

Tim Luke. JH

N&K

I see no water use into head
but we should either enter the
depth to water levels in WMTS &/or
correlate w/ Helen H. on getting
draw data in IDWR well log
database. Rept should be
filed w/ 0-8 2006 let's discuss.
Tim

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FEB 08 2006
DEPARTMENT OF
WATER RESOURCES

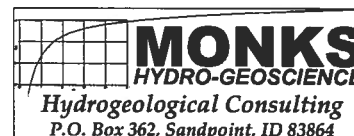
COCOA – Nederend Dairy Groundwater Monitoring Project 2005 Annual Report

January 30, 2005

Prepared by:
John Monks, P.G.

30 January, 2006

John F. Westra
Western Regional Manager
Western Regional Office
Idaho Department of Water Resources
2735 Airport Way
Boise, ID 83705-5082



RE: COCOA-Nederend Dairy Ground Water Monitoring Annual Report for 2005

Dear Mr. Westra:

The Conditions of Approval and Remarks for Transfer No. 5313 of Water Right No. 57-07045 require COCOA and Nederend Dairy to jointly conduct a water quality monitoring program, and to annually report analyses and conclusions. The Transfer of Water Right was signed October 30, 1998, and water quality monitoring began in February 1999. This report summarizes the water quality monitoring activities and water quality data collected during calendar year 2005.

Changes in Monitoring Well Network

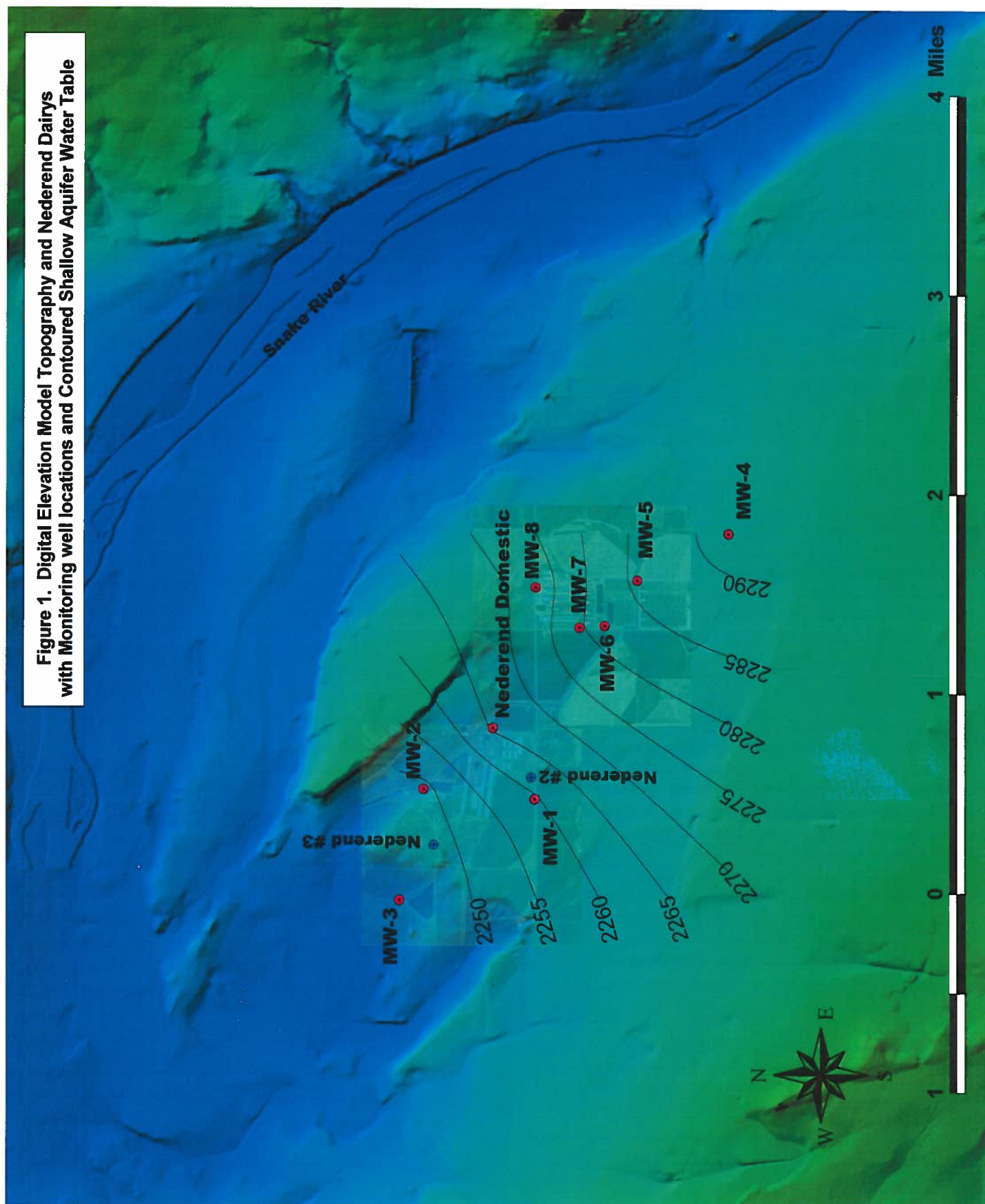
One new monitoring well was constructed in the shallow aquifer (refer to Figure 1 for well locations). Well MW-8 was constructed in August 2005 during abandonment of the "test well" (Well Tag No. D 0019749) at Dairy #2. The test well was drilled in April 2002. Total depth of the well as originally drilled was 500 feet, cased to a depth of 258 feet.

Well MW-8 was constructed by filling the well with bentonite from the bottom to a depth of ~ 65 feet, perforating the casing in a gravel layer at 44 – 65 feet, installing 10 feet of 2-inch PVC screen from 50 – 60 feet, and then filling the annular space between the 2-inch casing and 6-inch casing with bentonite to land surface.

Water Quality Data

Nitrate water quality data from wells completed in the shallow aquifer are plotted in Figure 2. Average nitrate concentrations in the shallow aquifer exceeded the EPA mcl of 10 mg/L at wells MW-1, MW-2, MW-3, MW-5, MW-6, MW-8 and Nederend Domestic during 2005. The highest nitrate concentrations occur at MW-8. Well MW-8 nitrate concentrations increased from 67.9 mg/L in August to 79.2 mg/L in November. The next highest nitrate concentrations occur at MW-2, where nitrate levels ranged from 46.9 mg/L in March to 21.9

Figure 1. Digital Elevation Model Topography and Nederend Dairys with Monitoring well locations and Contoured Shallow Aquifer Water Table



mg/L in June. At well Nederend Domestic, nitrate levels ranged from 24.7 mg/L in June to 7.72 mg/L in October. Overall, nitrated concentrations at Nederend Domestic have decreased steadily. At well MW-5 nitrate concentrations ranged from 33.0 mg/L in April to 26.1 mg/L in July.

Average nitrate concentrations decreased from 2004 at wells MW-1 (from 22.54 to 19.88 mg/L), MW-5 (from 28.69 to 21.5 mg/L) and Nederend Domestic (from 34.73 to 14.53 mg/L). At MW-2, average nitrate decreased slightly (40.53 mg/L in 2004 and 39.67 mg/L in 2005). Average nitrate increased at MW-3 (from 17.32 to 19.46 mg/L), MW-4 (from 6.85 to 7.11 mg/L), MW-6 (from 3.48 to 10.09 mg/L) and MW-7 (from 7.18 to 8.21 mg/L).

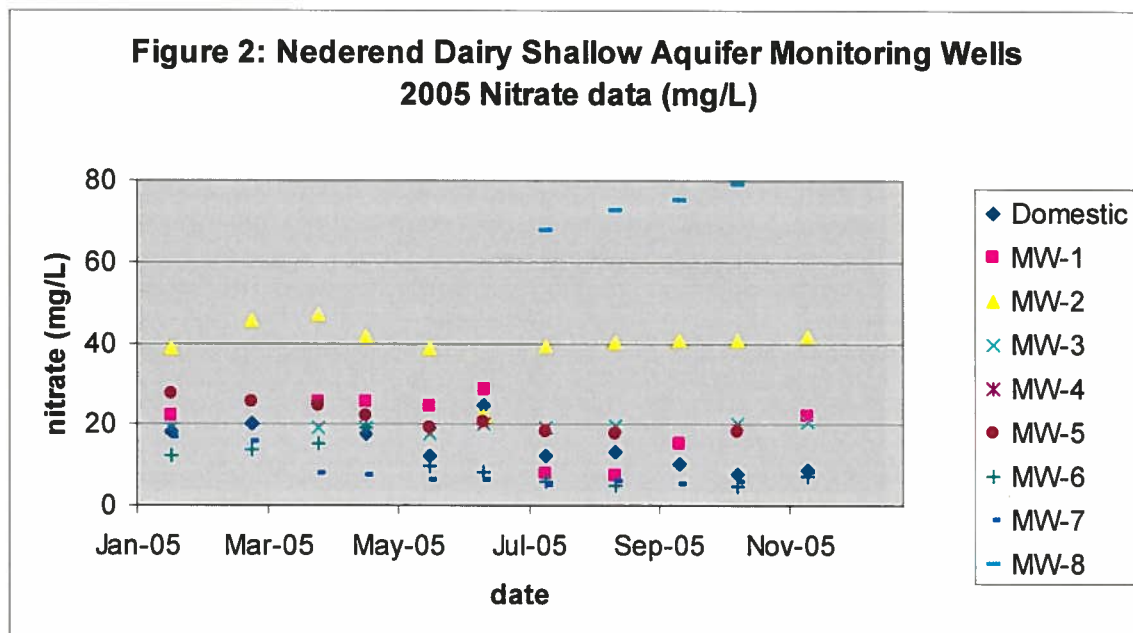


Table 1: 2005 Nederend Dairy Nitrate Water Quality Statistics

<i>Well Name:</i>	<i>average:</i>	<i>max:</i>	<i>min:</i>	<i>count:</i>	<i>standard deviation:</i>
MW-1	19.88 ↓	28.50	7.55	9	7.83
MW-2	39.67 ↓	46.90	21.90	11	6.47
MW-3	19.46 ↑	20.60	17.90	9	0.81
MW-4	7.11 ↑	8.53	6.16	7	0.74
MW-5	21.50 ↓	27.70	17.90	9	3.56
MW-6	10.09 ↑	19.20	4.67	10	4.81
MW-7	8.21 ↑	16.70	4.71	11	4.05
MW-8	73.73	79.20	67.90	4	4.70
Nederend Domestic	14.53 ↓	24.70	7.72	10	5.40

Nederend Dairy sulfate water quality data is plotted in figure 4. The highest sulfate concentrations are also found at well MW-2. Well MW-5 also has relatively high sulfate concentrations. MW-1, MW-3 and Nederend Domestic have similar sulfate concentrations. Relative to the other wells, MW-6 and MW-7 have relatively low concentrations of sulfate. Average sulfate increased at MW-1, MW-2, MW-3, MW-4, MW-5, MW-6 and MW-7 and decreased at Nederend Domestic.

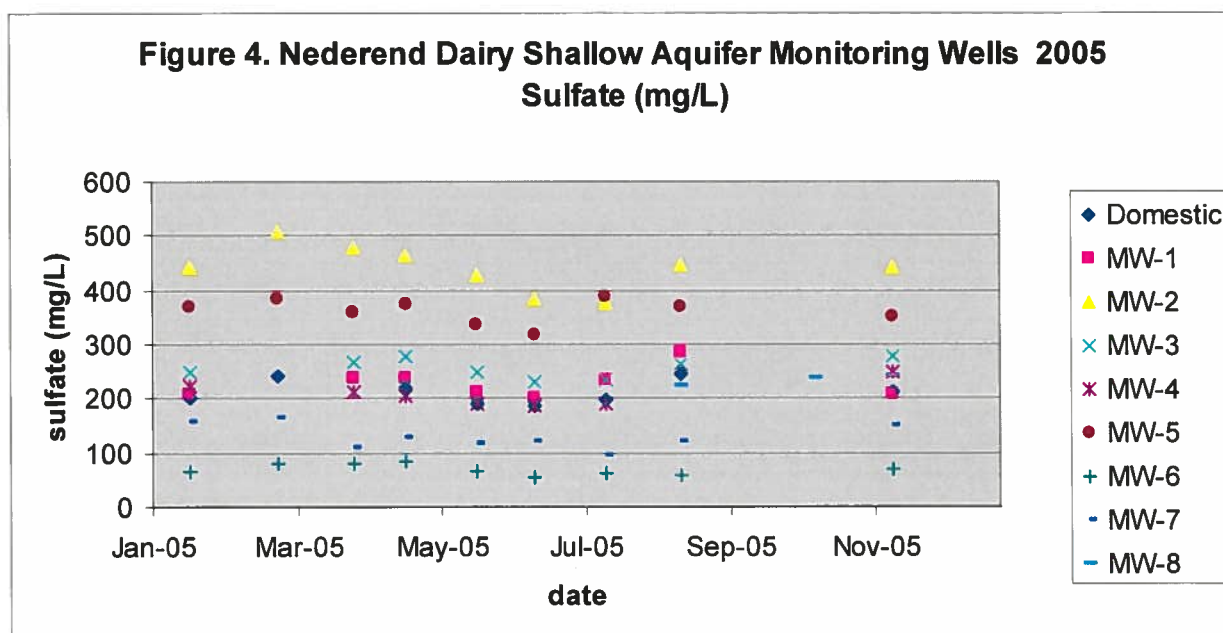
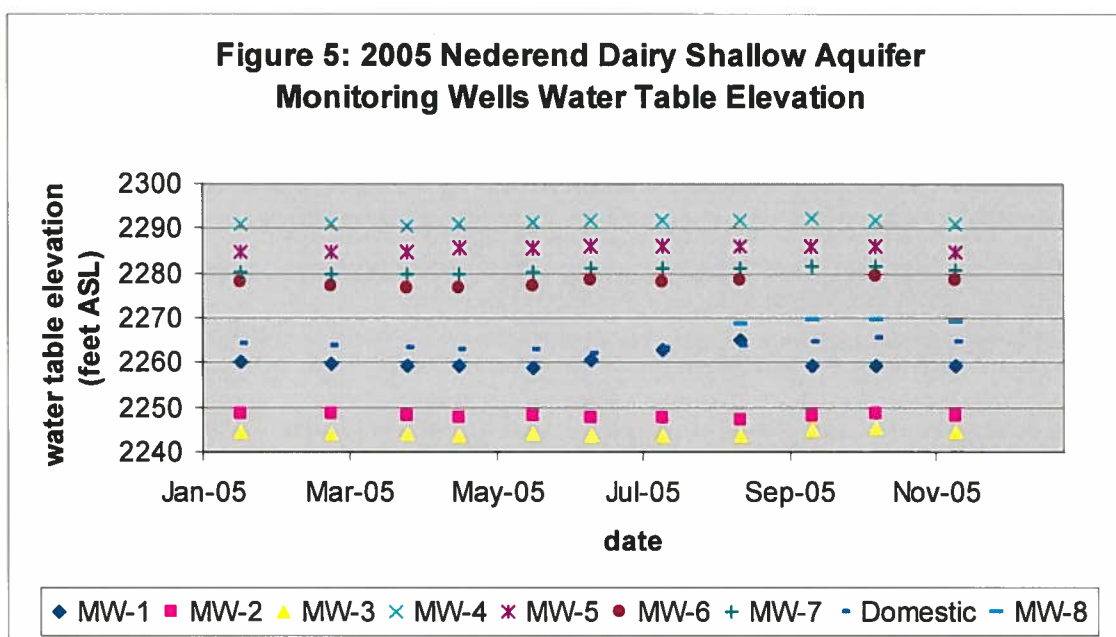


Table 3: 2005 Nederend Dairy Sulfate Water Quality Statistics					
Well Name:	average:	max:	min:	count:	standard deviation:
MW-1	228.25 ↑	286.00	202.00	8	27.28
MW-2	441.89 ↑	507.00	376.00	9	42.09
MW-3	256.13 ↑	279.00	229.00	8	18.54
MW-4	208.86 ↑	248.00	187.00	7	21.94
MW-5	360.89 ↑	387.00	320.00	9	21.92
MW-6	69.33 ↑	82.60	56.70	9	10.28
MW-7	129.72 ↑	166.00	94.50	9	23.69
MW-8	235.00 ↑	243.00	225.00	3	9.17
Nederend Domestic	211.63 ↓	244.00	186.00	8	22.21

Water Level Measurements

Water table elevation data from the shallow aquifer are plotted in Figure 5, and contoured water table elevations for October 2005 are shown in Figure 1. Groundwater flow direction in the shallow aquifer is to the northwest. The water table is closest to the land surface at MW-4 and MW-5, where the water table is 10-12 feet below ground surface. MW-4 and MW-5 are both located next to the drain. The drain at both wells is excavated into the coarse-grained gravels that the wells are screened in.



Seasonal variations in the water table occur in the shallow aquifer. The largest fluctuations during 2005 occurred at MW-1 (6.06 feet), which responds to pumping from well Nederend #2. The water table at Nederend Domestic fluctuated 3.90 feet, probably in response to recharge from irrigation. At MW-6 the water table has fluctuated 2.72 feet. Smaller seasonal variations occur at MW-3 (1.83 feet), MW-7 (2.09 feet), MW-2 (1.53 feet), MW-5 (1.45 feet) and MW-4 (1.41 feet).

Discussion

Water quality has improved at some monitoring wells and degraded at others. The most dramatic improvement has occurred at Nederend Domestic (Figure 6). Nitrate levels spiked at Nederend Domestic in the fall of 2003, going from 12.4 mg/L in June 2003 to 46.9 mg/L in October 2003. Similar spikes were seen in 2004 and 2005, with the peak level of nitrate decreasing in 2004 and 2005. The 2003 and 2004 spikes in nitrate concentration coincided with the seasonal high water

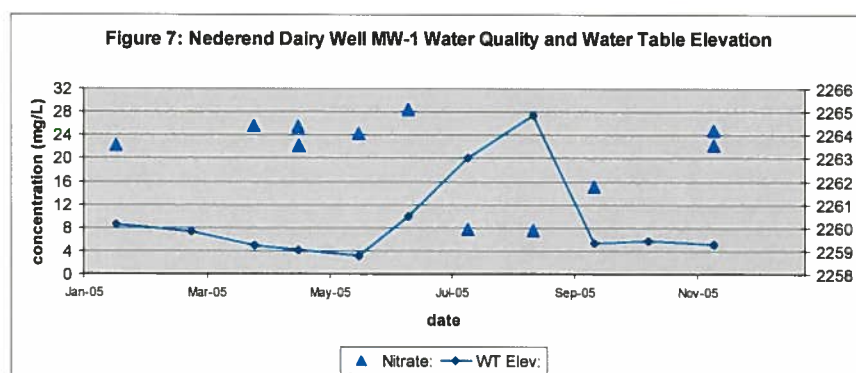
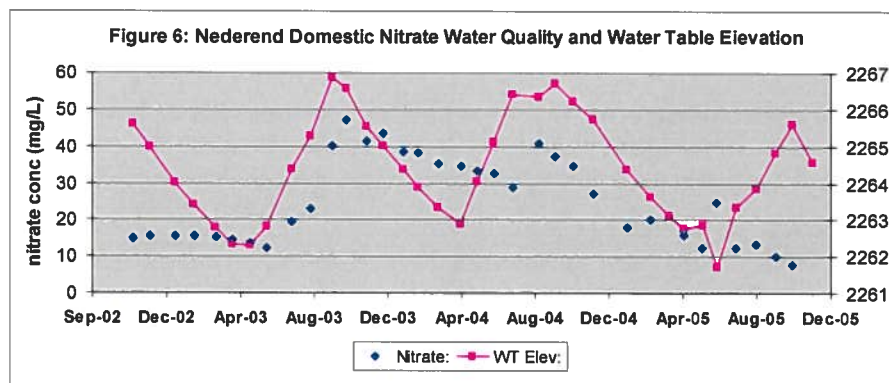
table. A possible explanation for this pattern of repeating, decreasing amplitude spikes is an over-application of nutrients on an upgradient field, which were then

leached through the soil column to the shallow aquifer during successive irrigation seasons. Each successive nitrate peak is lower as the concentration of nitrate at the source decreased over time.

Nitrate levels decreased at MW- 1 during July and August (Figure 7). During these months, water production shifted from well Nederend #2 to well Nederend #3 (refer to Figure 8). While production well Nederend #2 was pumping, nitrate levels at MW-1 exceeded 20 mg/L. During July and August, the water table recovered and nitrate levels dropped to less than 10 mg/L. As a result of the low nitrate levels at MW-1 in July and August, the average nitrate level at MW-1 in 2005 is lower than it was in 2004.

The influence of pumping at Nederend #2 on groundwater flow direction may explain the changes in nitrate levels that occurred at MW-1. Well Nederend #2 is screened in both the shallow aquifer and the deeper aquifer. When Nederend #2 is pumping, groundwater flow in the shallow aquifer near the well is radial towards Nederend #2.

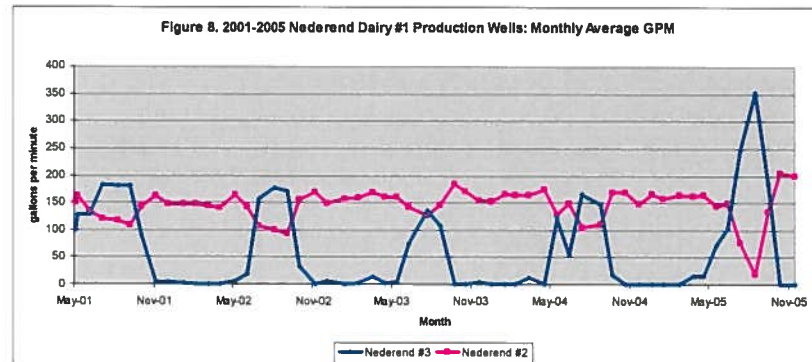
When Nederend #2 is pumping, groundwater flow at MW-1 is from the west-northwest, from beneath the center-pivot irrigated field north of MW-1 and Nederend #2. When Nederend #2 is shut down, the water table in the shallow aquifer at MW-1 recovers to static conditions and the regional gradient in the shallow aquifer is reestablished. When the regional gradient in the shallow aquifer is reestablished, groundwater flow direction at MW-1 is reversed, and groundwater flow is



from the southeast, from beneath the fields across Thompson Road to the southeast. Liquid manure from vacuum wagons and tank trucks has been applied to the field north of MW-1, and lagoon water is applied via the center pivot. The fields directly across the road from MW-1 have not had applications of liquid manure or lagoon water.

Figure 8 shows the average monthly gallons per minute from the production wells at Dairy #1, calculated from

monthly water meter readings. Production from Nederend #3 was considerably higher during summer of 2005 than it during previous summers,

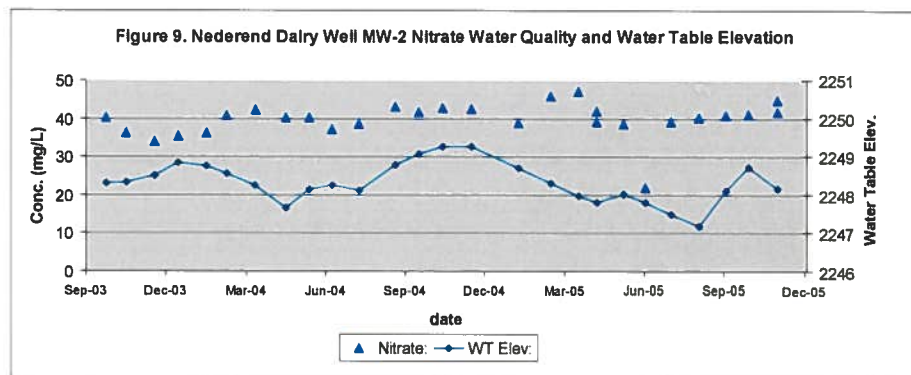


the
was
and

production from Nederend #2 was down. Both production wells are screened in the shallow aquifer.

Nitrate levels at MW-2 have been high since the well was installed in September 2003, with relatively little seasonal variation. Seasonal water level variations at MW-2 are also relatively small (~2 feet). The

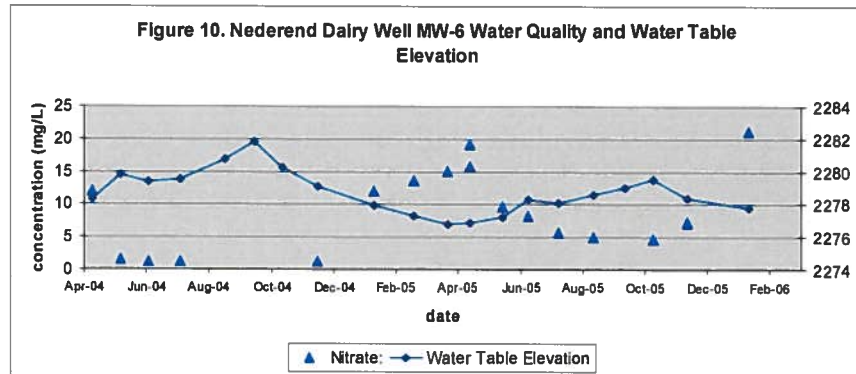
consistently high levels of nitrate at MW-2 suggest a source of nitrates that is also fairly constant, and not affected by seasonal



recharge from irrigation or precipitation. Possible nearby sources of high nitrate groundwater are the wastewater lagoons at Dairy #1 and the DeRuyter Dairy feedlot/corals across the drain to the north.

Water levels at MW-2 declined in June, July and August of 2005. In 2004, water levels rose during June and July, and then went down slightly in August. The water table at MW-2 appears to have been affected by increased pumping at Nederend #3 during the summer of 2005. MW-2 is ~1850 feet east of Nederend #3. MW-3 may also have been affected. From July to August of 2004 the water level at MW-3 rose 1.3 feet. From July to August of 2005 the water table rose 0.09 feet, then rose 1.41 feet from August to September. MW-3 is ~1350 feet northwest of Nederend #3.

At MW-6, nitrate levels went from 7.19 mg/L in November 2005 to 21.2 mg/L in January 2006. A similar increase occurred at MW-6 last year, when nitrate went from 1.34 mg/L in November 2004 to 12.1 mg/L in January 2005. Nitrate continued to climb at MW-6 to 19.2 mg/L in April 2005, and then declined to 4.67 mg/L in October. These peaks and lows in nitrate concentration coincide with water table lows and highs.



One possible explanation for the pattern developing at MW-6 is a constant source of high nitrate water upgradient of MW-6 that is diluted seasonally by recharge to the shallow aquifer from irrigation. The wastewater lagoons at Dairy #2, the collection ponds at the north end of the manure drying area, and the manure drying areas are all possible constant sources of high nitrate water, and the center-pivot irrigated field southeast MW-6 and the drain are likely sources of seasonal recharge.

The water level-nitrate pattern that occurs at MW-7 is similar to the pattern at MW-6. The hydrographs for MW-6 and MW-7 are very similar, suggesting that both wells are affected by the same recharge source. At MW-7, nitrate levels are slightly lower than they are at MW-6, and the nitrate peak occurs earlier (November at MW-7, April at MW-6).

Nitrate and chloride concentrations at well MW-8 are considerably higher than at any of the other monitoring wells. Potential upgradient sources for the high levels of nitrate and chloride include the wastewater lagoons at Dairy #2, the manure drying/composting area at Dairy #2, and the center-pivot irrigated field just east of the wastewater lagoons. According to Mr. Nederend, the field east of the wastewater lagoons at Dairy #2 received most of the wastewater from the dairy in the years prior to his taking over the dairy, and has relatively high levels of nitrogen in the soil.

A field investigation began in November 2005 to try to determine if the Dairy #2 lagoons and manure drying area are the source of the high levels of nitrate and chloride at MW-8. The first phase of the field investigation consisted of running four resistivity survey lines at Dairy #2. Preliminary results from the resistivity surveys indicate that the shallow aquifer is fairly

heterogeneous, with lenses/channels of higher resistivity sand/gravel in a matrix of lower resistivity sand.

Monitor wells MW-6 and MW-7 serve to illustrate this. MW-6 is 40 feet deep. The only sand/gravel encountered in MW-6 was at 6 to 7.5 feet below ground surface. At MW-7, ~660 feet to the south, coarse sand and gravel was present from 5 to 29 feet below ground surface. These sand/gravel deposits should act as preferential pathways for groundwater flow and contaminant transport.

The results of the resistivity survey will be used to target these preferential pathways for groundwater sampling using a direct-push sampler and construction of additional monitoring wells. The resistivity survey results also indicate that the shallow subsurface directly beneath the manure drying area is saturated. Electrodes driven ~18 inches into the ground in the manure drying area encountered saturated or nearly saturated soil with very low resistivity. When the resistivity survey report is completed, a copy will be sent to IDWR.

Conclusions

Water quality and water level data collected at Nederend Dairies demonstrate the sensitivity of the shallow aquifer beneath the dairies to activities occurring at the land surface. Water quality at some wells has improved, while at other wells it has gotten worse. As the time period over which water quality and water level data has been collected grows, seasonal patterns are beginning to emerge. These patterns indicate that nutrient management practices at Nederend Dairies may be affecting water quality in the shallow aquifer.

2006 Monitoring Program

Monthly water quality and depth to water data will continue to be collected at wells as outlined in the matrix below. Quarterly sampling will take place during the months of January, April, July and October, and semi-annual sampling in April and October.

Nederend Dairy 2006 Water Quality Monitoring Program Proposed parameter measurement Frequency				
Well Name:	Water level measurements:	pH, T, TDS, Conductivity, Ox-Red potential, Dissolved O2:	Nitrate:	Sulfate, chloride, coliform bacteria:
MW-1	Monthly	Monthly	Quarterly	Semi-annually
MW-2	Monthly	Monthly	Monthly	Semi-annually
MW-3	Monthly	Monthly	Quarterly	Semi-annually
MW-4	Monthly	Monthly	Quarterly	Semi-annually
MW-5	Monthly	Monthly	Quarterly	Semi-annually
MW-6	Continuously	Monthly	Monthly	Semi-annually
MW-7	Monthly	Monthly	Monthly	Semi-annually
MW-8	Continuously	Monthly	Monthly	Semi-annually
Nederend Domestic	Monthly	Monthly	Quarterly	Semi-annually

Additional activities designed to help improve the understanding of the hydrogeology at Nederend Dairies and the impacts on water quality from nutrient management practices are planned for 2006. Activities planned for 2006 include:

- Begin water level measurements at production wells. Wells Nederend #2 and Nederend #3 at Dairy #1, and Mirada #2 at Dairy #2 do not currently have water level measurement capabilities. Solinst Levelloggers have been installed in Well Mirada #1 at Dairy #2 and in MW-6 and MW-8.
- Continue field investigations to determine the source(s) of high levels of nitrate at MW-8.
- Characterize the hydrogeology and water quality in the vicinity of the lagoons and manure drying/composting areas at both dairies to determine if leakage from the lagoons is affecting water quality in the shallow aquifer.
- Conduct a water balance study of the manure drying area to determine if manure drying/composting activities are a potential source of recharge to the shallow aquifer.

If you have any questions or comments, please give me a call at 208-263-1991.

Sincerely,



John Monks, P.G.

January 30, 2006

Cc: Hans Nederend - Nederend Dairy, Ilene Dobbin – COCOA, Craig Tesch – ISDA

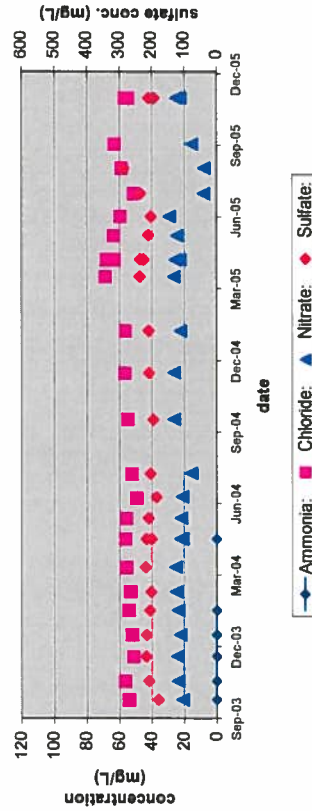
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MW-1 Adjacent to Nederend #2 along Thompson Road
2294.59 mp elevation UTM coordinates: 510662.7 4822801.5

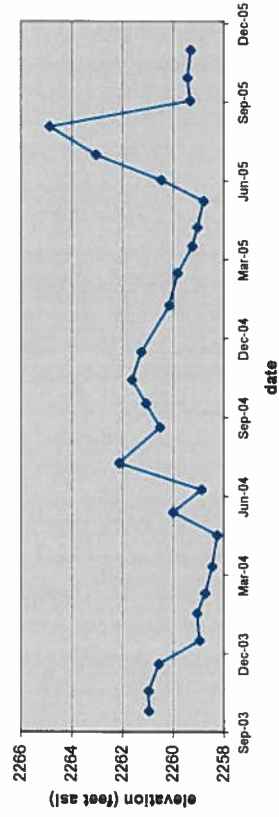
stddev:	0.00	1.80	1.43	13.45
avg:	0.01	53.39	23.09	206.86
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:
9/25/2003	0.01	53.4	20.6	180
10/19/2003	0.01	56.1	23.1	208
11/20/2003	0.01	51.1	23.5	218
12/18/2003	0.01	51.7	22.0	215
1/19/2004	0.01	53.6	23.2	206
2/12/2004		52.6	24.4	202
3/15/2004		55.2	24.8	219
4/21/2004		56.0	21.8	217
4/21/2004	0.005		20.6	200
5/18/2004		55.3	21.4	210
6/14/2004		49.1	20.8	186
7/15/2004		51.8	15.3	204
8/26/2004				NS
9/23/2004		54.3	25.6	195
10/21/2004				NS
11/23/2004	0.001	56.4	25.6	208
1/17/2005		56	22.2	209
2/24/2005				
3/28/2005		68.4	25.7	237
4/18/2005		67.7	25.4	236
4/19/2005		62.8	22.3	225
5/20/2005		63.1	24.3	211
6/14/2005		59.1	28.5	202
7/14/2005		51.1	7.75	235
8/16/2005		58.6	7.55	286
9/16/2005		62.9	15.2	
10/13/2005				present
11/15/2005		56.6	22.3	210
11/15/2005		54.2	24.9	192

WT Elev:	WT change:	comment	Temp	pH	SpecCond	TDS
2260.96						
33.83	0.01					
33.82	2260.97					
34.02	2260.57					
35.63	2258.96					
35.53	2259.06					
35.85	2258.74					
36.12	2258.47					
36.33	2258.26					
36.33	2258.26	ISDA Sample				
34.59	2260.00					
35.71	2258.88					
32.46	2262.13					
34.08	2260.51					
33.52	2261.07					
32.97	2261.62					
33.33	2261.26					
34.44	2260.15					
34.77	2259.82					
35.34	2259.25					
35.55	2259.04					
35.55	2259.04					
35.78	2258.81					
34.12	2260.47					
31.55	2263.04					
29.72	2264.87					
35.26	2259.33					
35.15	2259.44					
35.28	2259.31					
ISDA Sample	14.5	7.41	917	459		
ISDA Sample	13	7.18	1171	569		

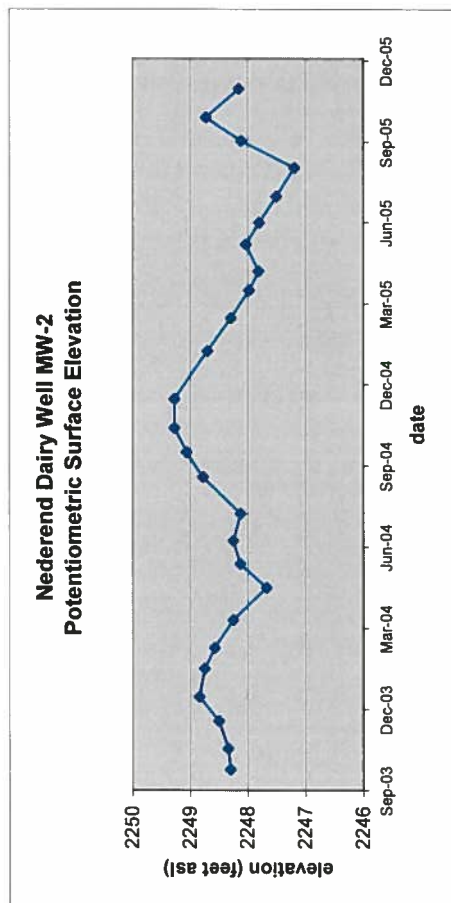
Nederend Dairy Well MW-1 Water Quality



Nederend Dairy Well MW-1
Potentiometric Surface Elevation



Well	Location	Depth (m)	UTM coordinates	Elevation (m)
MW-2	North of Dairy Lagoons and barns	2276.31	510742.2	4823698.7

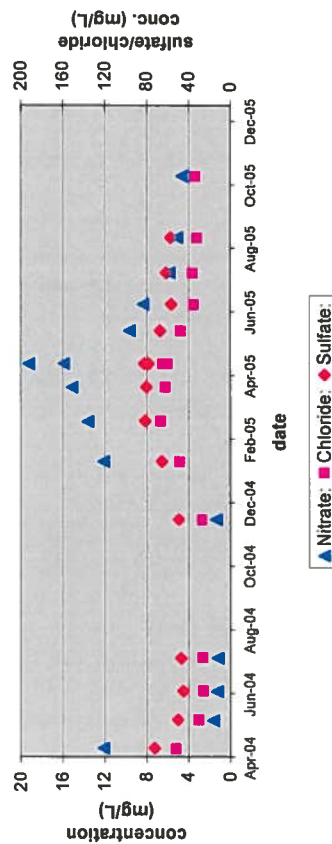
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MW-6 Next to corrals north of lagoons

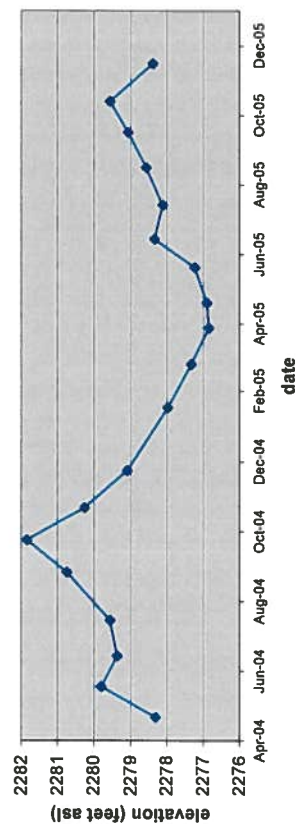
MMW-6	Next to corrals north of lagoons	UTM coordinates:	512048.0 4822439.7
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[illegible]

Nederend Dairy Well MW-6 Water Quality



Nederend Dairy Well MW-6 Potentiometric Surface Elevation



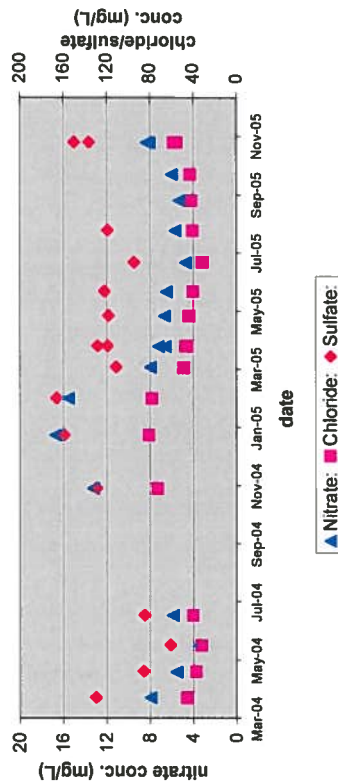
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MW-7 West end of lagoons at Dairy #2

2300.23 mp elevation UTM (zone 11) coordinates: 512061.9 easting: 4822237.0 northing:

date:	stdev:	0.02	5.59	1.82	28.07	WT elev.:	DTW:	Collform:	WT change:	comments:	Temp	pH	SpecCond	TDS
4/21/2004	avg:	0.02	38.75	5.68	90.40	2280.74	19.49	Sulfate:						
5/18/2004		0.03	45.6	7.91	129	2281.41	18.82	absent	0.67					
6/14/2004			37.2	5.51	85.9	2281.45	18.78	absent	0.04					
7/15/2004			32.2	3.46	61.7	2281.59	18.64	absent	0.14					
8/26/2004			40	5.84	85	2282.08	18.15	absent	0.49	not sampled				
9/23/2004						2282.57	17.66		0.49	not sampled				
10/21/2004						2281.8	18.43		-0.77	not sampled				
11/23/2004	0.001		72.8	13.2	129	2281.17	19.06	absent	-0.63					
1/17/2005			80.8	16.7	159	2280.49	19.74	absent	-0.68					
2/24/2005			78	15.5	166	2280.04	20.19	absent	-0.45					
3/28/2005			48.1	7.94	111	2279.73	20.5	absent	-0.31					
4/19/2005			46.7	7.19	128	2279.94	20.29	absent	0.21					
4/19/2005			45	6.55	119	2279.94	20.29	NA		ISDA DATA	15.3	7.31	690	344
5/20/2005			43.3	6.62	118	2280.34	19.89	absent	0.40					
6/14/2005			40.2	6.45	122	2281.05	19.18	absent	0.71					
7/14/2005			31.5	4.71	94.5	2280.99	19.24	absent	-0.06					
8/16/2005			40.4	5.65	119	2281.19	19.04	absent	0.20					
9/16/2005			41.6	5.28		2281.47	18.76	absent	0.28					
10/13/2005			42.8	5.99		2281.82	18.41	absent	0.35					
11/15/2005			58	8.32	150	2280.79	19.44	absent	-1.03					
11/15/2005			55.2	8.03	136	2280.79	19.44	NA		ISDA DATA	14.8	6.94	1200	599

Nederend Dairy Well MW-7 Water Quality



Nederend Dairy Well MW-7 Potentiometric Surface Elevation

