APPENDIX 3
PRACTICES FOR OIL AND GAS DRILLING AND OPERATIONS IN CAVE AND KARST AREAS

This appendix describes practices for detecting and avoiding significant caves and significant karst features with respect to oil and gas drilling, and for mitigating impacts to significant caves and karst when they cannot be avoided. These mitigations are predicated on the BLM's responsibilities for resource management and protection derived from the Federal Land Policy and Management Act, the Federal Cave Resources Protection Act, and the National Environmental Policy Act. The practices described here supersede those of the Draft "Interim Guide for Oil and Gas Drilling and Operations in Cave and Karst Areas" (February 1993).

POTENTIAL FOR CAVES OR KARST

A map of cave or karst potential will be maintained to provide the public with current information about the likelihood of the presence of cave or karst resources. The map will serve as an indicator of the potential for encountering caves or karst for which special practices could be required, following NEPA analysis, to mitigate drilling impacts. The primary use of the map is as a source of information for individuals or companies contemplating the leasing of federal minerals.

Three zones of cave or karst occurrence have been identified and categorized: high potential; medium potential; and low potential. Areas that contain known cave or karst features are in the high potential zone. Areas containing known soluble rock formations with the potential for cave or karst development are in the medium potential zone. These zones were identified using geologic maps and existing information on caves and karst. All other lands fall into the low potential zone. These zones may be increased or decreased in size as new information from drilling, cave exploration or other sources becomes available.

The cave or karst occurrence zones have been further divided into smaller geographic areas to provide an additional means of identification of a specific area (See Table A3-1 and Map A3-1). An estimate has been made for each of these areas as to the lowest likely depth at which caves might be expected. Again, this is simply a source of information for individuals or companies contemplating the leasing of federal minerals.

The lease notice "Potential Cave or Karst Occurrence Area" (Roswell 46), will be applied to leases when all or part of the lease is located in a high or medium potential cave or karst occurrence area. Refer to Figure A3-1 for an example of the lease notice. The purpose of the lease notice, as with maps of cave or karst potential, is to provide information to the purchasers of federal oil and gas leases.

Because the identification of cave or karst potential zones is only informational, the mitigations described below will be applied, when and where appropriate, irrespective of any identified zone of cave or karst potential. However, the emphasis of management will be on caves presently designated significant or on those designated in the future as significant, and on significant karst features.

Cave or Karst Occurrence Areas

High Potential

Medium Potential

Low Potential

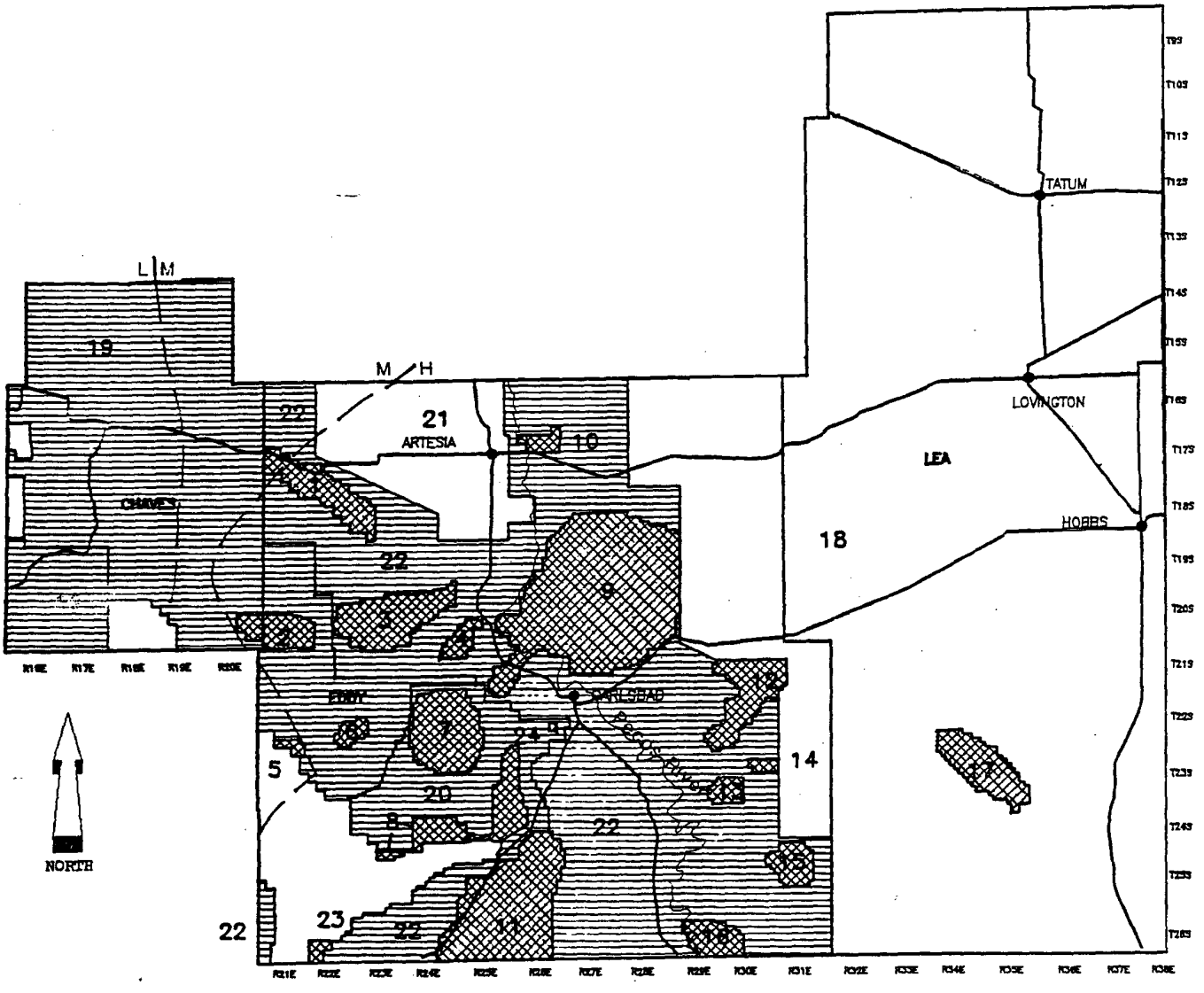
Oil & Gas Potential
Occurrence Boundaries

H = High Potential

M = Moderate Potential

L = Low Potential

NOTE - The table associated with this map shows the relative depth of each area shown on this map. For example, area number 9 is the Burton Flats area which has a high potential for the occurrence of caves or karst features to a depth of 350 feet.



SCALE
1/2" = 9.5 Miles
BLM-Roswell District, 1994

MAP A3-1

CAVE or KARST OCCURRENCE AREAS

Carlsbad Resource Area

Conditions of Approval (Appendix 2). These practices will be modified as new and cost effective technologies for cave and karst protection become available.

Detection Methods

The primary detection method will be the review of BLM or other records on the presence of caves or karst features in the area of interest, in conjunction with a field exam by a BLM employee or cave inventory contractor to determine the presence of unrecorded cave or karst features. Depending on the results of initial detection efforts and a determination of potential significance by the BLM, cave exploration could be employed to gain additional information. As various geophysical techniques are proven useful for cave detection and become generally available for use, they may be considered on a case-by-case basis as a means of locating unrecorded cave or karst features.

Surface Mitigation

Whether or not a proposed activity has been relocated to reduce potential impacts on caves or karst, surface mitigations will be applied, when needed, to minimize the risk of impacts during construction, drilling or production. Appropriate surface mitigations will be developed during the NEPA analysis of a proposal and could include one or more of the following practices, most of which have long been employed to mitigate impacts.

Practices to minimize potential impacts from reserve pit spills or leakage:

- The use of a closed system or steel tanks;
- Reorientation of the rig and related pit location, while giving consideration to human safety;

Practices to minimize potential impacts from leaking tanks or pipelines:

- The construction of berms around storage tanks sufficient to contain spills, in accordance with Conditions of Approval (Appendix 2);
- The installation of leak detection systems for pipelines or tanks;
- The use of permanent liners in storage tank areas;
- The use of differential pressure shut-off valves;
- The use of corrosion-inhibiting coatings and cathodic protection.

Practices to minimize the potential impacts of vented or escaping gases settling in caves:

- The flaring or venting of gas to protect human safety and to better disperse the gases and eliminate possible gas ignitions;
- The use of stock tank vapor recovery systems.

Subsurface Mitigation

Applicable and reasonable subsurface mitigations will be applied where the presence of caves or karst is obvious or expected, based on the results of detection efforts, and in lost circulation zones. The options could include, but are not limited to, the following practices.

<u>Drilling:</u>

- Cable tool drilling techniques will be used when possible in areas where encounters of caves or karst are expected at depths not greater that 350 feet.
- Rotary drilling techniques in cave or karst areas will include the use of either fresh water mud, foam, or compressed air as a circulating medium in zones where caves or karst are expected. Below those zones, the operator may use whatever drilling fluid is

percent of mud returns, and presence or absence of cuttings returning to the surface. As part of customary record keeping, each detectable void or sudden increase in the rate of penetration not attributable to a change in the formation type should be documented and evaluated as it is encountered.

The BLM may review data held by companies on wells drilled in cave or karst areas, to gain information about impacts to caves and karst. This information will be used to categorize lost-circulation zones on the basis of depth, relative volume, and severity, and to evaluate and compare the relative success or failure of different remedies attempted to combat lost-circulation problems while drilling and cementing casing in these zones. This information also will be used to update information about the occurrence of cave and karst features. Information concerning cave resources gathered during drilling will be submitted, as well, to be retained by the BLM in accordance with the Roswell District Cave Management Plan and the regulations implementing the Federal Cave Resources Protection Act.