BW - ___006___

OVERVIEW

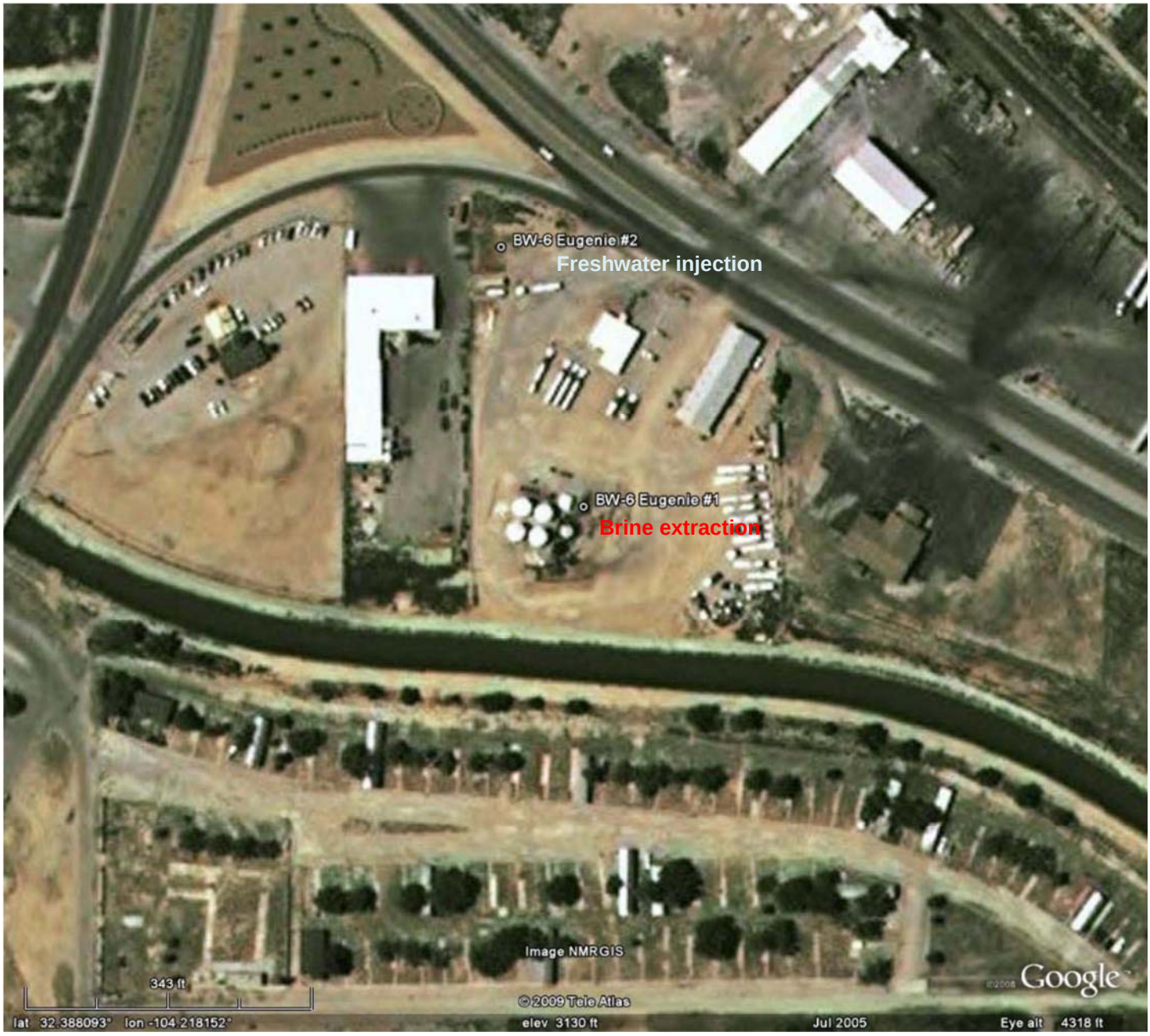
Evaluation of I&W's brine operation in Carlsbad (BW-6)

The I&W facility is situated immediately south of the inverted Y-shaped intersection of US 285 (South Canal Street) and US 180/62 (National Parks Highway) in the southern part of Carlsbad, New Mexico. I&W is primarily a trucking company providing hauling services related to the oil and gas industry. Brine for use in drilling mud and as a kill fluid for well workovers is manufactured at the site. The property also contains I&W's administrative offices, liquid storage tanks, and areas for vehicle parking and servicing including a truck wash. A feed store is located on the adjacent property to the west, a church on the property to the east, and a stretch of irrigation canal to the south beyond which is a trailer park.

Eugenie #1 (API# 30-015-22574, ULSTR M-17-22S-27E in Eddy County), was installed by Permian Brine Sales & Service of Odessa, Texas using a cable tool rig during August of 1978. The depth-to-salt (top of Salado Formation) is 456 feet below ground surface (ft bgs) where the bottom of the 5-1/2" casing was set. Total drilled depth of the hole was 663 ft bgs. 2-7/8" diameter tubing was initially set at a depth of 574 ft. Fresh water purchased from the City of Carlsbad was introduced down the annulus between the casing and the tubing with brine produced up the tubing. During 1979, brine was being produced at a rate of just over 600 barrels per day (bbl/day) using the single well. This level of production was insufficient for Permian's business needs so a second well, Eugenie #2 (API# 30-015-23031, ULSTR L-17-22S-27E), was installed by cable tool about 325 ft NW of the first well in late-November of 1979. The 5-1/2" casing on this well was set to

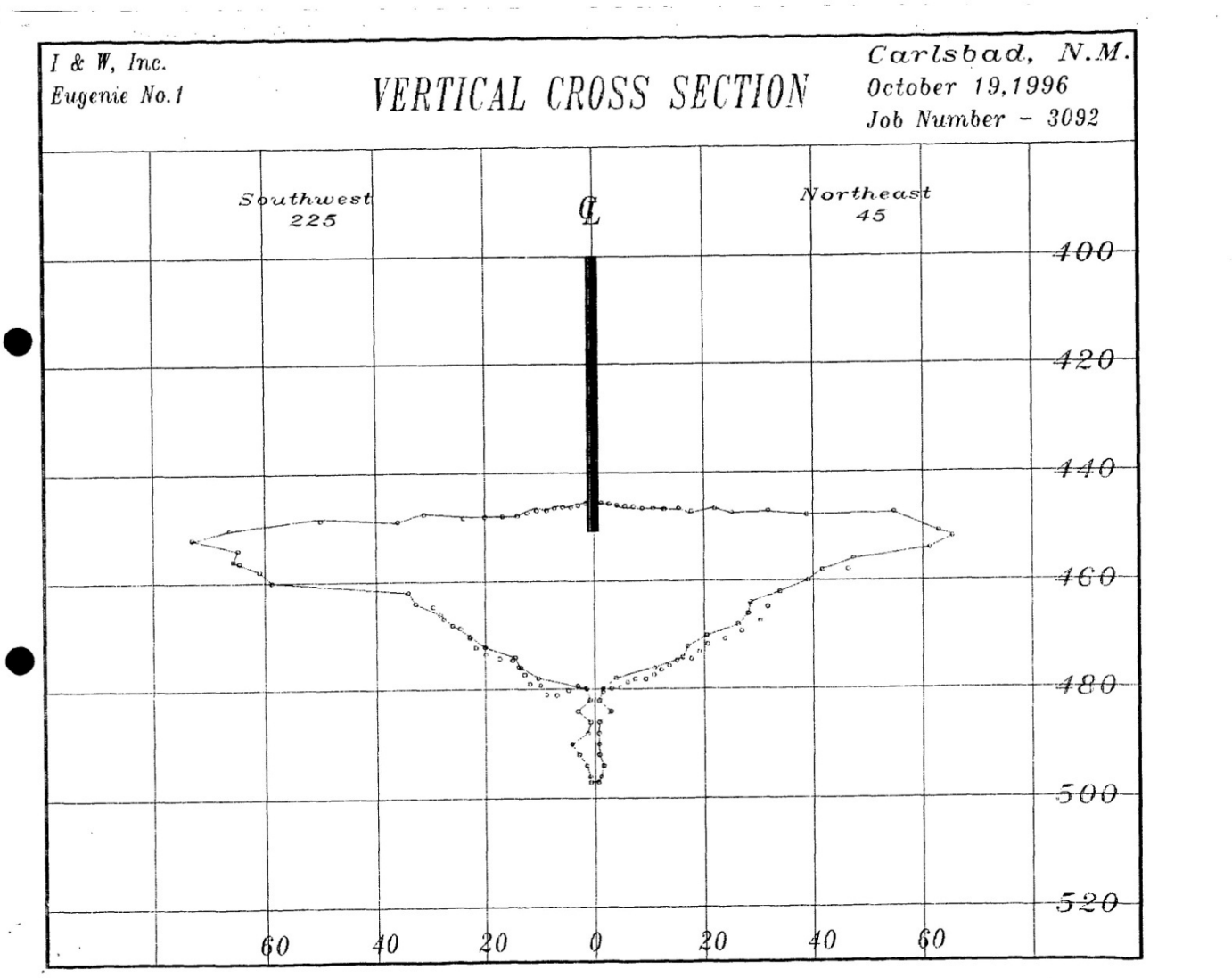
only 285 ft (top of Rustler Formation) with 2-7/8" tubing down to a depth of 583 feet. The salt was fractured between the two wells. Thereafter, fresh water was introduced down the tubing of Eugenie #2 and brine produced from the tubing in Eugenie #1. During 1980, brine was sold at an average rate of more than 1,200 bbl/day. From January thru September of 1981, the rate of brine production was nearly 1,700 bbl/day.

The facility was first permitted by the OCD on December 18, 1982 (GWB-5) operated by Permian Brine Sales. B&E, Inc. of Hobbs owned the land and took over operations in July 1983, with Permian still a minority partner. The Environmental Improvement Division (EID) took over regulatory responsibility from OCD in September 1983 and the permit was renewed by EID in 1987 under their designation DP-323. OCD regained oversight of brine well operations associated with the oil and gas industry in June 1989. During the first six months of 1989, the average brine production was only about 400 bbl/day.



Ownership of the facility transferred to I&W, Inc. in July 1995. OCD's April 1996 permit renewal required subsidence monitoring on a regular basis, but there is little reporting of such monitoring in our files. During 1995 and 1996, OCD repeatedly tried to schedule integrity testing and a cavern survey without success. OCD subsequently ordered I&W to cease brine production on October 11, 1996. This got I&W's attention as a sonar survey of the brine extraction well, Eugenie #1, was completed eight days later on October 19, 1996. At that time, the cavern roof appeared to be 135 ft

across but only the uppermost 45 feet of the mined volume was measured (452 to 497 ft bgs) with a calculated capacity therein of 30,899 bbls. System goes back into service thereafter. That sonar profile shows a highly symmetric inverted conical cavern centered around the brine extraction well, which would not make complete sense given the mode of operation (i.e. a 2-well system). This would be explained by the lack of a complete survey as the bottom of sonar log is 75 feet above the full production tubing depth. A deeper, lateral cavern should have existed between the injection and extraction wells. The sonar logging most likely had difficulty being lowered to greater depth due to the presence of relatively insoluble anhydrite interbedding within the Salado formation.

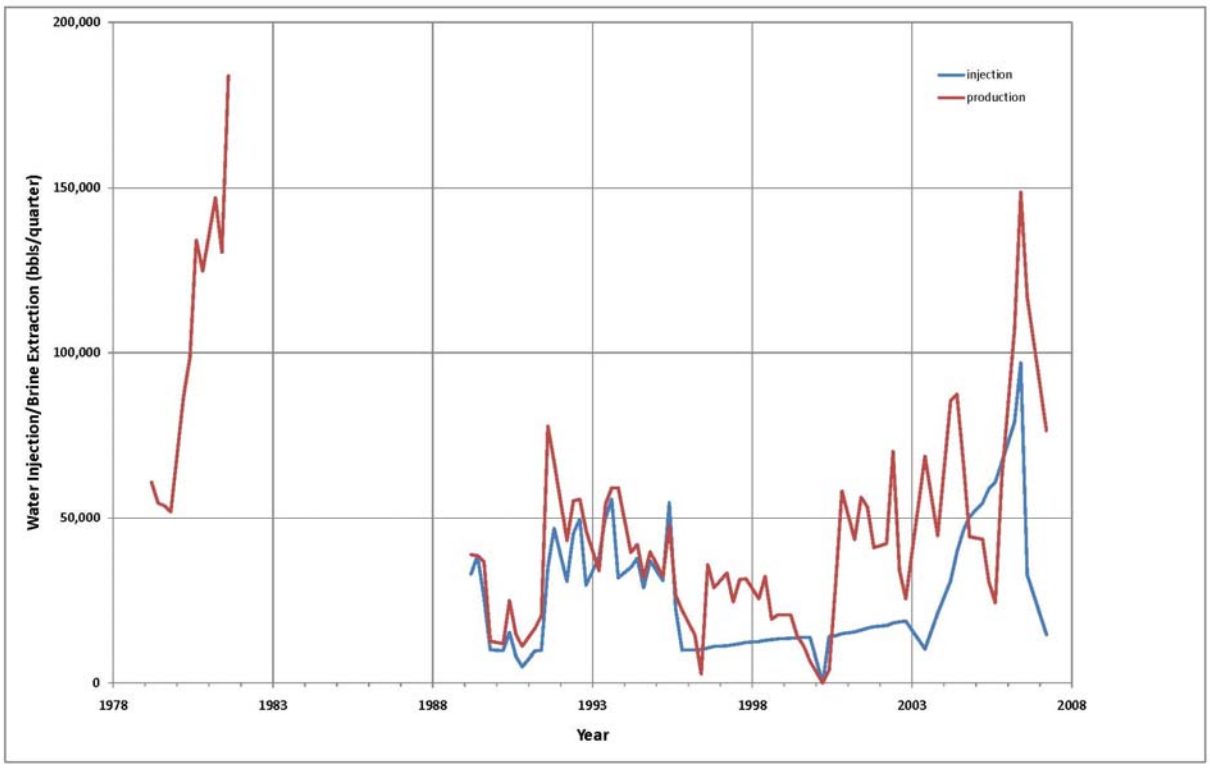


Furthermore, sonar testing was not undertaken on the Eugenie #2 fresh water injection well. It is reasonable to assume the solution cavern in the vicinity of the injection well would have been larger than the void surrounding the extraction well due to the absence of salt in the injected water. Production records are incomplete, but historic brine production by October 1996 may have reached 4.49 million barrels. If the average salt content by volume of the brine were 15% (roughly equivalent to “10 pound brine”), then the total subsurface solution cavern would have been 673,000 barrels, or nearly 22 times larger than the volume measured by the 1996 sonar survey.

During a cavern pressure test undertaken in November of 1999, the injection well showed substantial brine leakage at the surface. A Notice of Violation was immediately issued and Eugenie #2 was plugged in January 2000 per OCD direction. OCD requested I&W install three groundwater monitoring wells in the area to check for groundwater contamination. Depth to water is approximately 40 ft bgs. I&W installed two such wells in March 2000 and the water quality testing showed no indications of dissolved-chloride contamination. I&W reconfigured the operation to single-well brine production using Eugenie #1 after retesting of the cavern integrity in June 2000.

I&W’s renewal application of January 29, 2001 stated their brine production was only 200 bbl/day, though the average daily production reported for the prior quarter is 647 bbl/day. This production subsequently ramps up to 1,650 bbl/day by

the 2nd quarter of 2006 (148,813 barrels total quarterly production). A graph of the quarterly reported freshwater injection and brine production over time is provided below.

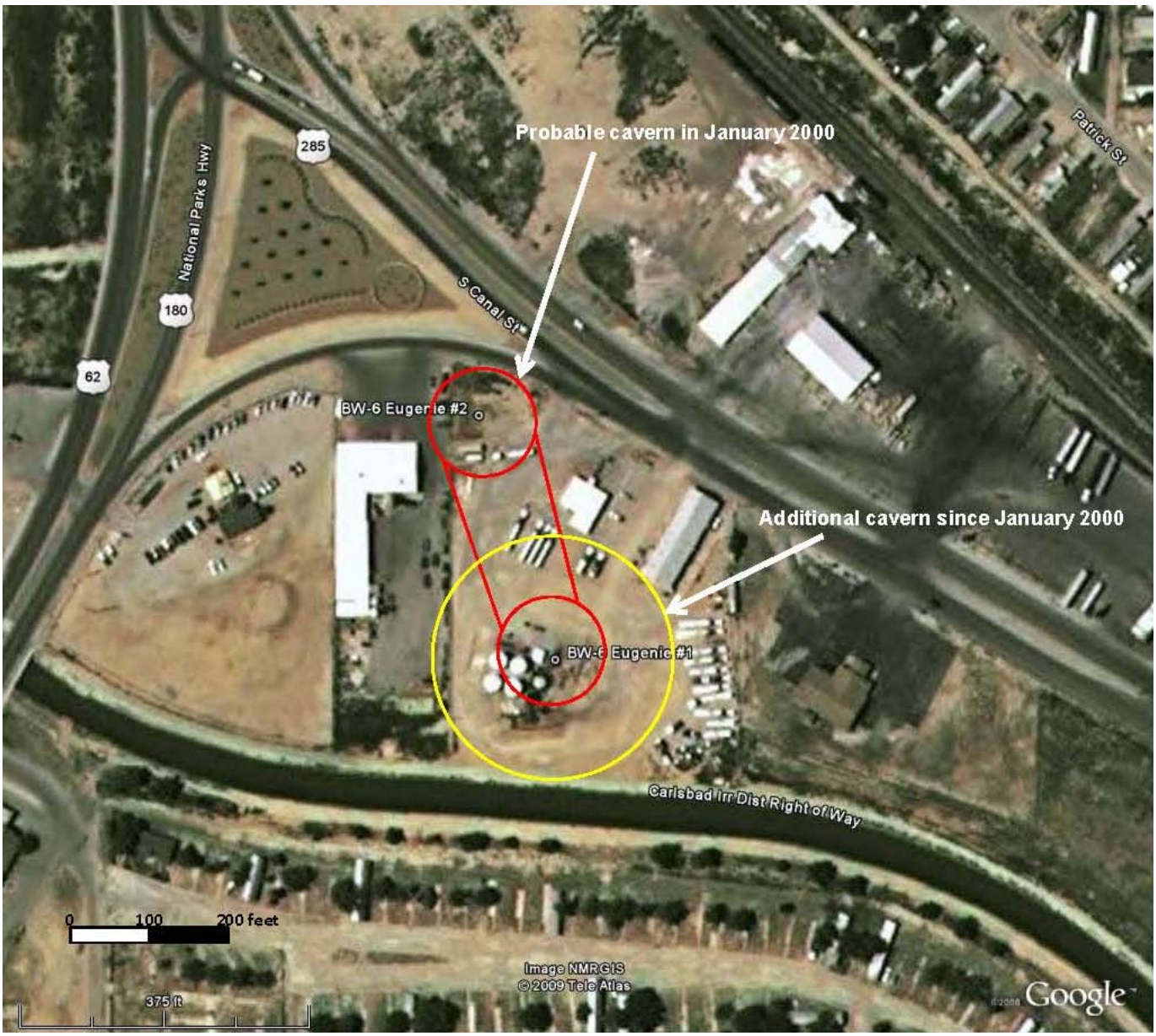


Another sonar log was run on the Eugenie #1 well during late-August 2007. Once more, only the uppermost portions of the cavern were surveyed; from depths of 435 to 474 ft bgs. The maximum observed diameter was 158 ft and the estimated cavern volume was 47,823 bbls.

The measured volume expansion in the upper cavern around Eugenie #1 between October 1996 and August 2007 was 16,924 bbls (47,823 – 30,899) or 54.8%. Growth in the maximum upper cavern diameter near the casing shoe was only 23 feet (158 – 135), or 17%. This would not be unusual as the volume of a circular cavern will increase by the square of its radius; i.e. for a fixed rate of volume increase, the radius (and thus the diameter) will increase at an ever slower rate. The most rapid growth in lateral cavern diameter will occur during the earliest phases of it's development. However, based on the available brine production records, between October 1996 thru the 1st Quarter of 2007, roughly 1.76 million barrels of brine were produced from Eugenie #1, equivalent to 264,519 bbls of additional cavern growth. This would place the total estimated cavern volume at 937,682 bbls (195,000 cubic yards) based on a total historic production of 6,25 million bbls of brine thru March 2007. Again, the actual subsurface brine cavern is likely 20 times larger than what was measured via sonar.

The brine well collapse associated with Jim's Water Service southwest of Loco Hills occurred on July 16, 2008. Brine production operations at Eugenie #1 were voluntarily shut in by I&W six days later on July 22nd. The well was plugged on October 1, 2008 after filling the cavity with brine. A bridge plug was set near the bottom of the production casing and cement circulated back to surface.

The actual geometry of the underground cavern today is largely unknown. This is complicated by the 2-well nature of the operation from 1980 thru 1999. The figure below provides estimates of the extent of underground caverns both at the end of 1999 (red) when multi-well brine production was terminated and the additional mined volume (yellow) when operations ended in July 2008, These would be the areas most affected by a full or even partial cavern collapse.



If sufficient warning could be provided such that any individuals in the area could evacuate, then loss of life would be avoided. However, if the northern bank of the irrigation canal were to be compromised at a time when the canal contained water, then a very serious compounding of the situation might occur. The only point at which the flow of water can be stopped is at Lake Avalon located north of Carlsbad. Approximately 10 miles of open ditch exist between the I&W facility and Avalon Dam. Not only would erosion into any sinkhole be greatly enhanced, but the surface water supply for agricultural use downstream of the facility would be cut off indefinitely.

Based on our experience with the brine well collapses at both Jim's Water Service (BW-5) and Loco Hills Water Disposal (BW-12), over time an ever larger area will be affected by surface cracks and sidewall calving as the sinkhole tries to establish a stable angle of repose. This could be twice the diameter of the initial collapse.

This would adversely impact every aspect of infrastructure in the area including commercial buildings, roadways, the canal, residences at the trailer park, along with above- and underground utilities.

PRELIMINARY RECOMMENDATIONS

• Compel I&W to cease all activity at the facility involving heavy equipment.

• Install a mobile seismometer at one or both wellheads, or initiate daily monitoring of subsidence at the surface by geodetic survey.

• Begin direct discussions with the City of Carlsbad, Eddy County Emergency Management, and the Carlsbad Irrigation District regarding contingencies in case of collapse.

• Retain experienced professional assistance to address possible means of cavity stabilization including an option of backfilling the cavern with inert materials.

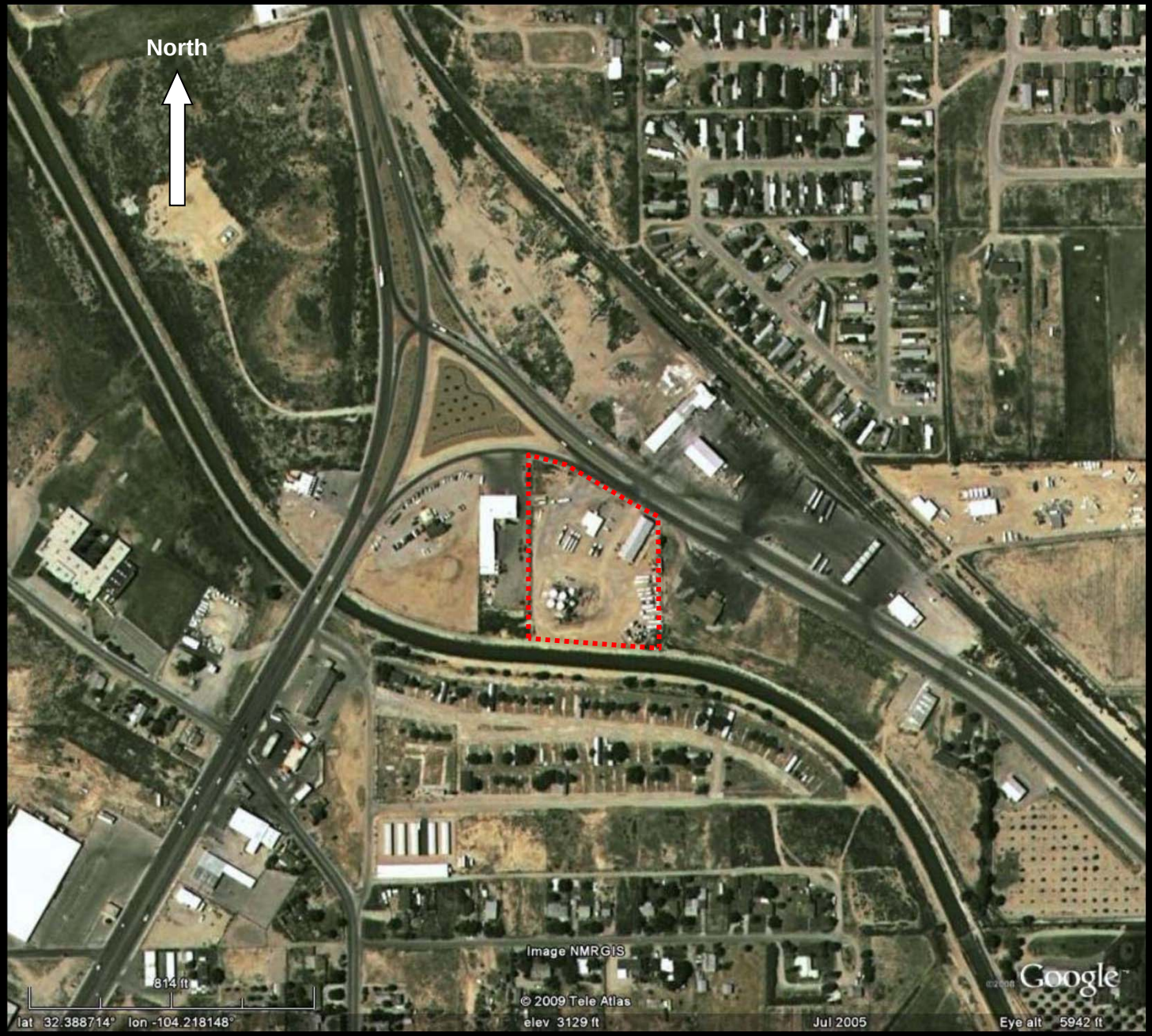
• Establish the lateral extent and depth of the cavern either by re-entry of both Eugenie #1 and #2 to undertake more complete sonar surveys, or by the use of surface seismic techniques.

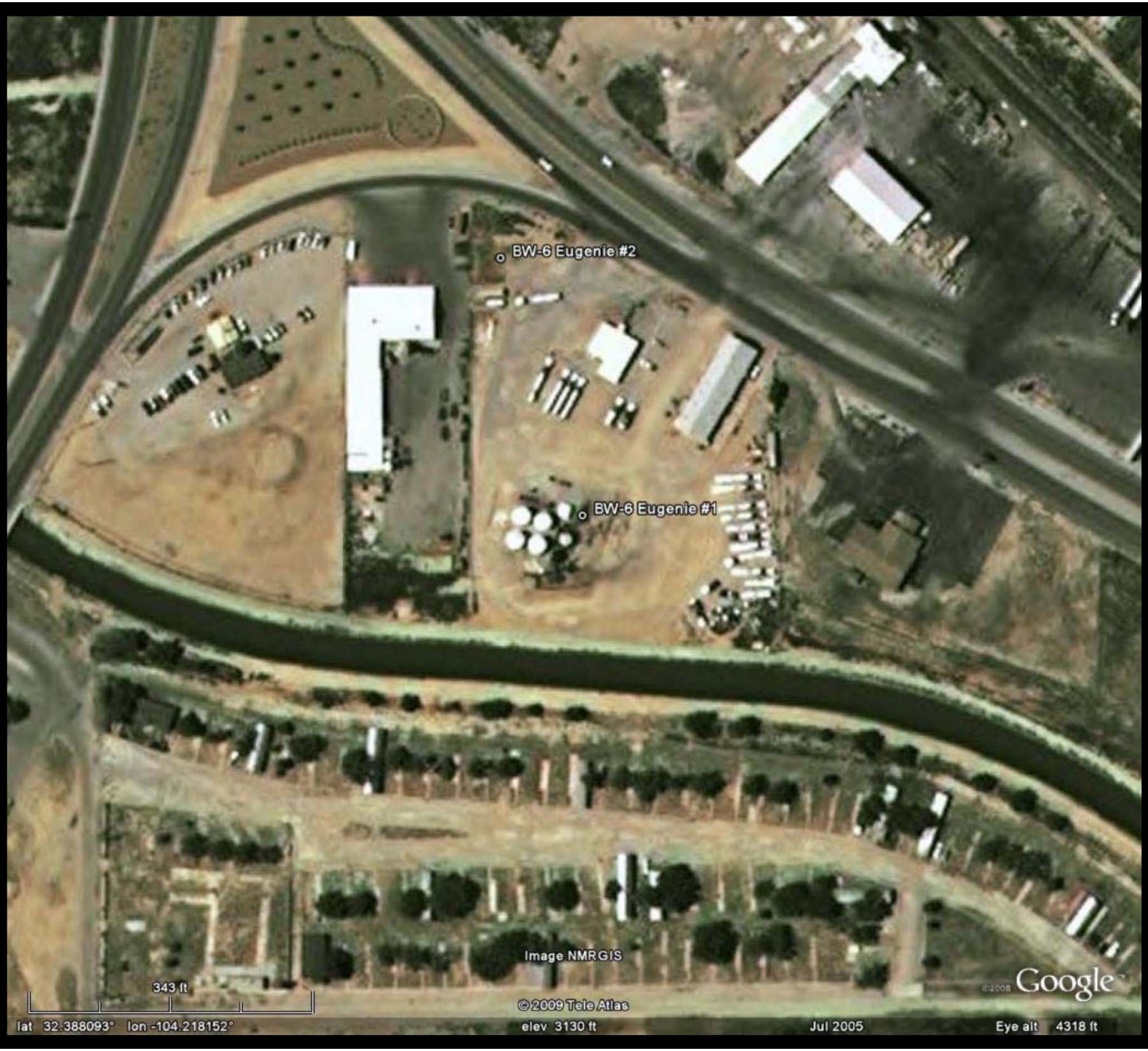
• Begin discussions with I&W, the City of Carlsbad, the Carlsbad Irrigation District, and any other interested parties with respect to cooperative participation (technical, logistical, and financial) in any stabilization effort.

Irrigation canal looking east

Eugenie #1

Eugenie #2

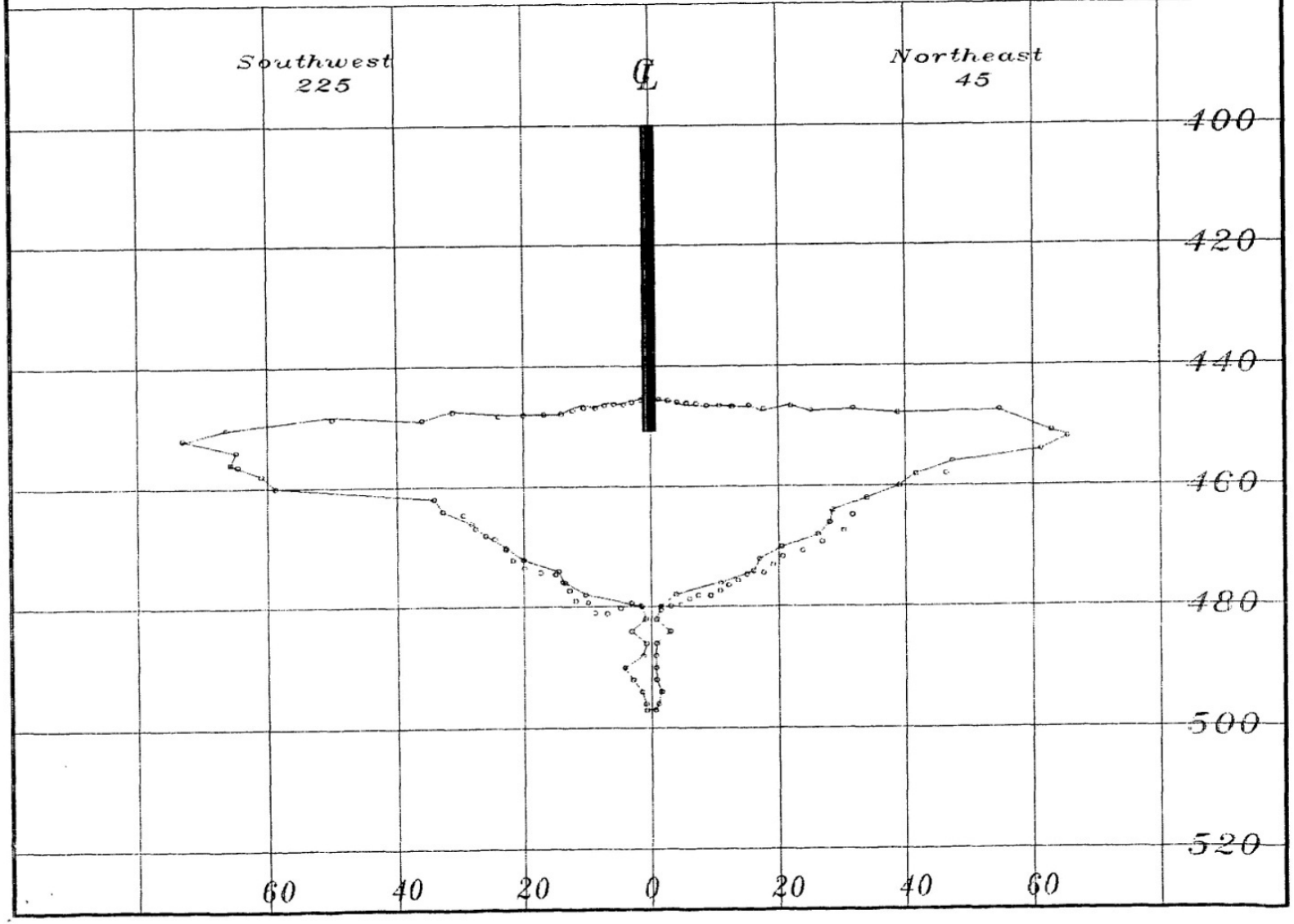

North
814 ft
Image NMRGIS
© 2009 Tele Atlas
lat 32.388714° lon -104.218148°
elev 3129 ft
Jul 2005
Eye alt 5942 ft
Google

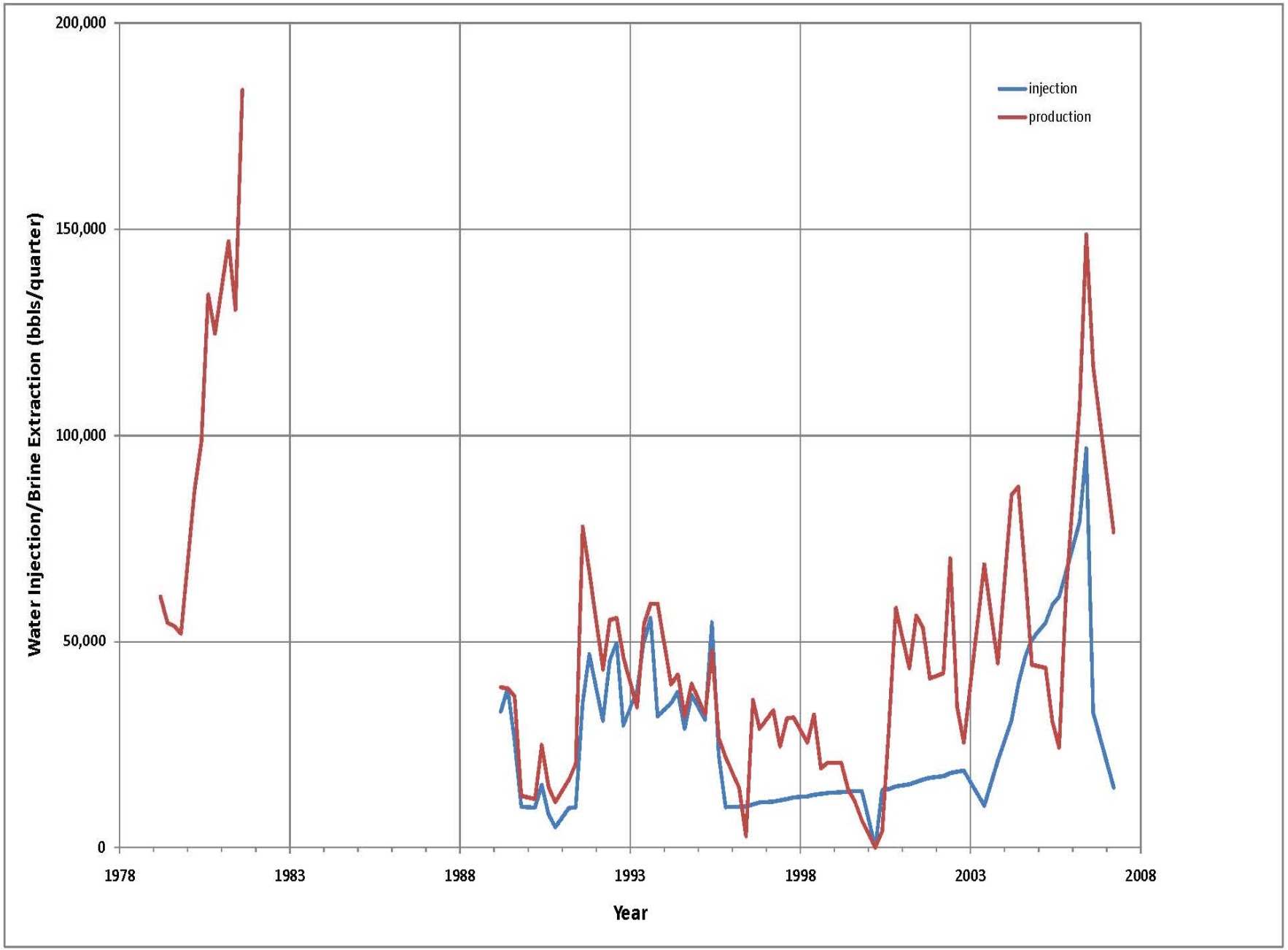

BW-6 Eugenie #2
BW-6 Eugenie #1
Image NMRGIS
343 ft
© 2009 Tele Atlas
Google
lat 32.388093° lon -104.218152°
elev 3130 ft
Jul 2005
Eye alt 4318 ft

I & W, Inc.
Eugenie No.1

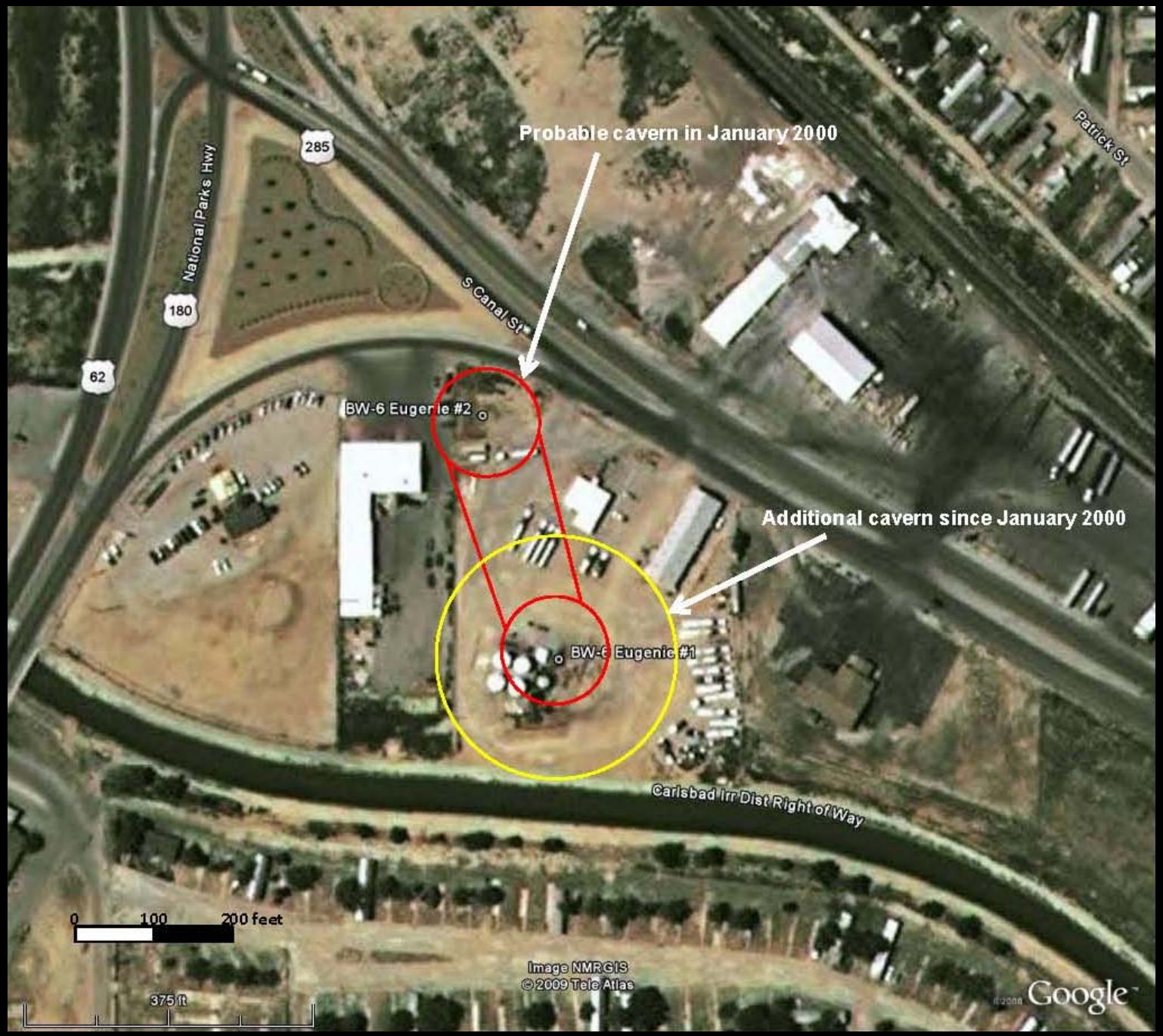
VERTICAL CROSS SECTION

Carlsbad, N.M.
October 19,1996
Job Number - 3092




200,000
150,000
100,000
50,000
0
Water Injection/Brine Extraction (bbls/quarter)
1978
1983
1988
1993
1998
2003
2008
Year
injection
production


Eugenie #1
08/30/2007
<- 180°
0° ->
Depth [ft]
450
500
50
0
50
Radius [ft]
1 inch:20 ft
073055 08/30/2007
CavViewII© SOCON, Germany
(08/30/2007)
5 1/2" : 442.0 ft
Tilting position
SOCON Sonar Well Services, Inc.


Probable cavern in January 2000
Additional cavern since January 2000
BW-6 Eugenie #2
BW-6 Eugenie #1
285
180
62
National Parks Hwy
S Canal St
Patrick St
Carlsbad Irr Dist Right of Way
0 100 200 feet
375 ft
Image NMRGIS
© 2009 Tele Atlas
Google


Areas of probable surface impact
285
National Parks Hwy
180
62
S Canal St
Patrick St
BW-6 Eugenie #2
BW-6 Eugenie #1
Carlsbad Irr Dist Right of Way
0
100
200 feet
375 ft
Image NMRGIS
© 2009 Tele Atlas
Google

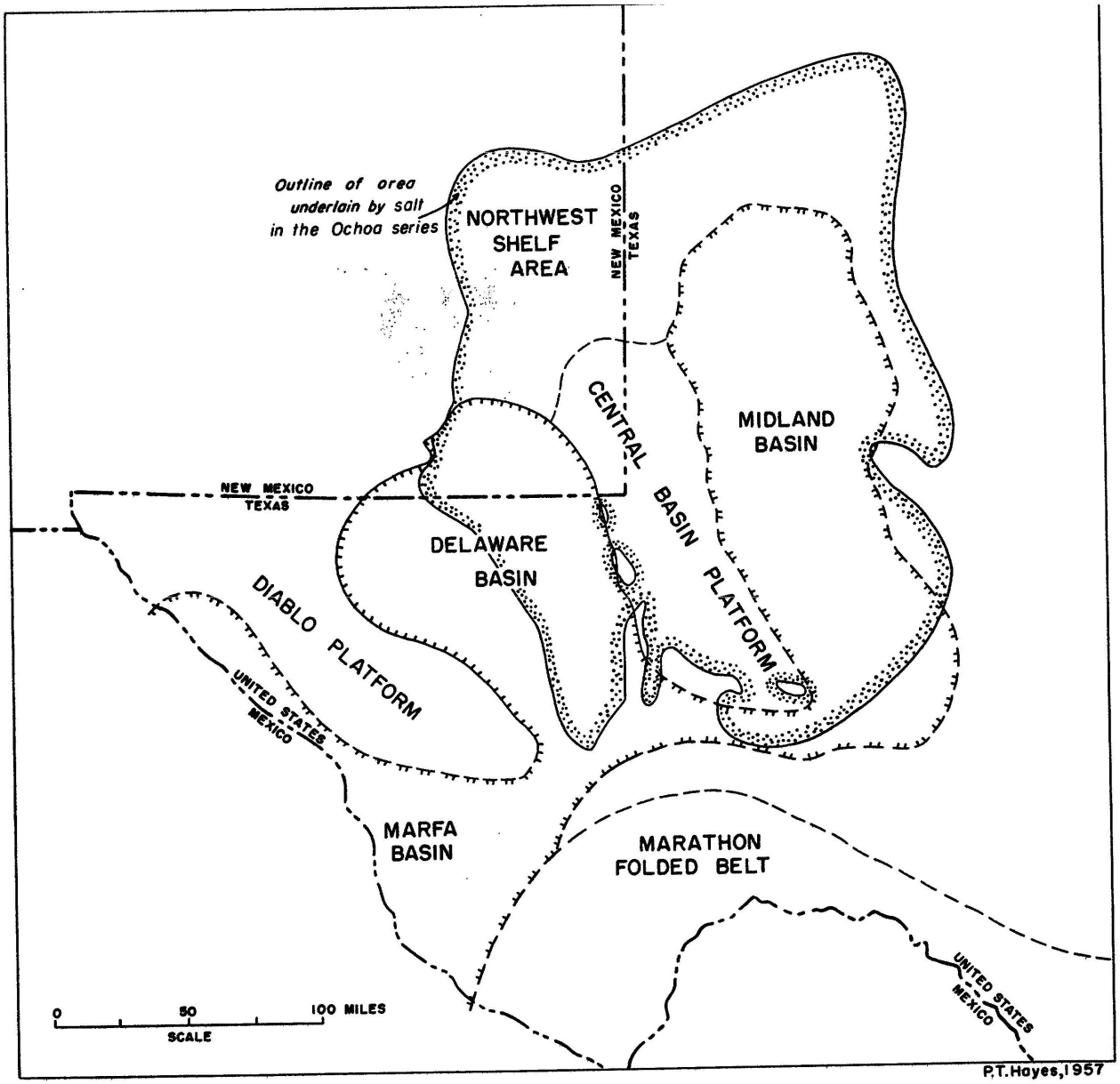


Fig. 1. Index map showing outline of area underlain by salt in the Ochoa series in relation to late Permian basins and shelf areas. (Adapted from King, 1948).

EAST

A'

23
WESTERN OIL PROD.
#1 MACHO STATE
16-8S-23E
CHAVES CO.

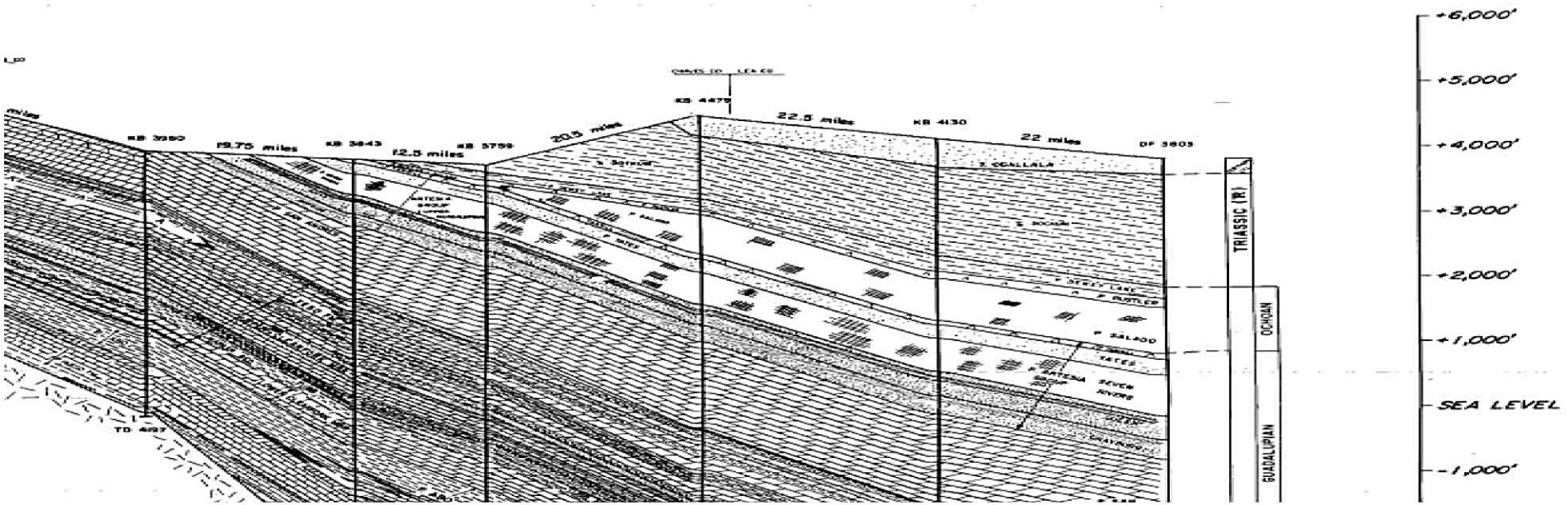
24
HONOLULU OIL
#1 MC CONKEY
10-9S-26E
CHAVES CO.

25
BRITISH AMERICAN
#1 WHITE RANCH
19-10S-28E
CHAVES CO.

26
PHILLIPS
#1 JAMES A
34-11S-31E
CHAVES CO.

27
UNION TEXAS
#1 SHELL STATE
6-13S-35E
LEA CO.

28
MC ALESTER FUEL
#1 PAT MC CLURE C
14-15S-37E
LEA CO.



I & W, Inc.
Eugenie No.1

VERTICAL CROSS SECTION

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October 19,1996
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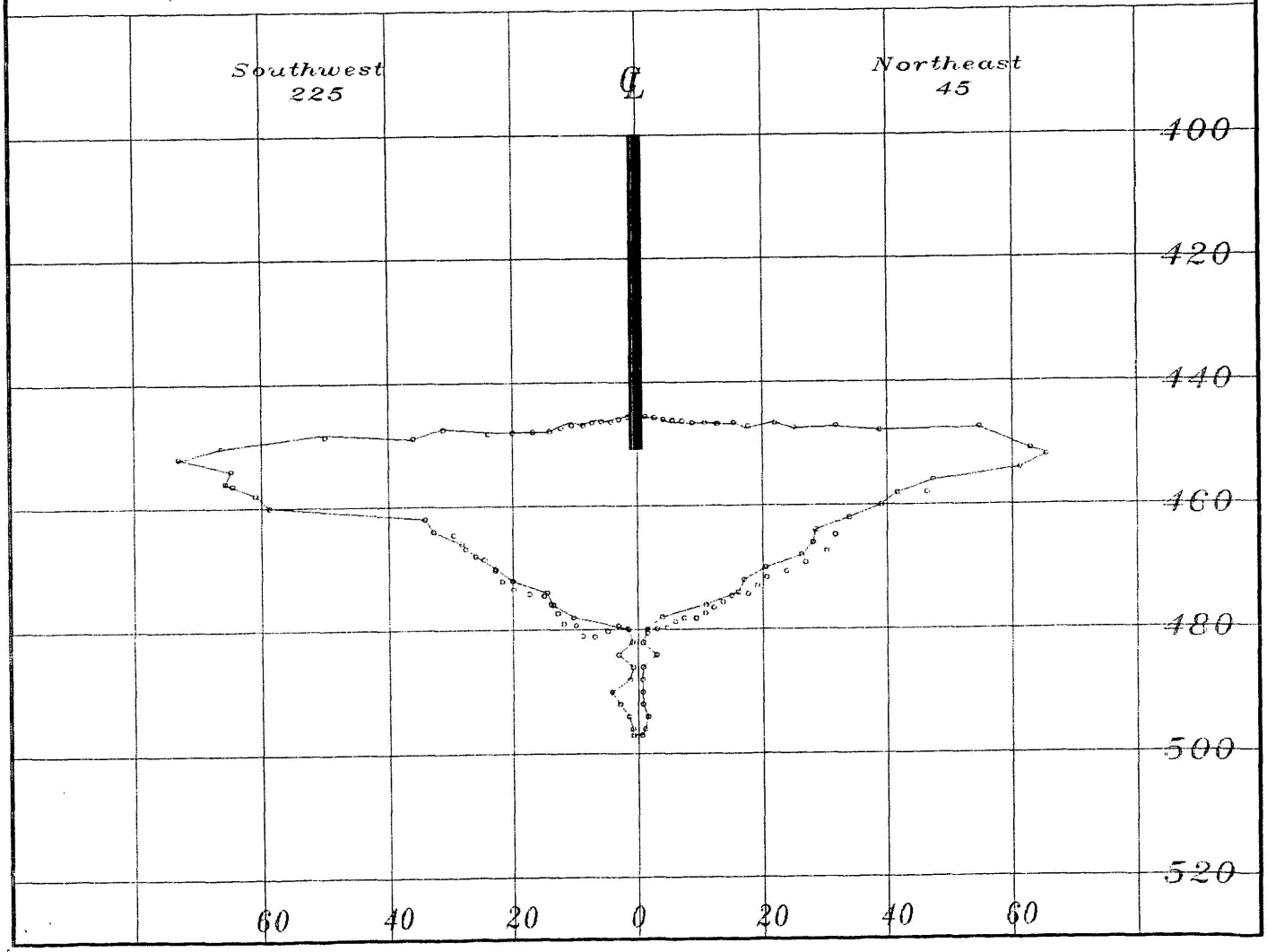
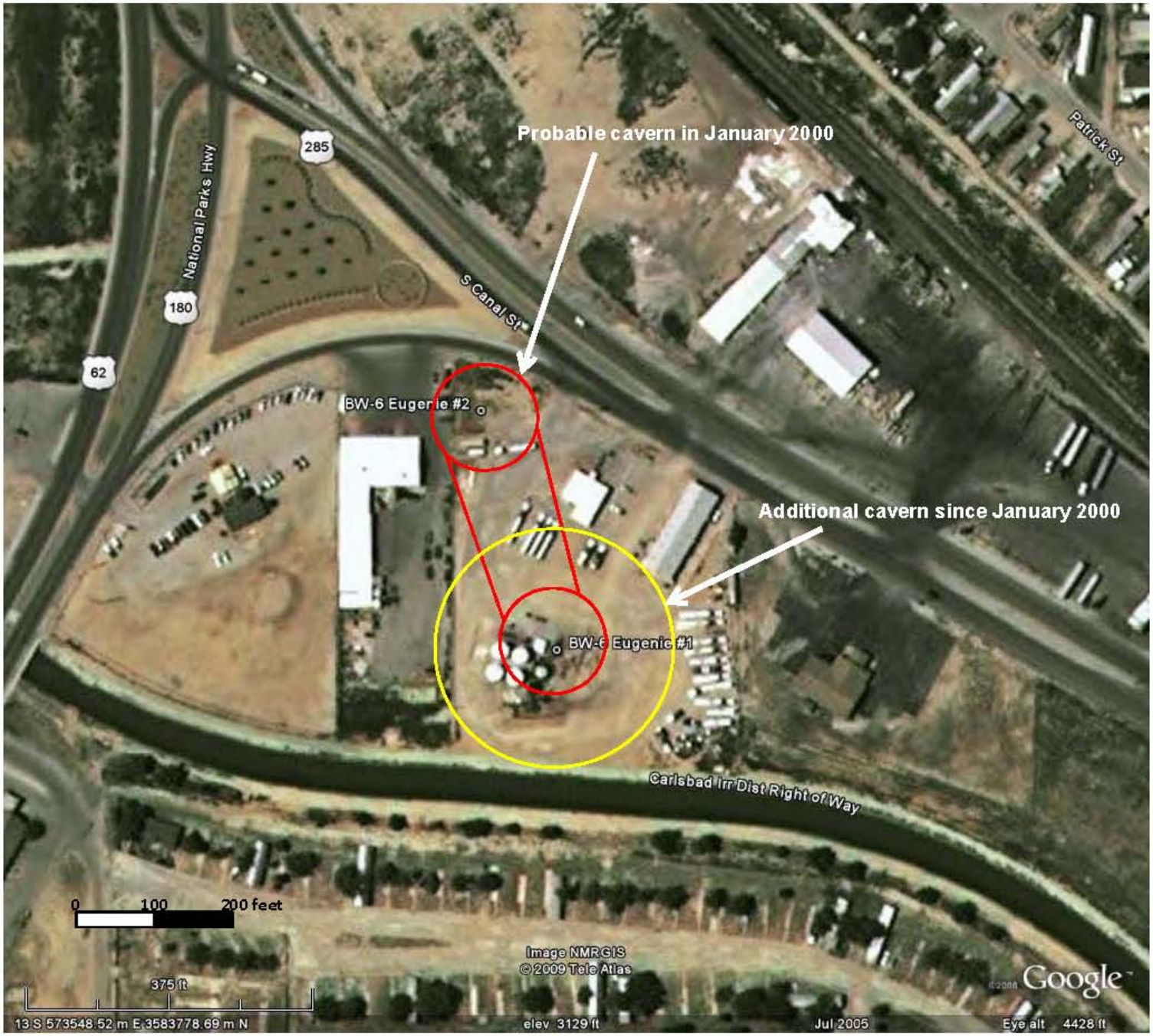
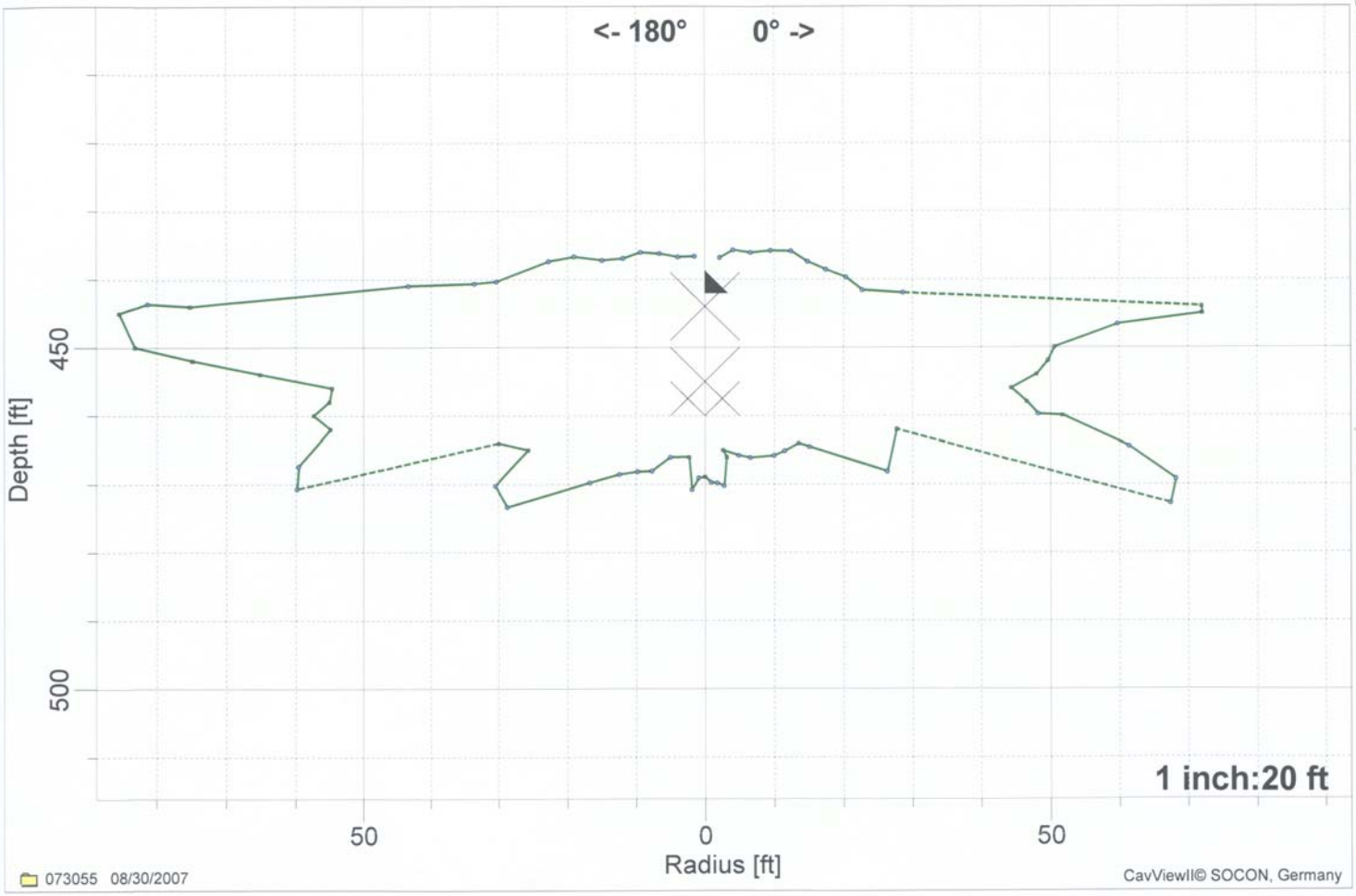



Probable cavern in January 2000
Additional cavern since January 2000
BW-6 Eugenie #2
BW-6 Eugenie #1
285
180
62
National Parks Hwy
S Canal St
Patrick St
Carlsbad Irr Dist Right of Way
0 100 200 feet
375 ft
Image NMRGIS
© 2009 Tele Atlas
Google
13 S 573548.52 m E 3583778.69 m N
elev 3129 ft
Jul 2005
Eye alt 4428 ft

Eugenie #1 **08/30/2007**



SOCON Sonar Well Services, Inc.

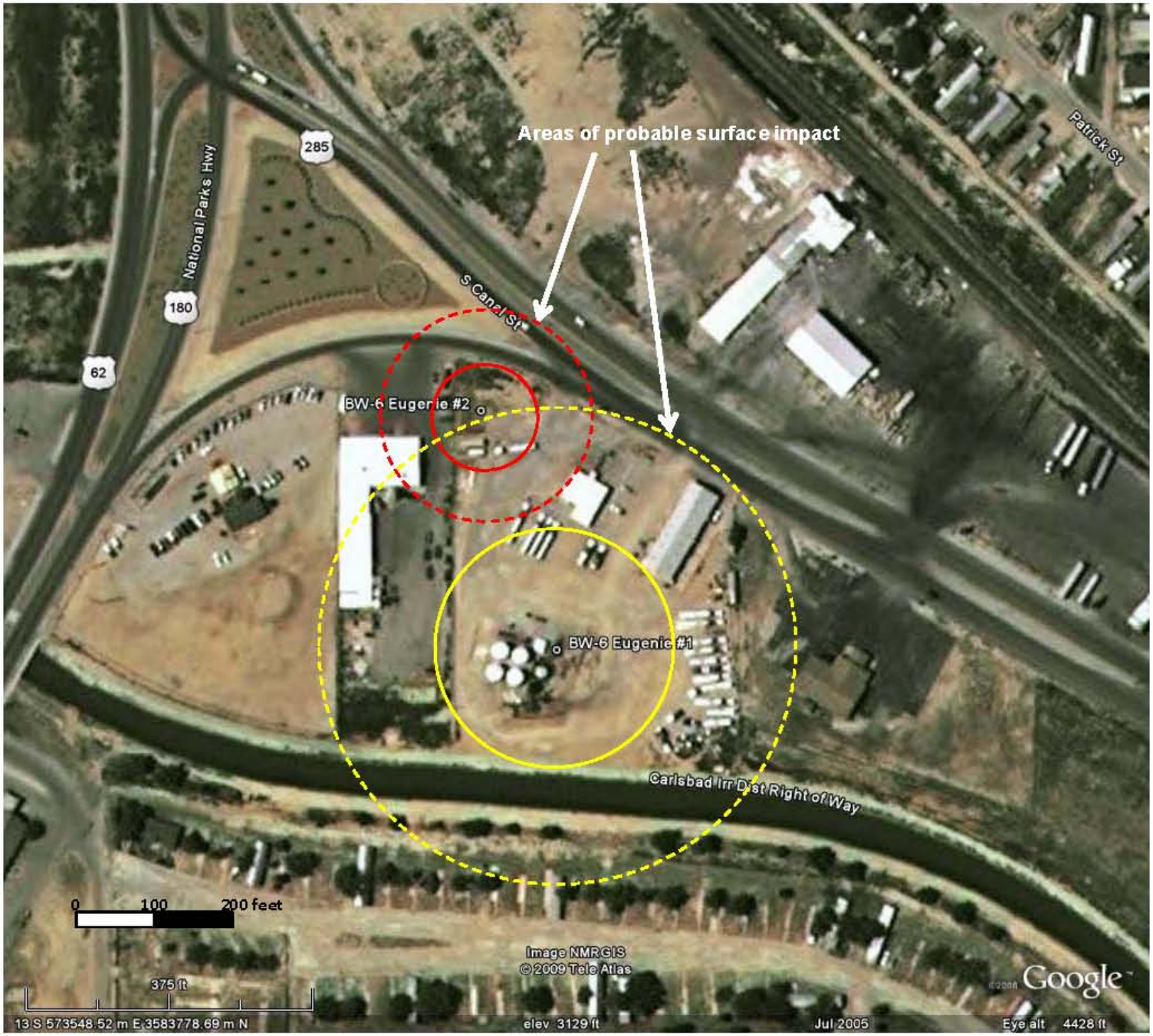

Areas of probable surface impact
285
National Parks Hwy
180
62
S Canal St
Patrick St
BW-6 Eugenie #2
BW-6 Eugenie #1
Carlsbad Irr Dist Right of Way
0 100 200 feet
375 ft
Image NMRGIS
© 2009 Tele Atlas
Google
13 S 573548.52 m E 3583778.69 m N
elev 3129 ft
Jul 2005
Eye alt 4428 ft

EXHIBIT A

WELL AND BENCHMARK LOCATION FOR I/W INC. FOR PURPOSES OF MONITORING GROUND SUBSIDENCE

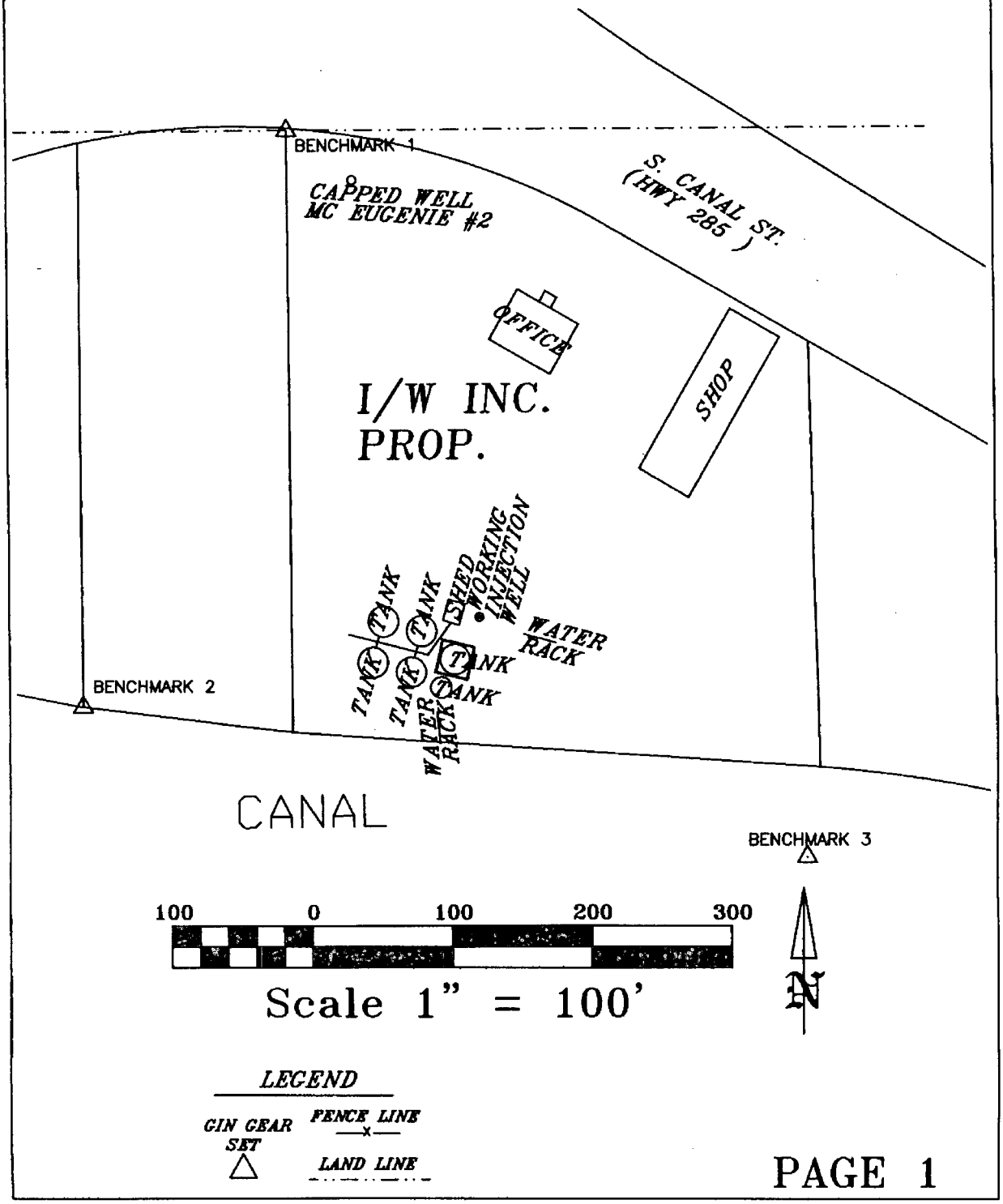



Image NMRGIS
814 ft
© 2009 Tele Atlas
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lat 32.388714° lon -104.218148°
elev 3129 ft
Jul 2005
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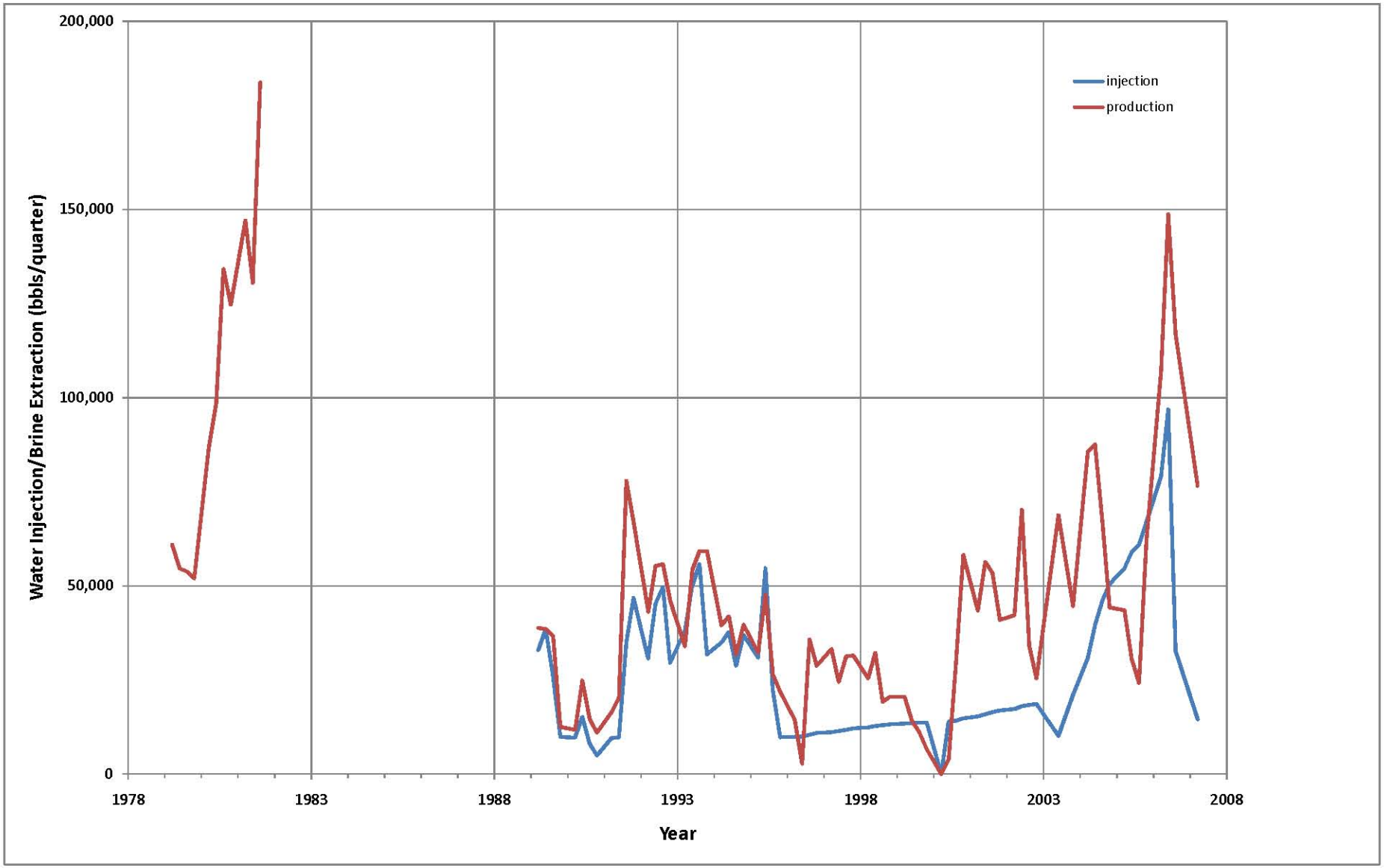
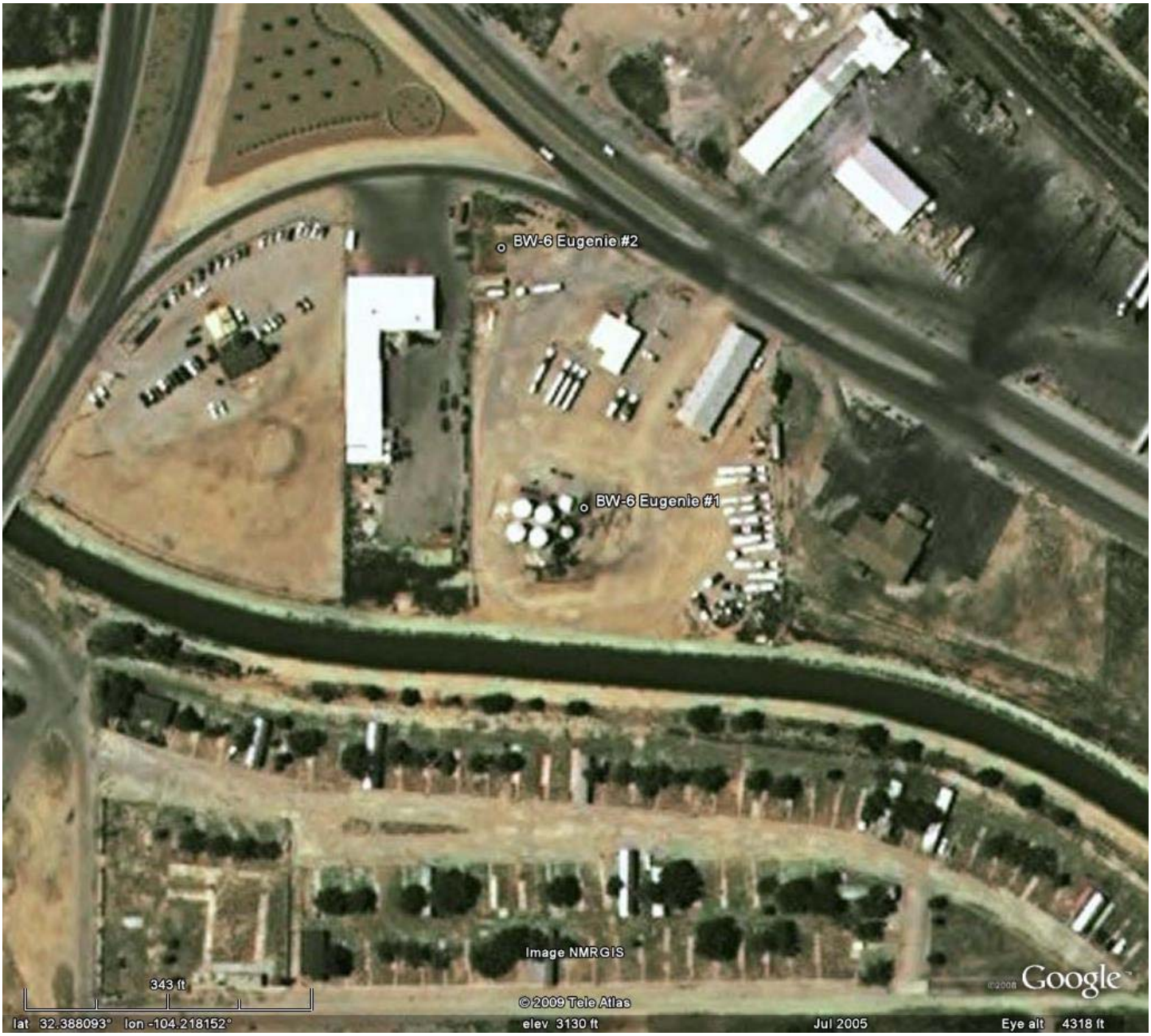

200,000
150,000
100,000
50,000
0
Water Injection/Brine Extraction (bbls/quarter)
1978
1983
1988
1993
1998
2003
2008
Year
injection
production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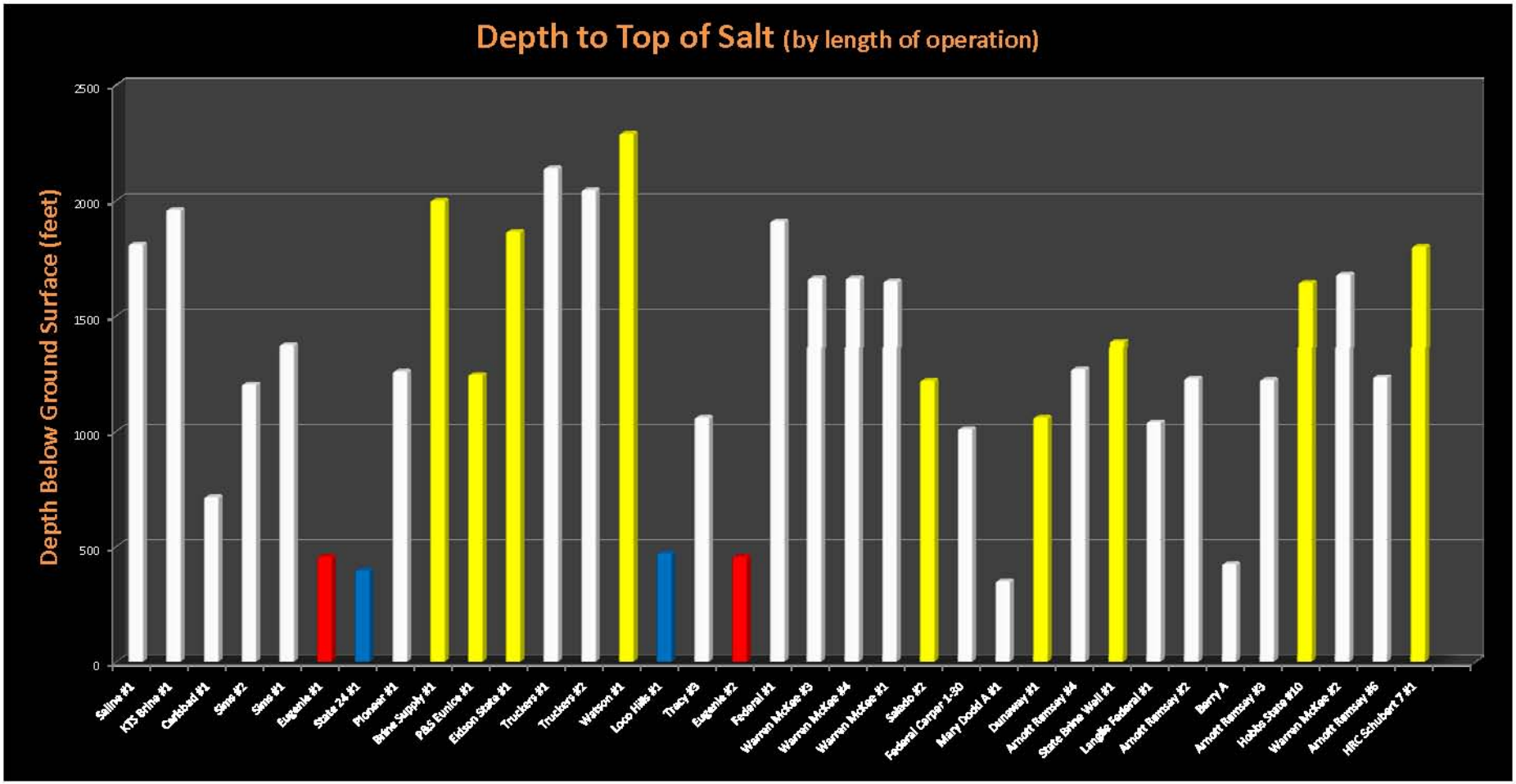
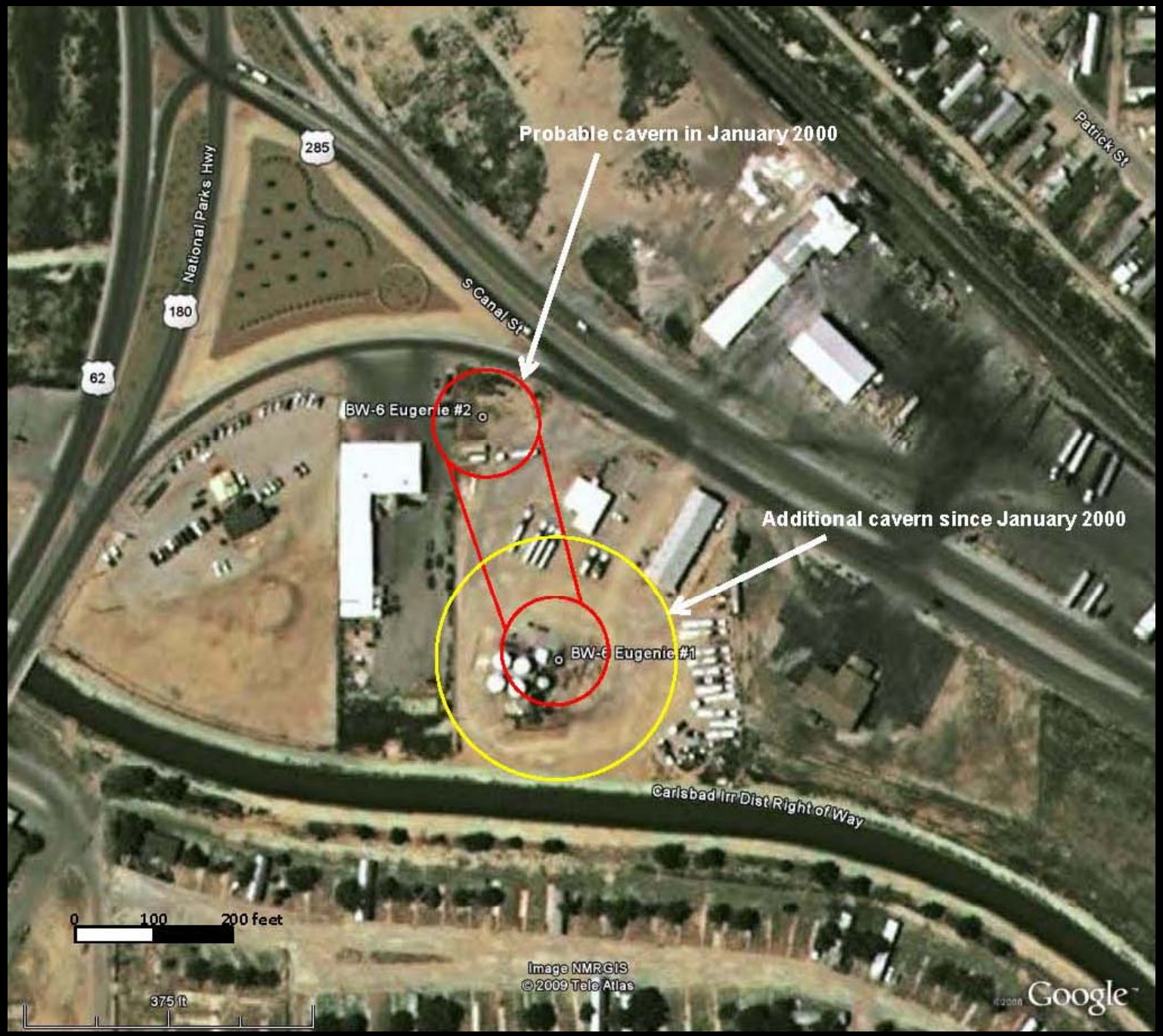

Depth to Top of Salt (by length of operation)
Depth Below Ground Surface (feet)
2500
2000
1500
1000
500
0
Saline #1
KTS Brine #1
Carlsbad #1
Sims #2
Sims #1
Eugenia #1
State 24 #1
Pioneer #1
Brine Supply #1
P&S Eunice #1
Eidson State #1
Truckers #1
Truckers #2
Watson #1
Loco Hills #1
Tracy #3
Eugenia #2
Federal #1
Warren McKee #3
Warren McKee #4
Warren McKee #1
Saladio #2
Federal Corper 1-30
Mary Dodd A #1
Dumaway #1
Arnott Ramsey #4
State Brine Well #1
Lingle Federal #1
Arnott Ramsey #2
Berry A
Arnott Ramsey #3
Hobbs State #10
Warren McKee #2
Arnott Ramsey #6
HRC Schubert 7 #1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BW-6 Eugenie #2
BW-6 Eugenie #1
285
180
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National Parks Hwy
S Canal St
Patrick St
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0 100 200 feet
375 ft
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