

**STATE OF NEW MEXICO  
BEFORE THE WATER QUALITY CONTROL COMMISSION**

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)  
**In the Matter of:** )  
)

**PROPOSED AMENDMENT** )  
**TO 20.6.2 NMAC (Dairy Rules)** )

**No.: WQCC 09-13 (R)**

**New Mexico Environment Department,** )  
**Petitioner.** )  
\_\_\_\_\_ )

**WRITTEN TESTIMONY OF BART FARIS**

My name is Bart Faris, and I am an environmental scientist with the Ground Water Quality Bureau of the New Mexico Environment Department ("NMED" or "Department"). I am presenting this written testimony on behalf of the Department in support of its petition to the New Mexico Water Quality Control Commission ("Commission") to amend the Ground and Surface Water Protection Regulations, 20.6.2 NMAC to include a new Part, 20.6.6 NMAC. In addition to the testimony below, I have also provided testimony addressing various sections as set forth in NMED Attachment 8.

**I. BACKGROUND AND EXPERIENCE**

I have a B.S. in Soil and Water Science from the University of Arizona, 1983. I have more than 25 years experience in water resources, hydrology, environmental resource management and restoration, natural resources and community development. My resume is attached to the Department's Notice of Intent to File Technical Testimony as NMED NOI Exhibit C.

## **II. INTRODUCTION**

The purpose of my testimony is to describe the groundwater contamination that exists at various dairies in New Mexico which are subject to an Abatement Plan (AP). This testimony also demonstrates the complexity of abatement procedures, which lead to high costs and considerable length of time to achieve abatement for the dairy or landowner. NMED has required Abatement Plans for 50 dairies throughout New Mexico (NMED Exhibit BF-1) because ground water monitoring through Discharge Plans (DP) has shown contamination at these dairies. Below, I describe four dairies which are examples of the size and scope of groundwater contamination found at dairies in New Mexico. The contaminants include nitrate as nitrogen (nitrate), total dissolved solids (TDS), sulfate, and chloride. The 50 dairies are at various phase of abatement, but the majority are pursuing plume definition under a Stage 1 AP. A few dairies have completed their Stage 1 AP activities and are in the process of implementing Stage 2 abatement. None of the 50 dairies have completed Stage 2 implementation to date. The following dairy examples show the estimated volume of contaminant plumes. Porosity was determined by the major lithologic unit encountered in the screened interval, a 20 foot depth of contamination was used if not measured in on-site vertical definition monitoring wells, and no sorption or retardation is attributed to any of the contaminants.

### **III. Former Valley Gold North Dairy (Prices Dairy Bernalillo)**

This former dairy is located at 618 NM Highway 528 in Bernalillo and operated from the late 1960's until 1998 when the dairy ceased operations and all cattle and manure were removed. Over the course of its existence, this dairy had 2 unlined (manure) and 1 clay lined lagoon. Discharge Plan DP-47 was approved in 1987 and a corrective action plan was required under the DP in 1997. In 2002 NMED approved removal of the former land application area from the DP.

In 2005, NMED required that once a site characterization report was submitted, the DP would be terminated and further ground water investigation and remediation would proceed under AP regulations. NMED approved the characterization report as completion of Stage 1 AP activities and required the submittal of a Stage 2 AP proposal in 2006. The proposal showed that the preferred abatement option would be the pump and discharge of contaminated ground water to the Town of Bernalillo's wastewater treatment plant. Following the public notice, an entity requested a hearing on the proposal primarily due to the concern that the treatment plant could not effectively treat the discharges, which lead to a suspension in Stage 2 activities and further site characterization. Additional site characterization revealed that there were two separate aquifers underlying the former dairy; the Valley Fill Aquifer and the Upper Santa Fe Aquifer. To date, there are 14 monitoring wells installed to define plume conditions, with 8 wells in the Valley Fill Aquifer and 6 in the Upper Santa Fe Aquifer. Ground water is at a depth of approximately 35 feet in the Valley Fill Aquifer and 85 feet in the Upper Santa Fe Aquifer. Ground water monitoring results from December 2009 show that the maximum concentrations for nitrate, TDS, and chloride were 140 milligrams per liter (mg/L), 3,190 mg/L, and 420 mg/L, respectively found within the Valley Fill Aquifer. Ground water sulfate results in the Upper Santa Fe aquifer ranged from 38.7 to 1,010 mg/L. Maximum nitrate concentrations in the Upper Santa Fe Aquifer were 35 mg/L. NMED Exhibit BF-2 shows nitrate concentrations in the Valley Fill Aquifer. All other wells are in the Upper Santa Fe Aquifer.

Plume volume estimates are provided for nitrate, TDS, and chloride above standards. The estimate of plume volume is based on (area) (depth) (avg. porosity) (7.48 gals./cu. ft.). The following table provides assumptions used and calculated volumes:



	Valley Fill Aquifer		Upper Santa Fe Aquifer	
Porosity	0.30		0.35	
Vertical definition	20		10*	
Nitrate (plume area)	1.07712 x 10 <sup>8</sup> gal (2,000 x 1,200ft)	330.55 ac.ft.	1.33518 x 10 <sup>8</sup> gal (1,700 x 3,000ft)	409.75 ac.ft.
TDS (plume area)	68,666,400 gal (1,800 x 850ft)	210.73 ac. ft.	1.1058 x 10 <sup>8</sup> gal (1,600 x 2,640ft)	339.37 ac.ft.
Chloride (plume area)	3,456,000 gal (1,600 x 360ft)	10.61 ac.ft.	47,124,000 gal (2,500 x 840ft)	144.62 ac.ft.

\*vertical depth assumption based on site lithology – no measured data from a vertical definition monitoring well

Table 1 - Former Valley Gold North Dairy Plume Volume Estimates

Please note that these contaminant plumes are comingled and the largest plume (nitrate) indicates the total estimated volume of contamination. Combining both aquifers shows an estimated total volume of contaminated ground water at 2.4123 x 10<sup>8</sup> gallons or 740.3 ac.ft.

#### IV. Cheyenne 1 and 3 Dairy

The site is located at 170 Cheyenne Road in Dexter, New Mexico. Wastewater has been discharged on-site to clay-lined and synthetically-lined impoundments and land application areas under Discharge Plan DP-677. The DP is under a renewal and modification that consists of combining both Cheyenne Dairy 1 and Cheyenne Dairy 3 under one Discharge Permit, increasing the discharge volume from 58,000 gallons per day to 180,000 gallons per day, increasing the land application area from 96 to 619 acres, and requiring abatement of ground water contamination. Corrective action to address ground water contamination was approved by NMED in 2004. Assessment activities have identified a shallow and deep aquifer. To date, there are 34 monitoring wells installed to define plume conditions, with 15 wells in the shallow aquifer and 19 in the deep aquifer. The dairy supplies bottle water to 3 adjacent domestic wells with contamination above standards. An additional domestic well owner declined bottled water from the dairy since he purchases his own for consumption. Ground water monitoring results from December 2009 show that the maximum concentrations for nitrate, TDS, and chloride were 100 mg/L, 3,440 mg/L, and 470 mg/L, respectively found within the shallow aquifer. Maximum nitrate concentrations in the

deep aquifer were 80 mg/L. Sulfate concentrations ranged from 410 mg/L to 1,500 mg/L. Ground water is at a depth of approximately 70 feet in the shallow aquifer and 107 feet in the deep aquifer. NMED Exhibits BF-3 and BF-4 show nitrate concentrations in the respective aquifers.

Plume volume estimates are provided for nitrate, TDS, and chloride above standards. The estimate of plume volume is based on (area) (depth) (avg. porosity) (7.48 gals./cu. ft.). The following table provides assumptions used and calculated volumes:

	Shallow Aquifer		Deep Aquifer	
Porosity	0.2		0.2	
Vertical definition	10		20*	
Nitrate (plume area)	86,169,600 gal (2,400 x 2,400 ft)	264.44 ac.ft.	$2.3936 \times 10^8$ gal (4,000 x 2,000 ft)	734.57 ac.ft.
TDS (plume area)	$1.00531 \times 10^8$ gal (2,400 x 2,800 ft)	308.52 ac. ft.	$2.011 \times 10^8$ gal (2,800 x 2,400 ft)	617.04 ac.ft.
Chloride (plume area)	86,169,600 gal (2,400 x 2,400 ft)	264.44 ac.ft.	$5.7446 \times 10^7$ gal (1,600 x 1,200 ft)	176.29 ac.ft.

\*vertical depth assumption based on site lithology – no measured data from a vertical definition monitoring well  
Table 2 – Cheyenne 1 and 3 Dairy Plume Volume Estimates

Please note that these contaminant plumes are comingled and the largest plume (TDS in the shallow aquifer and nitrate in the deep aquifer) indicates the total estimated volume of contamination. Combining both aquifers shows an estimated total volume of contaminated ground water at  $3.399 \times 10^8$  gallons or 1,043.09 ac.ft.

#### V. J&M Dairy

This dairy is located four miles north of Artesia within Section 20, Township 16 South, Range 26 East. Wastewater has been discharged to on-site lagoons and land application areas under Discharge Plan DP-765. The DP is under a renewal modification to discharge approximately 90,000 gallons per day to the lagoon and land application area via flood and sprinkler irrigation. Corrective action to address ground water contamination was approved by NMED in 2006.



Assessment activities have identified a shallow and deep aquifer. To date, there are 21 monitoring wells installed to define plume conditions with 8 wells in the shallow aquifer, 7 in the deep aquifer, and 5 showing mixed water levels. Ground water monitoring results from March 2009 show that the maximum concentrations for nitrate, TDS, and chloride were 200 mg/L, 4,700 mg/L, and 430 mg/L, respectively. Ground water is at a depth of approximately 35 feet in the shallow aquifer and 80 feet in the deep aquifer. The data indicate a connection between the two aquifers and mounding. NMED Exhibits BF-5 and BF-6 show nitrate concentrations in the respective aquifers.

Plume volume estimates are provided for nitrate, TDS, and chloride above standards. The estimate of plume volume is based on (area) (depth) (avg. porosity) (7.48 gals./cu. ft.). The following table provides assumptions used and calculated volumes:

	Shallow Aquifer		Deep Aquifer	
Porosity	0.35		0.25	
Vertical definition	10		20*	
Nitrate (plume area)	4.60771 x 10 <sup>8</sup> gal (3,200 x 5,500 ft)	1,414.04 ac.ft.	6.485 x 10 <sup>8</sup> gal (3,400 x 5,100 ft)	1,990.21 ac.ft.
TDS (plume area)	5.5771 x 10 <sup>8</sup> gal (5,600 x 3,800 ft)	1,711.54 ac. ft.	7.9587 x 10 <sup>8</sup> gal (5,600 x 3,800 ft)	2,442.43 ac.ft.
Chloride (plume area)	1.4975 x 10 <sup>8</sup> gal (2,200 x 2,600 ft)	459.56 ac.ft.	8.415 x 10 <sup>7</sup> gal (2,500 x 900 ft)	258.25 ac.ft.

\*vertical depth assumption based on site lithology – no measured data from a vertical definition monitoring well  
 Table 3 – J&M Dairy Plume Volume Estimates

Please note that these contaminant plumes are comingled and the largest plume (TDS) indicates the total estimated volume of contamination. Combining both aquifers shows an estimated total volume of contaminated ground water at 1.3536 x 10<sup>9</sup> gallons or 4,153.97 ac.ft.

## VI. Sun Valley Dairy

The dairy is located at 181 Links Road in Berino, New Mexico and has discharged wastewater on-site to synthetically, clay, and manure-lined impoundments under the history of Discharge Plan DP-170. The DP is under a renewal and modification to discharge up to 35,000

gallons per day of wastewater from the milking parlor flows to a primary synthetically lined lagoon. Wastewater from the primary lagoon is then pumped to two additional synthetically lined lagoons for disposal by total evaporation. The modification consists of increasing the discharge volume from 26,000 to 35,000 gallons per day and replacing the 26-acre land application area used for wastewater disposal with a synthetically lined lagoon system designed for total evaporative disposal of wastewater. Corrective action to address ground water contamination was approved by NMED in 2005. To date, there are 21 monitoring wells installed to define plume conditions. Potentiometric data clearly shows a ground water mound as seen in NMED Exhibit BF-7. Ground water monitoring results from July 2009 show that the maximum concentrations for nitrate, TDS, and chloride were 138.6 mg/L, 2,685 mg/L, and 1,140 mg/L, respectively. A background well (MW-14) does have TDS and chloride concentrations above standards at 1,515 mg/L and 500 mg/L, respectively. Ground water is at depths ranging from 37 to 66 feet. NMED Exhibit BF-8 shows nitrate concentrations in the shallow aquifer.

Plume volume estimates are provided for nitrate, TDS, and chloride above standards. The estimate of plume volume is based on (area) (depth) (avg. porosity) (7.48 gals./cu. ft.). The following table provides assumptions used and calculated volumes:

Shallow Aquifer		
Porosity	0.30	
Vertical definition	20*	
Nitrate (plume area)	6.3533 x 10 <sup>8</sup> gal (4,530 x 3,125 ft)	1,949.76 ac.ft.
TDS** (plume area)	7.7044 x 10 <sup>8</sup> gal (5,780 x 2,970 ft)	2,364.38 ac. ft.
Chloride** (plume area)	4.7124 x 10 <sup>8</sup> gal (4,200 x 2,500 ft)	1,446.18 ac.ft.

\*vertical depth assumption based on site lithology – no measured data from a vertical definition monitoring well

\*\* plume volume estimates are based on the background above standards concentrations

Table 4 – Sun Valley Dairy Plume Volume Estimates

Please note that these contaminant plumes are comingled and the largest plume (TDS)

indicates the total estimated volume of contamination.

The estimates of contaminant areas from 2 of the 4 dairy examples clearly show that groundwater contaminant plumes can and do extend beyond a mile in length. For comparison purposes, the Office of the State Engineer's Rules and Regulations Governing the Use of Public Underground Water for Household or Other Domestic Use 19.27.5.9.D NMAC allows 1.0 acre-feet of water use per year. The estimated volume of contaminated water from these 4 dairy examples would provide sufficient water to serve about 8,300 households for a whole year.

Not only have dairy facilities contaminated large volumes of ground water, as can be seen from these examples, the characterization of contamination can require numerous monitoring wells, and the abatement process can be time consuming, complex and costly.



List of Dairies where Abatement Plans have been required

Dairy	DP Number	Location	Abatement Plan	Abatement Plan Date	Max. NO3 Conc. (mg/L)	Average Depth to Ground Water (ft)	Notes
McCatharn	DP-585	Albuquerque	Stage 1	7/28/2006	230	90	
Prices North	DP-437	Bernalillo	Stage 2	4/3/2006	140	35 and 85	
Par 5 & Select Milk	DP-1131	Chaves County	Stage 1	9/25/2008	22	50	
3V	DP-791	Chaves County	Stage 1	9/25/2008	40	10	Joint AP with Yorktown
Yorktown	DP-162	Chaves County	Stage 1	9/25/2008	62	10	Joint AP with 3V
Aroyo	DP-764	Chaves County	Stage 1	9/24/2008	134	22	Joint AP with Southern Skies
Southern Skies	DP-164	Chaves County	Stage 1	9/24/2008	110	20	Joint AP with Arroyo
125 LLC (Baca Linda)	DP-487	Chaves County	Stage 1	9/23/2008	140	48 and 110	Joint AP with Double Aught
Double Aught	DP-480	Chaves County	Stage 1	9/23/2008	20	75 and 90	Joint AP with 125 LLC
Tom Visser	DP-343	Chaves County	Stage 1	9/23/2008	124	12	
Dexter	DP-606	Chaves County	Stage 1	9/24/2008	74	100	
Winchester	DP-1141	Chaves County	Stage 1	9/23/2008	90	25 and 65	Joint AP with Top Line
(Enchantment)	DP-683	Chaves County	Stage 1	9/23/2008	260	40	Joint AP with Winchester
Top Line Dairies	DP-765	Eddy County	Stage 1	7/1/2005	200	35 and 80	
J&M	DP-228	Chaves County	Stage 1	9/23/2008	99	52	Joint AP with Queso Grande
New Horizon	DP-227	Chaves County	Stage 1	9/23/2008	115	35	Joint AP with New Horizon
Queso Grande	DP-163	Chaves County	Stage 1	9/23/2008	98	25	
Pittle Farms	DP-762	Lea County	Stage 1	3/9/2009	29	85	
High Lonesome	DP-259	Lea County	Stage 1	3/9/2009	58	100	
Rockview	DP-340	Las Cruces	Stage 1	4/7/2006	104	45	
Bright Star*	DP-86	Las Cruces	Stage 1	4/7/2006	29	45	
Buena Vista 1*	DP-42	Las Cruces	Stage 1	4/7/2006	190	100	
Dominguez 2 (formerly D&J)*	DP-126	Las Cruces	Stage 1	4/7/2006	43	40	
Day Break*	DP-692	Las Cruces	Stage 1	4/7/2006	190	45 and 85	
Del Oro*	DP-624	Las Cruces	Stage 1	4/7/2006	169	10 to 60	
Dominguez*	DP-177	Las Cruces	Stage 1	4/7/2006	65	10 to 50	
Gonzalez*	DP-170	Las Cruces	Stage 1	4/7/2006	68	32 to 58	
Mountain View*	DP-1208	Santa Teresa	Stage 2	9/24/2009	138	37 to 66	
Sun Valley	DP-1025	Lea County	Stage 1	4/7/2006	22	10 to 38	
Tallmon	DP-898	Lea County	Stage 1	6/5/2009	89	60	
Doldersum (formerly Landmark)	DP-1199	Roosevelt	Stage 1	7/10/2009	20	60	
Bonestroo	DP-1287	Curry	Stage 1	7/29/2009	40	410	
Palla**	DP-1181	Roosevelt	Stage 1	8/18/2009	31	65	
La Jolla	DP-1181	Bernalillo County	Stage 1	8/3/2009	53	30	
Rasband	DP-718	Chaves County	Stage 1	6/10/2009	99	25	
DeGroot	DP-893	Valencia	Stage 1	5/20/2009	110	36	
Los Lunas	DP-190	Socorro	Stage 1	9/25/2009	70	66	
Correctional Facility, Former Honor Farm							
Oihart							

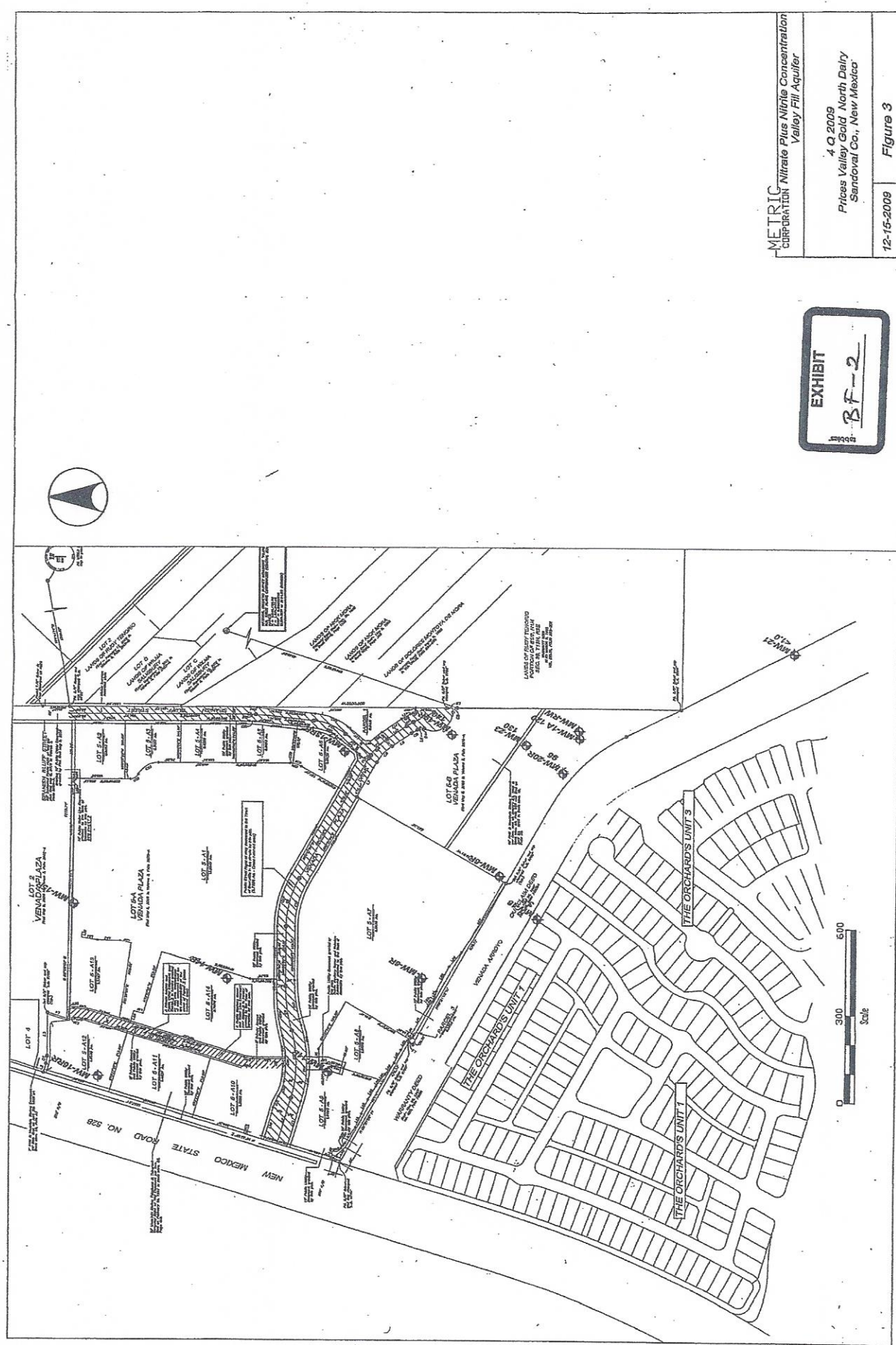


Elmira	DP-1195	Bernalillo	Stage 1	9/4/2009	38	110
Big Sky*	DP-833	Las Cruces	Stage 1	4/7/2006	113	39
Buena Vista 2*	DP-74	Las Cruces	Stage 1	4/7/2006	72	30
Desertland (no longer exists)*	DP-260	Las Cruces	Stage 1	4/7/2006	<10	12
River Valley*	DP-167	Las Cruces	Stage 1	4/7/2006	33	25
Sunset**	DP-257	Las Cruces	Stage 1	4/7/2006	181	15
Cheyenne 1&3	DP-677	Chaves County	Stage 2	pending	100	70 and 97
Wild West	DP-904	Chaves County	Stage 1	9/24/2008	62	90
Creekside	DP-913	Chaves County	Stage 1	9/30/2009	67	29
Nature's	DP-207	Chaves County	Stage 1	5/21/2009	21	20
Rockhill	DP-952	Chaves County	Stage 1	8/3/2009	30	110
El Visto	DP-738	Chaves County	Stage 1	9/30/2009	31	34
Woodcrest	DP-635	Chaves County	Stage 1	8/28/2009	50	10
Flecha	DP-921	Chaves County	Stage 1	pending	36	30

site ground water has high TDS at 2,116 mg/L

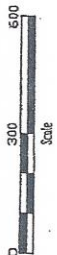
\*Doña Ana County Dairies that joined a Consortium to submit one Abatement Plan

\*\* Palla dairy will conduct corrective actions under the current Discharge Plan

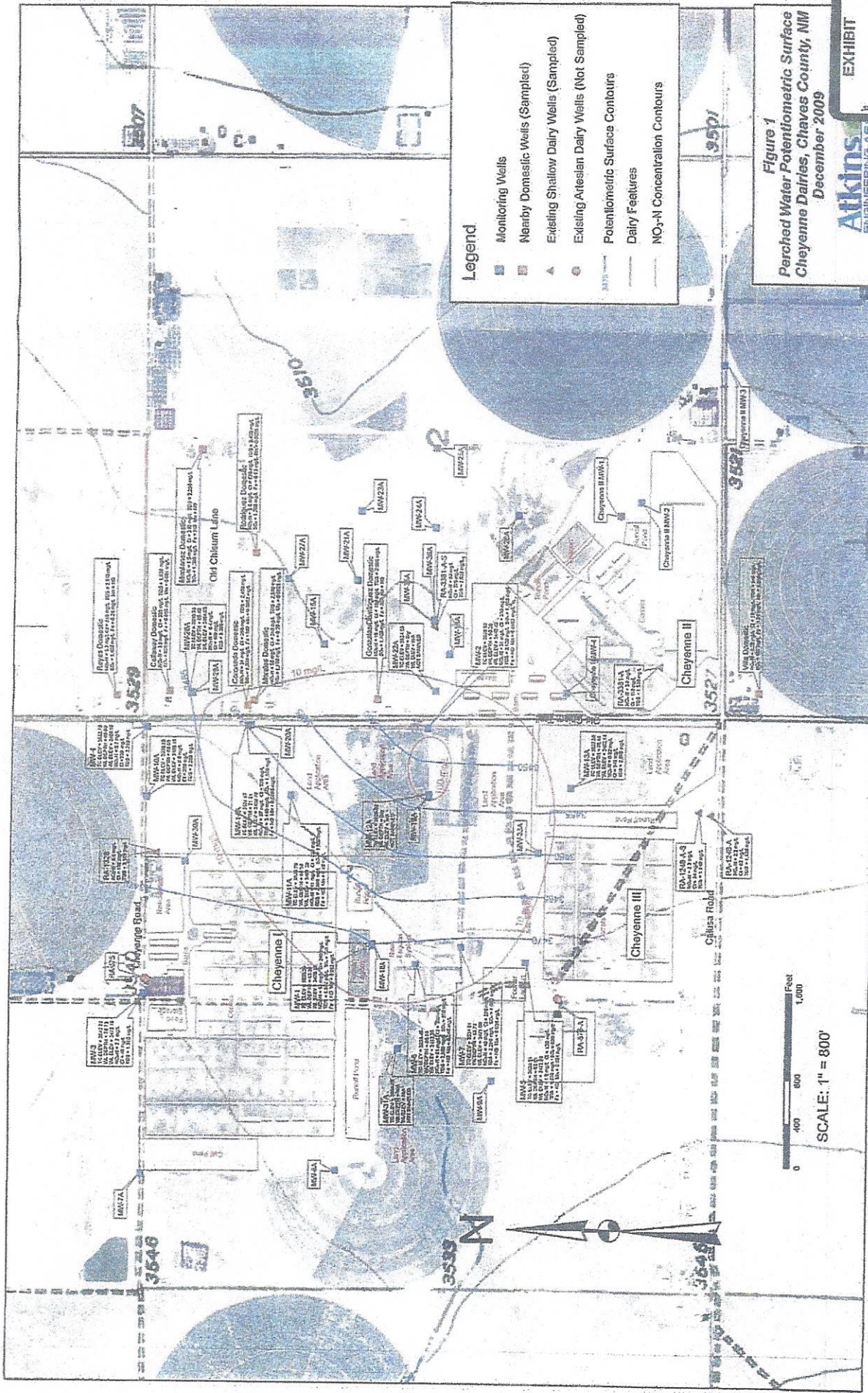


METRIC CORPORATION Nitrate Plus Nitrite Concentration Valley Fill Aquifer  
 4 Q 2009  
 Prices Valley Gold, North Daily Sandoval Co., New Mexico  
 12-15-2008  
 Figure 3

EXHIBIT  
 BF-2







**Legend**

- Monitoring Wells
- Nearby Domestic Wells (Sampled)
- Existing Shallow Dairy Wells (Sampled)
- Existing Artesian Dairy Wells (Not Sampled)
- Potentiometric Surface Contours
- Dairy Features
- NO<sub>3</sub>-N Concentration Contours

**Figure 1**  
**Perched Water Potentiometric Surface**  
**Cheyenne Dairies, Cheyenne County, NM**  
**December 2009**

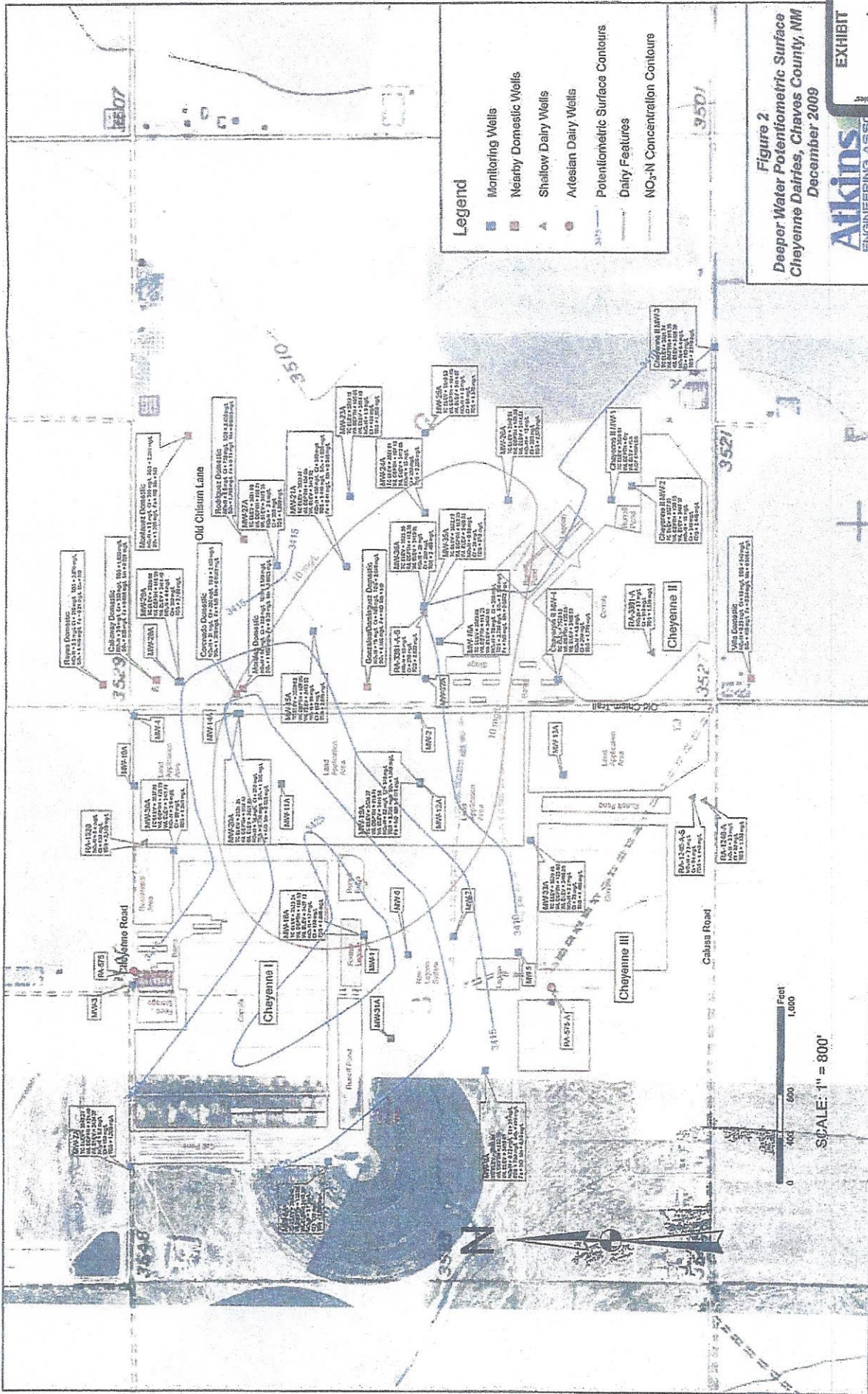
**ATKINS**  
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**EXHIBIT**  
**BF-3**

0 400 800 1,600 Feet  
 SCALE: 1" = 800'







**Legend**

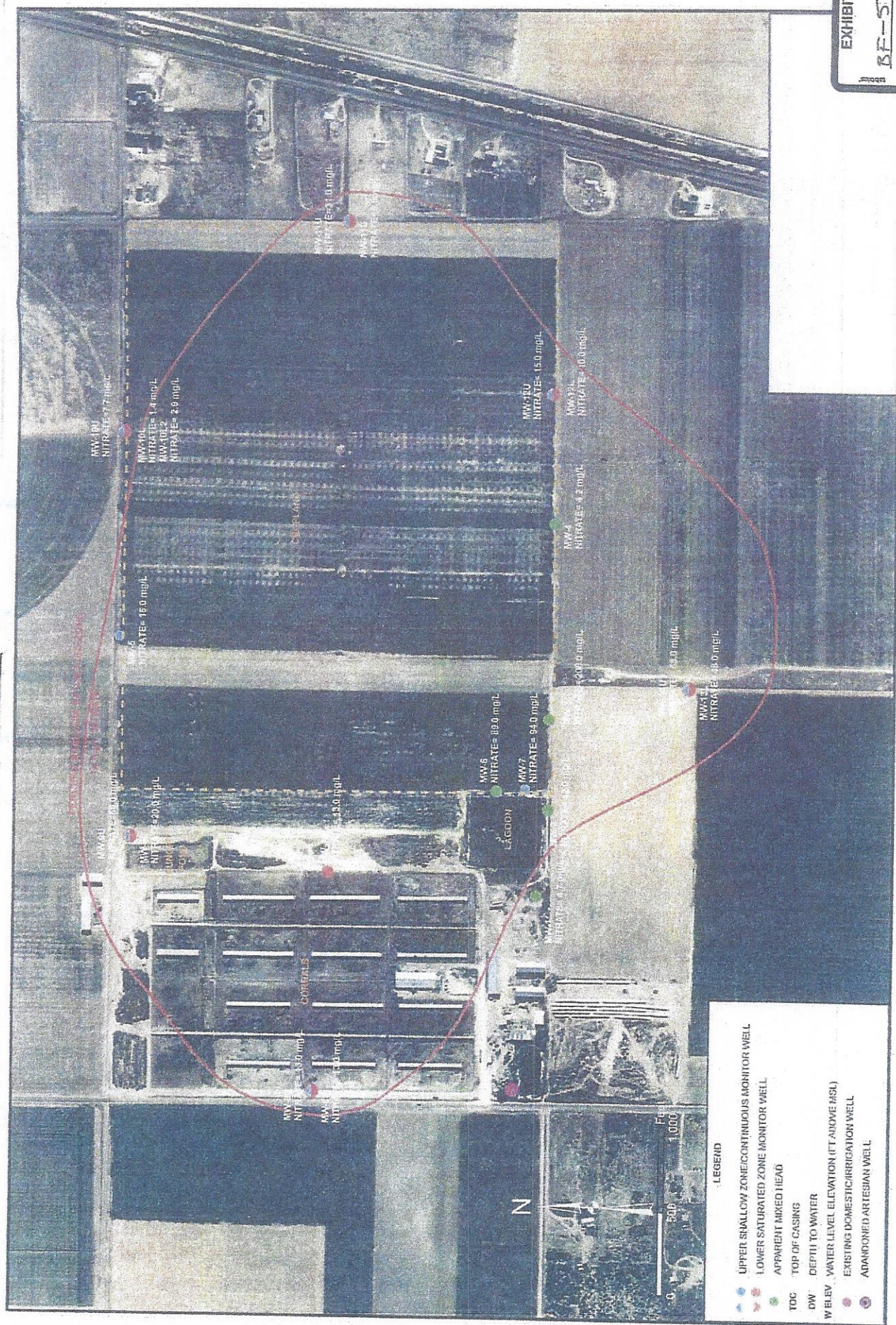
- Monitoring Wells
- Nearby Domestic Wells
- Shallow Dairy Wells
- Artesian Dairy Wells
- Potentiometric Surface Contours
- Dairy Features
- NO<sub>3</sub>-N Concentration Contours

**Figure 2**  
 Deeper Water Potentiometric Surface  
 Cheyenne Dairies, Cheaves County, NM  
 December 2009

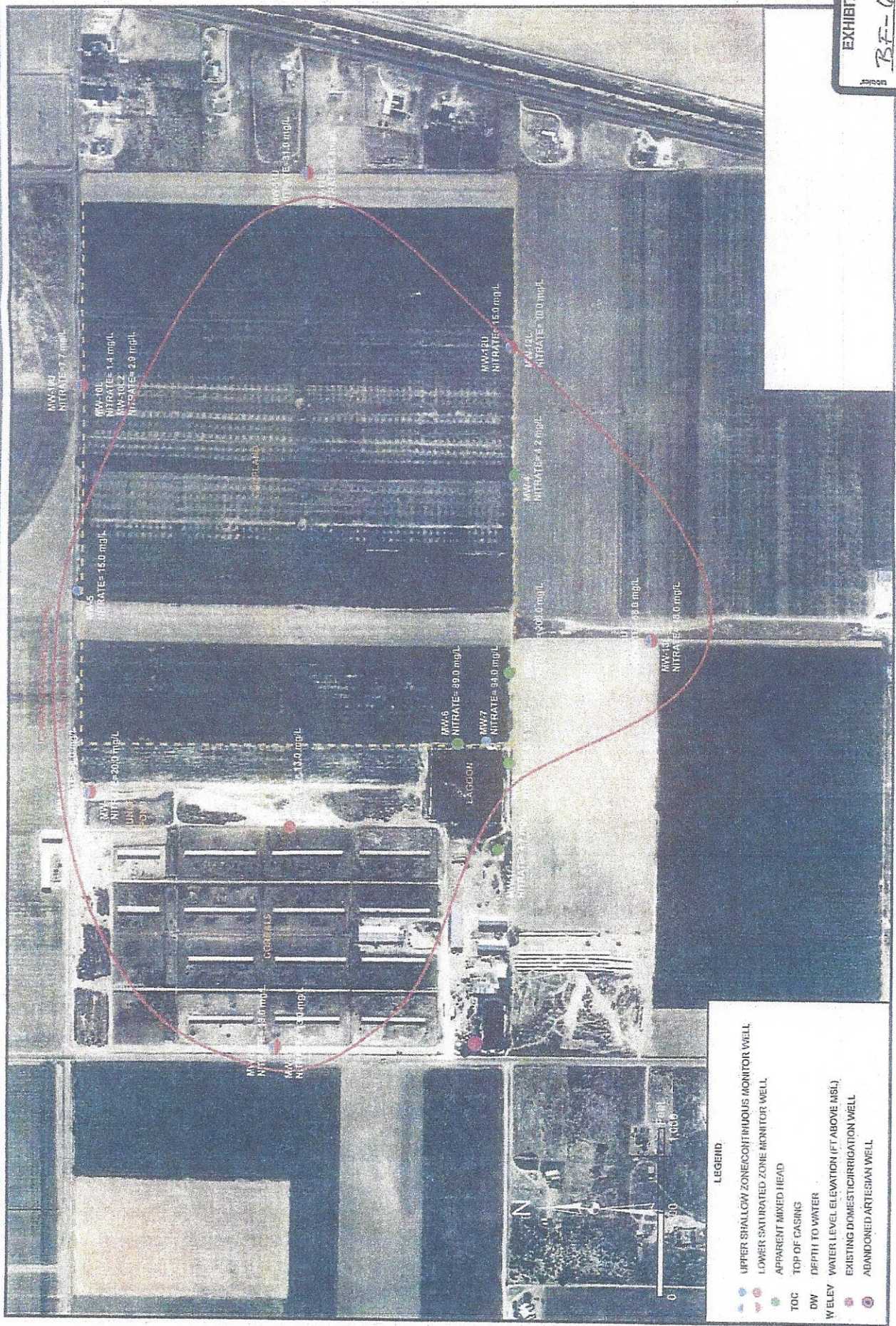
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EXHIBIT  
 BF-4











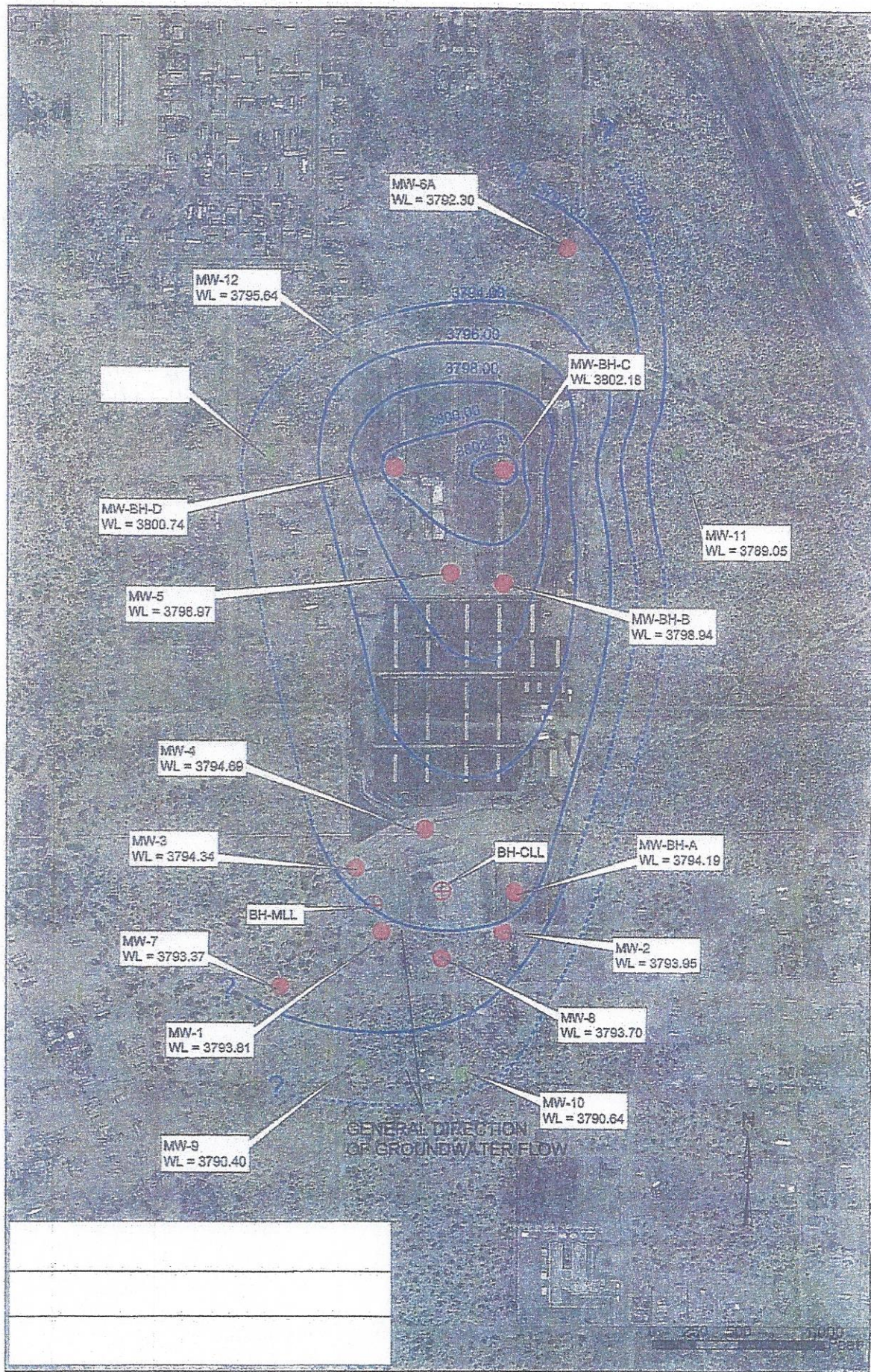


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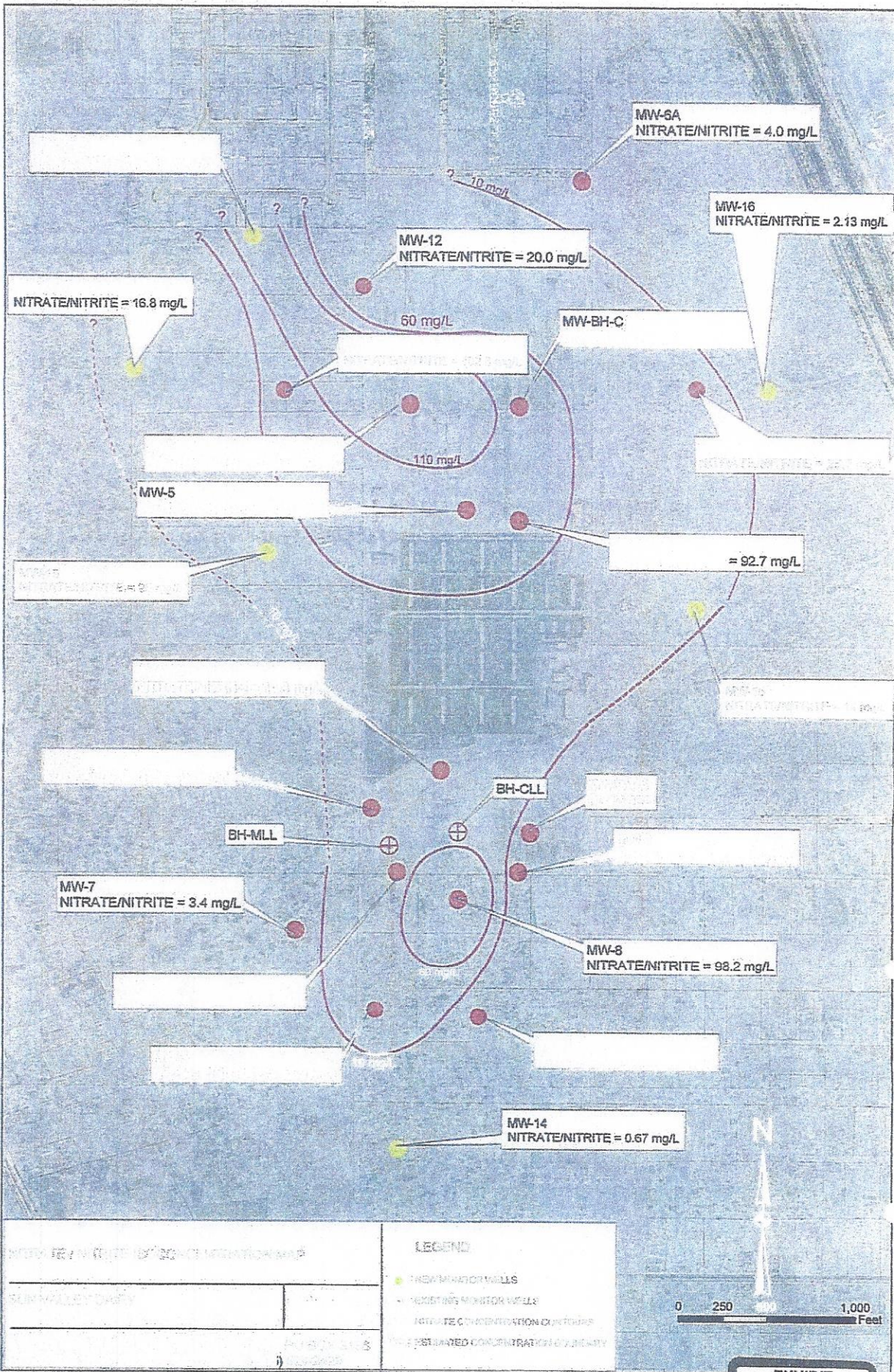


EXHIBIT  
 number BF-8