BW - ______5______

ENFORCMENT

JWS OF NEW MEXICO, INC.
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2008 DEC 17 PM 1 15

COMPLETE OIL FIELD SERVICES

December 11, 2008

Wayne Price
Environmental Bureau Chief
Oil Conservation Division
1220 South Saint Francis Drive
Santa Fe, New Mexico 87505

Jim Griswold
Hydrologist, Environmental Bureau
Oil Conservation Division
1220 South Saint Francis Drive
Santa Fe, New Mexico 87505

Carl J. Chavez, CHMM
Environmental Bureau
Oil Conservation Division
1220 South Saint Francis Drive
Santa Fe, New Mexico 87505

Re: **Jim's Water Service of New Mexico, Inc.**
Township 18 South, Range 28 East, Section 24, NW/4SE/4, Eddy County, New Mexico
Pit Closure Proposal and Related Access Issues

Gentlemen:

On October 28, 2008, Jim's Water Service (JWS) sent a letter to Mr. Brian Henington of the New Mexico State Land Office, outlining in detail JWS's proposed plan for dealing with the large sinkhole that suddenly and unexpectedly formed at the above-referenced location (copy attached). On November 25, 2008, in response to Mr. Wayne Price's November 17, 2008 email, we submitted further details of our proposed plan, which included fencing of the entire location, at a cost of approximately $65,000-$70,000, in order to protect public health and safety, (copy attached).

The action plan outlined in these letters constitute the closure plan that JWS has developed in response to both the New Mexico State Land Office (SLO) and the New Mexico Oil Conservation Division (OCD), in an effort to deal with a unique, naturally-occurring and potentially dangerous situation. We believe that this closure plan provides the necessary and appropriate protection of public health and safety, as well as water resources and the natural environment, in this dangerously unstable location. Although JWS's legal responsibility to construct the proposed fence remains in doubt, we believe it is important to safeguard public health and safety, and that further delay in building the fence would run the risk, for the state agencies and JWS alike, that someone will enter onto the site (with or without permission) and suffer injury. JWS wants to ensure that this single most critical objective – protecting public and worker health and safety – is achieved in a fast and efficient manner. As suggested in our November 25, 2008 letter, we stand ready to meet with OCD and SLO personnel, together or separately, to discuss implementation of the closure plan as necessary.

On Monday, December 8, 2008, JWS gave notification to Mr. Chavez, Mr. Price, and Mr. VonGonten of OCD and Mr. Carr of SLO that JWS's contractor had received the required 10½-foot fence posts, which were previously unavailable; that these were being loaded on the truck; and that new postholes will be dug starting this week. JWS will be proceeding with construction of the fence over the next three weeks. You are welcome to visit and inspect the construction process as it proceeds.

Also on December 8th, we received an email inquiry from Mr. Griswold expressing his concerns regarding OCD access to the site following installation of the new and improved fence. Mr. Griswold's inquiry raises access issues that affect not only JWS, but also SLO as the owner of the surface at this location. We would like to be sure that resolution of these issues is coordinated between all three parties. Again, as previously offered, we stand ready to meet or confer with OCD and SLO to address these and any related issues in the context of moving forward on the closure plan outlined in our October and November 2008 letters.

Best regards,

Sherry Glass

Sherry Glass
Engineering Technician
Jim's Water Service of New Mexico

Enclosure

cc: Jim Carr, District Resources Manager, II, New Mexico State Land Office
Larry Kehoe, Assistant Land Commissioner, New Mexico State Land Office
Brian Henington, Public Land Resources Assistant Director,
Field Operations, NMSLO
Glenn VonGonten, Oil Conservation Division

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Chavez, Carl J, EMNRD

From:	Sherry Glass [SGlass@kpk.com]
Sent:	Thursday, January 08, 2009 10:24 AM
To:	Brad Berge; Brian Henington; Chavez, Carl J, EMNRD; Davis O'Connor; Dimas Herrera; VonGonten, Glenn, EMNRD; J. Arnwine; Carr, Jim A.; Griswold, Jim, EMNRD; Kelsey H. Wasylenky; kgoil@msn.com; Kevin Kauffman; Larry Kehoe; Ocean Munds-Dry; Paul Phillips; Sherry Glass; Price, Wayne, EMNRD
Subject:	facsimile permission from SLO for fence around BW-005 area of concern
Attachments:	_081218_140310005_fax release for fence construction NM SLO_081124.pdf

Please find attached.
We are pleased to provide you with the attached letter from the New Mexico Commissioner of Public Lands, approving Jim's Water Service's fencing and closure plan for the JWS State 24 No. 1 well. As you know, we are completing construction of the fence, in cooperation with Mr. Jim Carr, the Carlsbad District Resource Manager, and this will be done by January 15, 2009. Dimas Herrera has indicated to me that Wayne Price of the OCD has his combination to the lock on the fence and will share it as needed with representatives from that agency. As suggested in our closure plan submitted to you [October 28, 2008 and November 25, 2008 and December 11, 2008], we would be happy to meet with you and SLO representatives or have you inspect the fencing, at your convenience. If you have any questions, please don't hesitate to contact me. Thank you.

Sherry Glass
Engineering Technician
Jim's Water Service

PATRICK H. LYONS
COMMISSIONER

State of New Mexico
Commissioner of Public Lands
310 OLD SANTA FE TRAIL
P.O. BOX 1148
SANTA FE, NEW MEXICO 87504-1148

COMMISSIONER'S OFFICE
Phone (505) 827-5760
Fax (505) 827-5766
www.nmstatelands.org

November 24, 2008

K.P. Kauffman Company, Inc.
ATTN: Sherry Glass
1675 Broadway, Suite 2800
Denver, Colorado 80202-4628

Ms. Glass,

The New Mexico State Land Office is granting JWS of New Mexico permission to install a chainlink fence around the "Loco Hills – JWS sinkhole." Installing the fence will provide mitigation measures for trespass situations and will ultimately provide for protection of the site. We would request that you work directly with Mr. Jim Carr (Carlsbad District Resource Manager- 575-885-1323) for the placement and exact location of the fence.

Thank you again for your cooperation in this matter.

Brian Henington
Deputy Director – Field Operations
310 Old Santa Fe Trail
PO Box 1148
Santa Fe NM 87504
bhenington@slo.state.nm.us

cc: Jim Carr, District Resource Manager- Carlsbad

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COMPLETE OIL FIELD SERVICES

November 25, 2008

Wayne Price
Environmental Bureau Chief
Oil Conservation Division
1220 South Saint Francis
Santa Fe, New Mexico 87505

Re: Jim's Water Service of New Mexico, Inc.
Pit Closure Proposal (Township 18 South, Range 28 East, Section 24, NW/4SE/4, Eddy County, New Mexico)

Dear Mr. Price:

I am writing in response to your November 17, 2008 email. We want to correct any misconceptions that may have arisen, and to see if we can reach common ground with both the State Land Office (SLO) and the Oil Conservation Division (OCD) on how to proceed in a cooperative and coordinated fashion, in light of the facts on the ground. At the present time, Jim's Water Service (JWS) has been subjected to different and somewhat inconsistent requirements from OCD and SLO. Therefore, we would like to develop an approach that is acceptable to all parties.

The central fact here is that a large sinkhole suddenly and unexpectedly swallowed up the JWS brine well on July 16, 2008. A JWS employee narrowly escaped having himself and his pickup truck swallowed by the expanding hole. From our study of the sinkhole thus far, including its large size, it is clear that naturally-occurring conditions and phenomena played a major role in this event and that the brine well, by itself, did not cause the sinkhole. The casing, tubing, and wellhead of the brine well are gone, buried under thousands of tons of earth, and cannot be recovered because the area is too unstable and dangerous to attempt recovery of any equipment. The sinkhole is still growing, although at a lesser rate.

Earlier this month, another sinkhole formed at the Loco Hills Disposal site, 12 miles to the northeast. In addition, a front-end loader broke through a caliche layer into another subsurface cavern south of Carlsbad, stranding the operator for several hours. It certainly appears that there is a region-wide phenomenon at work here.

Under these circumstances, the main priority of the SLO, which has jurisdiction over the surface lands at the site, is to ensure public health and safety. JWS has cooperated fully with SLO in this effort, immediately (last July) erecting a barbed wire fence around the sinkhole, providing warning signage, and making frequent site inspections. SLO is very focused and insistent on requiring JWS to construct a higher, more effective fence <u>as soon as possible</u>, because each day the site is not completely secured presents a continuing potential danger to the public. At present, the sinkhole is still active and the surrounding area, including the now-inactive brine lagoon, is considered quite unstable. The plan developed in cooperation with SLO was to fence the entire area, including the inactive brine lagoon, and thereby deny public access to the entire unstable area. The fence will be chain link, eight (8) feet high, and topped with barbed wire. The fence will cost approximately $65,000-$70,000.

JWS's October 28, 2008 letter (copy attached) to Mr. Henington of the SLO, which was also sent to Carl Chavez of your office, was intended to be responsive both to SLO and to Mr. Chavez's request for a closure plan. Our plan was intended to meet the requirements, as far as possible, of both SLO and OCD, consistent with physical realities and while meeting the paramount need of protecting public health and safety as well as worker health and safety.

Our October 28 letter explained in detail why any attempt to bury the liner and walls of the lagoon pit would be quite dangerous to workers and equipment, by exposing them to an area of great instability. (*See* October 28 letter page 2.) Also, given the soil, vegetation, and other conditions at the site, it would achieve little tangible benefit. (October 28 letter, page 3.) Accordingly, as the regulations provide, we have sought an exception waiver to NMAC 19.15.17.13, F(2)(d), because to remove the liner and deconstruct the walls of the below-surface lagoon pit would present far too great a risk to the safety of JWS as well as state personnel, for little if any environmental benefit.

Our October 28 letter also responded to Mr. Chavez's request for groundwater monitoring. It explained in detail our understanding that there are no significant sources for fresh water at this location, and our belief that monitoring would not generate useful data. (October 28 letter, page 2.) We see little need to conduct additional water quality monitoring, since JWS did not introduce any foreign or hazardous materials into the subsurface.

In addition, we believe that any need for groundwater monitoring is far outweighed by the safety risks it would create, because it would be extremely dangerous for workers and equipment to drill and complete water quality monitoring wells in this unstable area where further collapses are a real risk. If Mr. Chavez truly believes that monitoring wells are necessary, we request that he provide us with a detailed understanding of not only what he is looking for and why, but also his proposed locations for those wells. We do not want to repeat the Carlsbad incident where an equipment operator was trapped for several hours.

Obviously, the brine well cannot be closed in the conventional way by "plugging" and "abandonment," because it no longer exists. The wellhead and casing are buried by thousands of tons of earth, and it would be literally impossible as well as highly dangerous to try to pursue such plugging and abandonment. This is a situation where the forces of nature have conclusively superseded otherwise-applicable regulatory requirements.

In summary, we believe that the closure plan proposed in JWS's October 28 letter presents equivalent (and in fact better) protection of public health and safety, as well as water resources and the natural environment, in this unstable location. Prompt construction of the fence will be important in safeguarding public health and safety. Further delay in building the fence runs the risk for the state agencies and JWS alike that someone will, with or without permission, enter onto the site and be injured, or worse. We sent our October 28 plan to the SLO because we were trying to be fully responsive to them and their urgent need to protect public safety.

If, despite our explanation in this letter, you still find our proposed approach unacceptable, we would request a joint meeting with OCD and SLO to come up with an approach that meets both agencies' needs and to eliminate JWS being subject to inconsistent and uncoordinated regulatory requirements. JWS wants to ensure the single most critical objective –

protecting public and worker health and safety – is achieved in an efficient manner. We look forward to discussing this further with you.

Best regards,

Sherry Glass

Sherry Glass
Engineering Technician
Jim's Water Service of New Mexico

Enclosure

cc: Jim Carr, District Resources Manager, II, New Mexico State Land Office
Larry Kehoe, Assistant Land Commissioner, New Mexico State Land Office
Carl Chavez, OCD, Environmental Bureau, State of New Mexico
Brian Henington, Public Land Resources Assistant Director,
Field Operations, NMSLO

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Complete Oil Field Services

JWS of New Mexico, Inc.

October 28, 2008

Mr. Brian Henington
Public Land Resources Assistant Director, field operations
New Mexico State Land Office
310 Old Santa Fe Trail
Santa Fe, NM 87504

RE: Jim's Water Service of New Mexico, Inc. (JWS) Pit Closure Proposal
Township 18 South, Range 28 East
Section 24: NW/4SE/4
Eddy County, New Mexico

Dear Mr. Henington:

In light of the recent collapse of the JWS State 24 No. 1 well (BW 005) (hereinafter referred to as the "Brine Well"), JWS proposes to construct a fence to surround the sinkhole feature and unstable area which developed in the immediate vicinity of the Brine Well on July 16, 2008. In addition, JWS proposes to close its permitted, below-ground brine water storage pit offsetting the Brine Well located on the property described above. The following information summarizes the events surrounding the creation of the sinkhole, the status of the surrounding area, and the immediate plans JWS proposes to undertake.

A sinkhole developed on July 16, 2008 and the Brine Well collapsed into it. Based on our study thus far of the sinkhole, including its size, it is now clear that the Brine Well did not "cause" the sinkhole but that instead naturally-occurring phenomena came into play here. In fact, the "collapse" feature which became the sinkhole was observable in aerial photos taken before the original Nix well was drilled, and could with hindsight be identified after the collapse event. The casing, tubing and wellhead of the Brine Well cannot be recovered and the area is too unstable and dangerous to attempt to recover any equipment. We recognize and agree that this area is unstable, and that it should be fenced to protect the public and the environment. For this reason, JWS proposes to construct a fence entirely surrounding the area designated the 'Hot Zone' by the Oil Conservation Division of New Mexico (OCD) in their initial assessment of the sinkhole. The plans for this fence are depicted on Exhibit A attached hereto. The estimated cost of the fence is \$65,000 to \$70,000. In its plans for the fence, after discussion with SLO representatives, JWS

has agreed to enlarge the fenced area to include enclosure of the caliche pit and brine lagoon located in the vicinity of the Brine Well. The brine lagoon is a permitted and lined permanent below-ground pit located to the east of the Brine Well. Jim Carr, the SLO field officer for this area, concurs that fencing this entire area is necessary to protect the safety of the public.

In reviewing the immediate area of the Brine Well and brine lagoon within the context of this unstable area, JWS believes that fencing the lagoon and feature is the most appropriate solution and will have no detrimental effect on public health or the environment nor any fresh water source. The SLO is primarily concerned about constructing the fence in a timely manner, as each day the site is not secured presents a potential danger to the public. The sinkhole feature appears to be migrating slowly in an easterly direction, as indicated by the fissures occurring in concentric rings around the feature. At present, the feature is still active and the immediate surroundings are considered extremely unstable. Exhibit B attached hereto depicts a close-up of the fissures and migration direction.

As stated above, the sinkhole feature will not have any detrimental effect on any potential water sources in the area. The Rustler Formation is the only potential ground water source located in the general area of the Brine Well and is not generally a source of potable water in this area of the Delaware Basin. The Rustler Formation, though labeled an 'unconfined' aquifer, is in actuality discontinuous bedded karstic evaporites (predominately dolomites), with uncommonly seen briny water sands. The existence of briny water sands most likely indicates recharge is also from fractures, channels, and caverns in the dissolved interbedded rock. Furthermore, according to the Geology and Aggregate Resources District II manual on Eddy County, "[t]he Pecos River has no important tributaries from the east. Most drainageways east of the Pecos flow only short distances, and any surficial waters are quickly diverted into localized bolsons and *collapsed depressions* [emphasis added], or the water rapidly filters into the permeable eolian cover." Any usable fresh water aquifers are located far to the west or east of the Brine Well location, as indicated in the State of New Mexico's ground water resources maps available online (attached hereto as Exhibit I) and the Aggregate Resources District II Manual. The Roswell-Artesian basin maps and geologic overview map of Salado formation are attached hereto as Exhibits C & D. Recharge of the Rustler aquifer occurs through precipitation into the salty soils from the muddy washes present in the immediate area of this topographic 'low'. Therefore, as there are no sources for 'fresh water' in the immediate area of the brine well, there are no potable water sources to have been contaminated by the feature or the brine pit (lagoon).

Any attempt to bury the liner and walls of the lagoon pit would be extremely dangerous to workers and equipment. Because the brine lagoon is located to the east of the Brine Well feature, any equipment that would necessitate closing the pit by on-site burial of the liner and walls would be occurring in an area of great instability. Unless the SLO or the OCD would indemnify JWS against loss or injury to personnel or equipment to bury the material on site or move it offsite through the use of this equipment, it is too unstable to attempt in this area. It should be noted that all liquids and basic sediments and water have been either pulled or evaporated out of the brine lagoon at this time. Exhibit E attached hereto contains a statement regarding the status of liquids and BS&W as of May 2008.

Active remediation of the area by contouring or re-vegetating would not only present risks but would achieve little real benefit. The top twenty (20) feet of the surface of the area is composed of a mix of caliche, gravels and salty soils, labeled Qe (meaning Quaternary-age permeable eolian or wind-deposited surface on the Mescalero Pediment). The composure of the surface is depicted on the attached New Mexico Physiographic map of Eddy County, attached hereto as Exhibit F. According to the appraisal of State Institutional Lands conducted in September 1978 (attached hereto as Exhibit G), the best use for which the land may be adapted is "native pasture and wildlife habitat," with erosion indicated from "severe wind." Disrupting the surface of this area to remediate it will likely cause some of the soils to erode more than usual. Because the soils in this area are classified as a 'gravelly fine sand loam,' any remediation will render the soils less compacted, making them further susceptible to wind erosion. Furthermore, the vegetation on the land, including grasses, is classified as "blue grama, black grama, side-oats grama, little bluestem, Javelina, snakeweed, sand muhly, sand sagebrush, and mesquite." There are no natural streams, rivers, springs, ponds or water holes present. There exists no merchantable timber, irrigation ditches, nor domestic, irrigation or other purposed wells. There are no nearby cities, towns or village limits within twelve (12) miles of the sinkhole feature, and no existing or abandoned utilities, railroads, pipelines, borrow pits or improvements in the area. This area is literally in the middle of nowhere. Given these realities, the best solution is to fence the land to protect worker safety and public safety, but otherwise to leave the site in its current state.

As described herein, the installation of the proposed fence will mitigate danger to the public and wildlife and will keep curiosity-seekers out of the area permanently. The fence surrounding the sink hole feature, brine lagoon, and caliche pit will be constructed with eight (8) foot chain link with three-strand barb wire on top, and will include locked gates. Constructing such a fence in lieu of a pit closure will prevent livestock and wildlife losses and help maintain the feature in an easily-monitored condition. If it someday becomes possible to safely retrieve the equipment used in the operations of the brine pit, it can be attempted. At this time, the SLO and the OCD do not want any personnel inside the current fence, as the instability of the area presents a threatening condition. It would be a very unfortunate event if the use of heavy equipment in this area causes any damage to the State Highway 217, located adjacent to the collapsed Brine Well, by accelerating the migration of fissures in that direction.

Based on the technical merits described herein, JWS hereby requests an exception waiver to NMAC 19.15.17.13, subparagraph F(2)(d), addressing the on-site burial of the pit liner and testing of the soils under the liner. For the reasons stated above, JWS is convinced that removing the liner and deconstructing the walls of the below-surface pit (as outlined in Exhibit H attached hereto) would present far too great a risk to the safety of JWS and State personnel. JWS hereby requests that the OCD grant it an administrative exception waiver based on its closure plan described in this letter, which presents equivalent and in fact better protection of water resources, public health and safety and natural environment in this unstable area.

Please do not hesitate to contact me at the address or telephone number listed above should you have any questions. Thank you.

Best Regards,

Sherry Glass

Sherry Glass
Engineering Technician
Jim's Water Service of New Mexico

cc: Jim Carr, District Resources Manager, II, New Mexico State Land Office
Larry Kehoe, Assistant Land Commissioner, New Mexico State Land Office
Carl Chavez, OCD Environmental Bureau, State of New Mexico

Attachments

Price, Wayne, EMNRD

From: Price, Wayne, EMNRD
Sent: Monday, November 17, 2008 2:40 PM
To: 'Kent Gilbert'; 'sglass@kpk.com'
Cc: Chavez, Carl J, EMNRD; jcarr@slo.state.nm.us; Kostrubala, Thaddeus; Gum, Tim, EMNRD; Sanchez, Daniel J., EMNRD; Fesmire, Mark, EMNRD
Subject: JWS Brine well BW-05

Dear Kent and Sherry:

On November 04, 2008 OCD received a copy of a document dated October 28, 2008 sent to Mr. Brian Henington-NMSLO (Re: Pit Closure Proposal) from JWS. On November 13, 2008 OCD received a fax from JWS requesting permission to install fencing around sinkhole area JWS Well 005, NWSE Sec 24, T18s R 28e, Eddy County, NM. Last week Jim Carr of the NMSLO called and indicated they would like to proceed with building of the new fence to include the brine pond and caliche pit.

Since all of the property in question is owned by the state land office, OCD has no objections at this time in JWS proceeding with the fence project. However, please be aware that OCD is not approving of any closure plan at this time. If OCD requires monitoring or corrective action in the future then JSW will be responsible for removing the fence for remediation and then properly replacing the fence.

It should also be pointed out that the letter to the NMSLO has no standing with OCD at this time. The JWS BW-05 brine well was permitted pursuant to Water Quality Control Commission regulations 20.6.2 NMAC and any termination of the permit or pit closure must be addressed directly with OCD pursuant to the permit mechanism.

Carl Chavez- OCD has asked for ground water monitoring, but did not receive a response from JWS.
So therefore, In order to expedite this process OCD plans on writing a compliance order which will stipulate this process and require certain actions to be taken in order to protect public health, safety, fresh water and the environment. The compliance order will address permit deficiencies, future monitoring, remediation, financial assurance, and possible civil penalties for non-compliance.

Wayne Price-Environmental Bureau Chief
Oil Conservation Division
1220 S. Saint Francis
Santa Fe, NM 87505
E-mail wayne.price@state.nm.us
Tele: 505-476-3490
Fax: 505-476-3462

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www.kpk.com

COMPLETE OIL FIELD SERVICES

11-13-08

Via facsimile:

303-825-4825

To: Wayne Price, Bureau Chief, Environmental Division, State of New Mexico Oil Conservation Division 505-476-3462

RE: Request for permission to install fencing around sinkhole area, JWS Brine Well 005, NWSE sec 24, T18S, R28E, Eddy County, New Mexico

Please find attached proposal to the State Land Office, mailed to Brian Henington on October 28, 2008, as notification of plans for fencing on State Trust Lands, as part of request for business lease by State Land Office submitted to Jim's Water Service (JWS) on September 11, 2008. JWS would request permission from the OCD to proceed with this more permanent fence to make the area more secure to the public, local wildlife, and the environment.

Thanks,

Sherry Glass

SGLASS@KPK.COM

Sherry Glass
Engineering Technician for
Kent Gilbert
V. P. Environmental Engineering
kgoil@msn.com
303-478-8393

Pages, including cover: 5

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COMPLETE OIL FIELD SERVICES

JWS OF NEW MEXICO, INC.

October 28, 2008

Mr. Brian Henington
Public Land Resources Assistant Director, field operations
New Mexico State Land Office
310 Old Santa Fe Trail
Santa Fe, NM 87504

RE: Jim's Water Service of New Mexico, Inc. (JWS) Pit Closure Proposal
Township 18 South, Range 28 East
Section 24: NW/4SE/4
Eddy County, New Mexico

Dear Mr. Henington:

In light of the recent collapse of the JWS State 24 No. 1 well (BW 005) (hereinafter referred to as the "Brine Well"), JWS proposes to construct a fence to surround the sinkhole feature and unstable area which developed in the immediate vicinity of the Brine Well on July 16, 2008. In addition, JWS proposes to close its permitted, below-ground brine water storage pit offsetting the Brine Well located on the property described above. The following information summarizes the events surrounding the creation of the sinkhole, the status of the surrounding area, and the immediate plans JWS proposes to undertake.

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As stated above, the sinkhole feature will not have any detrimental effect on any potential water sources in the area. The Rustler Formation is the only potential ground water source located in the general area of the Brine Well and is not generally a source of potable water in this area of the Delaware Basin. The Rustler Formation, though labeled an 'unconfined' aquifer, is in actuality discontinuous bedded karstic evaporites (predominately dolomites), with uncommonly seen briny water sands. The existence of briny water sands most likely indicates recharge is also from fractures, channels, and caverns in the dissolved interbedded rock. Furthermore, according to the Geology and Aggregate Resources District II manual on Eddy County, "[t]he Pecos River has no important tributaries from the east. Most drainageways east of the Pecos flow only short distances, and any surficial waters are quickly diverted into localized bolsons and *collapsed depressions* [emphasis added], or the water rapidly filters into the permeable eolian cover." Any usable fresh water aquifers are located far to the west or east of the Brine Well location, as indicated in the State of New Mexico's ground water resources maps available online (attached hereto as Exhibit D) and the Aggregate Resources District II Manual. The Roswell-Artesian basin maps and geologic overview map of Salado formation are attached hereto as Exhibits C & D. Recharge of the Rustler aquifer occurs through precipitation into the salty soils from the muddy washes present in the immediate area of this topographic 'low'. Therefore, as there are no sources for 'fresh water' in the immediate area of the brine well, there are no potable water sources to have been contaminated by the feature or the brine pit (lagoon).

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Active remediation of the area by contouring or re-vegetating would not only present risks but would achieve little real benefit. The top twenty (20) feet of the surface of the area is composed of a mix of caliche, gravels and salty soils, labeled Qe (meaning Quaternary-age permeable eolian or wind-deposited surface on the Mescalero Pediment). The composure of the surface is depicted on the attached New Mexico Physiographic map of Eddy County, attached hereto as Exhibit F. According to the appraisal of State Institutional Lands conducted in September 1978 (attached hereto as Exhibit G), the best use for which the land may be adapted is "native pasture and wildlife habitat," with erosion indicated from "severe wind." Disrupting the surface of this area to remediate it will likely cause some of the soils to erode more than usual. Because the soils in this area are classified as a 'gravelly fine sand loam,' any remediation will render the soils less compacted, making them further susceptible to wind erosion. Furthermore, the vegetation on the land, including grasses, is classified as "blue grama, black grama, side-oats grama, little bluestem, Javelina, snakeweed, sand muhly, sand sagebrush, and mesquite." There are no natural streams, rivers, springs, ponds or water holes present. There exists no merchantable timber, irrigation ditches, nor domestic, irrigation or other purposed wells. There are no nearby cities, towns or village limits within twelve (12) miles of the sinkhole feature, and no existing or abandoned utilities, railroads, pipelines, borrow pits or improvements in the area. This area is literally in the middle of nowhere. Given these realities, the best solution is to fence the land to protect worker safety and public safety, but otherwise to leave the site in its current state.

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Based on the technical merits described herein, JWS hereby requests an exception waiver to NMAC 19.15.17.13, subparagraph F(2)(d), addressing the on-site burial of the pit liner and testing of the soils under the liner. For the reasons stated above, JWS is convinced that removing the liner and deconstructing the walls of the below-surface pit (as outlined in Exhibit H attached hereto) would present far too great a risk to the safety of JWS and State personnel. JWS hereby requests that the OCD grant it an administrative exception waiver based on its closure plan described in this letter, which presents equivalent and in fact better protection of water resources, public health and safety and natural environment in this unstable area.

Please do not hesitate to contact me at the address or telephone number listed above should you have any questions. Thank you.

Best Regards,

Sherry Glass
Engineering Technician
Jim's Water Service of New Mexico

cc: Jim Carr, District Resources Manager, II, New Mexico State Land Office
Larry Kehoe, Assistant Land Commissioner, New Mexico State Land Office
Carl Chavez, OCD Environmental Bureau, State of New Mexico

Attachments

JWS OF NEW MEXICO, INC.
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1675 BROADWAY, SUITE 2800
DENVER, COLORADO 80202-4628

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JWS OF NEW MEXICO, INC.

October 28, 2008

Mr. Brian Henington
Public Land Resources Assistant Director, field operations
New Mexico State Land Office
310 Old Santa Fe Trail
Santa Fe, NM 87504

RE: Jim's Water Service of New Mexico, Inc. (JWS) Pit Closure Proposal
Township 18 South, Range 28 East
Section 24: NW/4SE/4
Eddy County, New Mexico

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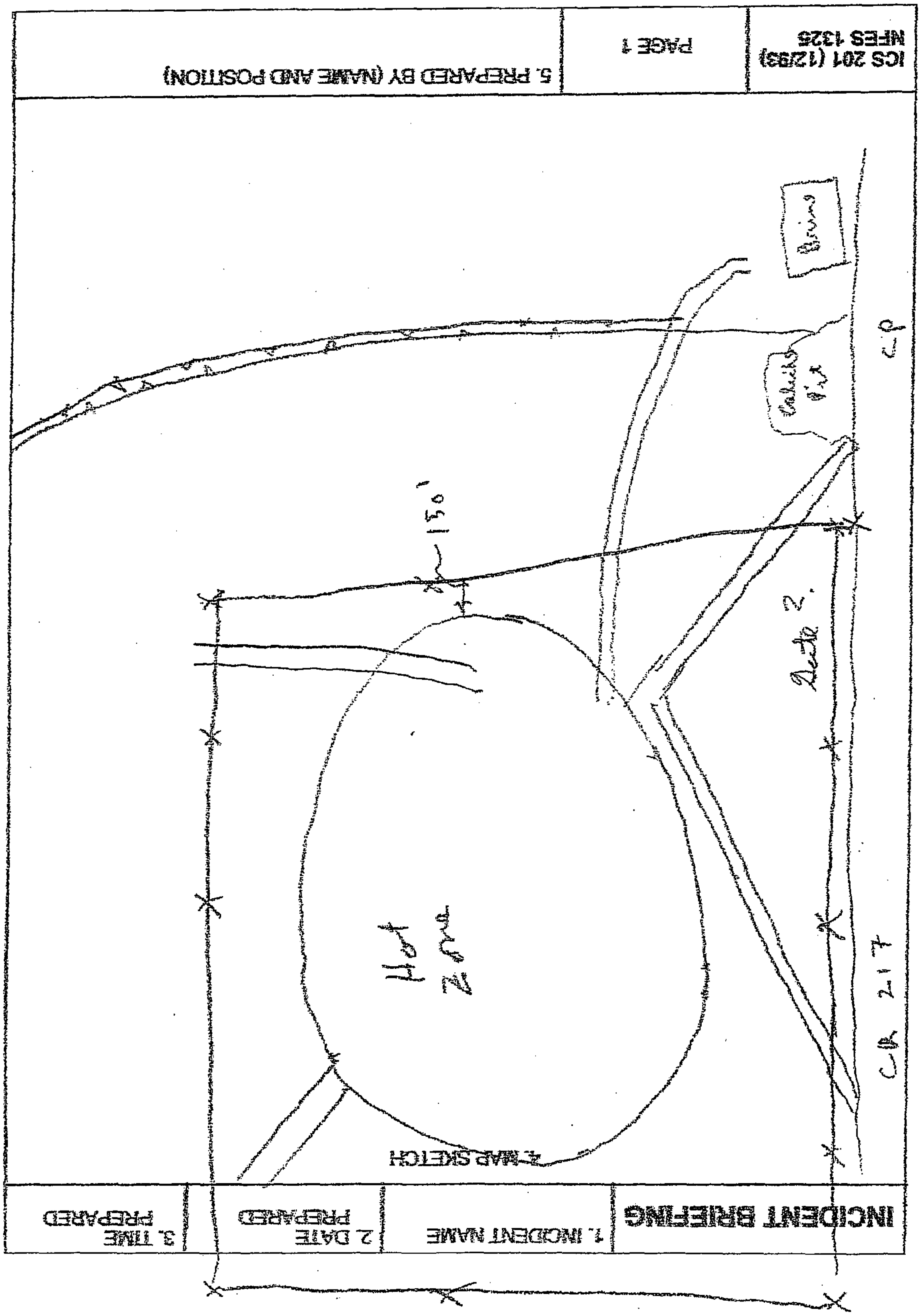
Attachments

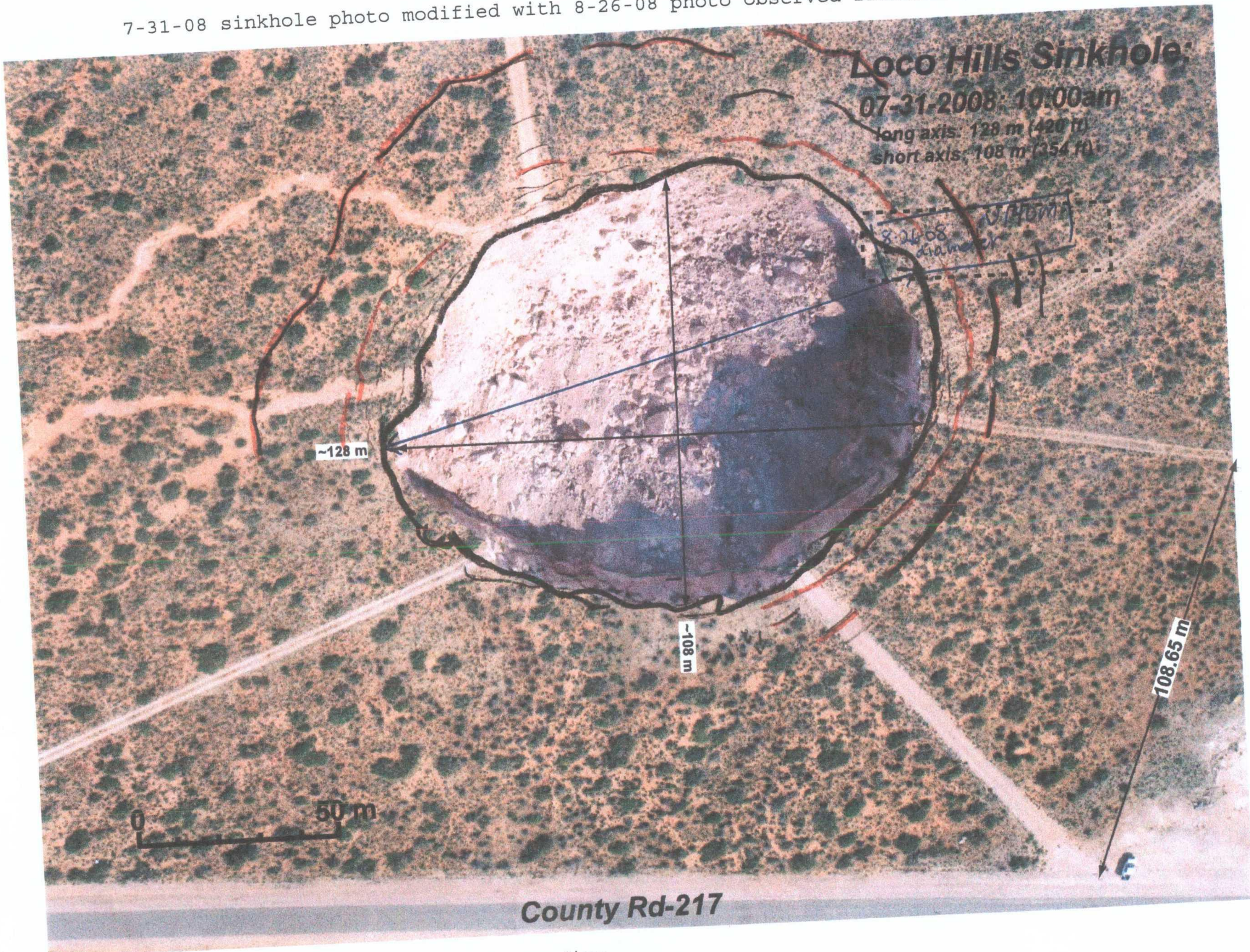
23 Jul 08



Not to scale
= two-track
O hot zone
CP command post

EXHIBIT A

7-31-08 sinkhole photo modified with 8-26-08 photo observed fissures and growth



new diameter estimated ~140m NESW trending

Exhibit B

from
COLLECTION OF HYDROLOGIC DATA
EASTSIDE ROSWELL RANGE EIS AREA
NEW MEXICO
by
Geohydrology
Associates, Inc.
BUREAU OF LAND MANAGEMENT
Denver, Colorado
Contract No. YA-512-CT7-217
1201 Childers Dr., N.E., Albuquerque, N.M. 87112
505-2936971
3225 Candelaria Rd., N.E., Albuquerque, N.M. 87107
505-345-5713

June 1978

Exhibit C, pg 1 of 6

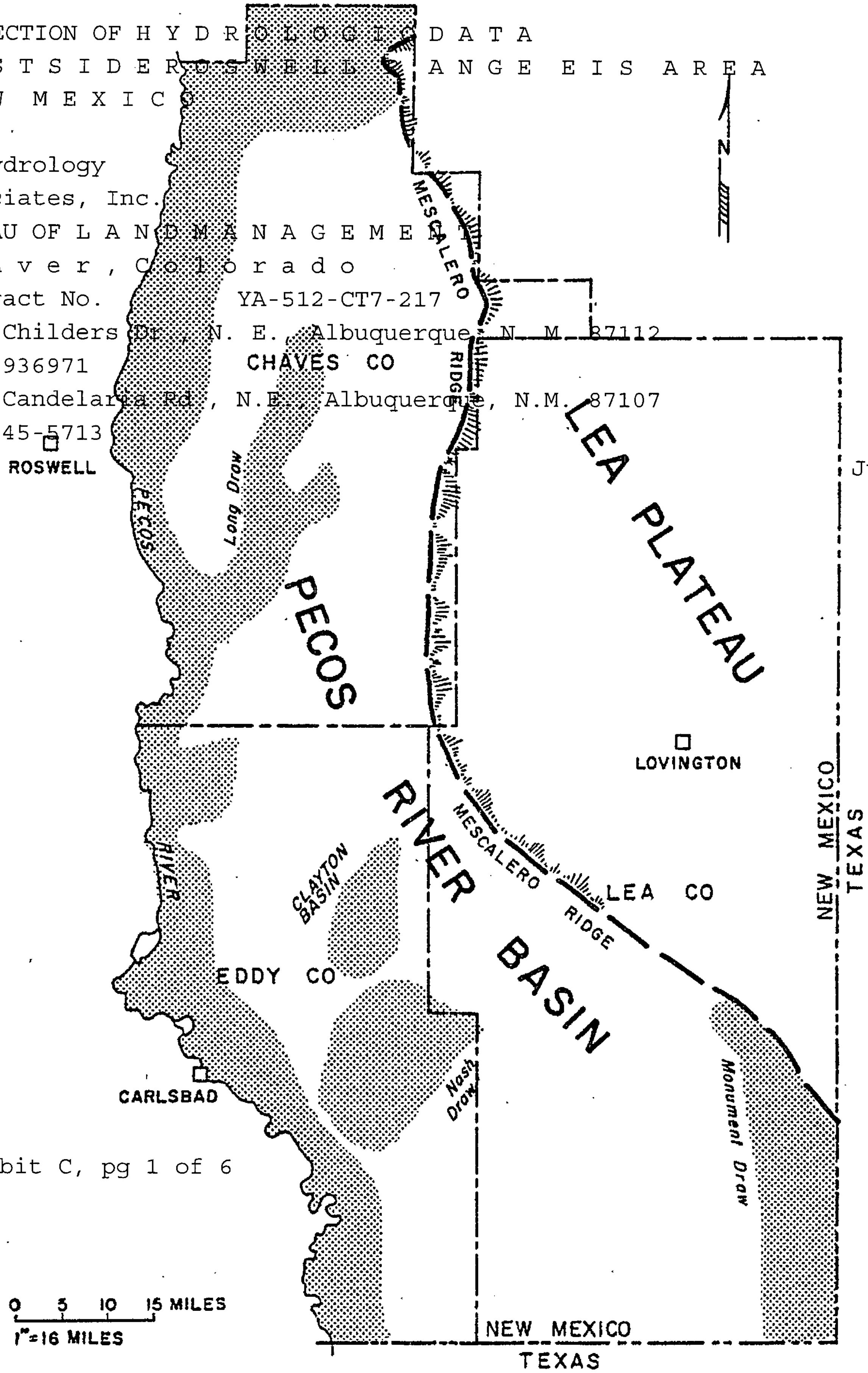


Figure 2.--Eastside Roswell area showing major drainage basins.

Well yields do not consider chemical quality of water that would be produced from any given aquifer. Although aquifer yields may be similar in a particular area, the water may be potable or nonpotable. A good example of these variations is found near the L. E. Ranch in T. 11 S., R. 28 E., Chaves County. The well at the ranch headquarters produces relatively large quantities of water of adequate quality for most uses. This well, however, is surrounded by a large area characterized by low yields and poor quality. The data given on figure 17 are intended to be used as a regional guide to aquifer yields. More detailed local information should be obtained before exploratory wells are drilled and tested.

Yields less than five gpm.

Wells tapping aquifers along the east side of the Pecos River valley will generally yield less than five gpm. These aquifers consist of interbedded shale, siltstone, and very fine-grained sandstone. Well capacity increases with depth, but most stock wells in the area have not been drilled deep enough to adequately test the aquifer system. There also is a belt of low capacity wells that parallels Mescalero Ridge in southeastern Eddy County. Wells in this area are generally deep, of low capacity, and produce inferior quality water.

Yields of five to ten gpm.

Much of eastern Chaves and Eddy Counties is underlain by a series of Triassic deposits that contain fine-grained sandstone and red shale. These same formations are present as a southeast-trending belt at the base of Mescalero Ridge. Wells tapping these sandstone aquifers generally produce spring represents a zone of weakness in the Rustler Formation. Large quantities of ground water in the form of brine moves southwestward beneath the axis of Clayton Basin and Nash Draw. This brine aquifer is under strong artesian head, and Surprise Spring is where this brine moves upward from the aquifer to the land surface.

Most springs are recognized by the amount of water produced and by the dependability of the discharge. However, many springs are overlooked by most observers because they are small or their discharge is seasonal. There are numerous seeps in Nash Draw which, if confined, would be considered springs; in most cases, however, these simply form marshy areas which lose large quantities of water by evapotranspiration. Numerous seeps along the edge of the Pecos River and Mescalero Ridge are not classified as springs throughout most of the year, but may discharge two or three gpm during wet seasons.

Chemical Quality

Water-quality standards set by the New Mexico Environmental Improvement Agency, as well as the recommended standards of the Public Health Service, were described in detail in the Chemical Quality portion of the Surface Water section of this report.

The chemical character of ground water is determined by the amount of soluble material in the aquifers through which the water moves. There is very little mineralization in precipitation, but soluble constituents are picked up by water as it moves over the land surface and through the ground. In much of Chaves and Eddy Counties, water-bearing formations contain evaporite deposits which are quite soluble. The principal salts in the water-bearing formations are halite (NaCl) and gypsum ($CaSO_4 \cdot 2H_2O$).

In addition to natural salt contamination from evaporites, salts are being added to the aquifers by potash refining operations and from oilfield brines. In most cases, however, these contaminants are being added to already nonpotable water.

As required by the Statement of Work, 20 samples were collected for complete chemical analysis (Table 6). Two of these samples were collected from uncontaminated surface-water sources and have been described in detail in a preceeding section of the report. Seventeen samples were collected from wells considered to be representative of individual aquifers or hydrologic conditions at a particular site. One sample was collected at the discharge point of the IMC refinery.

Numerous water quality samples have been collected during previous studies in the area; 67 unpublished analyses were in the files of the Water Resources Division of the U. S. Geological Survey. These analyses, in addition to those made for this study, are given in Table 6. The sample locations are shown in figures 18, 19, and 20.

One of the more useful field guides to water quality is the technique of measuring the specific conductance of a sample in the field. A Wheatstone bridge is used to measure the conductivity of an unknown sample; units are reported in micromhos (umhos) at 25^{o}C. Although there is no direct relationship between specific conductance and total dissolved solids (TDS), for field purposes the following relationship provides a reasonably the samples. On the basis of these criteria, set by the EIA, fully 75 percent of the ground water in the Eastside Roswell area is non-potable. In most cases, water from the Ogallala and alluvial aquifers would qualify as potable. The Rustler and Triassic samples, as well as the brines from deeper aquifers, are nonpotable.

It should be noted that these limits are "recommended" concentrations; water exceeding these various limits is used throughout New Mexico. For example, samples from municipal supplies at Roswell, Dexter, Hagerman, and Lake Arthur all exceed the recommended limits for total dissolved solids.

The cathartic effect of sulfate has been discussed in a previous section describing water quality in surface water; the reader is referred to the section of this report describing the chemical quality of surface water. The upper recommended limit for chloride is 250 mg/l. Concentrations greater than that amount would be harmful to persons on a "salt-free" diet, however, taste tolerance generally sets the limits which the average person will consume. Chlorides in water may impart a salty taste at concentrations as low as 100 mg/l, although in some water 700 mg/l may not be noticeable (Anon., 1950). Chloride concentrations of 1,500 mg/l are reported to be safe for livestock, chickens, and wildlife (Anon., 1956); levels in excess of 4,000 mg/l may be injurious (Adams, 1940).

In general, water throughout most of the Eastside Roswell area would not meet the recommended maximum concentrations set by the EIA.

Nevertheless, when consumed in small to moderate quantities, the water should not be injurious to humans, livestock, or wildlife. The taste tolerance to chlorides would generally prevent humans from consuming large quantities.

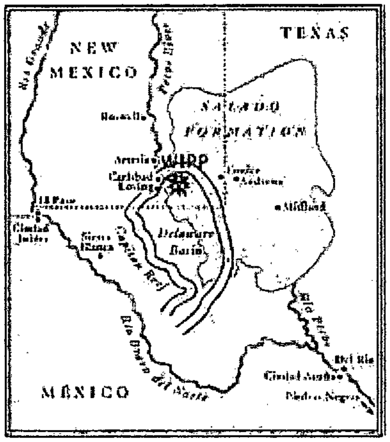
Water from the alluvium and/or the Ogallala should be suitable for irrigation; water from other aquifers in the area would not.

Due to variations in chemical quality of water, local tests should be made prior to establishing a permanent water supply.

Exhibit D, pg 1 of 4

Citizens for Alternatives to Radioactive Dumping

Geology Overview



Karst

Karst is a geological condition that develops when underground soluble rocks (limestone, dolomite, gypsum, anhydrite and halite--salt) are dissolved away by water. At the surface, karstlands typically have little or no surface runoff after rainstorms because the rainwater quickly percolates downward through sinkholes, disappearing streams and arroyos, and perforated surface rock (caprock). Most water movement takes place underground through enlarged fractures, channels and caverns in the dissolved rock. The water finally emerges to the surface again at a few large springs.

The WIPP site lies near Carlsbad, New Mexico in the northern Delaware Basin, part of a larger basin system formed when much of the Southwest was covered by an inland sea. The edge of the Delaware Basin is defined by an ancient reef, the Capitan Limestone (or Capitan Reef). This area, part of the Pecos River Valley, is one of the largest karstlands in the United States. Within one mile of WIPP and to the west lies Nash Draw, one of the largest surface karst features in the world. Many other karst features are also evident at WIPP. Extending into the southwestern part of the WIPP site is a karst valley 1 mile long. Curved around the northeast corner of the site and including borehole WIPP-14, are a chain of about 10 closed depressions; and south of the site is a vast karst area near the dune field at Mills Ranch. Sinkholes can be seen clearly just south of the WIPP boundary where one of the groundwater flow paths turns westward. West of the site there is another chain of sinkholes, including borehole WIPP-33, leading to Nash Draw.

Knowing whether karst features are present at the WIPP site is important because water can move much faster through these channels and conduits where the salt has been dissolved away. If karst conditions do exist at WIPP itself and radionuclides leak out of the repository and reach the karst channels, travel times for these contaminants to be carried offsite or even into the Pecos River could be dramatically shortened. Instead of taking thousands of years to reach the river, it could take just over 100 years. Radionuclides and hazardous chemicals could reach a water, oil or gas well within 2 miles of the site in as little as 15 years.

WIPP scientists and other, independent, scientists disagree about where exactly significant dissolution (dissolving away) of salts in the water-bearing Rustler Formation begins (more on individual formations below). DOE scientists draw the dissolution edge between Nash Draw and the WIPP site. Others, however, have found evidence for karst and rapid water flow across the WIPP site itself. (During the Hazardous Waste Facility Permit hearings, DOE scientist Dr. Dennis Powers couldn't name a single scientist who supported DOE's theories, who didin't work for DOE.) DOE's own 1976 Resistivity Survey concluded that there was a dissolution front on top of the Salado Formation that extended into the WIPP site. Since much of the evidence points to karstic channels and features in the Magenta Dolomite and other formations that DOE has not adequately tested, DOE doesn't have enough data to say truly where this dissolution line lies.

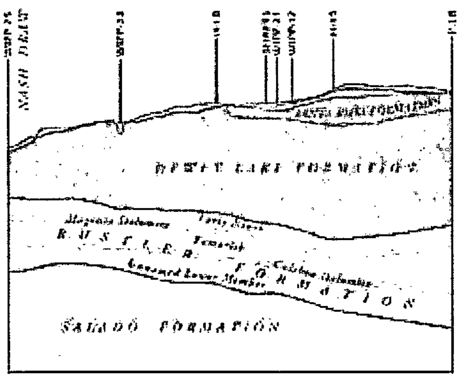
DOE cannot even say for sure where the water table lies (although it is believed to be in the Dewey Lake Redbeds), and doesn't have enough data on most of the formations above WIPP to model whether or not they are viable pathways for contaminants to leave the repository. Discharge/recharge patterns (how the water comes into the aquifers and where it leaves the system) of the Rustler Formation are unknown. Although it is generally agreed that water from the Culebra probably discharges into the Pecos River, "...flow direction, vertical seepage, karst [and] present-day recharge..." are not well understood.*EEG 61: Review of the WIPP Draft Application to Show Compliance with EPA Transuranic Waste Disposal Standards)* Because of this lack of information, it is impossible to tell whether it will take 100 or 1000 years for contamination from the site to reach the Pecos River (and from there, the Rio Grande and water supplies for millions of homes, ranches and farms). It is disappointing, to say the least, that after more than 20 years of investigation DOE scientists still have such a poor understanding of the site.

The Mescalero Caliche

At WIPP the caprock is the Mescalero Caliche Formation which is covered by windblown sand. This formation is no barrier to water movement since up to 15% of it has been dissolved away, leaving the sand in direct contact with the fractured sandstone below. Caliche is essentially limestone and can be dissolved. Breaches are also caused by taproots or fractures. The result is a perforated caprock that funnels water into the karst formations below.

The karst valley at WIPP noted above, consists of solution-subsidence troughs formed when surface rocks collapsed into underground caverns. In some parts of the valley there are conduits or solution pipes through the caliche. In other places the caliche is mostly gone leaving only remnants or a powdery residue (dissolution residue). After heavy rainstorms, water runs along the surface until it finds a breach in the caliche and disappears below.

The Santa Rosa Formation



The Santa Rosa Sandstone pinches out south and west of the WIPP shafts. DOE has claimed that groundwater in the Santa Rosa is isolated, discontinuous or perched (a *perched aquifer* is water that collects or ponds above localized areas where the rock is impenetrable and prevents downward flow) and that there is "little or no water" in this formation. In fact, water has shown up in this formation within 215 feet of the WIPP Exhaust Shaft. Unfortunately, DOE has not collected enough data to know whether or not this formation is a potential migration pathway for contaminants.

A water-saturated layer or horizon was found in the lower Santa Rosa/Upper Dewey Lake Redbeds Formations. This horizon is at the same depth where water has been flowing into the Exhaust Shaft. DOE has claimed that this water is either the result of condensation from the ventilation system (even though their own investigation said this was unlikely) or recharge from ponds constructed on the surface. 1997 studies reported that this area was saturated with water over more than 80 acres, however, which makes recent recharge from these ponds an unlikely source. Again, not enough data has been collected to definitively describe the source of this Exhaust Shaft water.

The Dewey Lake Redbeds Formation

The upper part of the Dewey Lake Redbeds consists of open fractures filled with water. About 170 feet below the surface most fractures are filled with gypsum. (see photo at left) This doesn't mean that the Dewey Lake is impenetrable, however. There are feeder channels in this formation near the waste panels that transmit water from the surface down to the Rustler Formation below. Water has been found in this formation at 9 locations within the WIPP site including the shafts themselves and in 6 other locations within 3 miles of the site boundary. These locations are clustered in the south-central part of the site and south of the site where the Rustler Formation water is freshest and the Santa Rosa Formation is absent. This data indicates that the recharge area for the Dewey Lake Redbeds and the Rustler Formation is in the south-central part of the site and south of the site--everywhere that the Santa Rosa Formation is not present. Again, DOE has not collected enough data to model the Dewey Lake Redbeds as a migration pathway.

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WIPP Background Table of Contents

Sundance Services Inc.
P.O. Box 1737
Eunice, NM 88231

Invoice

DATE	INVOICE #
5/31/2008	46587

BILL TO
Jim Water Station P.O. Box 1387 Artesia, N.M. 88211-1387

Exhibit E pg 1 of 3

Project	TERMS

QUANTITY	DESCRIPTION	RATE	AMOUNT
140	BS&W Tank Bottoms	4.50	630.00T
	NM Sales Tax	6.6875%	42.13
		Total	$672.13

DW

900295

Exhibit E pg 2 of 3

...vices, Inc.

...157 ★ Eunice, New Mexico 88231

(575) 394-2511

Ticket # 82909

Lease Operator/Shipper/Company: Yates

Lease Name: Decater

Transporter Company: JWS Time 6:06 AM/PM

Date: 5-22-08 Vehicle No. 328 Driver No. ____

Charge To: JWS

TYPE OF MATERIAL

- [ ] Produced Water
- [ ] Drilling Fluids
- [ ] Completion Fluids
- [x] Tank Bottoms
- [ ] Contaminated Soil
- [ ] C-117 No.:
- [ ] Other Materials
- [ ] BS&W Content:

Description: Solids

- [ ] JETOUT
- [ ] CALLOUT

VOLUME OF MATERIAL 95 BBLS. YARDS

AS A CONDITION TO SUNDANCE SERVICES, INC.'S ACCEPTANCE OF THE MATERIALS SHIPPED WITH THIS JOB TICKET, OPERATOR/SHIPPER REPRESENTS AND WARRANTS THAT THE WASTE MATERIAL SHIPPED HEREWITH IS MATERIAL EXEMPT FROM THE RESOURCE, CONSERVATION AND RECOVERY ACT OF 1976, AS AMENDED FROM TIME TO TIME, 40 U.S.C. 6901, ET SEQ., THE NM HEALTH AND SAF. CODE 361.001 ET SEQ., AND REGULATIONS RELATED THERETO, BY VIRTUE OF THE EXEMPTION AFFORDED DRILLING FLUIDS, PRODUCED WATERS, AND OTHER WASTE ASSOCIATED WITH THE EXPLORATION, DEVELOPMENT OR PRODUCTION OF CRUDE OIL OR NATURAL GAS OR GEOTHERMAL ENERGY.

ALSO AS A CONDITION TO SUNDANCE SERVICES, INC.'S ACCEPTANCE OF THE MATERIALS SHIPPED WITH THIS JOB TICKET, TRANSPORTER REPRESENTS AND WARRANTS THAT ONLY THE MATERIAL DELIVERED BY OPERATOR/SHIPPER TO TRANSPORTER IS NOW DELIVERED BY TRANSPORTER TO SUNDANCE SERVICES, INC.'S FACILITY FOR DISPOSAL.

THIS WILL CERTIFY that the above Transporter loaded the material represented by this Transporter Statement at the above described location, and that it was tendered by the above described shipper. This will certify that no additional materials were added to this load, and that the material was delivered without incident.

DRIVER: Rook Kesler

FACILITY REPRESENTATIVE: Eddie T

Exhibit E pg 3 of 3

...vices, Inc. Artesia 88211-1387 (505) 1358 748

...137 ★ Eunice, New Mexico 88231 P.O. Box 1387

(575) 394-2511

Ticket # 82792

Lease Operator/Shipper/Company: Yates

Lease Name: Flint TB

Transporter Company: JWS Time 6:41 AM/PM

Date: 5-21-08 Vehicle No. 328 Driver No.

Charge To: JWS

TYPE OF MATERIAL

- [ ] Produced Water
- [ ] Drilling Fluids
- [ ] Completion Fluids
- [x] Tank Bottoms
- [ ] Contaminated Soil
- [ ] C-117 No.:
- [ ] Other Materials
- [ ] BS&W Content:
- [ ] JETOUT
- [ ] CALLOUT

Description: Solids

VOLUME OF MATERIAL 45 BBLS. YARDS

AS A CONDITION TO SUNDANCE SERVICES, INC.'S ACCEPTANCE OF THE MATERIALS SHIPPED WITH THIS JOB TICKET, OPERATOR/SHIPPER REPRESENTS AND WARRANTS THAT THE WASTE MATERIAL SHIPPED HEREWITH IS MATERIAL EXEMPT FROM THE RESOURCE, CONSERVATION AND RECOVERY ACT OF 1976, AS AMENDED FROM TIME TO TIME, 40 U.S.C. 6901, ET SEQ., THE NM HEALTH AND SAF. CODE 361.001 ET SEQ., AND REGULATIONS RELATED THERETO, BY VIRTUE OF THE EXEMPTION AFFORDED DRILLING FLUIDS, PRODUCED WATERS, AND OTHER WASTE ASSOCIATED WITH THE EXPLORATION, DEVELOPMENT OR PRODUCTION OF CRUDE OIL OR NATURAL GAS OR GEOTHERMAL ENERGY.

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DRIVER: [signature]

FACILITY REPRESENTATIVE: Eddie T

EDDY COUNTY

INTRODUCTION

Eddy County is in southeastern New Mexico, adjoining Texas on the south, Lea County on the east, Chaves County on the north, and Chaves and Otero counties on the west. The total area is 4,180 square miles (2,675,200 acres), of which 68 percent is Federal land, 19 percent is State land, and 13 percent is deeded land. The total population of Eddy County is 41,119 (1970 census). Carlsbad, the largest town, county seat, and economic and cultural center, has 21,297 inhabitants.

Basic industries of Eddy County are oil, tourism, farming, ranching, and mining. The oil industry is located principally in the vicinity of Artesia and eastward. A thriving tourist industry flourishes around the famous Carlsbad Caverns. The city of Carlsbad is almost totally dependent on tourism. Farming is confined principally to the Pecos River valley and its associated water supply; ranching is confined to the sparsely vegetated grasslands of higher elevations. Potash is the major product of the mining industry, as Eddy County has about 90 percent of the potash reserves of the United States.

The main transportation routes are U.S. Highways 62, 82, 180, and 285. In addition, State Roads 31, 360, 83, 128, 394, and 216 and a branch line of the Santa Fe Railway serve the area, with Carlsbad as the hub.

PHYSIOGRAPHY

Eddy County lies principally in the Pecos section of the Great Plains province of the United States. About 5 square miles of the High Plains section of the Great Plains province lie in the northeastern corner of the county. In the southeastern quadrant, about 50 square miles of a High Plains (?) outlier are preserved. The Guadalupe Mountains, in the southwest corner of the county, are in the Sacramento section of the Basin and Range province.

This physiographic diversity and resulting geomorphic complexity make it convenient to divide the area into surfaces east of the Pecos and surfaces west of the Pecos.

Surfaces East of the Pecos

Llano Estacado

A small portion of the Llano Estacado surface lies in the northeastern corner of the county. Its westward terminus is defined by a bold, west-facing escarpment known as Mescalero Ridge. This ridge rises abruptly 100 to 200 feet above the low-lying Mescalero Pediment. The Llano is a flat to gently rolling, virtually treeless, featureless surface, well preserved by a resistant caliche caprock that forms the High Plains of New Mexico.

In the southeastern quadrant of the county, another of the Llano Estacado (?) surfaces covers an area of about 50 square miles. The designation of Llano Estacado to this erosional remnant is questionable. Topographically, it is higher than the surrounding area, but it is not in proper position to be definitely of Llano Estacado age. However, it is here considered to be an outlier of the Llano Estacado surface, even though it may be a transitional or intermediate surface between the Llano Estacado proper and the surrounding younger surfaces which are related to Pecos River dissection.

Mescalero Pediment

The Mescalero Pediment, an erosional surface cut on eastward-dipping Permian and Triassic rocks, covers most of the area that lies east of the Pecos River in Eddy County. From near the Pecos River channel to its intersection with the Llano Estacado escarpment, the pediment surface rises gently eastward 25 to 40 feet per mile. Large depressions such as Nash Draw and Clayton Basin occur in the potash area and radically modify the surface. They probably were formed by solution and subsequent collapse of underlying salt beds. Rocks adjacent to but unaffected by collapse are left differentially high and often stand as prominent ridges overlooking the depressions. Nimenim Ridge, Quahada Ridge, and Livingston Ridge are examples of these bordering prominences.

Extensive sand dunes, known as Mescalero Sands, cover much of the pediment surface. These dunes are predominantly coppice-type dunes, stabilized or semi-stabilized by mesquite bush. A few dunes are still actively drifting, but these generally are small and isolated. Where no dunes occur, the surface is usually veneered with cover sands of eolian origin. This heavy dunal and nondunal cover effectively conceals the bedrock surface in most places.

Surfaces West of the Pecos

Geomorphic surfaces west of the Pecos River are less concealed than those to the east, yet the boundaries between them are often indistinct. Close inspection shows a steplike sequence that ascends from the Pecos River to the limestone uplands along the western county line and beyond. These surfaces, from oldest to youngest, are Sacramento Plain, Diamond "A"-Blackdom Plain, Orchard Park Plain, and Lakewood terrace.

The Sacramento, Diamond "A" and Blackdom surfaces are grouped collectively here and sometimes are referred to as the Pecos slope. The term is used here for simplicity, and no new terminology is suggested, implied, or intended. The Pecos slope is the broad limestone cuesta that slopes gently eastward from near the crest of the Sacramento Mountains to the Pecos River flood plain.

Sacramento Surface

The Sacramento surface is not recognized in Eddy County. It lies to the west in the high elevations near the Sacramento Mountains and is the mountain-front or mountain-slope portion of the Pecos slope. It is equivalent to the Llano Estacado surface.

Diamond "A" Surface

The Diamond "A" surface lies below the Sacramento and is the most extensive surface of the Pecos slope. It probably represents the first significant lowering of base level by the Pecos River and its tributary system during Pleistocene time. Upper Permian and Triassic rocks have been partially stripped, and the surface is formed in part on the San Andres Limestone. This surface is considered to be exhumational and erosional. The boundary between it and the higher Sacramento surface is not always distinct.

The Diamond "A" surface and the Mescalero Pediment are similar geomorphically since both are erosional surfaces related to dissection by the Pecos River system. They differ markedly in the type of bedrock on which each surface is cut. The Diamond "A" surface is strongly influenced by its proximity to the resistant San Andres Limestone, whereas the configuration of the Mescalero pediment is a reflection of easily eroded Permian and Triassic rocks that have been modified by collapse depressions and eolian cover.

Blackdom Surface

The Blackdom surface lies below the Diamond "A" surface. It is the lowest and youngest surface of the Pecos slope and represents a pre-Wisconsin (?) cycle of incision and subsequent aggradation by the Pecos River and its tributaries. Large deposits of mostly limestone gravels underlie this surface. In northern Eddy County the gravels are well preserved and often protected by a resistant caliche caprock. In southern Eddy County the Blackdom is highly dissected, and isolated caliche-capped knobs rise above the younger alluvium.

Cemented gravels (quartzose conglomerates of Bretz and Horberg, 1949) are associated with Blackdom and constitute a unique deposit.

Orchard Park Surface

The Orchard Park surface is the alluvial valley of the Pecos River and is the site of about 90 percent of the farms in Eddy County. It is normally about 50 feet below the Blackdom surface and slopes gently, sometimes imperceptibly, toward the river. Slack-water and flood-plain deposits of silt and clay and braided, localized deposits of sand and gravel underlie this surface.

Lakewood Terrace

The Lakewood terrace is a narrow, ill-defined surface astride the Pecos River, about 10 to 15 feet below the Orchard Park surface, usually with no distinct topographic break. It probably represents an incisional spurt during very late Pleistocene glacial events that temporarily halted aggradation of the Pecos Valley.

Mountains

The Guadalupe Mountains, a dissected plateau, lie in the southeastern corner of the county, forming a conspicuous topographic feature, a south-pointing "V." The apex of the "V" is Guadalupe Peak, located in Texas about 6 to 7 miles south of the state line. From Guadalupe Peak northward, the mountains bifurcate into a northwest and a northeast limb.

The Guadalupe Mountains proper, including Brokeoff Mountains in Otero County, form the northwest limb of the "V." There are prominent fault scarps on the southwestern edge of the limb, and Haupache monocline marks the northeastern edge.

Guadalupe Ridge, a surface expression of the great Capitan Reef, forms the northeast limb of the "V." Where the reef goes underground about 9 miles south of Carlsbad, Guadalupe Ridge is no longer topographically prominent—it merges with the lower country of Azotea Mesa and Seven Rivers Hills. Seven Rivers Embayment, a low-lying area formed in easily eroded evaporite rocks, lies between the limbs of the "V."

DRAINAGE

The Pecos River, the master stream of Eddy County and the only through-flowing stream, crosses the northern county line about 1.5 miles east of U.S. Highway 285 in Sec. 2, T. 16 S., R. 26 E. It leaves Eddy County and New Mexico as it crosses the state line near 32° N. latitude, 104° longitude.

In Eddy County the Pecos flows through broad alluvial valleys that are separated by narrow inter-valley constrictions. In some places along the valley it washes against and is rimmed by bluffs of Permian evaporitic rocks. The river flows southward from the county line to Lake McMillan. Below Lake McMillan it flows southeastward to Carlsbad in a relatively narrow channel through the Seven Rivers-Ocotillo-Avalon Hills and Telltale Bluffs area. Below Carlsbad it maintains its southeasterly course but again flows through a broad alluvial valley, occasionally channeled against Permian bluffs. About 20 miles southeast of Carlsbad the Pecos turns southward and is again confined to a relatively narrow channel as it cuts through the Rustler Hills area and into Texas. The waters are impounded in several places in Eddy County for irrigation and recreational purposes.

The tributary system west of the Pecos is well developed. From the northern county line to the vicinity of Seven Rivers, Cottonwood Creek, Eagle Creek, Rio Penasco and North, Middle, and South Seven Rivers are the principal drainageways. None of these streams are perennial, but they can carry large volumes of water after heavy rains. All are graded to the Pecos; most are deeply incised into the Pecos Plain and head in the limestone uplands of the Sacramento Mountains.

South of Seven Rivers, tributaries rise in the Guadalupe Mountains area. Rocky Arroyo, Dark Canyon, Last Chance Canyon, McKittrick Draw, Black River and the Delaware River are the principal tributaries. Black River and Delaware River are perennial, or very nearly so. All others are ephemeral.

The Pecos River has no important tributaries from the east. Most drainageways east of the Pecos flow only short distances, and any surficial waters are quickly diverted into localized bolsons and collapsed depressions, or the waters rapidly filter into the permeable eolian cover.

GEOLOGIC HISTORY

Eddy County has a long and complex geologic history, especially from a sedimentational standpoint during Permian time (280 to 230 m.y. ago).

Paleozoic Era

During most of the early Paleozoic Era, this area was a shallow carbonate sea, shelving the Sonoran geosyncline to the south. Regional tectonic and sedimentational frameworks are obscure, for no early Paleozoic rocks are exposed in Eddy County.

Near the end of the Pennsylvanian Period (280 m.y. ago) Eddy County and the southwestern United States became increasingly unstable tectonically. This instability culminated with the Marathon disturbance which initiated formation of the Delaware basin and its associated positive areas. Some of these structural elements markedly influenced later sedimentation and tectonics.

During the Wolfcampian and Leonardian Series of the Permian Period, seas gradually spread northward across a broad shelf and ultimately covered most of southeastern New Mexico. The San Andres Limestone was deposited on this shelf which formed a huge, epicontinental, carbonate sea. The structural framework of the Delaware basin continued to take shape, and deposition within the basin was concomitant with that on the shelf. Near the end of Leonardian time formation of the Delaware basin was complete, and Eddy County lay, from north to south, in a shelf-basin margin and basin position. These contiguous and contemporaneous, yet dissimilar, environments greatly influenced sedimentation throughout the remainder of Permian time.

During Guadalupian time of the Permian Period, dynamic sedimentation of carbonate and evaporite rocks occurred. Around the rim of the Delaware basin ideal environmental conditions for reefal growth existed. The rim was topographically high, the waters were shallow, well-ventilated, agitated, and warm. In this excellent marine-life environment the great Capitan Reef began to form.

The Capitan Reef grew rapidly and flourished throughout Guadalupian time, surrounding the Delaware basin, controlling environments, and influencing sedimentation. Paradoxically, as the reef flourished, it became an effective barrier to the shelf behind it, depriving the shelf of the free interchange of waters. As ventilation decreased, the shelf became increasingly hypersaline, evaporites were deposited, and the shelf began to dry. Gradually the shelf and basin became irreversibly hypersaline as they were periodically cut off from open sea water. As the basin tended toward hypersalinity, reefal growth ended, and much of Eddy County became an enormous evaporite pan. During Ochoan time widespread salt deposition occurred and Eddy County potash beds were deposited. For the remainder of the Permian Period, extensive redbeds and associated evaporites were developed until evaporation outpaced deposition, the area was uplifted epeirogenically, exposed, and desiccated.

Mesozoic Era

Fluvial conditions prevailed during the Triassic Period (230 to 180 m.y. ago) as streams built huge flood plains and deltas across the old Permian redbed surface. Triassic sediments of Eddy County are mostly red shales and silts with some fine-grained red sandstone.

Eddy County may have been a positive area during the latter part of the Mesozoic Era. Jurassic and Cretaceous rocks either were not deposited across the postulated highland or have since been completely removed by erosion.

Cenozoic Era

The Tertiary Period (70 m.y. ago to Recent) was a time of tectonic activity. The Guadalupe Mountains were uplifted, the entire area was raised epeirogenically, and older structural elements were reactivated. This activity was followed by vigorous dissection, and an extensive erosional surface was cut on Permian and Triassic rocks. On this erosional surface the fluviatile Ogallala Formation of Pliocene age (10 to 1 m.y. ago) was deposited.

The basal gravels of the Ogallala Formation surged across the old erosional surface, engulfing and leveling the landscape and forming a gigantic alluvial apron, or outwash plain. Near the end of Pliocene time (1 m.y. ago) deposition slowed, then finally ceased. As the climate tended toward aridity, a caliche caprock formed over the Ogallala sediments. Today this caliche caps a distinct geomorphic surface, the Llano Estacado.

Only a small portion of the Ogallala Formation remains in Eddy County; however, gravelly remnants west of the Pecos River in Chaves County indicate the Ogallala was originally deposited over a much larger area. Its westward extension has been retreating eastward throughout Quaternary time, so that its present westward limit is now far to the east of the river.

A dramatic reversal of climate initiated the Pleistocene Epoch (1 m.y. ago to Recent). When continental glaciers lay across Canada and the northern United States, the flanks of the southern Rocky Mountains in New Mexico were draped with relatively small glaciers and the climate of the usually arid to semiarid region was much different than it is today. The southernmost glaciation was in the Sierra Blanca of south-central New Mexico. These glaciers produced pluvial periods and the volume of water was greatly increased. The Pecos River was spawned by this almost limitless water supply.

Dating of the inception and integration of the Pecos River and of the events which took place along its course is a matter of conjecture since no faunal studies, charcoal dating, or other dating techniques have been used in this study.

It is reasonable to assume that dissection by rejuvenated Tertiary streams was well underway by earliest Pleistocene time and that the Pecos River entered the area in about Kansan time at the zenith of the humid cycle that initiated the Pleistocene Epoch. The Pecos probably formed, initially, along a series of sinkholes that captured the general eastward and southeastward drainage. Subsequent integration occurred soon after. As the river flowed southward into sinkholes formed in the evaporite rocks, water became impounded, eventually overflowed, and moved progressively southward into the next catchment basin. This leaps-and-bounds method of integration aided by the virtual absence of hard-rock barriers within the easily eroded evaporite rocks made rapid progress, and the river's present course was well established early in its history.

The Pecos River system has been the prime force in shaping the present landscape, and dissection has continued almost unabated throughout Quaternary time (1 m.y. ago to present). It rises in the glaciated southern Rocky Mountains and has been very responsive to glacial and interglacial events. The steplike sequence of erosional surfaces astride the Pecos River valley in southern New Mexico is a reflection of these events.

The Diamond "A" surface and the Mescalero Pediment represent the first significant lowering of base level by the Pecos River and its tributaries. These two surfaces comprise a very broad plain across which the Pecos River and its powerful tributary system flowed. Incision was not profound, for the river planated a vast area and had considerable lateral mobility which leveled and smoothed the bedrock surface. The tributary system, at least on the west, was equally mobile and contributed greatly to planation.

These two surfaces, each sloping gently from the Pecos River to higher elevations, are exhumed surfaces in part, but are also erosional. They represent a prolonged cycle of pedimentation, for both can be considered pediments and probably correlate with Surface II (Leonard and Frye, 1962) in the Trans-Pecos region of Texas. A pre-Wisconsin age is applicable to these surfaces.

In either late pre-Wisconsin or early Wisconsin time, significant incision of the broad Diamond "A"-Mescalero surface occurred. The actual amount was probably greater than now indicated, but it has been concealed by a later aggradational cycle that is drowning the Blackdom surface by alluviation. Also, in the southern part of the county, the surface is highly dissected, and only isolated knobs protrude out of younger alluvium.

After the initial incision, extensive aggradation occurred. Widespread gravel deposits, mostly limestone, are found under the Blackdom surface. These gravels probably represent large rock fans that encroached onto the valley floor. This indicates a period of relative stability and of sluggish activity by the Pecos River as well as an interglacial or short-lived period of aridity.

During Wisconsin time further significant incision of the Blackdom surface occurred. This cycle represents the maximum down cutting of the Pecos River, about 100 feet below the present channel; however, depth to bedrock varies, and it is difficult to make a precise estimate of maximum channel erosion. This vigorous incisional cycle was followed by a prolonged aggradational cycle, which today forms the Orchard Park surface or main valley floor of the Pecos.

The Lakewood terrace is narrow, ill-defined, and lies astride the river channel. It represents an incisional spurt during the final moments of late Wisconsin time, which temporarily halted the aggradational cycle that continues today. Some historical down cutting has occurred in the present channel within the last 100 years.

Throughout Quaternary time widespread solution has occurred. Formation of the famous Carlsbad Caverns, a product of carbonate rock solution that began in Tertiary time, continues today. Large depressions related to salt solution and collapse have formed and continue to form mostly in the eastern half of the county. Widespread solution has occurred in gypsiferous strata, especially along the course of the Pecos. These gypsum sinkholes largely control the present position of the river.

The Guadalupe Mountains have continued to be tectonically active. Prominent fault scarps and fault-controlled drainage are common in the higher elevations. These mountains and adjacent lower areas have undergone moderate dissection, and form some of the more spectacular erosional features of Eddy County.

CARLSBAD CAVERNS

How were the caverns formed? One might say they were conceived during the Permian Period about 240 million years ago, when the Tansill and Capitan limestone formations were deposited at the edge of a warm shallow sea. These formations were part of an organic reef complex that bordered the Delaware basin during Permian time.

The reef was subsequently buried by sedimentary material brought in by many different agents of weathering. The area was uplifted during the Laramide Orogeny (period of mountain building) which ended about 60 million years ago. Earth movements fractured the reef, allowing ground water to enter. The first signs of solution probably appeared along these fractures and bedding surfaces. Water seeped into these areas, dissolved some of the rock, and enlarged the openings. As time passed the openings grew larger and larger until finally they formed the large chambers and passageways for which the caverns are famous. One single chamber in the caverns is 1.25 miles in circumference and its ceiling arches 200 feet above the floor.

Most investigators agree that the original cavities formed in a phreatic (ground water) environment because of corroborative evidence shown by solution pockets on the ceilings, walls, and floors of many of the underground chambers.

Additional tectonic movement that began about 3 million years ago and extended to Recent time raised the local area, the caverns were drained, and vadose conditions ensued. As the water was replaced by air, most of the solution stopped, and parts of the walls and ceilings collapsed under their own weight. Even before the caverns were completely drained another stage of cave development began. Over many thousands of years most of the passageways and chambers have been decorated with stalactites, columns, and stalagmites composed of calcite and aragonite deposited by underground water that has seeped down through the zone of aeration. A myriad of crystalline forms decorates the walls, ceilings and floors of the caverns today, and they continue to attract thousands of visitors each year.

STRATIGRAPHY

Quaternary

Alluvium (Qal): sand, gravel, silt, and clay
Eolian (Qe): wind-blown sand, primarily active or recently active dune areas
Alluvium and bolson deposits (Qab): silt, sand, clay, and discontinuous, braided deposits of fine-grained sand and gravel; includes local deposits of relatively well-stabilized wind-blown sand; rarely having local incrustations of soft, nodular caliche
Lake deposits (Qld): fine-grained, gypsiferous silt, sand, and clay
Caliche (Qc): moderately to well-indurated, nodular caliche grading laterally into well-cemented, laminated caprock; also poorly developed, soft, nodular caliche and local braided deposits of clayey gravel
Caliche and gravel (Qcg): caliche-capped limestone gravel, sand, silt, and clay underlain by deposits of lime-cemented conglomerate
Gravel deposits (Qg): braided, high-level deposits of partly cemented quartzose gravel and sand
Terrace deposits (Qt): well-sorted stream deposits of limestone gravel, sand, and silt
Pediment deposits (Qp): discontinuous deposits of silt, clay, and gravel with local encrustations of soft, nodular caliche; rarely having a thin, laminated caprock
Alluvial fans (Qaf): angular to subangular gravel in a matrix of silt and clay
Older fan deposits (Qof): highly dissected deposits of caliche-cemented sand, silt, clay, and gravel
Gatuna Formation (Qgt): orange to orange-red silts and clays with discontinuous interbeds of fine-grained, partly cemented sand and gravel derived from the Ogallala Formation; includes collapse breccia from Triassic and Permian rocks

Tertiary

Ogallala Formation (To): well-indurated, laminated, often brecciated caliche caprock that grades downward into nodular caliche overlying soft sandstone, clay, and cemented gravel
Intrusives (Ti): brown, fine-grained, vesicular trachyte dikes

Triassic

Triassic rocks undivided (₹): maroon sandstone, siltstone, and shale

Permian

Dewey Lake Redbeds (Pd): red sandstone, siltstone, and shale
Rustler Formation (Pr, Prs(1)): anhydrite, gypsum, interbedded red and green sandy clay, and some beds of dolomite
Salado Formation (Psl, Prs (2)): residual material derived from the solution of halite and anhydrite, polyhalite and other potassium salts, and red sandy shale

Back Reef Facies: (Shelf)

Tansill Formation (Pt): light olive-gray to very pale orange, fine-grained, laminated dolomite, and rare thin beds of very pale orange, fine-grained quartz sandstone and siltstone
Yates Formation (Pya): very pale orange to yellowish-gray, fine-grained, laminated dolomite, alternating with grayish-orange to pale yellowish-orange, calcareous quartz siltstone or very fine-grained sandstone
Seven Rivers Formation (Psr): gray to white dolomitic limestone, white and red gypsum, orange-red siltstone and shale
Queen Formation (Pq): massive quartzose sandstone with red to white gypsum, siltstone, and dolomite
Grayburg Formation (Pgr): interbedded, yellowish-gray, fine-grained dolomite and limestone with interbeds of pale orange, cross-laminated quartz siltstone

Reef Facies:

Capitan Limestone (Pcp) Reef facies: thick-bedded to massive, very light-gray to pinkish-gray limestone
Reef talus facies: thick-bedded, recrystallized, reef-derived limestone detritus
Both lithofacies have post-Permian fracture fillings and sandstone dikes
Goat Seep Limestone (Pgs): thick-bedded to massive, light-gray limestone and dolomite

Forereef Facies: (Basin)

Castile Formation (Pc): white, massive gypsum with some interlaminated white gypsum and dark-gray limestone in the lower part; includes residuals of the Salado Formation
Bell Canyon Formation (Pbc): gray siltstone and very fine-grained quartz sandstone, with few limestone members
Cherry Canyon Formation (Pcc): soft, irregularly bedded, yellowish-gray to light-brown quartzose sandstone with some beds of light-green shale
Artesia Group undivided (Pat): primarily red to white gypsum with some interbeds of dolomite, sandstone, and siltstone; essentially represents a lateral facies change where the Seven Rivers, Queen, Yates and Tansil Formations become indistinguishable as separate units
San Andres Formation (Psa): gray, massive- to thin-bedded limestone and dolomite; includes Cherry Canyon Sandstone Tongue north of latitude 32° 10'
Yeso Formation (Py): variegated, friable to hard, coarse-grained sandstone; fine-grained, pink-yellow, gypsiferous shale; dark-gray, often earthy limestone with some beds of gypsum

AGGREGATE RESOURCES

Eddy County has abundant aggregate resources of diverse types. Limestone, dolomite, gravel, and caliche are available. No serious availability problem relative to future road-building programs is anticipated. However, problems of quality control will most assuredly exist, and it is well to know the quality of each aggregate type. The quality comparison tables (5-1 and 5-2) allow one to make a rapid comparison of the different aggregates found throughout Eddy County.

Quarry Rock

Limestone and Dolomite

An unlimited supply of limestone and dolomite is available mostly west of the Pecos River. Good quality aggregates can be developed within the Guadalupe Mountains and their associated lower lying hills on the broad limestone plain west of the Pecos River, sporadically from dolomite found in the Rustler Formation east of the Pecos, and within the Cottonwood Hills south of Carlsbad.

The steep, bold, southeast-facing scarp that defines Guadalupe Ridge is formed by limestone of the great Capitan Reef (Capitan Limestone). Northwest of the reef other carbonate formations crop out in linear belts parallel to the reef. These are the limestone and dolomites of the Seven Rivers, Yates, Grayburg, and Tansill formations. All of these rocks will make excellent aggregate within the carbonate facies; however, they grade laterally and sometimes very rapidly into evaporites (gypsum and anhydrite) as they regress from the reef.

The rapid change from good quality quarry aggregate to soft evaporite beds can be seen along State Road 137 where it crosses Rocky Arroyo. Across the canyon a sheer cliff of dolomitic limestone may be observed. Within a few hundred feet, in a westerly direction, the massive dolomitic limestone beds exposed in the canyon wall change into evaporite beds. Obviously such a change within an operational quarry would be undesirable; therefore, all quarry sites selected in these back reef formations should be thoroughly explored before being designated for use.

West of the Pecos River and north of the Guadalupe Mountains, a broad limestone plain is formed on the San Andres Limestone. Excellent quarry aggregate can be produced from this thin-bedded to massive, well-indurated, crystalline limestone.

Dolomite quarries can be located locally in the Rustler Formation east of the Pecos River and in the Cottonwood Hills south of Carlsbad. One such quarry, located northeast of Carlsbad near U.S. Highway 62

Mescalero or Blackdom. This may be explained by the fact that the Llano surface is older, and multiple soil profiles with caliche horizons occur randomly over the Llano Estacado. No multiple profiles have been observed on the other surfaces. In the past caliche has been limited to asphalt and all-weather surface roads; further research may show that concrete aggregate can be produced from caliche deposits.

The stream system west of the Pecos has a generous supply of limestone gravel. With a minimum amount of special treatment, high quality aggregates for all phases of highway construction can be produced from these deposits. These gravels have good abrasive and soundness qualities but frequently have clay in excess of specification limits. Clay problems are easily eliminated by wasting and adding sandy filler during production. Concrete aggregate production will require washing. Abundant supplies of gravel occur on some of the older landscapes such as the Blackdom and Orchard Park surfaces. The abrasive and soundness qualities of these materials are somewhat poorer than those of the stream system, yet they are well within specification limits for road-building purposes. Below Carlsbad, near the Pecos River, these older gravels have slightly higher quantities of quartzose pebbles, but usually the gravels are predominantly limestone.

Well-cemented conglomerate is exposed in the lower part of some of the older landscapes. Although excellent aggregates can be produced from this conglomerate, handling costs make its use prohibitive.

The quality of caliche should be checked when locating pits on the Mescalero Pediment since laboratory tests show that its qualities are often marginal. When locating quarries in the dolomite beds of the Rustler Formation quality should be evaluated because of the intimate relationship of the dolomite and anhydrite. All horizons that will be used for construction should be thoroughly investigated when exploring limestone and dolomite formations, for these rocks are often associated with earthy or argillic materials that could be detrimental to the final product. The effects of the magnesium content in the gravel and quarry products from this area should probably be investigated before using these materials for concrete aggregate because the percentage of dolomite is relatively high in most of the deposits from which they are derived. Further exploration may reveal usable gravel deposits along the margins of the Pecos River flood plain near the confluences of the old tributaries and the river channel. During wetter periods the tributaries were probably high-energy streams that carried coarse materials onto the old Pecos flood plain. Since then aggradation, channel changing, and slack-water deposits have destroyed the surface expression of the deposits.

Eddy County has unlimited reserves as far as road-building aggregates are concerned. This does not mean that good construction sand and gravel or quarry rock are available in quantity in every area or that all marginal deposits can be processed to supply satisfactory aggregate. However, development has occurred near points of consumption where materials meeting the requirements are available.

ORIGIN OF THE CEMENTED GRAVELS OF THE PECOS VALLEY

The "cemented gravels" (quartzose conglomerate of Bretz and Horberg, 1949) of the Pecos Valley of New Mexico are a unique deposit. The gravels are best described as conglomerate with gravels of diverse origin in a siliceous or calcareous binder and fall roughly into two types. Gravels of the quartzose conglomerate are more diverse and are usually bound in a siliceous cement. Gravels of the limestone conglomerate are principally limestone, bound in a travertine or other type of calcium carbonate cement. The degree of induration is remarkable. Outcrops are sporadic and have been observed on surfaces as high as, or possibly higher than, the Blackdom surface and as low as the floor of

TABLE 5-1
QUALITY COMPARISON OF CALICHE

Pit Number	Quad. Number	Material	Depth (feet)	PI	LA Wear	Soundness Loss
		MESCALERO SURFACE				
5967	118	Caliche cap	0.0 - 6.0	2	22.0	3.5
5967	118	Dolomite	6.0 - 12.0		32.8	--
0376	106	Caliche cap	0.0 - 6.0	4	32.4	49.1
4941	119	Caliche cap	0.0 - 1.0	4	26.4	14.9
4941	119	Nodular caliche	1.0 - 5.0	6		
6643	107	Caliche cap	0.0 - 1.5	3	37.0	17.4
6643	107	Nodular caliche	1.5 - 7.0	11		
0394	107	Composite sample	0.0 - 6.0	n.p.	34.8	34.5
0485	107	Composite sample	0.0 - 8.0	n.p.		40.6
5547	119	Caliche cap	0.0 - 4.0	n.p.	40.0	
5547	119	Nodular caliche	4.0 - 8.0	12		
		BLACKDOM SURFACE				
6402	106	Caliche cap	0.0 - 4.0		34.8	
6402	106	Gravel	4.0 - 11.0	7	22.4	6.8
0352	105	Caliche cap	0.0 - 3.0	6	25.0	14.1
0352	105	Gravel	3.0 - 15.0	7	17.2	
0354	105	Caliche cap	0.0 - 2.5	7	29.3	
0354	105	Gravel	2.5 - 8.5	6	26.6	
0356	105	Composite sample	0.0 - 6.0+	16	24.8	6.1
5550	118	Caliche cap	0.0 - 3.0	s.n.p.	42.8	
5973	118	Caliche cap	0.0 - 3.0	s.n.p.	30.4	
		LLANO ESTACADO SURFACE				
0392	107	Composite sample caliche	0.0 - 4.0	n.p.	36.0	
5584*	107	Caliche cap	0.0 - 6.0	n.p.	29.2	
6066*	107	Caliche cap	0.0 - 4.0	n.p.	32.4	5.2
6066	107	Nodular caliche	4.0 - 6.0	n.p.	29.6	5.2
0455	119	Caliche cap	0.0 - 1.0	n.p.	31.6	
0455	119	Nodular caliche	1.0 - 4.0	n.p.	66.2	
5541*	119	Caliche cap	0.0 - 4.0	n.p.	32.8	
5541	119	Nodular caliche	4.0 - 8.0	n.p.		
5548*	119	Caliche cap	0.0 - 3.0	n.p.	23.0	
5548	119	Nodular caliche	3.0 - 8.0	10	35.6	

*Pits located in Lea County believed to be representative of the Llano surface in Eddy County.

Note: Pits on the Blackdom surface were developed primarily for the gravel content. The above information shows a comparison between the Mescalero, Llano, and Blackdom caliches.

the Pecos River. The age as well as the origin of the cemented gravels is questionable.

The age of the gravels is possibly middle Pleistocene. The initial incisional cycle of that time was followed by an extensive and somewhat prolonged aggradational period. During this aggrading period huge rock deltas encroached upon the Blackdom flood plain, filling and choking existing waterways. During the incisional period of Wisconsin time, or during times of great flood, some of the gravels were flushed downstream and were spread out on lower surfaces or dropped into deep scour channels. This flushing action has displaced the gravels both stratigraphically and topographically and has caused their apparent ubiquity.

The origin of the cemented gravels presents a perplexing problem: How did these gravels become so highly indurated in such a short span of geologic time?

Much of the cementing material is calcareous, and very often it is travertine. It is not unreasonable to assume that lime-enriched springs, hence ground water, contributed the calcareous cement to the gravels. As the gravels lay exposed, or nearly so, they were in contact with the percolating and enriched waters. Percolation through the gravels, followed by precipitation of the calcium carbonate, would have been an effective cementing process. Precipitation of travertine by spring water, which occurs along some streams in the area today, is ample evidence that this process of cementation is feasible.

The gravels also received a calcium carbonate supply from river waters. The river waters were probably fed by some of the springs and were enriched. Periodic flooding of the gravels followed by rapid drying periods served to perpetuate the percolation and precipitation process and to accelerate cementation.

Climatic fluctuation was probaby the principal cause of the advanced and rapid induration of the gravels. The regional, long-term reversals of climate during the Pleistocene, alternating between wet and dry periods, probably established permanency of the carbonate-matrix buildup. The wet periods were predominantly periods of carbonate precipitation. However, local fluctuation of climate was probably the overriding force of cementation and induration. Local short-lived, wet-dry cycles such as intense, diurnal thundershower activity or climatic fluctuation in 10- to 50-year cycles all could have been effective. These local, rapid shifts of wet and dry periods could have provided the processes needed to advance the cementation-induration process.

As with regional, long-term climatic shifts, the local, short-lived wet periods were times of carbonate build-up, and the extremely dry periods were times of carbonate precipitation. The extremely wet year of 1941 and the very dry years of the early 1950s are examples of these local, short-lived reversals. Hence, the origin of the cemented gravels is attributed to precipitation of calcium carbonate by enriched ground waters and river waters; the cementation process has been accelerated by sharp, dramatic reversals of the local climate.

TABLE 5-2
QUALITY COMPARISON OF GRAVEL SOURCES

Pit Number	Quad. Number	Material	Depth (feet)	PI	LA Wear	Soundness Loss
			COTTONWOOD CREEK			
0349	105	Gravel	0.0 - 4.0	4	22.4	
			EAGLE CREEK			
0353	105	Gravel	0.0 - 0.6+	7	21.6	1.0
0355	105	Gravel	0.0 -	8	17.8	
			RIO PENASCO			
0350	105	Gravel	0.0 - 9.0	n.p.	21.6	1.0
0359	105	Gravel	3.0 - 6.0	11	19.0	1.0
0351	105	Gravel	0.0 - 8.0	14	20.0	1.7
54135	105	Gravel	0.0 - 10.0+	7	20.0	
54141	105	Gravel	0.0 - 9.0+	8	21.0	
54142	105	Gravel	0.0 - 9.0+	3	20.0	
0378	106	Gravel	0.0 - 5.0+	7	19.6	7.0
6250	106	Gravel	0.0 - 6.0+	6	22.0	1.4
			FOUR MILE DRAW			
0357	105	Gravel	3.0 - 6.0+	7	20.0	
0360	105	Gravel	0.0 - 6.0+	6	20.8	
0364	105	Gravel	0.0 - 6.0+	10	20.0	1.0
0365	105	Gravel	0.0 - 6.0+	5	17.6	
			NORTH SEVEN RIVERS			
0361	105	Gravel	0.0 - 10.0+	7	22.0	4.7
0362	105	Gravel	0.0 - 6.0+	7	21.6	
0363	105	Gravel	6.0 - 10.0+	7	20.0	
0366	105	Gravel	0.0 - 6.0+	6	20.0	1.5
			NORTH AND SOUTH SEVEN RIVERS COMBINED			
6201	105	Gravel	0.0 - 8.0	4	26.0	1.8
			SOUTH SEVEN RIVERS			
0369	105	Gravel	0.0 - 6.0	n.p.	22.4	2.8
			ROCKY ARROYO			
0342	118	Gravel	0.0 - 6.0+		18.4	
			McKITTRICK DRAW			
6557	118	Gravel	0.0 - 7.0	9	22.0	0.98
			DELAWARE RIVER (TERRACE)			
0323	118	Gravel	2.5 - 14.0	n.p.	19.2	1.7
			RIO PENASCO (TERRACE)			
6236	105	Gravel	1.0 - 15.0	n.p.	23.2	6.1
			BLACKDOM SURFACE (INTERFLUVES)			
0352	105	Caliche conglomerate	0.0 - 3.0	n.p.	25.0	14.1
0352	105	Gravel	3.0 - 15.0	n.p.	17.2	
0354	105	Caliche conglomerate	0.0 - 2.5	n.p.	29.3	
0354	105		2.5 - 8.0+	9	26.6	
5527	106	Caliche and gravel	0.0 - 6.0	8	26.2	
6065	106	Gravel	2.0 - 17.0	14	22.0	1.3
6402	106	Caliche cap	0.0 - 4.0	n.p.	34.8	
6402	106	Gravel	4.0 - 11.0	n.p.	22.4	6.8
			GATUNA FORMATION			
0489	106	Gravel	0.0 - 3.0	n.p.	38.8	
0454	119	Gravel	1.0 - 20.0	12	29.0	

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0355	105	Gravel	0.0 -	8	17.8	
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0350	105	Gravel	0.0 - 9.0	n.p.	21.6	1.0
0359	105	Gravel	3.0 - 6.0	11	19.0	1.0
0351	105	Gravel	0.0 - 8.0	14	20.0	1.7
54135	105	Gravel	0.0 - 10.0+	7	20.0	
54141	105	Gravel	0.0 - 9.0+	8	21.0	
54142	105	Gravel	0.0 - 9.0+	3	20.0	
0378	106	Gravel	0.0 - 5.0+	7	19.6	7.0
6250	106	Gravel	0.0 - 6.0+	6	22.0	1.4
			FOUR MILE DRAW			
0357	105	Gravel	3.0 - 6.0+	7	20.0	
0360	105	Gravel	0.0 - 6.0+	6	20.8	
0364	105	Gravel	0.0 - 6.0+	10	20.0	1.0
0365	105	Gravel	0.0 - 6.0+	5	17.6	
			NORTH SEVEN RIVERS			
0361	105	Gravel	0.0 - 10.0+	7	22.0	4.7
0362	105	Gravel	0.0 - 6.0+	7	21.6	
0363	105	Gravel	6.0 - 10.0+	7	20.0	
0366	105	Gravel	0.0 - 6.0+	6	20.0	1.5
			NORTH AND SOUTH SEVEN RIVERS COMBINED			
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			SOUTH SEVEN RIVERS			
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0342	118	Gravel	0.0 - 6.0+		18.4	
			McKITTRICK DRAW			
6557	118	Gravel	0.0 - 7.0	9	22.0	0.98
			DELAWARE RIVER (TERRACE)			
0323	118	Gravel	2.5 - 14.0	n.p.	19.2	1.7
			RIO PENASCO (TERRACE)			
6236	105	Gravel	1.0 - 15.0	n.p.	23.2	6.1
			BLACKDOM SURFACE (INTERFLUVES)			
0352	105	Caliche conglomerate	0.0 - 3.0	n.p.	25.0	14.1
0352	105	Gravel	3.0 - 15.0	n.p.	17.2	
0354	105	Caliche conglomerate	0.0 - 2.5	n.p.	29.3	
0354	105		2.5 - 8.0+	9	26.6	
5527	106	Caliche and gravel	0.0 - 6.0	8	26.2	
6065	106	Gravel	2.0 - 17.0	14	22.0	1.3
6402	106	Caliche cap	0.0 - 4.0	n.p.	34.8	
6402	106	Gravel	4.0 - 11.0	n.p.	22.4	6.8
			GATUNA FORMATION			
0489	106	Gravel	0.0 - 3.0	n.p.	38.8	
0454	119	Gravel	1.0 - 20.0	12	29.0	

PHYSIOGRAPHIC MAP OF EDDY COUNTY

LEGEND

- LAKE DEPOSITS
  (Alkaline silts and clays)
- LAKEWOOD TERRACE
  Silt, sand, gravel and clay, includes recent alluvium of the Pecos River
- ORCHARD PARK SURFACE
  Silt, sand, gravel and clay, locally caliche capped; includes recent alluvium
- BLACKDOM SURFACE
  Caliche capped limestone gravel
- MESCALERO PEDIMENT *Covered*
  Clay, silt, sand and gravel; locally caliche capped
- MESCALERO PEDIMENT *Bedrock*
  Primarily evaporites
- LLANO ESTACADO
  Caliche capped, sands, silts and clays; locally has thick sand cover
- MOUNTAIN SLOPES AND PEAKS *Bedrock*
  Primarily limestone and dolomite
- COTTONWOOD HILLS *Bedrock*
  Primarily evaporites

Boundaries of geomorphic surfaces are modifications of geologic contact lines

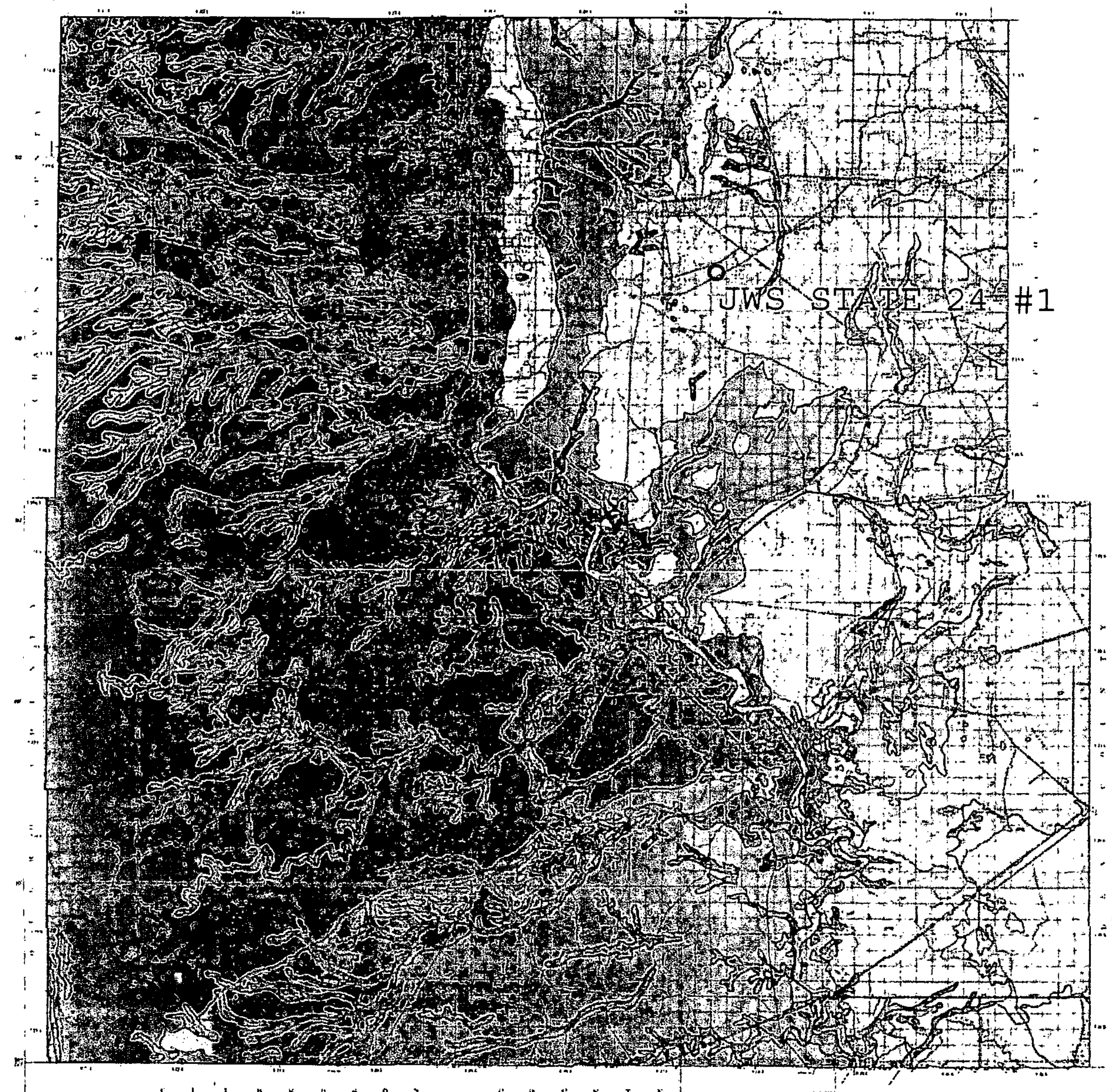


FIGURE 5-1

EXHIBIT G pg 1 of 2

PERMIAN BRINE SALES & SERVICE, INC.

NEW MEXICO STATE LAND OFFICE

APPRAISEMENT OF STATE INSTITUTIONAL LANDS

FOR right-of-way PURPOSES

To the Commissioner of Public Lands, Santa Fe, N. M.

SIR:

I have personally inspected the following described tract of land in Eddy County, New Mexico, and submit this appraisement report together with a statement of the natural character and conditions thereof:

Subdivision	Sec.	Twp.	Range	Acres
See Exhibit				

Attach Exhibit if more space is needed for entire description or to complete answers below

CHARACTER OF LAND

Answer the following questions in all appraisals:

State the best use for which the land may be adapted native pasture and wildlife habitat

State what other uses, if any, it may be or is being used for none

What is the general terrain or topography of the land? level to gently sloping

What type(s) of soil? gravelly fine sand loam Are there any signs of erosion? yes

If so, what type and to what extent? severe wind

What kind of vegetation is on the land, including grasses, if any? blue grama, black grama, side-oats grama, little bluestem, Javelina, snakeweed, sand muhly, sand sagebrush, and mesquite

Is the land cultivated, grassland, or other? grassland

If cultivated, is it dry land or irrigated farm land? (state acreage involved) not cultivated

Are there natural streams, rivers, springs, ponds, and water holes on the land? If so, describe same none

State kind of merchantable timber, quality, and present condition, if any none

What irrigation ditches are on the land? If none, then distance of nearest one none 12 miles west to the Pecos River Vallety

State the number of wells, depth, and type, on the land, whether used for domestic, irrigation, or other purposes none

State nearest distance to city, town, or village limits and name of municipality Artesia, New Mexico 12 miles northwest

Are there any existing or abandoned utility (electric, telephone, or telegraph) lines, railroads, public roads or highways, pipelines, borrow pits, material pits, cooperative irrigation ditches, reservoirs, airports, land strips, or trash dumps on the land? none If so, please describe and give approximate location none If any of the above are found on the land, are they a benefit or detriment to the land? Explain none

List all improvements, their location, and value (including, but not limited to, houses, barns, stables, their sizes and how built; wells and their depth and description; windmills; fences, their amount, kind, and length; and all other improvements) none

Name and address of present owner of improvements is: none

. State if any trespass or waste has been done to the land, or to any existing natural products thereon, and in what manner, by whom if known, and how it detracts from the value of the land only the trespass to graze cattle and operate oil wells

Does the land have any recreational potential, such as cabin sites, etc? Explain none

Answer the following questions in specific category [redacted]

BUSINESS LEASE:

If known, what type of business is the land going to be used for by the applicant?

Or is the land being leased for speculative purposes, if known?

Estimate how much the parcel would lease for on a yearly basis for commercial purposes

List amounts for which parcels of fee land similarily situated lease for (monthly or annual rentals) . If land applied for is within municipal limits, state type and kinds of businesses or uses to which surrounding properties are being put ______

State what (type and kind) improvements are located on this land that are beneficial to and consistent with business or commercial use of this land ______

RIGHT OF WAY AND WATER EASEMENT:
Is this State land within a declared water basin? Capitan Water Basin
Will the construction or use of this right of way (water easement) increase or decrease the value of surrounding State lands? increase How? [redacted]
Have you examined the plat (survey for right of way) accompanying the application? yes
If yes, then is the acreage (width) requested sufficient or excessive for purposes of the right of way? sufficient. Are there any other rights of way (easements) that bisect or cross over the one being applied for? yes What type and kind? see plats
Are there any existing water wells within one mile of lands inspected? none
If so, how many and how far distant therefrom? none
If known, at what depth is fresh water known to exist in this area? not known
If known, what damage will be done, if any, to the tangible property of state's prior patentees or lessees of this land by reason of applicant's use in making and constructing of a right of way (water easement) as requested? none

SALT WATER DISPOSAL SITES:
Have you examined the plat showing the disposal well(s) from which produced salt water is to be disposed of together with necessary pipelines and haul roads, if any? ______
If known, what is the formation into which the salt water will be injected? ______. Will a pipeline, roadway, or other means of conveyance be necessary to dispose of the salt water in the instant application? ______
If so, what? ______
What tangible surface damage, if any, will occur to other state lessees or patentees by the proposed salt water disposal site, roadway, or pipeline? ______

Based upon your examination of the land applied for, is there an existing abandoned dry hole(s) located thereon? ______. To what depth, if known ______

How? Provide water for making brine for drilling of Oil and Gas wells.

AFFIDAVIT

STATE OF NEW MEXICO) ss
County Lea)

I am well acquainted with the character of said described land and that my personal knowledge of said land is such as to enable me to testify understandingly with regard thereto.

After having personally inspected the within described tract of land, I HEREBY APPRAISE THE SAME at and state the ACTUAL CASH VALUE of same for the purpose desired to be $50.00 per acre (indicate per acre, square foot, or other), and certify that I am not interested in said land or leasing or sale thereof.

Signed John W. West
P.O. 412 North Dal Paso
Hobbs, New Mexico 88240

Subscribed and sworn (affirmed) to before me this 8th day of September, 19 78.

Alma Russell

My Commission Expires: August 10, 1980

NOTE: The Laws of New Mexico require that all statements in appraisements must be made from personal knowledge, and not upon information and belief; save only those with reference to the actual value of the land appraised. This appraisement must be sworn to before a Notary Public or County Magistrate.

EXHIBIT G pg 2 of 2

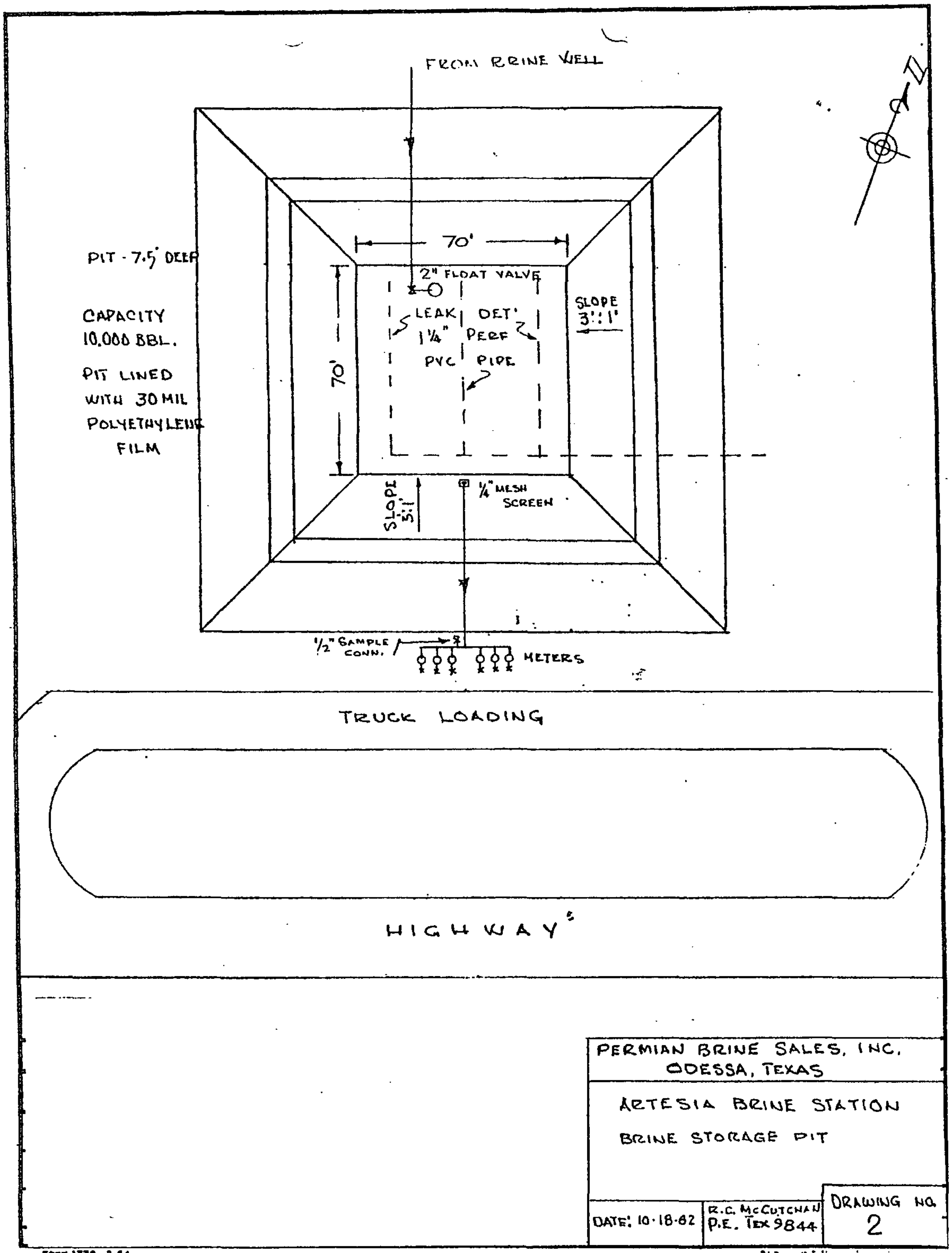
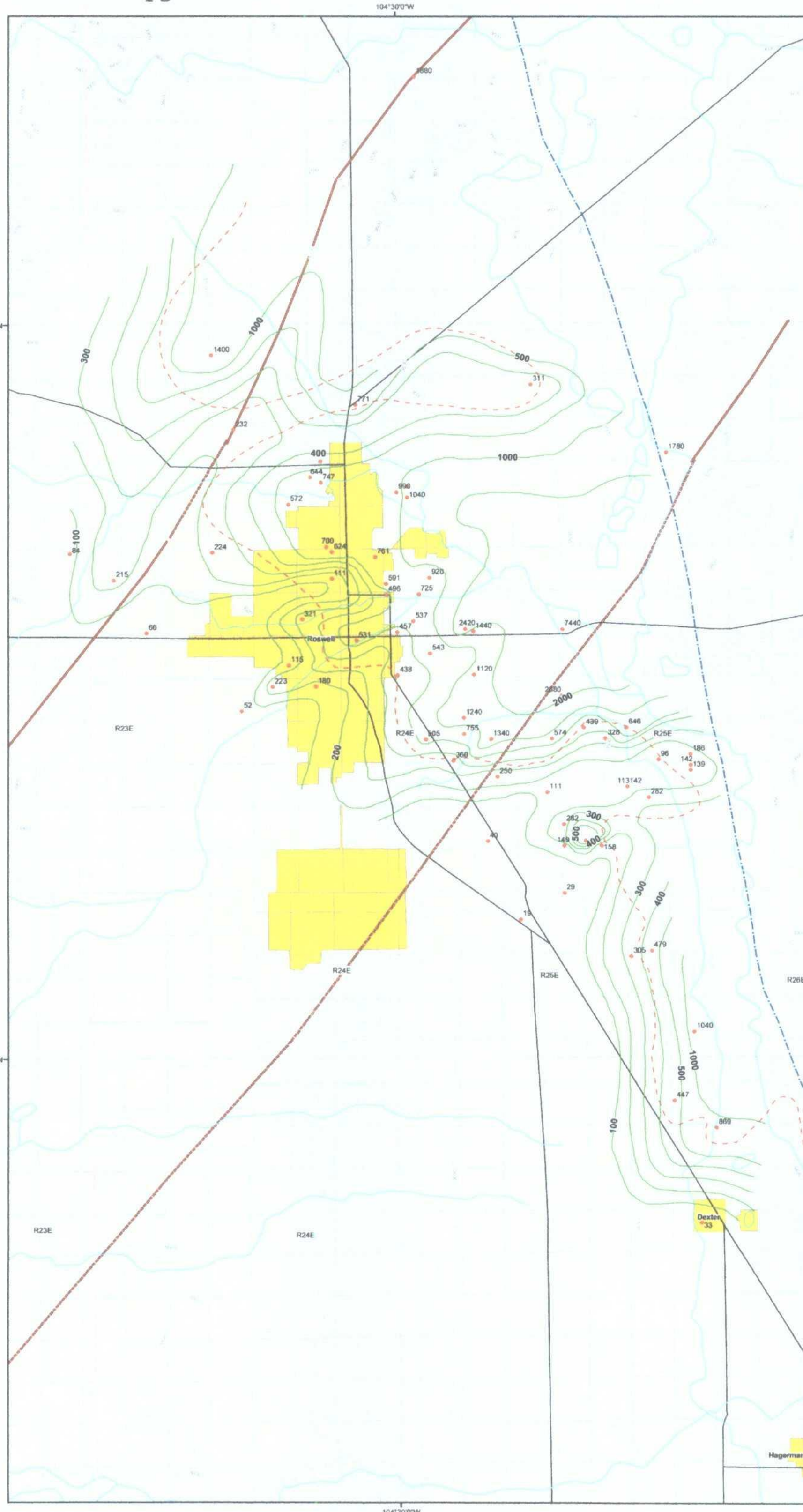

FROM BRINE WELL
PIT - 7.5' DEEP
CAPACITY
10,000 BBL.
PIT LINED
WITH 30 MIL
POLYETHYLENE
FILM
70'
70'
2" FLOAT VALVE
LEAK DET'
1¼" PERF
PVC PIPE
SLOPE
3':1'
SLOPE
3:1
¼" MESH
SCREEN
½" SAMPLE
CONN.
METERS
TRUCK LOADING
HIGHWAY
PERMIAN BRINE SALES, INC.
ODESSA, TEXAS
ARTESIA BRINE STATION
BRINE STORAGE PIT
DATE: 10-18-82
R.C. McCUTCHAN
P.E. TEX 9844
DRAWING NO.
2

Exhibit H



- Artesian Wells
- 1978 freshwater-saltwater interface (Welder, 1983)
- subsurface faults
- surface faults
- Aquifer boundary (modified from Welder, 1983)

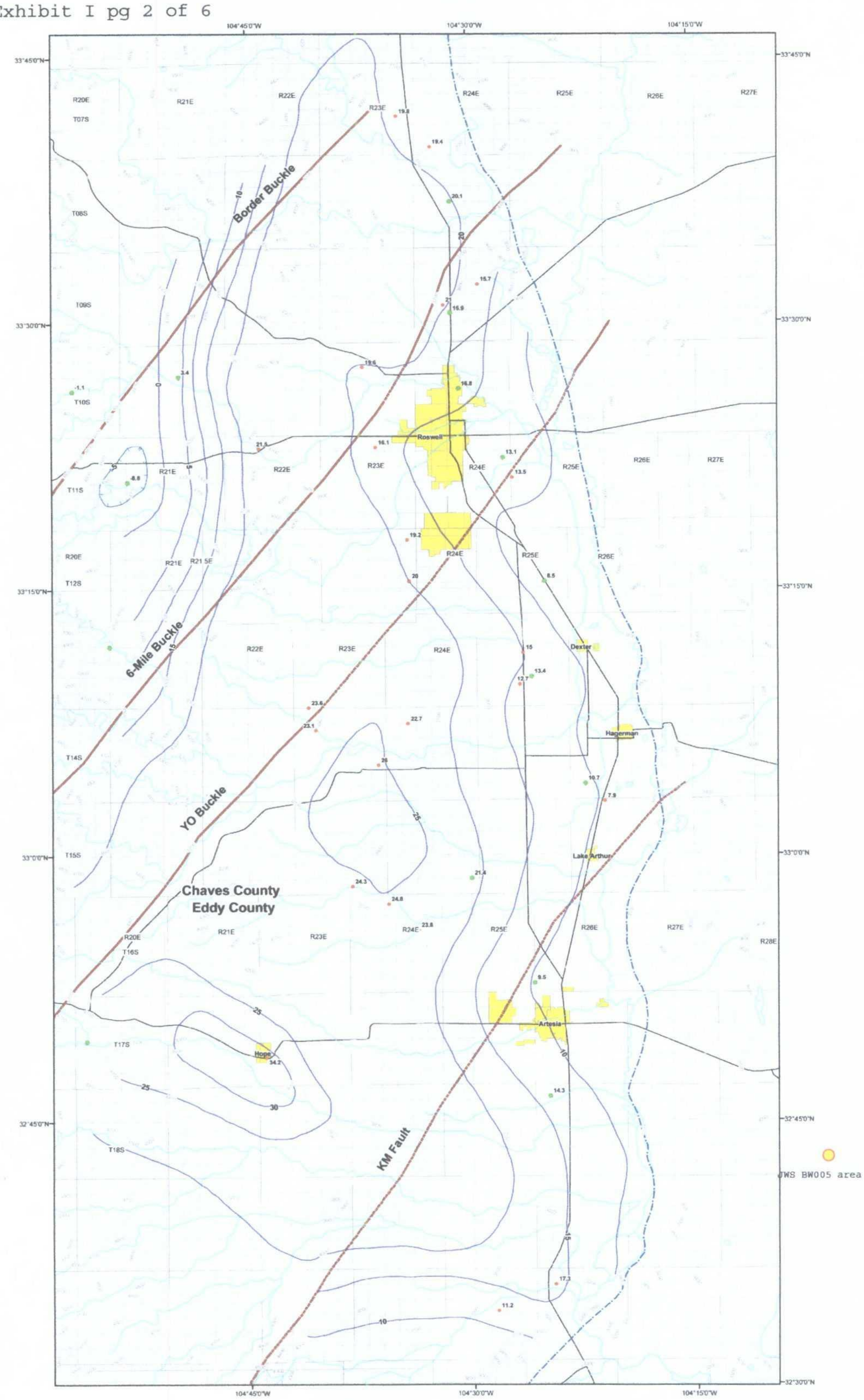
1:100,000

0 2 4 6 8 Miles

0 5 10 Kilometers

Plate 2 **Distribution of Chloride Concentration in the Artesian Aquifer: March, 2005**

contour interval: variable



Artesian Wells

Monitoring Wells

1:250,000

Contour Interval = 5 ft.

0 5 10 15 20 Miles

0 5 10 15 20 Kilometers

surface faults

subsurface faults (Kelley, 1971)

Aquifer boundary (modified from Welder, 1983)

Plate 4 Variation in Hydraulic Head in the Artesian Aquifer: Roswell Artesian Basin

January, February, 1975 - 2005

Exhibit I pg 3 of 6

NEW MEXICO STATE ENGINEER
SANTA FE, NEW MEXICO

PREPARED IN COOPERATION WITH
THE UNITED STATES GEOLOGICAL SURVEY

Resource and Service Center

TECHNICAL REPORT 42
ROSWELL BASIN
NEW MEXICO

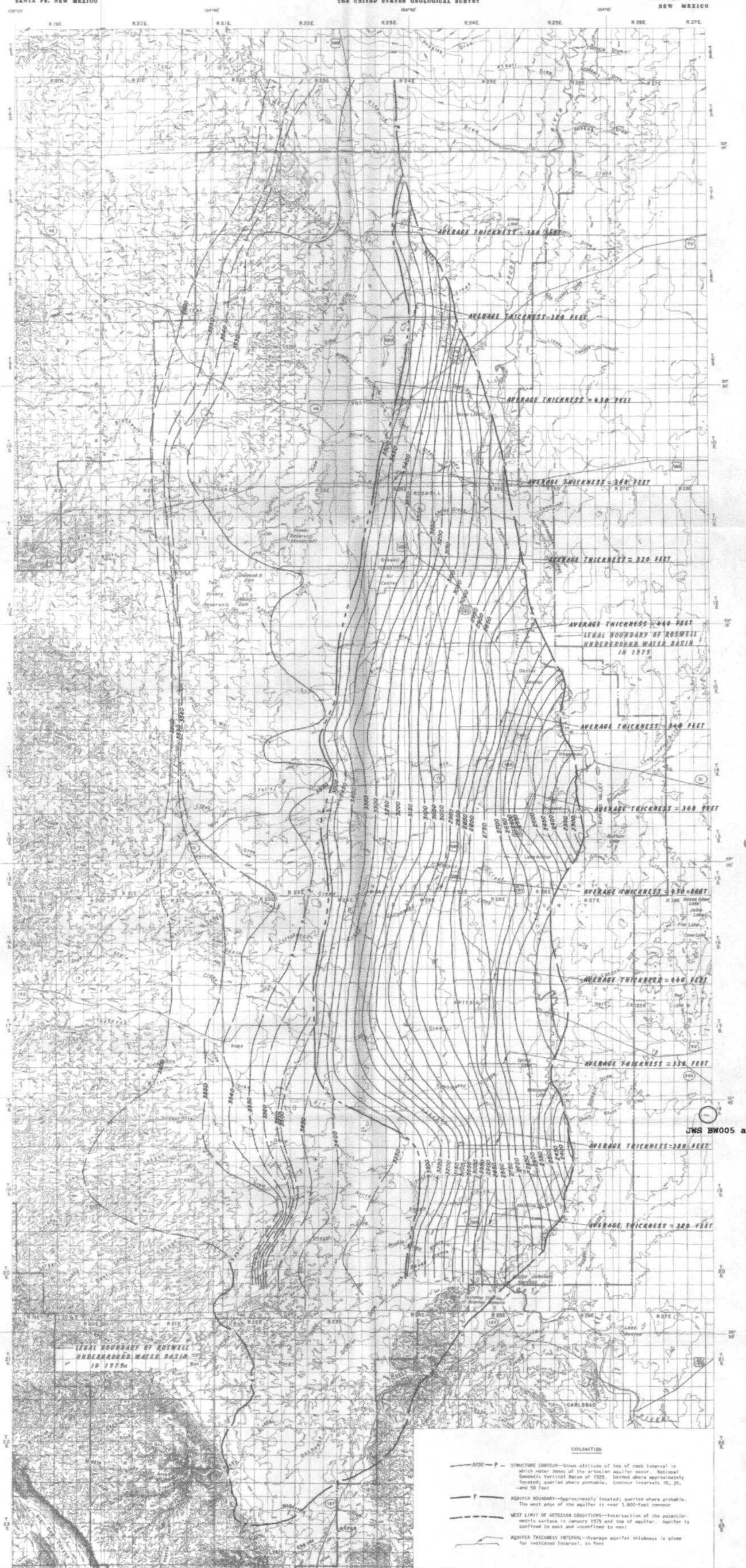


Figure 6. Map showing the configuration of the top of the artesian aquifer in January 1975, Roswell basin, Chaves and Eddy Counties, New Mexico.

Plate W-10

8

NEW MEXICO STATE ENGINEER
SANTA FE, NEW MEXICO

PREPARED IN COOPERATION WITH
THE UNITED STATES GEOLOGICAL SURVEY

TECHNICAL REPORT 43
ROSWELL BASIN
NEW MEXICO

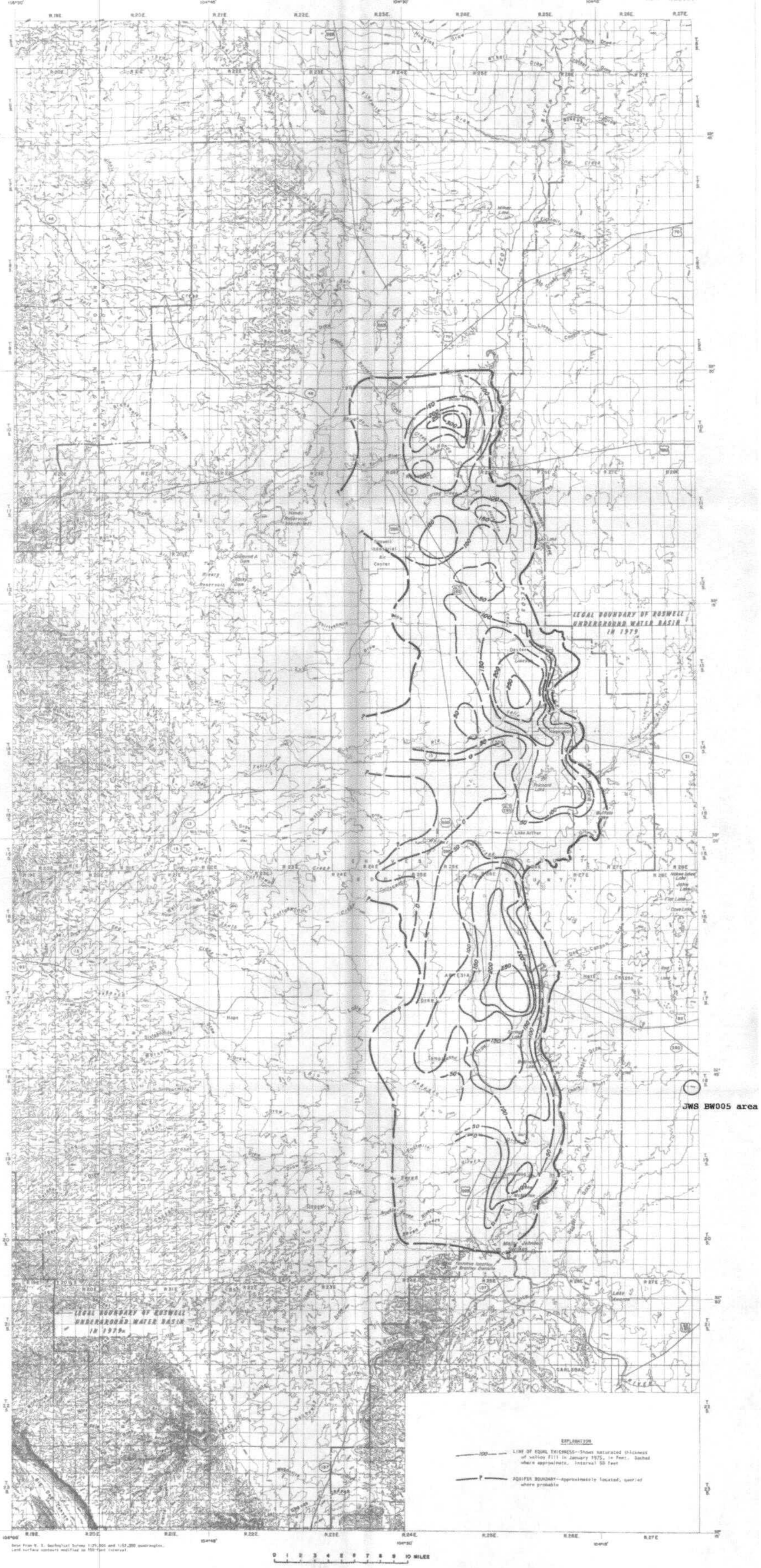


Figure 8. Map showing the saturated thickness of the valley fill in January 1975, Roswell basin, Chaves and Eddy Counties, New Mexico.

Plate W-12

20

NEW MEXICO STATE ENGINEER
SANTA FE, NEW MEXICO

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TECHNICAL REPORT 42
ROSWELL BASIN
NEW MEXICO

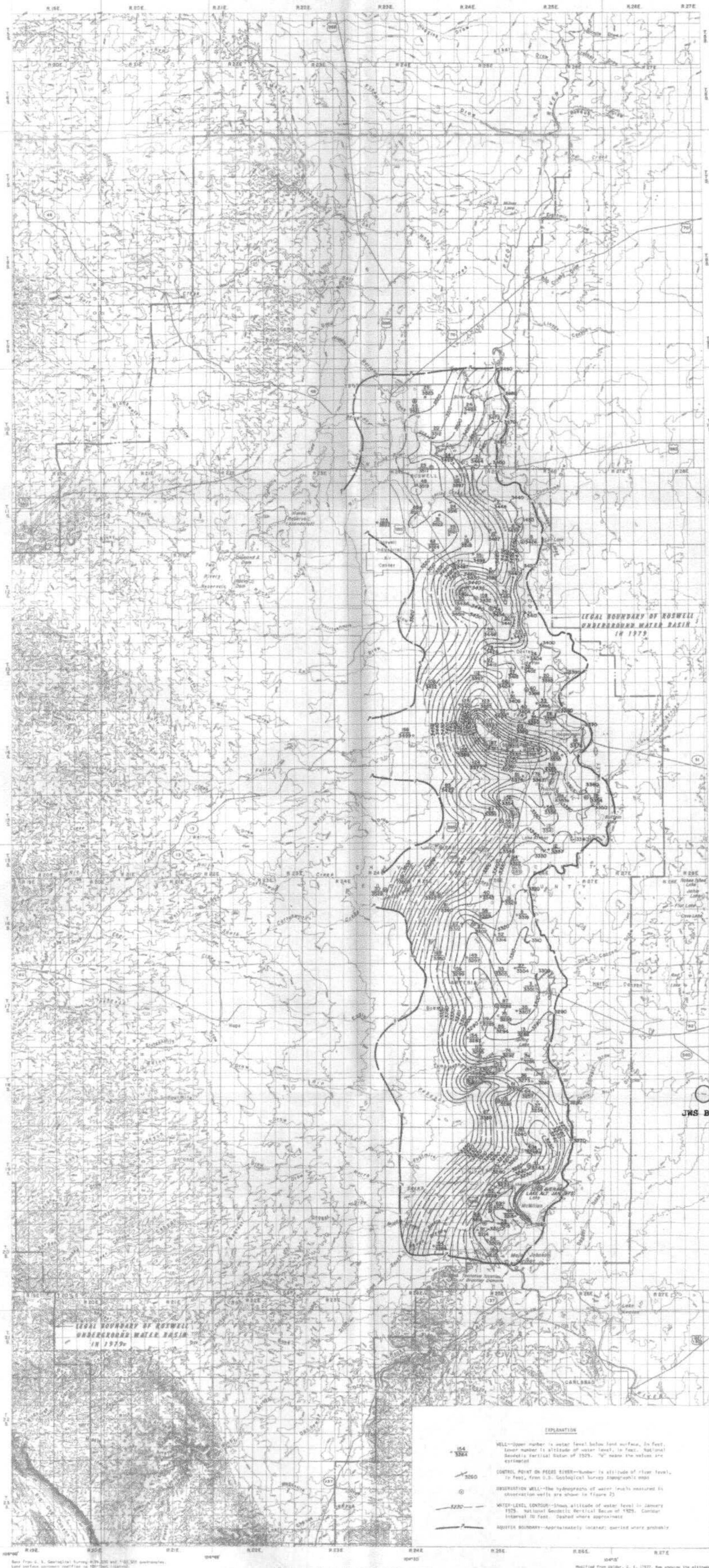

Figure 20. Map showing the configuration of the water level in the shallow aquifer in January 1975, Roswell basin, Chaves and Eddy Counties, New Mexico.

Plate W-16

Exhibit I pg 6 of 6

2C

NEW MEXICO STATE ENGINEER
SANTA FE, NEW MEXICO

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THE UNITED STATES GEOLOGICAL SURVEY

TECHNICAL REPORT 43
ROSWELL BASIN
NEW MEXICO

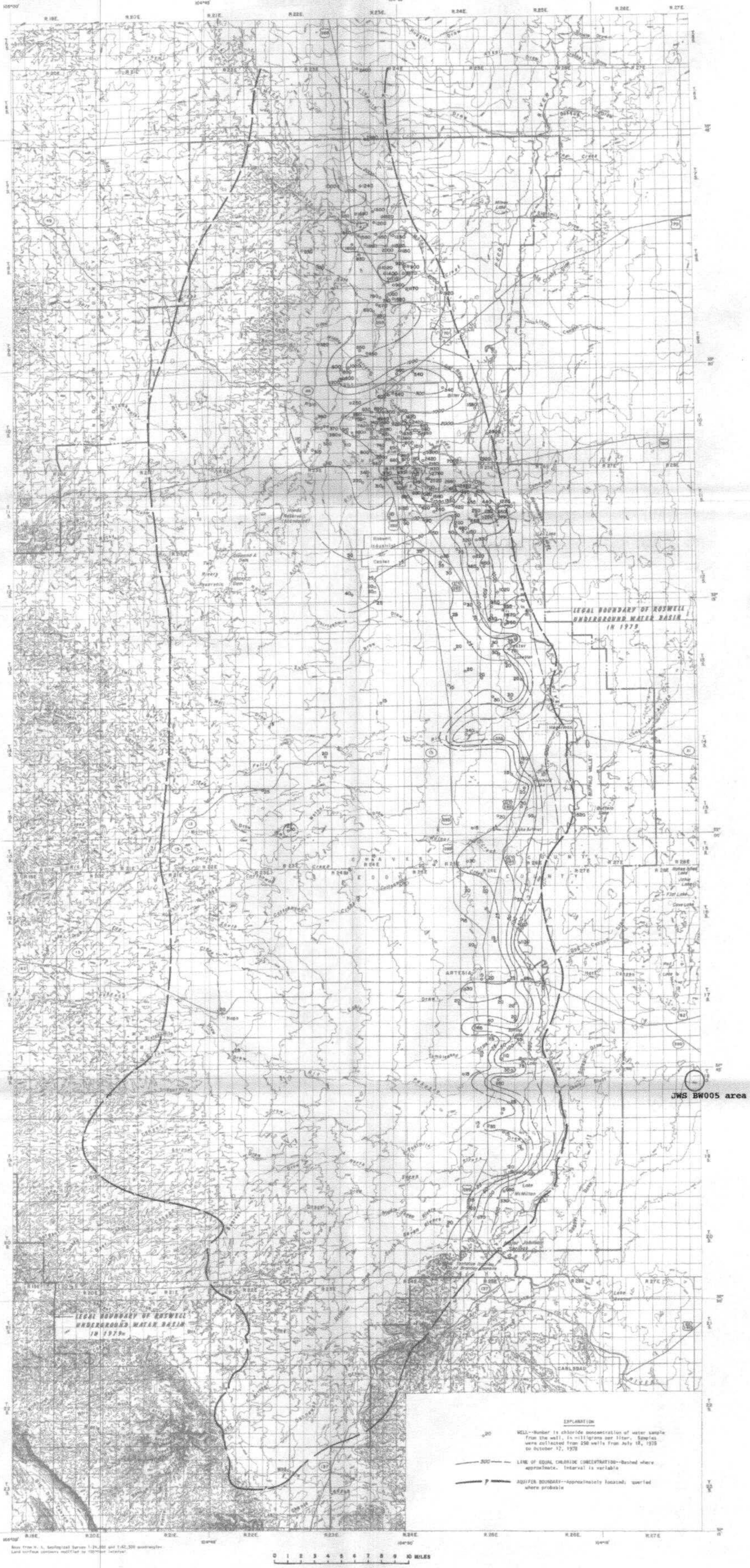


Figure 26. Map showing the chloride concentration of water samples from the artesian aquifer in 1978, Roswell basin, Chaves and Eddy Counties, New Mexico.

Plate W-18

(b) The operator shall provide the surface owner notice of the operator's proposal of an on-site closure method. The operator shall attach the proof of notice to the permit application.

(c) The operator shall comply with the closure requirements and standards of Paragraphs (2) and (3), as applicable, of Subsection F of 19.15.17.13 NMAC if the proposed closure method for a drying pad associated with a closed-loop system or for a temporary pit involves on-site burial pursuant to Paragraph (2) of Subsection D of 19.15.17.13 NMAC or Paragraph (2) of Subsection B of 19.15.17.13 NMAC, or involves an alternative closure method pursuant to Paragraph (3) of Subsection D of 19.15.17.13 NMAC or Paragraph (3) of Subsection B of 19.15.17.13 NMAC and Subsection B of 19.15.17.15 NMAC.

(d) The operator shall place a steel marker at the center of an on-site burial. The steel marker shall be not less than four inches in diameter and shall be cemented in a three-foot deep hole at a minimum. The steel marker shall extend at least four feet above mean ground level and at least three feet below ground level. The operator name, lease name and well number and location, including unit letter, section, township and range, and that the marker designates an on-site burial location shall be welded, stamped or otherwise permanently engraved into the metal of the steel marker. A person shall not build permanent structures over an on-site burial without the appropriate division district office's written approval. A person shall not remove an on-site burial marker without the division's written permission.

(e) The operator shall report the exact location of the on-site burial on form C-105 filed with the division.

(f) The operator shall file a deed notice identifying the exact location of the on-site burial with the county clerk in the county where the on-site burial occurs.

(2) In-place burial.

(a) Where the operator meets the siting criteria specified in Paragraphs (2) or (3) of Subsection C of 19.15.17.10 NMAC and the applicable waste criteria specified in Subparagraphs (c) or (d) of Paragraph (2) of Subsection F of 19.15.17.13 NMAC, an operator may use in-place burial (burial in the existing temporary pit) for closure of a temporary pit or bury the contents of a drying pad associated with a closed-loop system in a temporary pit that the operator constructs in accordance with Paragraphs (1) through (6) and (10) of Subsection F of 19.15.17.11 NMAC for closure of a drying pad associated with a closed loop system.

(b) Prior to closing an existing temporary pit or to placing the contents from a drying pad associated with a closed-loop system into a temporary pit that the operator constructs for disposal, the operator shall stabilize or solidify the contents to a bearing capacity sufficient to support the temporary pit's final cover. The operator shall not mix the contents with soil or other material at a mixing ratio of greater than 3:1, soil or other material to contents.

(c) Where ground water will be between 50 and 100 feet below the bottom of the buried waste, the operator shall collect at a minimum, a five point, composite sample of the contents of the drying pad associated with a closed-loop system or the contents of a temporary pit after treatment or stabilization, if treatment or stabilization is required, to demonstrate that benzene, as determined by EPA SW-846 method 8021 B or 8260B, does not exceed 0.2 mg/kg; total BTEX, as determined by EPA SW-846 method 8021 B or 8260B, does not exceed 50 mg/kg; TPH, as determined by EPA SW-846 method 418.1 or other EPA method approved that the division approves, does not exceed 2500 mg/kg; the GRO and DRO combined fraction, as determined by EPA SW-846 method 8015M, does not exceed 500 mg/kg; and chlorides, as determined by EPA method 300.1, do not exceed 500 mg/kg or the background concentration, whichever is greater. The operator may collect the composite sample prior to treatment or stabilization to demonstrate that the contents do not exceed these concentrations. However, if the contents collected prior to treatment or stabilization exceed the specified concentrations the operator shall collect a second five point, composite sample of the contents after treatment or stabilization to demonstrate that the contents do not exceed these concentrations.

(d) Where the ground water will be more than 100 feet below the bottom of the buried waste, the operator shall collect at a minimum, a five point, composite sample of the contents of the drying pad associated with a closed-loop system or the contents of a temporary pit after treatment or stabilization, if treatment or stabilization is required, to demonstrate that benzene, as determined by EPA SW-846 method 8021B or 8260B, does not exceed 0.2 mg/kg; total BTEX, as determined by EPA SW-846 method 8021B or 8260B, does not exceed 50 mg/kg; the GRO and DRO combined fraction, as determined by EPA SW-846 method 8015M, does not exceed 500 mg/kg; TPH, as determined by EPA method 418.1 or other EPA method that the division approves, does not exceed 2500 mg/kg; and chlorides, as determined by EPA method 300.1, do not exceed 1000 mg/kg or the background concentration, whichever is greater. The operator may collect the composite sample prior to treatment or stabilization to demonstrate that the contents do not exceed these concentrations. However, if the contents collected prior to treatment or stabilization exceed the specified concentrations the operator shall collect a second five point, composite sample of the contents after treatment or stabilization to demonstrate that the contents do not exceed these concentrations.

(e) Upon closure of a temporary pit, or closure of a temporary pit that the operator constructs for burial of the contents of a drying pad associated with a closed-loop system, the operator shall cover the geomembrane lined, filled, temporary pit with compacted, non-waste containing, earthen material; construct a division-prescribed soil cover; recontour and re-vegetate the site. The division-prescribed soil cover, recontouring and re-vegetation shall comply with Subsections G, H and I of 19.15.17.13 NMAC.

(f) For burial of the contents from a drying pad associated with a closed-loop system, the operator shall construct a temporary pit, in accordance with Paragraphs (1) through (6) and (10) of Subsection F of 19.15.17.10 NMAC, within 100 feet of the drying pad associated with a closed-loop system, unless the appropriate division district office approves an alternative distance and location. The operator shall use a separate temporary pit for closure of each drying pad associated with a closed-loop system.

(3) On-site trench burial.

(a) Where the operator meets the siting criteria in Paragraph (4) of Subsection C of 19.15.17.10 NMAC, an operator may use on-site trench burial for closure of a drying pad associated with a closed loop system or for closure of a temporary pit when the waste meets the criteria in Subparagraph (c) of Paragraph (3) of Subsection F of 19.15.17.13 NMAC. The operator shall use a separate on-site trench for closure of each drying pad associated with a closed-loop system or each temporary pit.

(b) Prior to placing the contents from a drying pad associated with a closed-loop system or from a temporary pit into the trench, the operator shall stabilize or solidify the contents to a bearing capacity sufficient to support the final cover of the trench burial. The operator shall not mix the contents with soil or other material at a mixing ratio of greater than 3:1, soil or other material to contents.

(c) The operator shall collect at a minimum, a five point, composite sample of the contents of the drying pad associated with a closed-loop system or temporary pit to demonstrate that the TPH concentration, as determined by EPA method 418.1 or other EPA method that the division approves, does not exceed 2500 mg/kg. Using EPA SW-846 method 1312 or other EPA leaching procedure that the division approves, the operator shall demonstrate that the chloride concentration, as determined by EPA method 300.1 or other EPA method that the division approves, does not exceed 250 mg/l and that the concentrations of the water contaminants specified in Subsection A of 20.6.2.3103 NMAC as determined by appropriate EPA methods do not exceed the standards specified in Subsection A of 20.6.2.3103 NMAC, unless otherwise specified above. The operator may collect the composite sample prior to treatment or stabilization to demonstrate that the contents do not exceed these concentrations. However, if the contents collected prior to treatment or stabilization exceed the specified concentrations the operator shall collect a second five point, composite sample of the contents after treatment or stabilization to demonstrate that the contents do not exceed these concentrations.

(d) If the contents from a drying pad associated with a closed-loop system or from a temporary pit do not exceed the criteria in Subparagraph (c) of Paragraph (3) of Subsection F of 19.15.17.13 NMAC, the operator shall construct a trench lined with a geomembrane liner located within 100 feet of the drying pad associated with a closed-loop system or temporary pit, unless the appropriate division district office approves an alternative distance and location. The operator shall design and construct the lined trench in accordance with the design and construction requirements specified in Paragraphs (1) through (8) of Subsection J of 19.15.17.11 NMAC.

(e) The operator shall close each drying pad associated with a closed-loop system or temporary pit by excavating and transferring all contents and synthetic pit liners or liner material associated with a closed-loop system or temporary pit to a lined trench. The excavated materials shall pass the paint filter liquids test (EPA SW-846, method 9095) and the closure standards specified in Subparagraph (c) of Paragraph (3) of Subsection F of 19.15.17.13 NMAC.

(f) The operator shall test the soils beneath the temporary pit after excavation to determine whether a release has occurred.

(i) Where ground water is between 50 and 100 feet below the bottom of the temporary pit, the operator shall collect, at a minimum, a five point, composite sample; collect individual grab samples from any area that is wet, discolored or showing other evidence of a release; and analyze for BTEX, TPH, benzene, GRO and DRO combined fraction and chlorides to demonstrate that benzene, as determined by EPA SW-846 method 8021B or 8260B, does not exceed 0.2 mg/kg; total BTEX, as determined by EPA SW-846 method 8021B or 8260B, does not exceed 50 mg/kg; TPH, as determined by EPA SW-846 method 418.1 or other EPA method approved that the division approves, does not exceed 2500 mg/kg; the GRO and DRO combined fraction, as determined by EPA SW-846 method 8015M, does not exceed 500 mg/kg; and chlorides, as determined by EPA method 300.1, do not exceed 500 mg/kg or the background concentration, whichever is greater. The operator shall notify the division of

K.P. KAUFFMAN COMPANY, INC.
WORLD TRADE CENTER
1675 BROADWAY, 28TH FLOOR
DENVER, COLORADO 80202-4628

TELEPHONE (303) 825-4822
FACSIMILE (303) 825-4825
www.kpk.com

AUG - 4 2008
OCD-ARTESIA

JWS
JWS OF NEW MEXICO, INC.

Via USPS- CERTIFIED MAIL-RETURN RECEIPT REQUESTED

August 1, 2008

State of New Mexico
Oil Conservation Division
District II office
1301 W. Grand Ave.
Artesia, New Mexico 88210

Re: Form C-103
Sundry Notice sinkhole development 7-16-08, summation of incident report
API #30-015-02036
State 24 No. 1

To Whom It May Concern:

Please see attached sundry (in triplicate) regarding the referenced well. This brine well was reported as lost on the morning of July 16, 2008. The sundry and attachments are the incident report for this event. I will send more information on the ongoing investigation that Jim's Water Service (JWS) and K. P. Kauffman Company, Inc. (KPK) are conducting at this time when the information becomes available. We will continue to notify you of anyone on site. Please call me if you have any questions. Thanks!

Sherry Glass
Sherry Glass
Engineering Technician
KPK/JWS

Attachments

Cc: Mr. Wayne Price, OCD, Santa Fe, New Mexico office

Submit 3 Copies To Appropriate District Office
District I
1625 N French Dr., Hobbs, NM 88240
District II
1301 W Grand Ave , Artesia, NM 88210
District III
1000 Rio Brazos Rd , Aztec, NM 87410
District IV
1220 S St. Francis Dr., Santa Fe, NM 87505

State of New Mexico
Energy, Minerals and Natural Resources

OIL CONSERVATION DIVISION
1220 South St. Francis Dr.
Santa Fe, NM 87505

AUG - 4 2008
OCD-ARTESIA

Form C-103
June 19, 2008

WELL API NO. 3001502036
5. Indicate Type of Lease STATE ☒ FEE ☐
6. State Oil & Gas Lease No. M19609

SUNDRY NOTICES AND REPORTS ON WELLS
(DO NOT USE THIS FORM FOR PROPOSALS TO DRILL OR TO DEEPEN OR PLUG BACK TO A DIFFERENT RESERVOIR USE "APPLICATION FOR PERMIT" (FORM C-101) FOR SUCH PROPOSALS)

7. Lease Name or Unit Agreement Name State 24
1. Type of Well: Oil Well ☐ Gas Well ☒ Other Brine extraction
8. Well Number ~~No. 001~~
2. Name of Operator Jim's Water Service
9. OGRID Number
3. Address of Operator 11413 US Highway 82, Artesia, NM 88210
10. Pool name or Wildcat

4. Well Location
Unit Letter J : 1988 feet from the south line and 1930 feet from the east line
Section 24 Township 18S Range 28E NMPM Eddy County

11. Elevation (Show whether DR, RKB, RT, GR, etc.) 3503' GL

12. Check Appropriate Box to Indicate Nature of Notice, Report or Other Data

NOTICE OF INTENTION TO:		SUBSEQUENT REPORT OF:	
PERFORM REMEDIAL WORK ☐	PLUG AND ABANDON ☐	REMEDIAL WORK ☐	ALTERING CASING ☐
TEMPORARILY ABANDON ☐	CHANGE PLANS ☐	COMMENCE DRILLING OPNS. ☐	P AND A ☐
PULL OR ALTER CASING ☐	MULTIPLE COMPL ☐	CASING/CEMENT JOB ☐	
DOWNHOLE COMMINGLE ☐		sinkhole development 7-16-08	
OTHER: ☐		OTHER summation of incident report ☒	

13. Describe proposed or completed operations. (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work). SEE RULE 1103. For Multiple Completions: Attach wellbore diagram of proposed completion or recompletion.

Please see attached summation of incident events, remediation, and accounting of JWS, BLM, OCD, and others following incident 7-16-08. JWS is proceeding with investigation of event using our specialists at present and will monitor roadway along 217 for additional subsidence.

Spud Date: Rig Release Date:

I hereby certify that the information above is true and complete to the best of my knowledge and belief.

SIGNATURE Sherry Glass TITLE Engineering Technician DATE 8-1-08

Type or print name Sherry Glass E-mail address: sglass@kpk.com PHONE: 303.825.4822

For State Use Only

Accepted for record
NMOCD

APPROVED BY: TITLE DATE
Conditions of Approval (if any):

Summation of JWS brine well collapse, OCD permit #BW-005, Eddy County, New Mexico

7-16-08: Mark Netherlin of JWS arrived at the wellhead site at approximately 8:15 a.m., saw the collapse of the wellhead start after hearing a loud noise (rumble), got back in his truck and reversed quickly to a safe distance on the pavement along Hwy 217, then called the JWS field office. Dimas Herrera, the GM of the JWS field office, arrived within half an hour and called the OCD, BLM, State Land Office, Eddy Co. Emergency Response and County Roads and Sheriff's office. Dimas called corporate office to report loss of brine well. The hole was approximately 30' x 40' wide at that point, with undetermined depth. Other field hands arrived from the field office and blocked off all access roads with posts, flagging ribbons and old pallets and lumber available at the brine reserve pit. OCD (Mike Bratcher) reported later to Energy, Minerals and Natural Resources (EMNR) District 2 office in Artesia about disappearance of the well. Many successive collapses occurred over the course of the day, with noise and dust obscuring the sinkhole from sight. Sheriff was on location to close road.
7-17-08: OCD was onsite and Mark Netherlin gave a verbal report to Wayne Price of OCD, who had assumed Incident Commander (IC) role. The sinkhole was very active, had grown to approximately 120' x 100'. A perimeter around the outside of the visual cracks was established with stakes and flagging. Kent Gilbert of Denver office flew to Artesia to go to site and meet with OCD, established a log book for visitors to site, and incidents report. Kent, Dimas and Wayne agreed to wait until Monday to set up fence to allow sinkhole to stabilize. Kent Gilbert and Dimas Herrera then walked perimeter of site to place numbered flags on visible surface cracks to map and record distances from approximate far wall of hole to each flag (please see attachment 1). The Eddy County Mobile Command Center arrived, Jim Carr, District Manager of Field Operations Division of State (SLO) arrived and inspected the site. David Herroll of the BLM assumed IC from Wayne Price and was safety officer when Mark Netherlin, Pat Seiser of the National Caverns and Karst Research Institute (NCKRI), and Carl Chavez of the OCD walked the perimeter to examine the cracks paralleling the feature. Wayne Price called for a safety meeting to assign tasks to the personnel at the site and go over the dangers to avoid on the site.
7-18-08: The sinkhole was very active, with loud rumbling, ground-shaking and dust thrown up. The hole is approximately 200' x 200'. John Stewart of EMNR stated there was little fresh ground water present in this location (from Rustler Formation). The BLM representatives arrived with 4 karst specialists, including George Veni, the Executive Director of the NCKRI and Lewis Derrick, Eddy County Commissioner. David Herroll assumed IC, and did the incident safety briefing for the day and indicated he wanted 'Keep Out-Danger' signs posted, as he noticed cracks along the east side and undercutting of the north and west walls. Wayne Price had diagrammed the 'Hot Zone' indicated on the attached map (please see attachment 2), expecting the feature to stabilize within one week. Pat Seiser spray painted a scale on the roadway for the expected flyovers. Robert Brader of the SLO requested a chain link fence around the site. The Eddy County

Mobile Command Center was assigned to the location and JWS personnel were assigned to be on site 24 hours a day. The state police arrived and ranchers requesting access to their lands were told they could not go by the access roads in the 'Hot Zone' by Lewis Derrick. Dimas Herrera and the OCD conducted GPS and range finder surveys on the flagged stress cracks and the perimeter of the hole. State police arrived on the site at 3:40 p.m. 7-19-08: JWS personnel posted 2 state signs, indicating penalties and danger of trespass of property on T-posts with wire strung in between around access onto site from 217. Glenn Von Gonten and Edward Hansen (OCD) arrived on site. There were two flyovers, at 9:22 and 9:40 a.m. Some activity at the site indicated the feature was mainly deepening. Email from George Veni (NCKRI) to Carl Chavez (OCD) indicates his interest in coordinating an exchange of information and ideas regarding this sinkhole and the brine production well in Carlsbad.

7-20-08: Rental trailer secured for the JWS crew to stay in, OCD requested meals for their personnel on site. Some activity, with NCKRI photos indicating growth except for the W-SW-S area. OCD queried JWS personnel about fence status.

7-21-08: KPK discussing cave specialists to help mitigate situation, lessen impacts to public safety and help in KPK investigation of event. NCKRI flyover, JWS began installing fence posts and cemented in place. Jenny Rennie (Eddie County Commissioner), Robert Brader (Eddy Co. OEM), and Joel Arnwine (Eddy Co. OEM) walked perimeter of hole. Jim Herring (Bogel Farms ranch foreman) came to check on progress of the fence. Hole was active, lots of dust from fallout. Size is approximately 220' x 220'. Massive sinkhole activity occurred in the evening. Two trespassers were encountered on the north side of the area at 22:00, state police were informed.

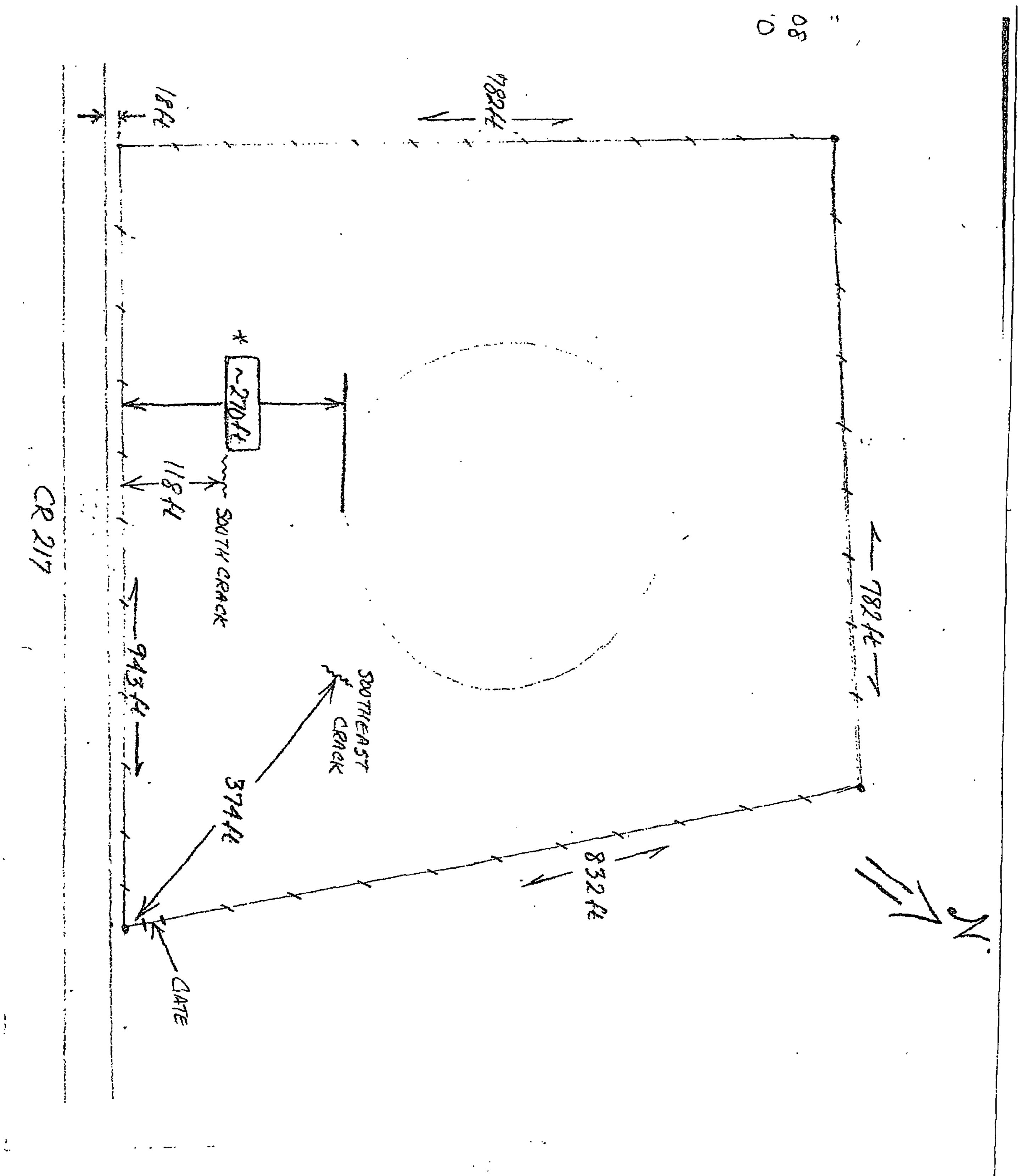
7-22-08: Aerial photos indicating feature over brine well are discussed at KPK, acquiring and sorting documents from JWS for review. Sheriff visits the site, JWS directed to dig a trench with a backhoe on high ground on east side to direct drainage from the sinkhole. Cemented fence corner post at Reed & Stevens Travis well location to southwest of feature, but directed by David Herroll to put fencing crews to dig ditch for drainage from sinkhole, so workers pulled off fencing project. Hole was very active in the evening.

7-23-08: Pipeline markers were flagged. Ten workmen for JWS working on installing fencing and finishing ditch by backhoe. OCD puts Travis well (Reed and Stevens, operator) to the west back on line. Activity resumes, with S-SE sidewalls caving back approximately 50'. The Eddy County Mobile Command unit decides to de-mobilize on 7-24-08. Leonard Lowe and Jim Griswold from OCD were on site. Hole active in the evening, as indicated by dusting.

7-24-08: Activity larger on south side, helicopter flyover, outermost fractures at 118' to 217.

7-25-08: Finished fencing, lock on gate. Hole is still active, with lots of dust from the edges. Highway (217) is opened. (please see attachment 3, sketch of fence around sinkhole, and attachment 4, photos of sinkhole)

S. Glass for JWS
8/1/2008



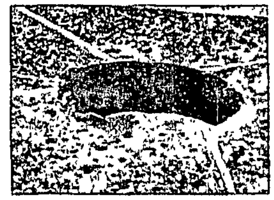
attachment 3


sbc global sinkhole 001


sbc global sinkhole 002


sbc global sinkhole 003


sbc global sinkhole 004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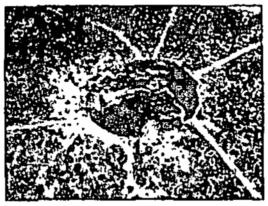
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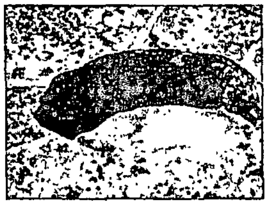
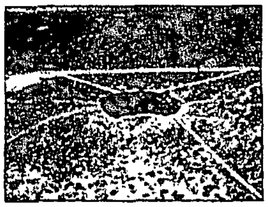

sbc global sinkhole 007


sbc global sinkhole 008


sbc global sinkhole 009


sbc global sinkhole 010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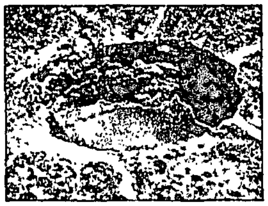
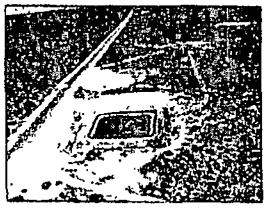
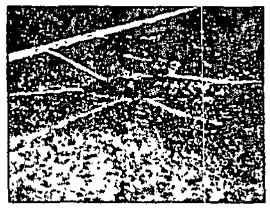

sbc global sinkhole 012


sbc global sinkhole 013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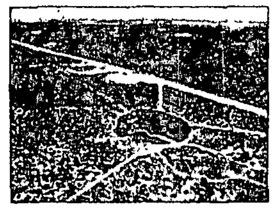
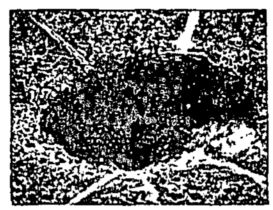

sbc global sinkhole 016


sbc global sinkhole 025

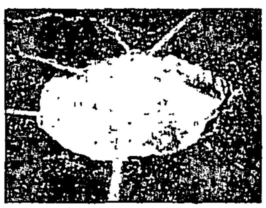

sbc global sinkhole 026


sbc global sinkhole 028


sinkhole1

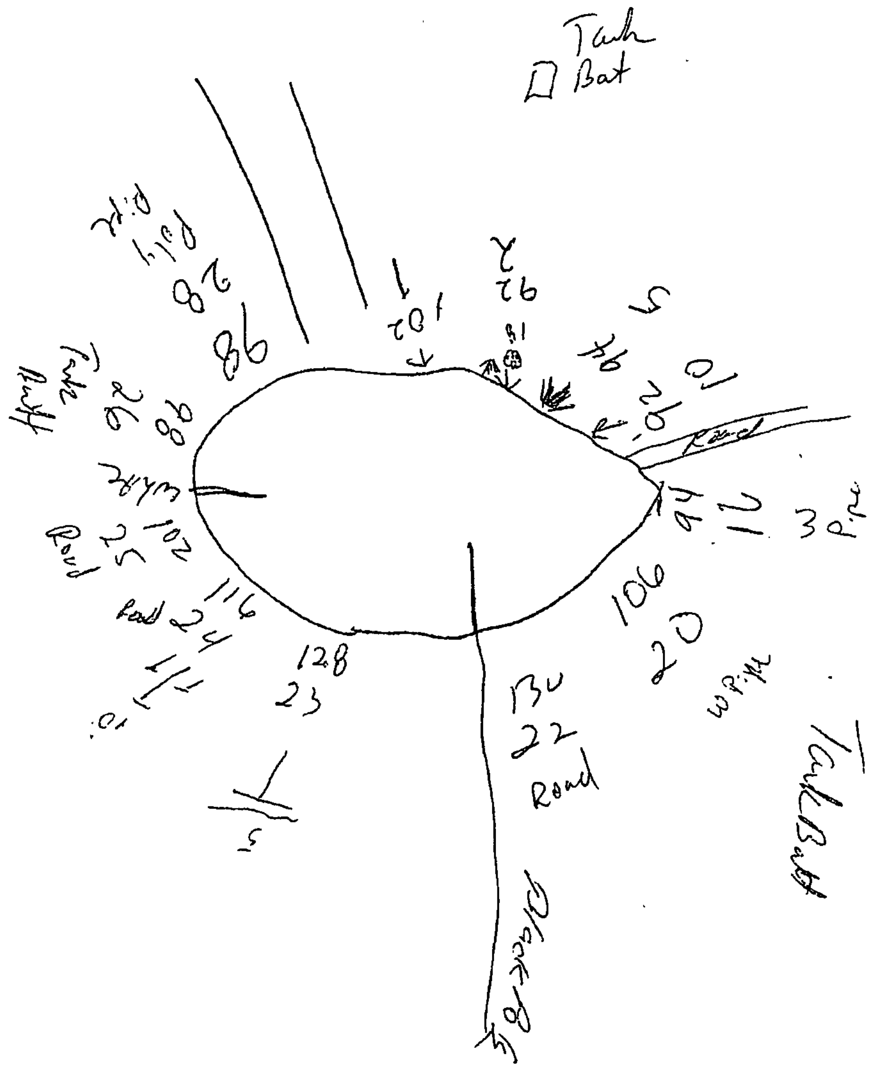

sinkhole2


sinkhole3


sinkhole4


sinkhole5

attachment 4

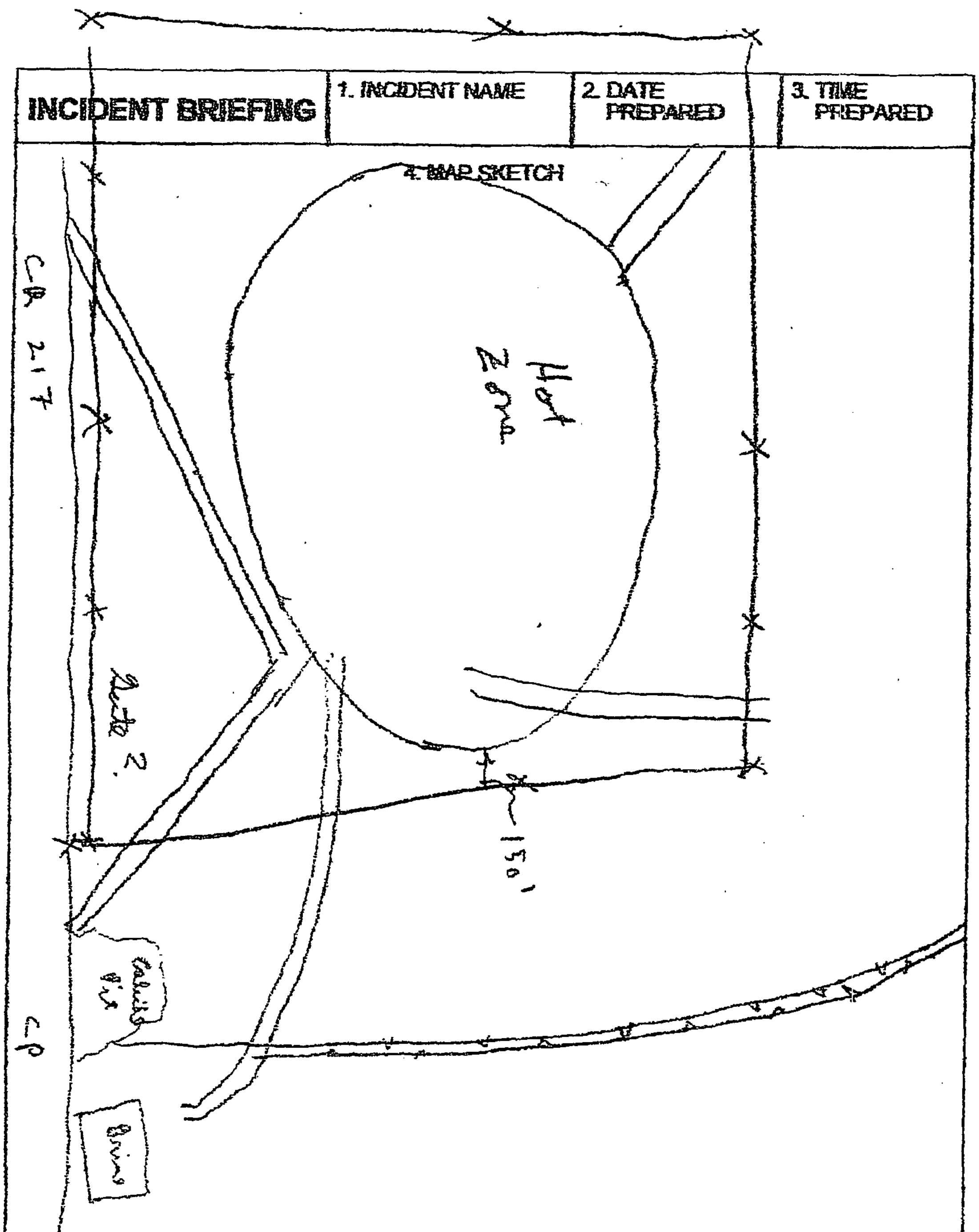


225
3
75

attachment 1

INCIDENT BRIEFING	1. INCIDENT NAME	2. DATE PREPARED	3. TIME PREPARED

4. MAP SKETCH



Not to scale
= two track
O Hot zone
CP command post

23 Jul 08

ICS 201 (12/93) NFES 1325	PAGE 1	5. PREPARED BY (NAME AND POSITION)

attachment 2