	-	-
2126407	391422	01230	Freeport Sulphur	Dibert, Stark & Brown	4	71	2493	-	2339	2422	-	-
2125751	391198	01232	Freeport Sulphur	Dibert, Stark & Brown	10	71	1354	-	1251	1319	-	-
2126771	390682	01233	Sun Oil	Dibert, Stark & Brown	2A	71	1283	-	-	1260	-	-
2127414	391026	01234	Sun Oil	Dibert, Stark & Brown	3A	71	1330	-	-	1307	-	-
2124292	391684	01238	Gulf Refg.	Stark, Dibert & Brown	2	71	1373	-	[b]1165	-	-	
2123822	391715	01239	Gulf Refg. Co.	Stark, Dibert & Brown	11	71	1436	-	[b]1250	-	-	
2123315	391743	01240	Gulf Refg. Co. of La.	Stark, Dibert & Brown	8	71	1254	-	[b]1253	-	-	
2122497	391972	01242	States Prod. Co.	Mrs. Starks, W.H.	2C	71	1406	-	[b]1303	-	-	
2122346	391797	01243	Gulf Refg. Co. of La.	Stark, Dibert & Brown	1	71	1420	-	[b]1335	-	-	
2124298	390884	01245	Gulf Refg. Co.	Stark, Dibert & Brown	15	71	1250	-	[b]1180	-	-	
2122352	390296	01246	Gulf Refg. Co.	Stark, Dibert & Brown	14	71	1266	-	[b]1272	-	-	
2124221	389317	01248	Gulf Refg. Co. of La	Stark, Dibert & Brown	4	71	1368	-	[b]875	-	-	
2124207	388815	01249	Gulf Refg. Co. of La.	Stark, Dibert & Brown	5	71	1302	-	-	-	[b]1261	
2124351	388288	01250	Union Oil & Gas of La.	Stark, Dibert & Brown	2	71	1772	-	-	-	[b]1605	
2127378	387757	01251	Sun Oil	Dibert, Stark & Brown	54	71	4755	-	-	-	[a]4627	-
2127414	387335	01252	Sun Oil	Dibert, Stark & Brown Cypress	11	71	7427	-	-	-	-	-
2126768	387067	01253	Sun Oil	Dibert, Stark & Brown Cypress	12	71	7425	-	-	-	-	-
2126516	387513	01254	Sun Oil	Dibert, Stark & Brown	52	71	4671	-	-	-	4619	-
2125955	387293	01255	Sun Oil	Dibert, Stark & Brown	81	71	4600	-	-	-	-	-
2125945	387264	01256	Sun Oil	Dibert, Stark & Brown	56	71	4833	4797	-	-	-	-
2125097	387381	01257	Sun Oil	Dibert, Stark & Brown	80	71	4238	-	-	-	[a]4137	-
2123834	387242	01259	Sun Oil	Dibert, Stark & Brown	68	71	3984	-	-	-	-	-
2122926	387461	01260	Oryx Energy Co.	Diebert, Stark & Brown	67	71	4190	-	-	-	4167	-
2125990	391639	01261	Freeport Sulphur	Dibert, Stark & Brown	19	71	1444	-	-	1418	-	-
2126495	391535	01262	Freeport Sulphur	Dibert, Stark & Brown	16	71	1475	-	1071	1423	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2126887	391166	01263	Freeport Sulphur	Dibert, Stark & Brown	21	71	1319	-	1100	1287	-	-
2120331	391754	01265	Gulf Refg. Co.	Stark, Dibert & Brown	23	72	1599	-	[b]1537	-	-	
2118277	391224	01267	Freeport Sulphur	Dibert, Stark & Brown	17	72	1291	-	1043	1223	-	-
2117660	391658	01268	Freeport Sulphur	Dibert, Stark & Brown	8	72	2435	-	2285	2390	-	-
2120793	390265	01269	Gulf Refg. Co.	Stark, Dibert & Brown	21	72	1566	-	[b]1341	-	-	
2118150	390173	01272	Sun Oil	Dibert, Stark & Brown	6A	72	1889	-	1507	-	1851	-
2119231	389467	01273	Sun Oil	Dibert, Stark & Brown Cypress	4A	72	1139	-	-	-	1116	-
2118482	388661	01274	Sun Oil	Dibert, Stark & Brown	5A	72	2510	-	2447	-	2471	-
2122256	390292	01275	Gulf Refg. Co.	Stark, Dibert & Brown	14A	72	1401	-	[b]1260	-	-	
2121460	388234	01276	Sun Oil	Dibert, Stark & Brown	79	72	2704	-	-	-	[a]2457	-
2122065	387695	01277	Sun Oil	Dibert, Stark & Brown	63	72	4046	-	-	-	[a]3997	-
2121466	387314	01278	Sun Oil	Dibert, Stark & Brown	61	72	5125	4987	-	-	-	-
2121164	387732	01279	Sun Oil	Dibert, Stark & Brown	82	72	4189	-	-	-	-	-
2121173	387830	01280	Sun Oil	Dibert, Stark & Brown	66-D	72	3789	-	-	-	-	-
2120278	387747	01281	Sun Oil	Dibert, Stark & Brown	69	72	4680	-	-	-	[a]3707	-
2119315	388016	01282	Sun Oil	Dibert, Stark & Brown	71	72	4490	-	-	-	[a]4447	-
2118684	387022	01283	Sun Oil	Cypress Brown Unit	1	72	8371	-	-	-	-	-
2118178	387344	01284	Sun Oil	Dibert, Stark & Brown	15	72	8197	-	-	-	-	-
2117767	387855	01285	Sun Oil	Dibert, Stark & Brown	17	72	8200	-	-	-	5580	-
2115063	391861	01286	Sun Oil	Dibert, Stark & Brown	75	73	6505	-	-	-	6483	-
2113421	391139	01287	Sun Oil	Dibert, Stark & Brown	58	73	12684	-	-	-	-	-
2115129	390065	01288	Sun Oil	Dibert, Stark & Brown Cypress	29	73	5560	-	-	-	[b]5548	-
2114386	390015	01289	Sun Oil	Dibert, Stark & Brown	38	73	11681	-	-	-	-	-
2115934	389431	01290	Sun Oil	Dibert, Stark & Brown	42	73	5385	5337	-	-	-	-
2115416	389477	01291	Sun Oil	Dibert, Stark & Brown	26	73	7262	-	-	-	7239	-
2115961	389020	01292	Sun Oil	Dibert, Stark & Brown Cypress	21	73	8500	-	-	-	7651	-
2114466	388870	01293	Sun Oil	Dibert, Stark & Brown	50	73	11608	-	-	-	-	-
2116943	388511	01294	Sun Oil	Dibert, Stark & Brown	73	73	5234	-	-	-	-	-
2116423	388400	01295	Sun Oil	Dibert, Stark & Brown	18	73	8463	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2116919	387965	01297	Sun Oil	Dibert, Stark & Brown	16	73	8200	-	-	-	-	-
2116305	387418	01298	Sun Oil	Dibert, Stark & Brown	47	73	10512	-	-	-	-	-
2111029	389874	01299	Sun Oil	Dibert, Stark & Brown	1B	25	14510	-	-	-	-	-
2116418	385803	01300	Sun Oil	Dibert, Stark & Brown	70	74	10452	-	-	-	-	-
2117918	386339	01301	Sun Oil	Cypress	11	75	8811	-	-	-	-	-
2119263	386627	01302	Sun Oil	Cypress	7	75	8327	-	-	-	-	-
2119860	386345	01303	Sun Oil	Cypress	6	75	8325	-	-	-	-	-
2121370	386834	01304	Sun Oil	Cypress	1	75	7426	-	-	-	6049	-
2122042	385996	01306	Sun Oil	Cypress	8	75	8072	-	-	-	-	-
2121332	386834	01307	Sun Oil	Cypress	1	75	770	-	-	-	-	-
2120995	386015	01308	Sun Oil	Cypress	3	75	8283	-	-	-	-	-
2121020	386000	01309	Sun Oil	Cypress	4	75	8303	-	-	-	-	-
2120843	385752	01310	Sun Oil	Cypress	2	75	9569	-	-	-	-	-
2120969	386029	01311	Sun Oil	Cypress	5	75	8310	-	-	-	-	-
2120673	385450	01312	Sun Oil	Cypress	9	75	12505	-	-	-	-	-
2119510	385686	01313	Oryx Energy Co.	Cypress	10	75	10250	-	-	-	-	-
2121985	385211	01314	Sun Oil	Cypress	12	75	9915	-	-	-	-	-
2122709	385930	01315	Sun Oil	Dibert, Stark & Brown Cypress	27	76	7858	-	-	-	-	-
2123023	385011	01316	Oryx Energy Co.	Dibert, Stark & Brown	36	76	12860	-	-	-	-	-
2123360	385863	01317	Sun Oil	Dibert, Stark & Brown Cypress	30	76	7826	-	-	-	-	-
2124020	385854	01318	Sun Oil	Dibert, Stark & Brown Cypress	32	76	7897	-	-	-	7874	-
2125072	386334	01319	Sun Oil	Dibert, Stark & Brown	1	76	504	-	-	-	-	-
2125422	387004	01320	Oryx Energy Co.	Dibert, Stark & Brown	60	76	4941	-	-	-	-	-
2125674	386591	01321	Sun Oil	Dibert, Stark & Brown Cypress	14	76	7223	-	-	-	7200	-
2126312	386833	01322	Sun Oil	Dibert, Stark & Brown Cypress	13	76	7404	-	-	-	7193	-
2126729	384656	01324	Sun Oil	Dibert, Stark & Brown	49	76	8897	-	-	-	-	-
2125571	384368	01325	Sun Oil	Dibert, Stark & Brown	51	76	10006	-	-	-	-	-
2130323	387080	01327	Sun Oil	Dibert, Stark & Brown	34	77	12000	-	-	-	-	-
2130238	386778	01328	Sun Oil	Dibert, Stark & Brown	33	77	12084	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2131278	386305	01329	Sun Oil	Dibert, Stark & Brown	48	77	9021	-	-	-	-	-
2130226	385785	01330	Oryx Energy Co.	Dibert, Stark & Brown	39ST1	77	9975	-	-	-	-	-
2130772	384867	01331	Sun Oil	Dibert, Stark & Brown	40	77	11008	-	-	-	-	-
2129060	385162	01332	Sun Oil	Dibert, Stark & Brown	64	77	9100	-	-	-	-	-
2129744	383907	01334	Sun Oil	Dibert, Stark & Brown	44	77	9939	-	-	-	-	-
2136024	386744	01335	Sun Oil	Dibert, Stark & Brown	1C	78	11515	-	-	-	-	-
2142140	386091	01336	Sun Oil	Polmer, M.J. & I.F.	1	79	14758	-	-	-	-	-
2128266	391636	03473	Freeport Sulphur	Dibert, Stark & Brown	23	70	1473	-	1266	1438	-	-
2119977	386575	03474	Sun Oil	Cypress	13	75	8012	-	-	-	-	-
2137490	396866	03475	Oryx Energy Co.	Lyric R & R	10	66	11800	-	-	-	-	-
2129685	378983	03521	Texaco, Inc.	Lyric Realty & Parking	2	13	15069	-	-	-	-	-
2136157	387872	03527	Magna Oil Co.-G. McCord	Pure Oil Co. Fee	1	69	14051	-	-	-	-	-
2129364	388862	03528	Sun Oil	Dibert, Stark & Brown	86	70	7243	-	-	-	-	-
2126744	387660	03564	Sun Oil	Dibert, Stark & Brown	87	71	4652	-	-	-	4629	-
2137923	399115	03638	Humble O&R Co.	Rob 3 Sd Unit-Coulon	10A	56	10717	-	-	-	-	-
2136033	391984	03686	Magno Oil Corp.	Pure Oil Co.	2	69	9446	-	-	-	-	-
2116961	388714	03725	Sun Oil	Dibert, Stark & Brown	88	73	4591	-	-	-	4568	-
2133152	392017	03726	Sun Oil	Mire, O.J.	3	69	3815	-	-	-	3792	-
2136081	392046	03727	Magna Oil Corp.	Pure Oil Co. Fee	3	69	9940	-	-	-	-	-
2136454	397379	03817	Sun Oil	Lyric Ra Su A-LR&P	11	66	10500	-	-	-	-	-
2134385	402495	03818	Magna Oil Corp.	Levert Land Co.	1C	57	16214	-	-	-	-	-
2134385	402495	03818	Triton Oil & Gas Corp.	Levert	2CST1	57	14881	-	-	-	-	-
2114552	394023	03827	Humble O&R Co.	Dibert, Stark & Brown	1	62	9928	-	-	-	9822	-
2130184	392163	03865	Sun Oil	Dibert, Stark & Brown	12	70	2101	-	-	-	[a]4767	-
2129763	391670	03866	Freeport Sulphur	Dibert, Stark & Brown	20	70	1814	-	1524	-	-	-
2129018	391653	03867	Freeport Sulphur	Dibert, Stark & Brown	24	70	1637	-	1380	1598	-	-
2112639	393588	03892	Humble O&R Co.	Brown, E.W. Jr.	1	62	13599	-	-	-	-	-
2113243	398466	20107	Apache Corp.	Williams Inc.	1	61	17500	-	-	-	-	-
2113040	396436	20121	Florida Gas Expl.	Brown, E.W. Jr.	1	62	16200	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2113195	396441	20148	Florida Gas Expl.	Brown, E.W. Jr.	2	62	15550	-	-	-	-	-
2113059	400513	20153	Florida Gas Expl.	Williams Inc.	2	61	17700	-	-	-	-	-
2115518	400324	20165	Florida Gas Expl.	Williams Inc	3	61	15972	-	-	-	-	-
2111279	397475	20173	Florida Gas Expl.	Brown, E.W.	3	13	18420	-	-	-	17857	-
2109183	400105	20200	Florida Gas Expl.	Brown, E.W.	1 A	13	18382	-	-	-	-	-
2111079	395452	20201	Florida Gas Expl.	Brown, E.W.	5	24	15941	-	-	-	-	-
2115142	399047	20202	Florida Gas Expl.	Brown, E.W.	4	61	16270	-	-	-	-	-
2121340	401391	20203	Placid Oil Co.	Lafargue, W.S.	1	60	15955	-	-	-	-	-
2127787	389805	20272	John W. Mecom	Dibert Stark & Brown	10M	70	2015	-	-	-	[b]1506	
2123316	401743	20287	Placid Oil Co.	Dibert, Stark & Brown	1	59	15803	-	-	-	-	-
2118686	402051	20321	Placid Oil Co.	Mecom	1	60	16620	-	-	-	-	-
2108725	390820	20352	Santa Fe Minerals	Brown, E.W.	1	25	13445	-	-	-	-	-
2141919	388905	20592	Union Oil Co. of Calif.	Ducros Plantation	1	68	15040	-	-	-	-	-
2122900	397043	20609	Joe W. Elsbury Jr.	Mecom, John	1	64	4857	-	-	-	[a]4797	-
2144694	380785	20613	Eason Oil	Pennington, C.	1	46	11720	-	-	-	-	-
2122974	397647	20645	Joe W. Elsbury	Mecom, John	2	59	5975	-	-	-	-	-
2136841	395816	20757	Sun Oil	Lyric Realty	12	66	9515	-	-	-	-	-
2122518	403085	20810	Sun Oil	Tabor, A.R.	1	55	17307	-	-	-	-	-
2121981	385367	20857	Sun Oil	Cypress	14	75	10019	-	-	-	-	-
2116227	387959	20858	Sun Oil	Dibert, Stark & Brown	89	73	10015	-	-	-	-	-
2114974	396992	20870	Apache Corporation	DS&B	1ST1	62	14452	-	-	-	-	-
2128226	388363	20936	Sun Oil	Dibert, Stark & Brown	90	70	4536	-	-	-	-	-
2125066	386276	20954	Sun Oil	Dibert, Stark & Brown	91	76	7641	-	-	-	-	-
2109675	386390	20964	Occidental	Brown, E.W. Jr.	1	36	12688	-	-	-	-	-
2127115	386588	21062	Oryx Energy	Dibert, Stark & Brown	92	76	9680	-	-	-	-	-
2133375	391785	21092	Brock Expl. Corp.	Mire, O.J.	1	69	4461	-	-	-	-	-
2133667	393292	21124	Brock Expl. Corp.	Drexler, J.L.	1	66	4030	-	-	-	3947	-
2136063	393344	21147	Union Oil Co. of Calif.	Mire, P. & L.R.	1	66	8962	-	-	-	-	-
2121914	386287	21180	Sun Oil	Cypress	15	75	8068	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

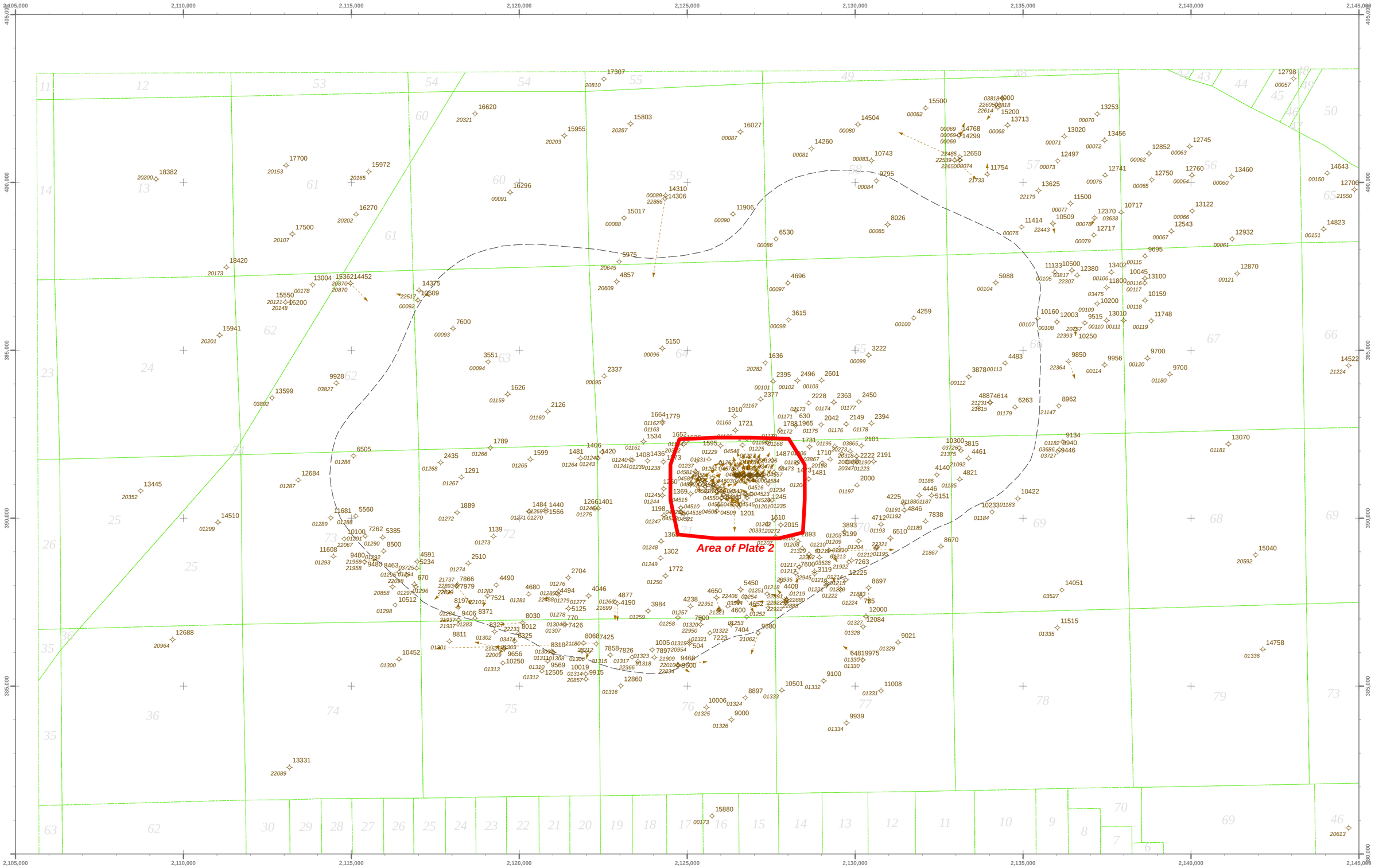
Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2126211	387382	21221	Sun Oil	Dibert	93	71	4600	-	-	-	[a]4527	-
2144696	394549	21224	American Quasar of N.M.	Energy Realty Inv.	1	66	14522	-	-	-	-	-
2134016	393450	21231	Brock Expl. Corp.	Bernard, W.J.	2	66	4887	-	-	-	[a]4797	-
2128628	388932	21329	Sun Oil	Dibert-Stark	94	70	4445	-	-	-	[a]4377	-
2133097	392101	21375	Union Oil Co. of Calif.	Pure Fee	2	69	10300	-	-	-	-	-
2145575	399305	21449	Spooner Petr. Co.	Energy Rlty. Inv.	1	65	12663	-	-	-	-	-
2134019	393439	21515	Dynamic Expl. Inc.	Bernard	1	66	4614	4427	-	-	-	-
2144866	399786	21550	Northcott Expl.	Energy Realty	1	65	12700	-	-	-	-	-
2119541	386123	21626	Sun Oil	Cypress	16	75	15000	-	-	-	-	-
2122580	388749	21692	Texas Brine Company[c]	E. W. Brown	1	71	6525	-	-	-	-	-
2122850	387512	21699	Sun Oil	Stark, Dibert	95	71	4877	-	-	-	[a]4767	-
2123209	388799	21706	Texas Brine Company[c]	E. W. Brown	2	71	6501	-	-	-	-	-
2133934	400246	21733	Sun Oil	Levert, J.B. Land	3A	57	11754	-	-	-	-	-
2118163	388024	21737	Sun Oil	Dibert, Stark & Brown	96	72	4770	-	-	-	-	-
2123909	388673	21745	Texas Brine Company[c]	E. W. Brown	3	71	6504	-	-	-	-	-
2147500	394073	21847	Tomlinson Intr. Inc.	Le Jeune, F.E.	1	66	17488	-	-	-	-	-
2132553	389157	21867	Sun Oil	Mire, D.S.&B.	97	70	8670	-	-	-	-	-
2130402	387927	21883	Sun Oil	Dibert, Stark & Brown	98	70	8697	-	-	-	-	-
2124722	385642	21909	Oryx Energy	Dibert, Stark & Brown	100	76	9300	-	-	-	-	-
2129891	388747	21922	Sun Oil	Dibert, Stark & Brown	103	70	7263	-	-	-	-	-
2118192	386973	21937	Oryx Energy Co.	DS&B	99	72	8900	-	-	-	-	-
2115394	388702	21958	Oryx Energy Co.	DS & B	101	73	9480	-	-	-	-	-
2119560	386115	22009	Sun Oil	Cypress	17	75	9656	-	-	-	-	-
2124745	385613	22010	Sun Oil	Dibert, Stark & Brown	104	76	9600	-	-	-	-	-
2114785	389391	22067	Sun Oil	Stark, Dibert & Brown	102	73	10100	-	-	-	-	-
2113156	382586	22089	Lgs Expl. Inc.	Brown, E.W. Jr.	1	74	13331	-	-	-	-	-
2116645	388320	22098	Sun Oil	Dibert Stark Brown	105	73	8100	-	-	-	-	-
2119053	387696	22101	Sun Oil	Dibert, Stark & Brown	106	72	7521	-	-	-	-	-
2135462	399757	22179	Txp Oper.	Levert, J.B. Land	1	57	13625	-	-	-	-	-

Table A-1: Listing of Oil & Gas Wells in the Vicinity of the Chacahoula Salt Dome (Continued)

[All coordinates and depths in feet. Easting and Northing are Louisiana state plane coordinates, NAD27. Short API numbers are prefixed by the state code (17) plus the county code (057), and suffixed by the sidetrack code (00 for a vertical well, 01 for first sidetrack, etc.). CR - caprock; Anh - anhydrite]

Easting	Northing	Short API	Operator	Lease	Well No.	Section	TD	Top CR/ Salt	Top CR	Top Anh	Top Salt	Base Salt
2122292	386263	22212	Sun Oil	Cypress Brown	1	75	7425	7247	-	-	-	-
2120097	386892	22233	Oryx Energy	Cypress	18	75	8030	-	-	-	-	-
2128891	389031	22292	Cabot Oil & Gas Corp	Diebert, Stark & Brown	107	70	4269	-	-	-	-	-
2131051	389410	22321	Sun Oil	Dibert, Stark & Brown	109	70	6510	-	-	-	-	-
2136353	394673	22364	Sun Oil	Lyric Realty & Parking	15	66	9850	-	-	-	-	-
2136559	395626	22393	Sun Oil	L.R.& P. Co.	16	66	10250	-	-	-	[a]8327	[a]8617
2126590	387874	22406	Oryx Energy Co.	Dibert, Stark & Brown	111	71	5450	-	-	-	-	-
2135887	398780	22443	Alfred C. Glassell, Jr.	Rogers, J.V.	2	57	10509	-	-	-	-	-
2121122	387764	22488	Oryx Energy Co.	Dibert, Stark & Brown	112	72	4494	-	-	-	-	-
2117018	396791	22517	Coastal O&G	D.S. & B.	1	63	14375	-	-	-	-	-
2132958	400668	22539	Nomeco O&G	Levert, J.	2	57	11908	-	-	-	10837	-
2134202	402319	22614	Llog Exploration Co.	Levert, J.	2	57	4000	-	-	-	-	-
2133120	400664	22650	Nomeco O&G Co.	Levert-Morvant	1	57	12650	-	-	-	-	-
2124710	385631	22834	Cabot Oil & Gas Corp	Dibert Stark & Brown	113	76	9468	-	-	-	-	-
2127944	387566	22880	Cabot Oil & Gas Corp	Dibert Stark & Brown	116	70	7260	-	-	-	-	-
2124357	399612	22886	Cabot Oil & Gas Corp	Dibert Stark & Brown	118	59	14310	-	-	-	-	-
2127959	387573	22888	Cabot Oil & Gas Corp	Dibert Stark & Brown	119	70	6560	-	-	-	-	-
2127937	387526	22891	Cabot Oil & Gas Corp	DS&B	120-AL	70	7260	-	-	-	-	-
2118141	387994	22893	Cabot Oil & Gas Corp	Dibert Stark & Brown	117	72	7979	-	-	-	-	-
2118568	387443	22899	Cabot Oil & Gas Corp	Dibert Stark & Brown	121	72	7866	-	-	-	-	-
2127934	387489	22922	Cabot Oil & Gas Corp	D S & B	122-AL	70	6894	-	-	-	-	-

a. Data from Magorian and Neal (1990)
b. Data from the 1961 NOGS structure map (Spillers, 1962)
c. Information from Louisiana Department of Natural Resources (http://sonris-gis.dnr.state.la.us/gis/sonris/viewer.htm)



North American Datum of 1927. Projection and grid ticks: Louisiana state coordinate system, south zone, in feet (Lambert conformal conic).

February 2007

EXPLANATION

NOGS Salt Contours — Approximate Extent of Salt at -10,000 ft

Well Locations
SYMBOL, BOTTFLAG

- Gas & Oil Well
- Bottomhole Location
- Deviated Well Path
- Section Line

TD

API

SCALE: 1:24,000

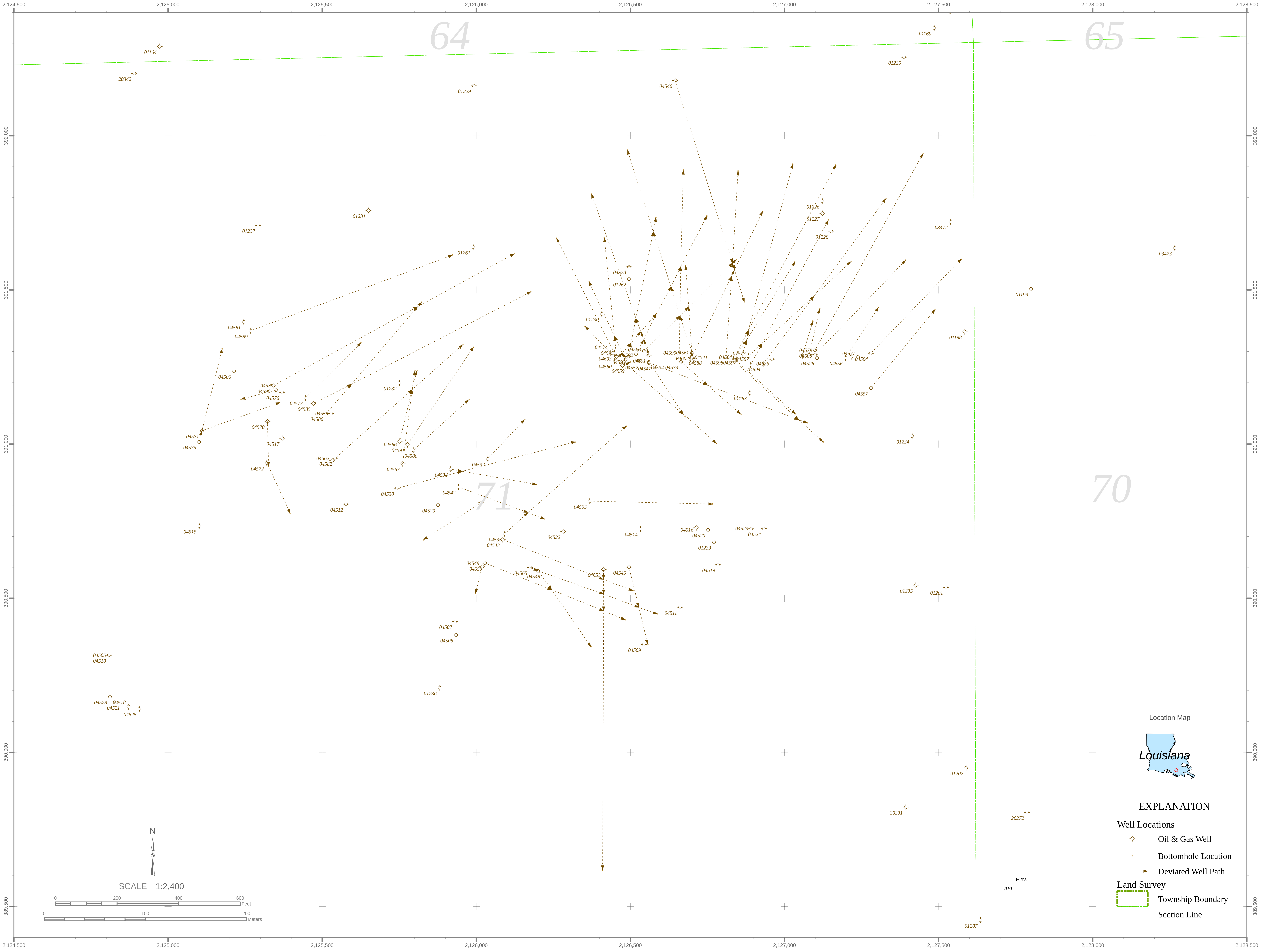
0 1,000 2,000 3,000 4,000 5,000 6,000 Feet

0 1,000 2,000 Meters

N

Location Map

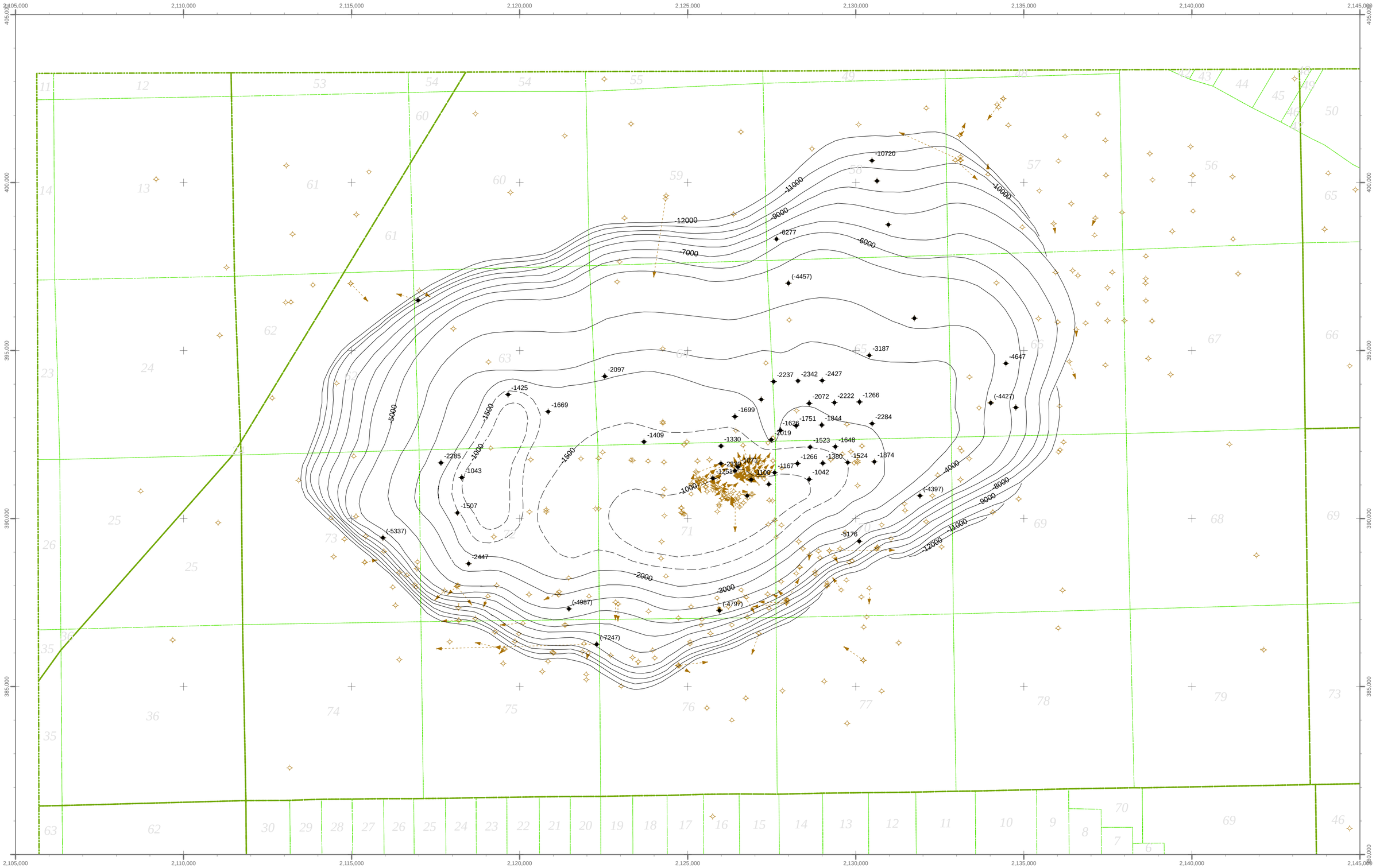
WELL LOCATION MAP FOR THE CHACAHOULA SALT DOME, LOUISIANA



North American Datum of 1927. Projection and grid ticks: Louisiana state coordinate system, south zone, in feet (Lambert conformal conic).

February 2007

WELL DETAIL IN THE AREA AFFECTED BY HISTORICAL SULPHUR MINING ACTIVITIES



North American Datum of 1927. Projection and grid ticks: Louisiana state coordinate system, south zone, in feet (Lambert conformal conic).

February 2007

EXPLANATION

Structure on Top of Caprock
- 500-ft interval
- 1000-ft interval

Top of Caprock Data
- Elev. Direct Control

Well Locations
- Oil & Gas Well
- Bottomhole Location
- Deviated Well Path

Land Survey
- Township Boundary
- Section Line

SCALE 1:24,000

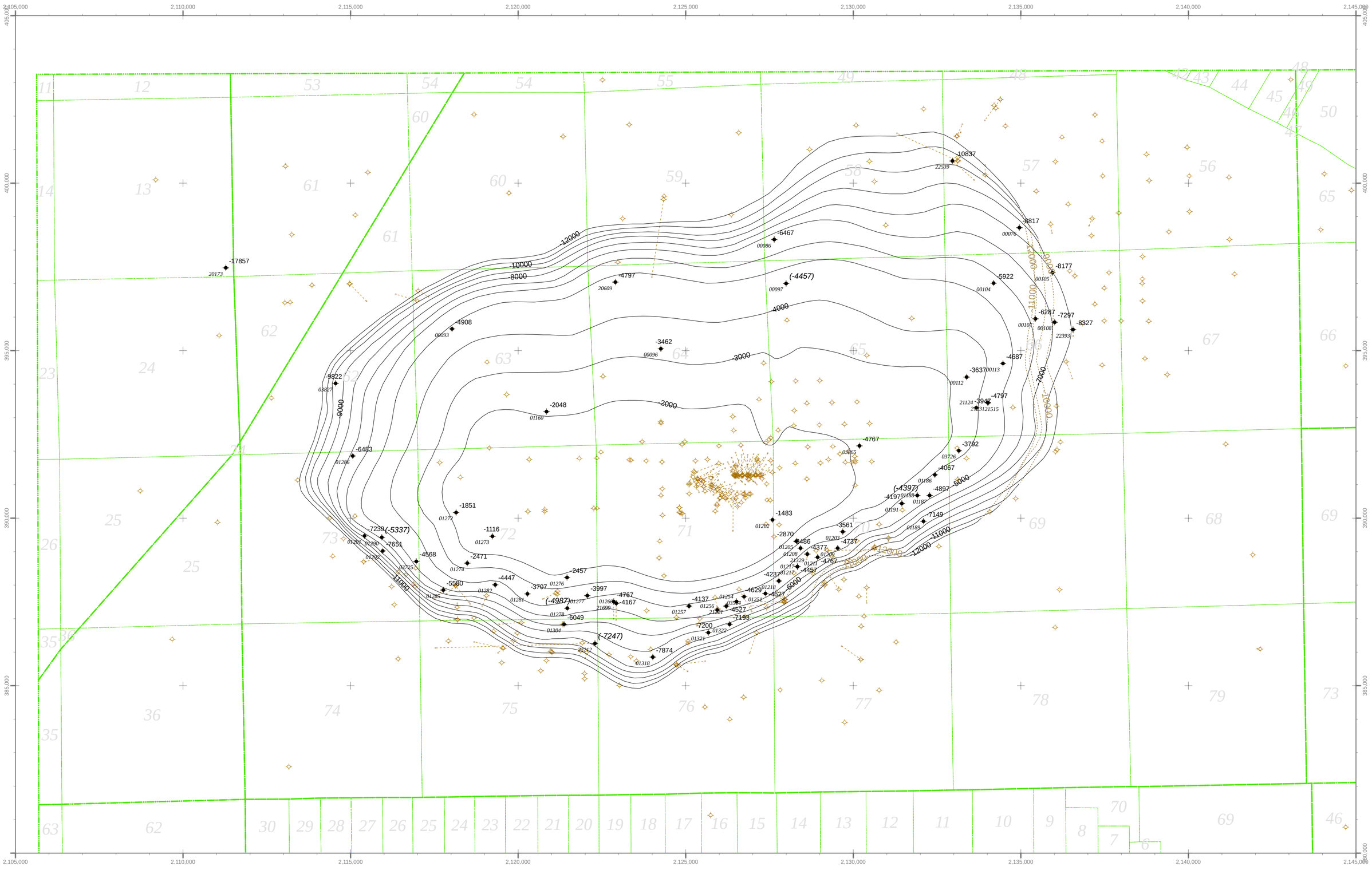
0 1,000 2,000 3,000 4,000 5,000 6,000 Feet

0 1,000 2,000 Meters

N

Location Map

STRUCTURE ON TOP OF CAPROCK (OR ANHYDRITE), CHACAHOULA SALT DOME, LOUISIANA



North American Datum of 1927. Projection and grid ticks: Louisiana state coordinate system, south zone, in feet (Lambert conformal conic)

February 2007

EXPLANATION

Structure on Top of Salt
- 1000-ft interval
- Salt Below Overhang

Top of Salt Data
- Direct Control

Well Locations
- Oil and Gas Well
- Bottomhole Location
- Deviated Well Path

Land Survey
- Township Boundary
- Section Line

SCALE 1:24,000

0 1,000 2,000 3,000 4,000 5,000 6,000 Feet

0 1,000 2,000 Meters

N

Location Map

STRUCTURE ON TOP OF SALT, CHACAHOULA SALT DOME, LOUISIANA

DISTRIBUTION:

U.S. Department of Energy (via CD-R only)
Strategic Petroleum Reserve Project Management Office
900 Commerce Road East
New Orleans, LA 70123

U.S. Department of Energy (3)
Strategic Petroleum Reserve Program Office
1000 Independence Avenue, SW
Washington, DC 20585
ATTN: D. Johnson, FE-421

Sandia Internal:

MS 0706 D.J. Borns, 6312
MS 0706 B.L. Ehgartner, 6312
MS 0706 Anna S. Lord, 6312
MS 0706 C.A. Rautman, 6312
MS 0706 A.R. Sattler, 6312
MS 0706 S. Wallace, 6312 for SPR library (5)
MS 9018 Central Tech. Files, 8944 (2)
MS 0899 Technical Library, 4536 (2)