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COCOA – Nederend Dairy Groundwater Monitoring Project 2004 Annual Report

January 31, 2005

Prepared by:
John Monks, P.G.

 **MONKS**
HYDRO-GEOSCIENCE
Hydrogeological Consulting
P.O. Box 362, Sandpoint, ID 83864

31 January, 2005

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 2004

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 2004.

Changes in Monitoring Well Network

Four monitoring wells were constructed in the shallow aquifer during April 19-20, 2004 (refer to Figure 1 for well locations). Well MW-4 was drilled upgradient of areas where dairy waste is applied. MW-4 was drilled to a depth of 25' and is screened from -15' to -25' below ground surface (bgs). From ground surface to -8 feet was moist, fine-grained, "clumpy" sand. A thin layer of gravel and sand was encountered from -8 to -8.5 feet. From -8.5 feet to -12.5 feet was more moist, fine-grained, "clumpy" sand. From -12.5 feet to -25 feet was sand and gravel.

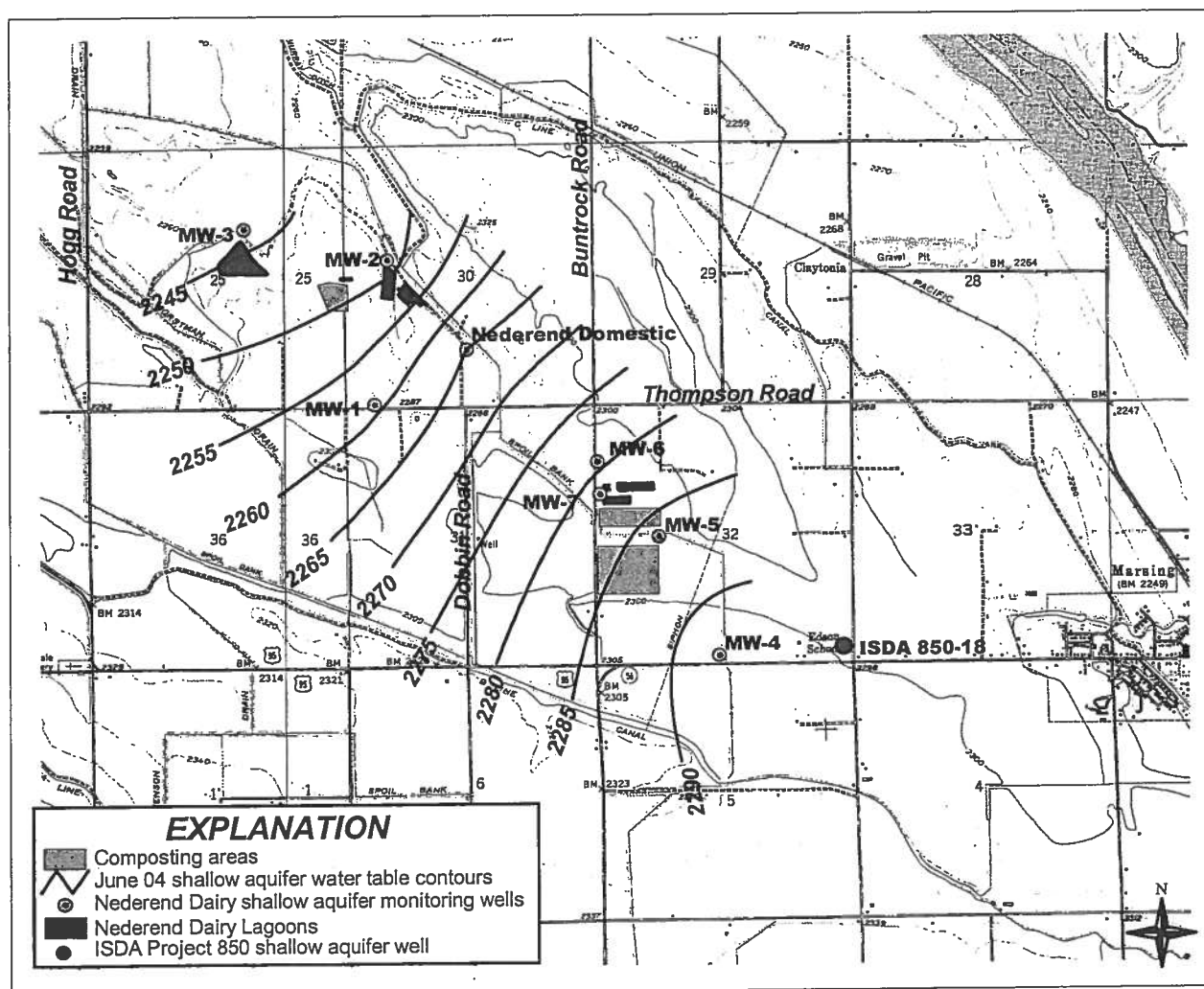
Well MW-5 is ~2700' northwest of MW-4. A center pivot irrigated field lies between MW-4 and MW-5. MW-5 is just south of the drain, at the northeast corner of the manure composting area. MW-5 was drilled to a depth of 25' and is screened from -15' to -25' bgs. From ground surface to -6 feet was moist, fine-grained, "clumpy" sand. A thin layer of gravel and sand was encountered from -6 to -7.5 feet. From -7.5 feet to -10 feet was more moist, fine-grained, "clumpy" sand. From -10 feet to -24 feet was sand and gravel. From -24 to -25 feet was clay.

Well MW-6 is northwest of the Dairy #2 lagoons. MW-6 was drilled to a depth of 40 feet and is screened -30' to -40' bgs. From ground surface to -6 feet was moist, fine-grained, sand. A thin layer of gravel and sand was encountered from -6 to -7.5 feet. From -7.5 feet to -25 feet

was fine sand with increasing amounts of clay. From -25 to -30 feet was clay. From -30 to -40 was black sand.

Well MW-7 is west of the Dairy #2 lagoons, ~680 feet south of MW-6. MW-7 was drilled to a depth of 30 feet and is screened -20' to -30' bgs. From ground surface to -2 feet was sand and gravel. From -2 to -5 feet was moist, fine-grained, sand. Gravel and sand was encountered from -5 to -29 feet. From -29 to -30 feet was clay.

Well Nederend Domestic is completed in the shallow aquifer and has been monitored on a monthly basis since 1999. Wells Nederend #2 and Nederend #3 are dairy production wells that are completed in both the shallow and deep aquifers. Well Nederend #3 was not sampled in 2004. Well Nederend #2 was sampled for nitrate in March 2004 and for nitrate, sulfate, ammonia, chloride and bacteriology by ISDA in November.



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 and Nederend Domestic during 2004. The highest nitrate concentrations are found at MW-2. Well MW-2 nitrate concentrations ranged from 36.3 mg/L in January to 42.6 mg/L in October. At well Nederend Domestic, nitrate levels ranged from 28.9 mg/L in July 2004 to 40.9 mg/L in August 2004. The August 2004 nitrate spike coincided with detections of fecal coliform bacteria. At well MW-5 nitrate concentrations ranged from 33.0 mg/L in April to 26.1 mg/L in July.

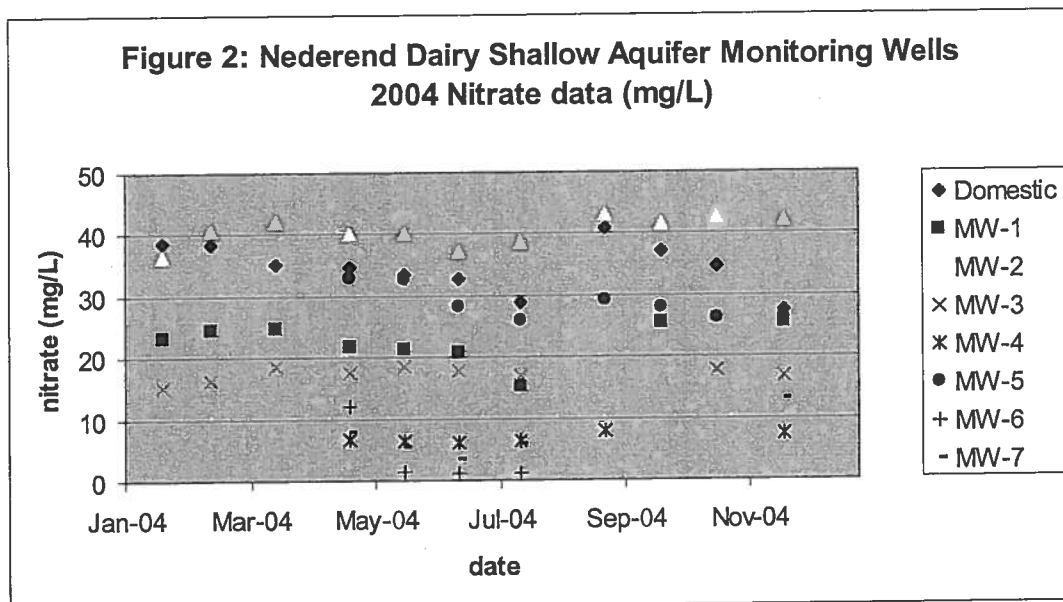


Table 1: 2004 Nitrate Water Quality Statistics					
Well Name:	average:	max:	min:	count:	standard deviation:
MW-1	22.54	25.6	15.3	9	3.26
MW-2	40.43	43.1	36.3	11	2.25
MW-3	17.32	18.6	15.3	9	1.06
MW-4	6.85	7.92	6.19	6	0.67
MW-5	28.69	33.0	26.1	8	2.76
MW-6	3.48	12.1	1.2	5	4.82
MW-7	7.18	13.2	3.46	5	3.71
Nederend Domestic	34.73	40.9	27.4	11	4.07

Chloride water quality data from Nederend Dairy is plotted in figure 3. The highest chloride concentrations are found in well MW-2. MW-5 also has relatively high chloride concentrations. Chloride concentrations at Nederend Domestic reached their highest levels in August 2004 at 81.99 mg/L, coinciding with the spike in nitrate that occurred at the well. Chloride concentrations at MW-6 and MW-7 were low relative to the other wells throughout most of the year. Chloride concentrations at MW-7 increased from 40 mg/L in July 2004 to 72.8 mg/L in November.

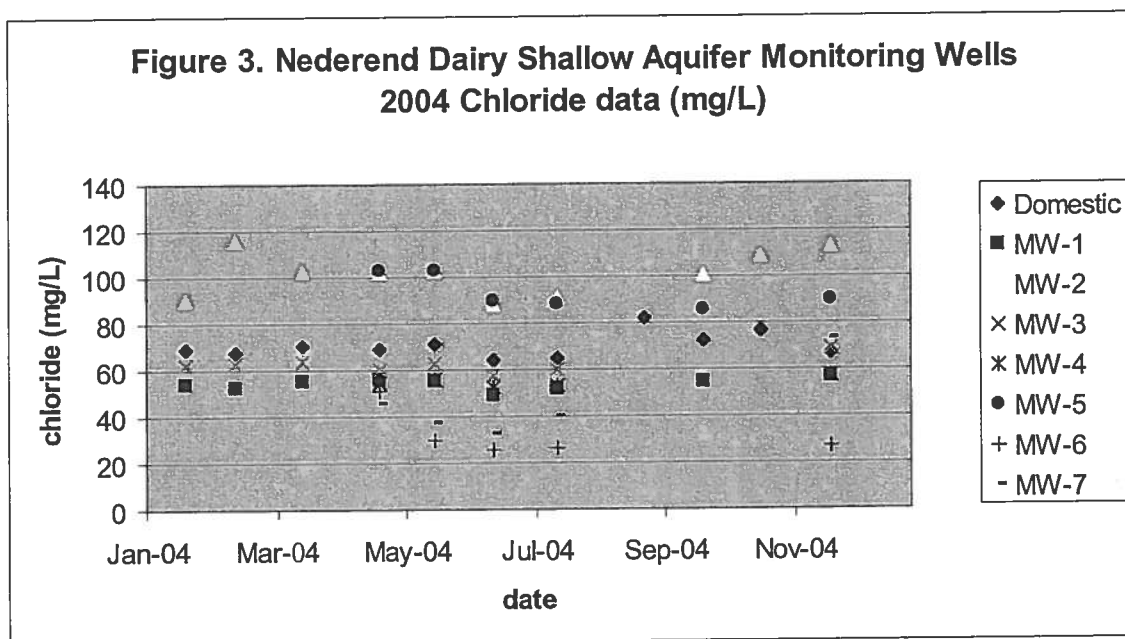


Table 2: 2004 Chloride Water Quality Statistics					
Well Name:	average:	max:	min:	count:	standard deviation:
MW-1	53.81	56.4	49.1	9	2.34
MW-2	101.66	116.0	88.3	10	9.51
MW-3	62.23	68.8	57.5	8	3.34
MW-4	54.74	57.4	52.5	5	2.04
MW-5	93.10	103	85.2	6	7.84
MW-6	31.72	51	25.2	5	10.92
MW-7	45.56	72.8	32.2	5	15.98
Nederend Domestic	70.26	81.9	64.2	11	5.20

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. Sulfate concentrations at Nederend Domestic reached their highest levels in August 2004 at 240 mg/L, coinciding with the spike in nitrate that occurred at the well. Relative to the other wells, MW-6 and MW-7 have relatively low concentrations of sulfate.

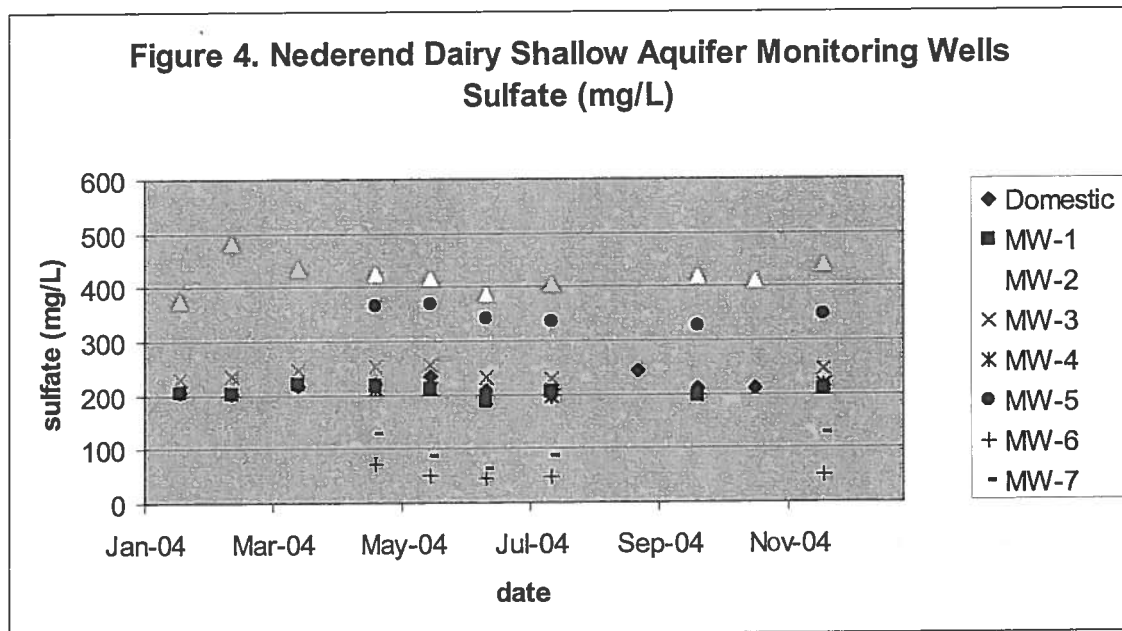
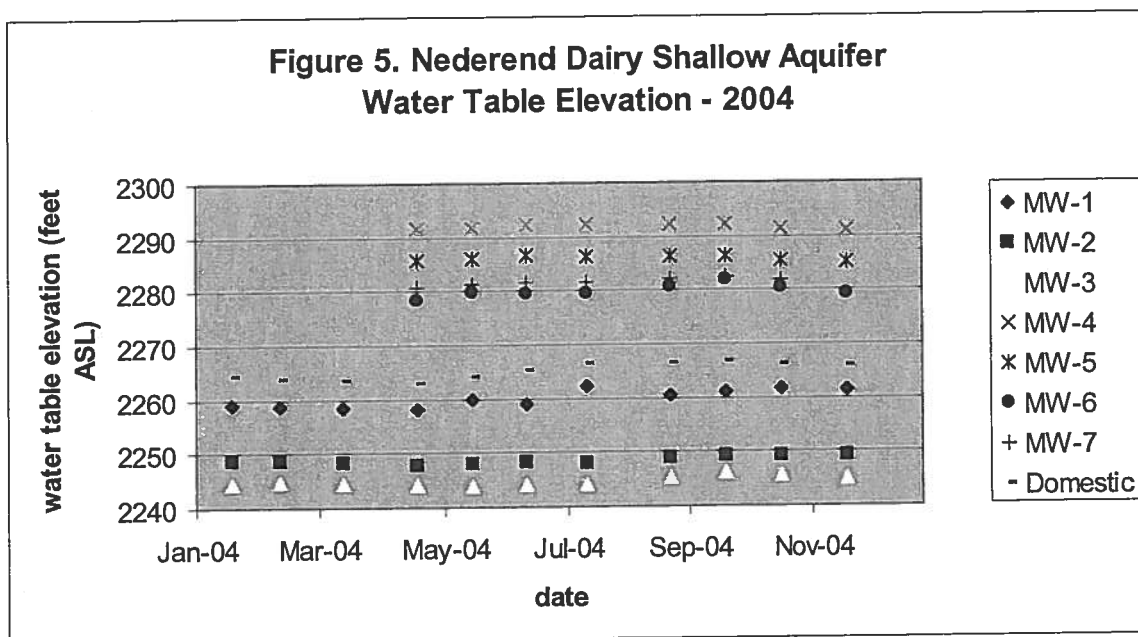


Table 3: 2004 Sulfate Water Quality Statistics					
<i>Well Name:</i>	<i>average:</i>	<i>max:</i>	<i>min:</i>	<i>count:</i>	<i>standard deviation:</i>
MW-1	205.22	219	186	9	10.28
MW-2	419.10	482	375	10	29.92
MW-3	240.63	255	228	8	10.80
MW-4	205.20	216	193	5	10.47
MW-5	347.50	369	326.0	6	16.98
MW-6	52.84	72.4	45.2	5	11.10
MW-7	98.12	129	61.7	5	29.81
Nederend Domestic	215.09	244	198	11	13.94

Water Level Measurements

Water table elevation data from the shallow aquifer are plotted in Figure 5, and contoured water table elevations for June 2004 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 down 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 are seen at Nederend Domestic (3.83 feet) and MW-1 (3.87 feet). The water table at Nederend Domestic, where monthly measurements date back to November 2002, fluctuates in response to recharge from irrigation. At MW-1, the water table also fluctuates in response to recharge, but is affected by drawdown from pumping at well Nederend #2. At MW-6 the water table has fluctuated 3.53 feet since measurements began in April 2004. Smaller seasonal variations occur at MW-3 (2.27 feet), MW-7 (1.83 feet), MW-2 (1.60 feet), MW-5 (1.33 feet) and MW-4 (1.04 feet). The data records for MW-4, MW-5, MW-6 and MW-7 do not cover a full year yet.

Discussion

Average nitrate concentration at well Nederend Domestic has increased over time, from 8.87 mg/L in 2001, to 10.31 mg/L in 2002, 25.14 mg/L in 2003, and to 34.73 mg/L in 2004. Average chloride at Nederend Domestic also increased from, rising from 68.63 mg/L in 2003 to 70.26 mg/L in 2004. Over the same time period, average sulfate has declined slightly from 220.92 mg/L in 2003 to 215.09 mg/L in 2004. The source(s) of the contaminants found at Nederend Domestic remain unknown. Potential sources for the contaminants found at Nederend Domestic are upgradient fields where dairy waste is applied, wastewater lagoons at Nederend Dairy #1, the composting area at Nederend Dairy #1, and unknown upgradient sources.

Well MW-2 has the highest concentrations of nitrate, chloride and sulfate. Nitrate levels at MW-2 appear to be increasing with time. Potential sources for the contaminants found in well MW-2 are the adjacent wastewater lagoons, upgradient fields where dairy waste is applied, wastewater lagoons at Nederend Dairy #1, the composting area at Nederend Dairy #1, and unknown upgradient sources.

Well MW-5 also has elevated levels of nitrate, chloride and sulfate. Potential sources for the contaminants found at MW-5 are the adjacent composting yard, the center pivot irrigated field that lies between MW-4 and MW-5, or an unknown upgradient source. Well MW-5 was first sampled in April 2004, at approximately the same time that composting operations began in the adjacent field. Nitrate and chloride levels at MW-5 have decreased since April, suggesting that the composting yard may not be the main source of the contaminants. The location of well MW-5 relative to most manure waste application and storage areas suggests that an upgradient source may be present. ISDA well 850-18 is a domestic well completed in the shallow aquifer upgradient of MW-5. Well 850-18 has been sampled as part of ISDA project 850 since 1999. Elevated levels of nitrate, chloride and sulfate have been measured at 850-18 since sampling began. A November 2004 water sample from ISDA well 850-18 had 38.2 mg/L nitrate, 1151 mg/L sulfate, and 164 mg/L chloride. The water quality record at well 850-18 indicates an upgradient source of contamination is present that is not related to dairy operations.

Water quality at wells MW-1 and MW-3 remained fairly constant during 2004. At well MW-4, nitrate concentrations have increased slightly from 6.6 mg/L in April 2004 to 7.47 mg/L in November, possibly the result of seasonal influences from the adjacent drain.

Conclusions

Water quality in the shallow aquifer at Nederend Dairies continues to decline. The average nitrate concentration at well Nederend Domestic has increased four-fold since 1999. Water quality data from ISDA Project 850 well 850-18 indicates that an upgradient source of contamination not related to dairy waste management is present.

2005 Monitoring Program

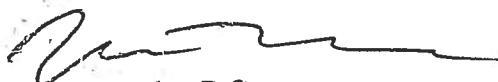
Monthly water quality and depth to water data will continue to be collected at wells Nederend Domestic, MW-2, MW-4, MW-5, MW-6 and MW-7. Water quality data will be collected on a quarterly basis at MW-1 and MW-3. When one year worth of monthly data have been collected at MW-4, MW-5, MW-6 and MW-7, the data will be evaluated and a determination made regarding the frequency of water quality sampling events.

The following additional ground water monitoring activities are proposed for 2005:

1. Construct a nested pair of monitoring wells with completions in the shallow aquifer and the deeper black sand aquifer. The new wells will be constructed as part of abandoning the test well at Dairy #1. The new wells will be used to monitor water quality in the shallow aquifer and to measure head differences between the two aquifers.
2. Conduct electrical resistivity geophysical surveys to determine if the method is suitable for mapping water quality in the shallow aquifer.
3. If the method is suitable, use electrical resistivity surveys to map the location and extent of contaminant plumes in the shallow aquifer and attempt to locate contaminant sources.

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

Sincerely,



John Monks, P.G.

Cc: Hans Nederend - Nederend Dairy, Ilene Dobbin - COCOA, Gary Bahr - ISDA

**Nederend Dairy 2004 Shallow Aquifer Water Quality
and Water Table Elevation Data Summaries**

1/31/2005

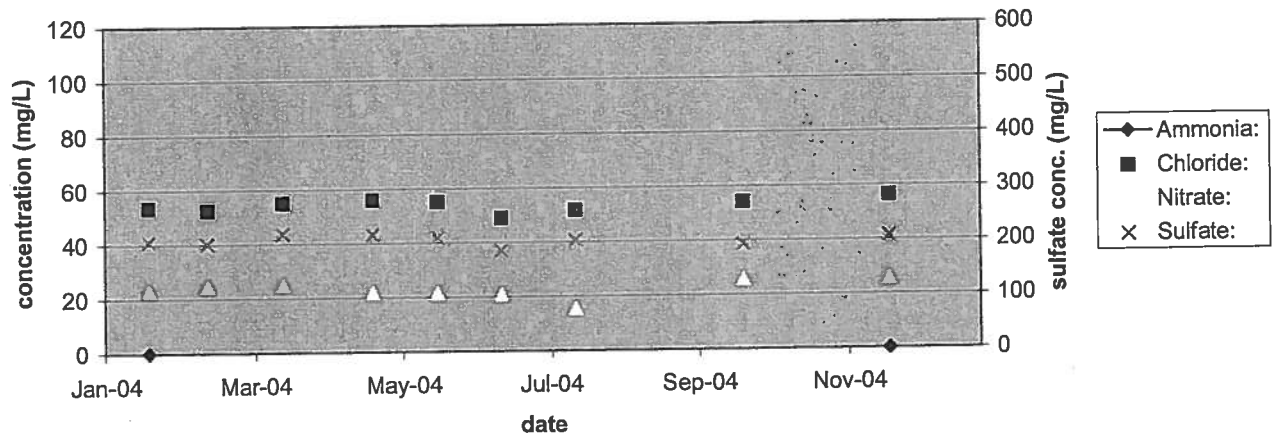
MW-1 Adjacent to Nederend #2 along Thompson Road

2294.59 mp elevation

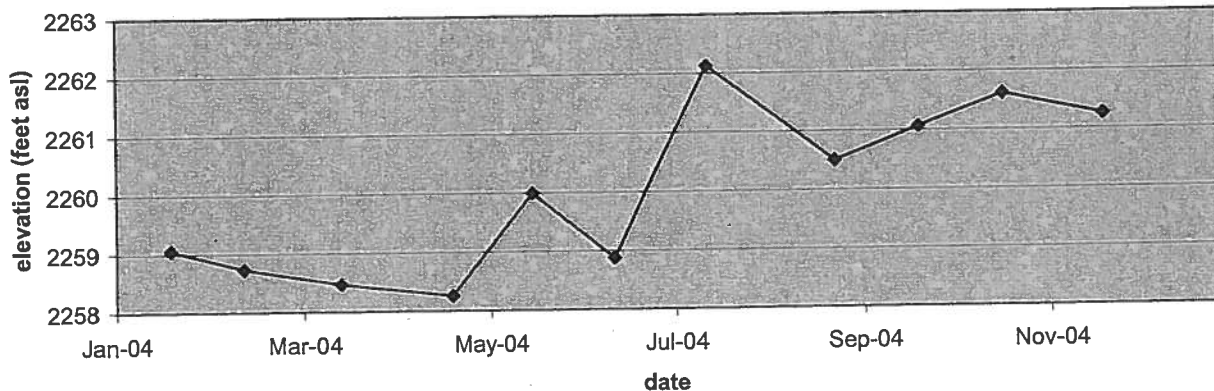
UTM coordinates: 510662.7 4822801.5

stdev:	0.01	2.34	3.26	10.28				
avg:	0.01	53.81	22.54	205.22				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT Elev:	WT change:
1/19/2004	0.01	53.6	23.2	206	absent	35.53	2259.06	0.10
2/12/2004		52.6	24.4	202	absent	35.85	2258.74	-0.32
3/15/2004		55.2	24.8	219	absent	36.12	2258.47	-0.27
4/21/2004		56.0	21.8	217	absent	36.33	2258.26	-0.21
5/18/2004		55.3	21.4	210	absent	34.59	2260.00	1.74
6/14/2004		49.1	20.8	186	absent	35.71	2258.88	-1.12
7/15/2004		51.8	15.3	204	absent	32.46	2262.13	3.25
8/26/2004						34.08	2260.51	-1.62
9/23/2004		54.3	25.6	195	absent	33.52	2261.07	0.56
10/21/2004						32.97	2261.62	0.55
11/23/2004	0.001	56.4	25.6	208	absent	33.33	2261.26	-0.36

Nederend Dairy Well MW-1 Water Quality



**Nederend Dairy Well MW-1
Potentiometric Surface Elevation**



1/31/2005

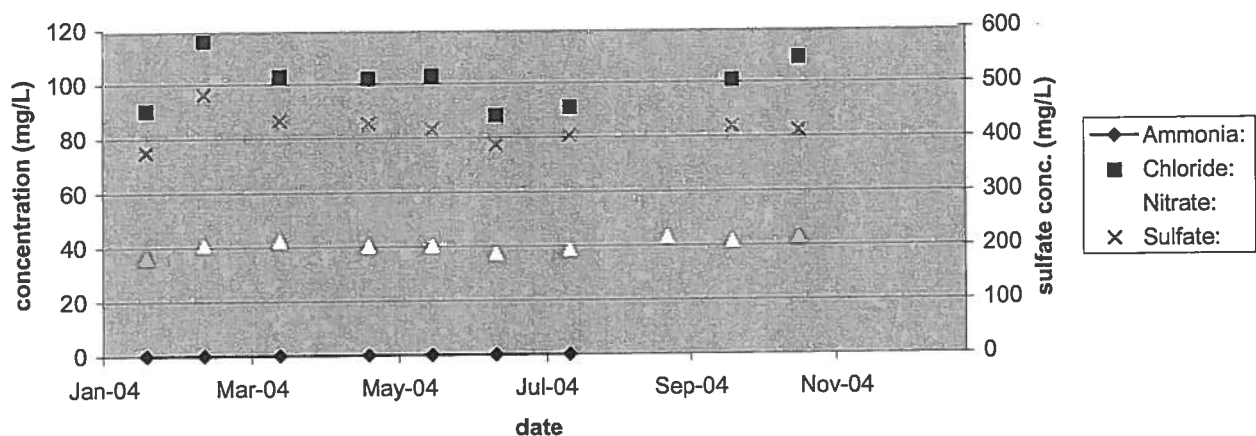
MW-2 North of Dairy Lagoons and barns

2276.31 mp elevation

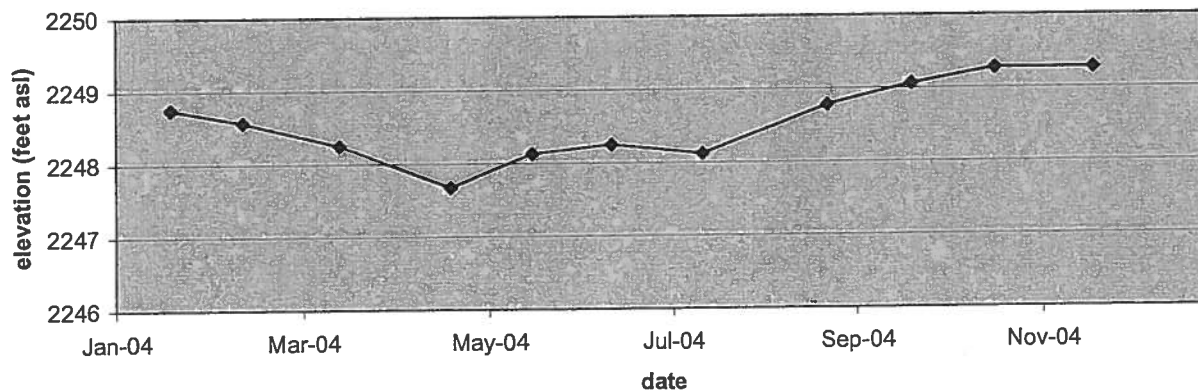
UTM coordinates: 510742.2 4823698.7

stdev:	0.01	9.51	2.27	29.92				
avg:	0.01	101.66	40.45	419.10				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT Elev:	WT change:
1/19/2004	0.01	90.3	36.3	375	invalid	27.56	2248.75	-0.09
2/12/2004	NA	116.0	40.7	482	invalid	27.74	2248.57	-0.18
3/15/2004	NA	103.0	42.2	433	absent	28.06	2248.25	-0.32
4/21/2004	NA	102.0	40.2	426	absent	28.64	2247.67	-0.58
5/18/2004	NA	103.0	40.2	415	invalid	28.18	2248.13	0.46
6/14/2004	NA	88.3	37.2	386	absent	28.06	2248.25	0.12
7/15/2004	NA	91	38.5	403	absent	28.19	2248.12	-0.13
8/26/2004	NA		43.1		absent	27.53	2248.78	0.66
9/23/2004	NA	101	41.5	419	absent	27.25	2249.06	0.28
10/21/2004	NA	109	42.6	411	absent	27.04	2249.27	0.21
11/23/2004	0.001	113	42.4	441	absent	27.04	2249.27	0.00

Nederend Dairy Well MW-2 Water Quality



Nederend Dairy Well MW-2 Potentiometric Surface Elevation



1/31/2005

MW-3 North of mixing lagoon

2265.33 mp elevation

UTM coordinates:

easting:

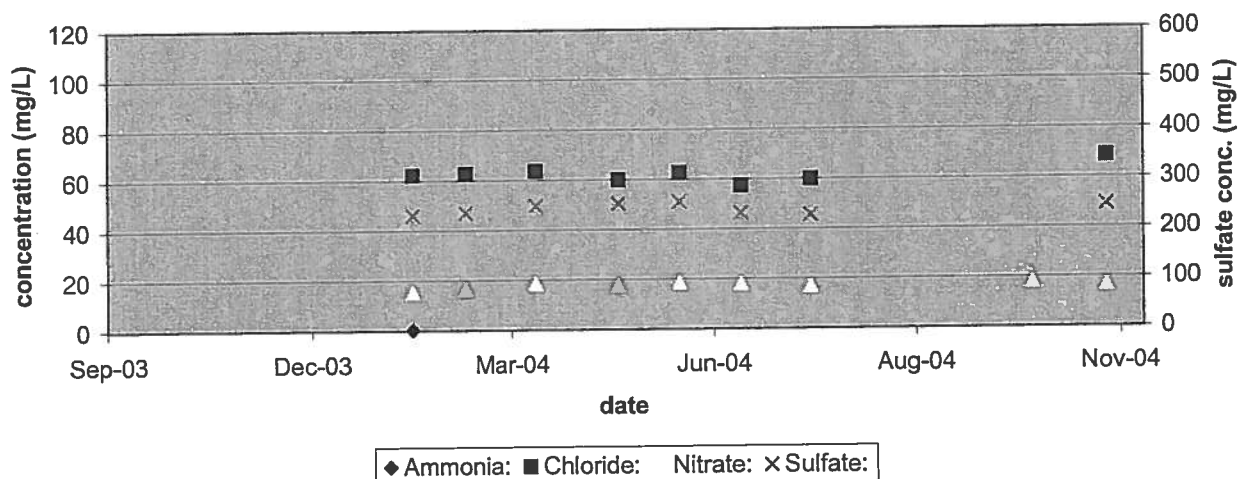
northing:

509846.5

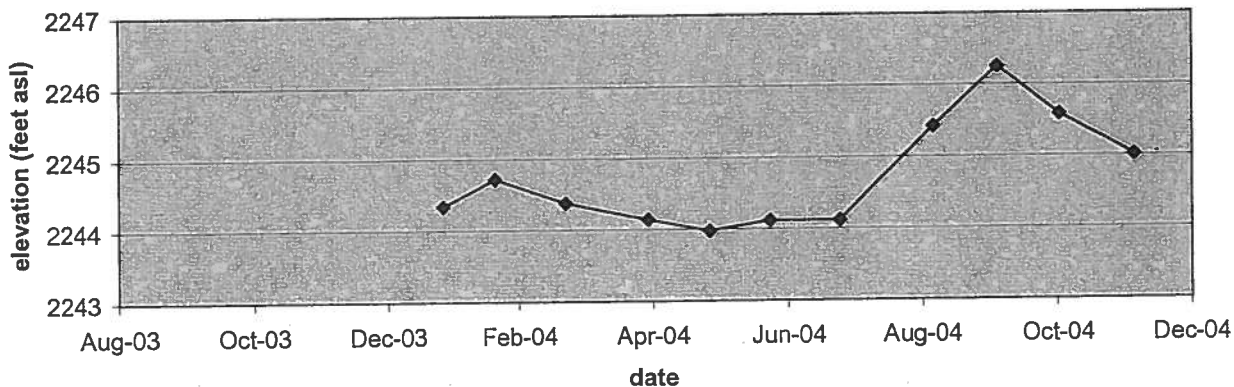
4823893.3

stdev:	0.01	3.34	1.06	10.80				
avg:	0.01	62.23	17.32	240.63				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT elev.:	WT change:
1/19/2004	0.01	62.3	15.3	230	invalid	20.99	2244.34	-0.16
2/12/2004		62.8	16.4	235	invalid	20.61	2244.72	0.38
3/15/2004		63.7	18.6	248	invalid	20.95	2244.38	-0.34
4/21/2004		60.0	17.5	252	absent	21.19	2244.14	-0.24
5/18/2004		62.7	18.5	255	invalid	21.35	2243.98	-0.16
6/14/2004		57.5	17.9	231	absent	21.21	2244.12	0.14
7/15/2004		60	17	228	present	21.21	2244.12	0.00
8/26/2004						19.91	2245.42	1.30
9/23/2004						19.08	2246.25	0.83
10/21/2004			17.9			19.75	2245.58	-0.67
11/23/2004	0.001	68.8	16.8	246	absent	20.32	2245.01	-0.57

Nederend Dairy Well MW-3 Water Quality



Nederend Dairy Well MW-3 Potentiometric Surface Elevation



1/31/2005

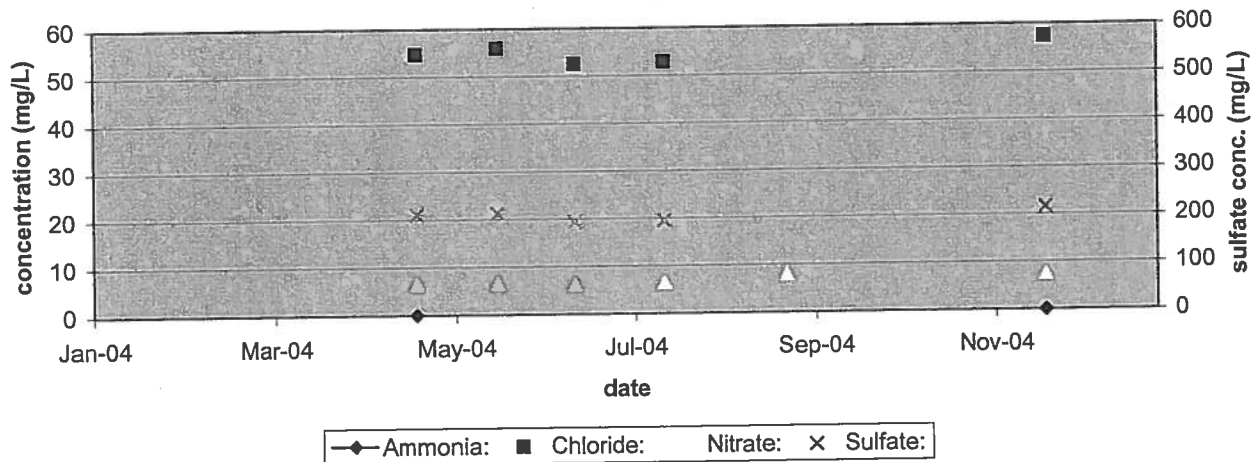
MW-4 North of Hwy 55, upgradient well

2305.73 mp elevation

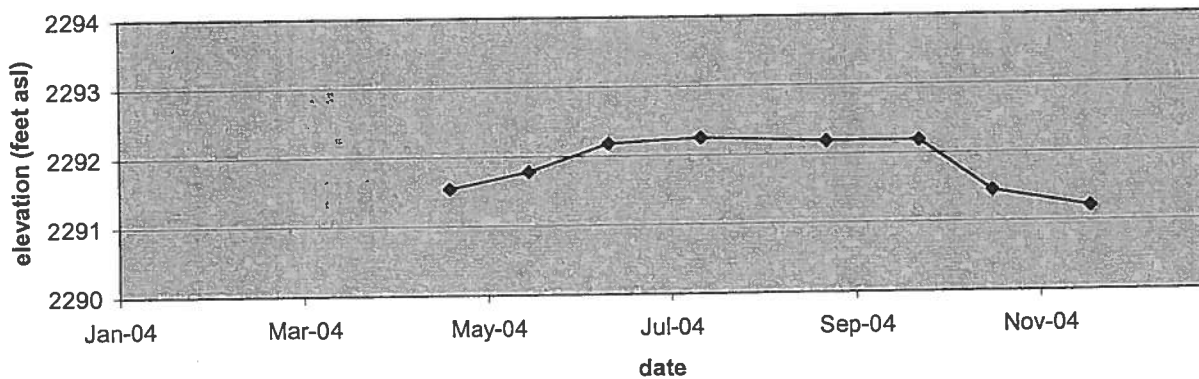
UTM coordinates: 512805.9 4821231.9

stdev:	0.01	2.04	0.67	10.47				
avg:	0.01	54.74	6.85	205.20				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT elev.:	WT change:
4/21/2004	0.01	54.8	6.6	210	present	14.19	2291.54	
5/18/2004		56.0	6.6	212	present	13.95	2291.78	0.24
6/14/2004		52.5	6.2	193	present	13.55	2292.18	0.40
7/15/2004		53	6.45	195	present	13.48	2292.25	0.07
8/26/2004			7.92		absent	13.54	2292.19	-0.06
9/26/2004						13.54	2292.19	0.00
10/21/2004						14.28	2291.45	-0.74
11/23/2004	0.001	57.4	7.43	216	absent	14.52	2291.21	-0.24

Nederend Dairy Well MW-4 Water Quality



**Nederend Dairy Well MW-4
Potentiometric Surface Elevation**



1/31/2005

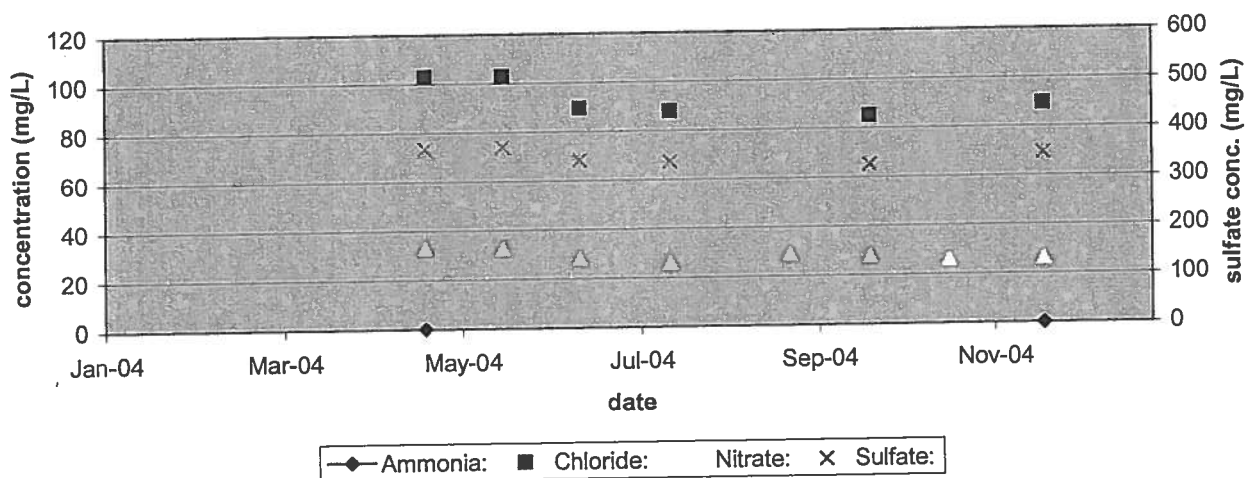
MW-5 North end of Pivot east of manure drying yard

2298.9 mp elevation

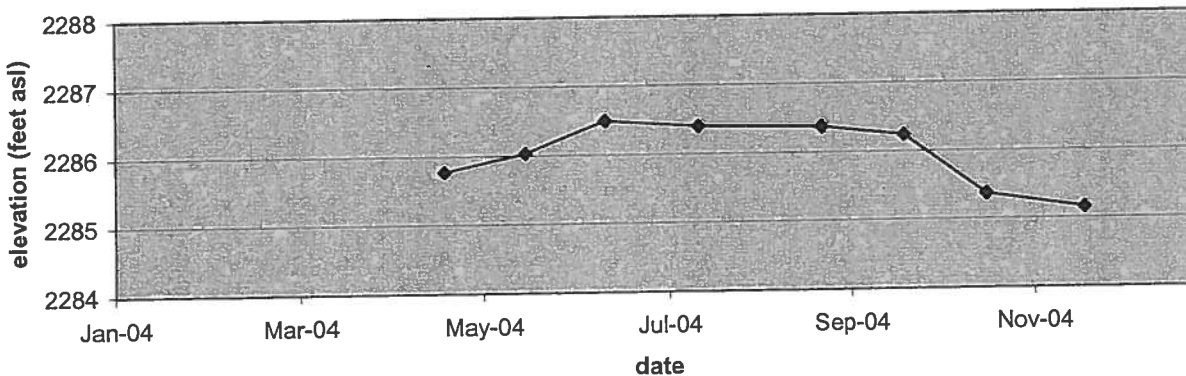
UTM coordinates: 512429.5 4821971.7

stdev:	0.03	7.84	2.76	16.98				
avg:	0.03	93.10	28.69	347.50				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT elev.:	WT change:
4/21/2004	0.05	103.0	33.0	366	present	13.13	2285.77	
5/18/2004		103.0	32.6	369	present	12.87	2286.03	0.26
6/14/2004		89.7	28.3	341	absent	12.41	2286.49	0.46
7/15/2004		88	26.1	336	absent	12.5	2286.4	-0.09
8/26/2004			29.1		absent	12.53	2286.37	-0.03
9/23/2004		85.2	27.9	326	absent	12.66	2286.24	-0.13
10/21/2004			26.2		absent	13.53	2285.37	-0.87
11/23/2004	0.001	89.7	26.3	347	absent	13.74	2285.16	-0.21

Nederend Dairy Well MW-5 Water Quality



Nederend Dairy Well MW-5 Potentiometric Surface Elevation



1/31/2005

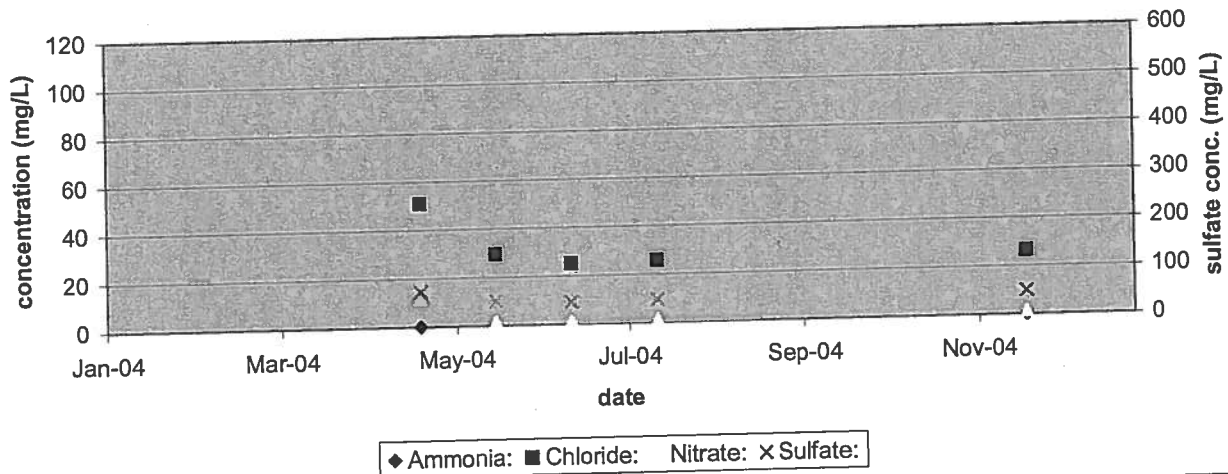
MW-6 Next to corrals north of lagoons

2300.41 mp elevation

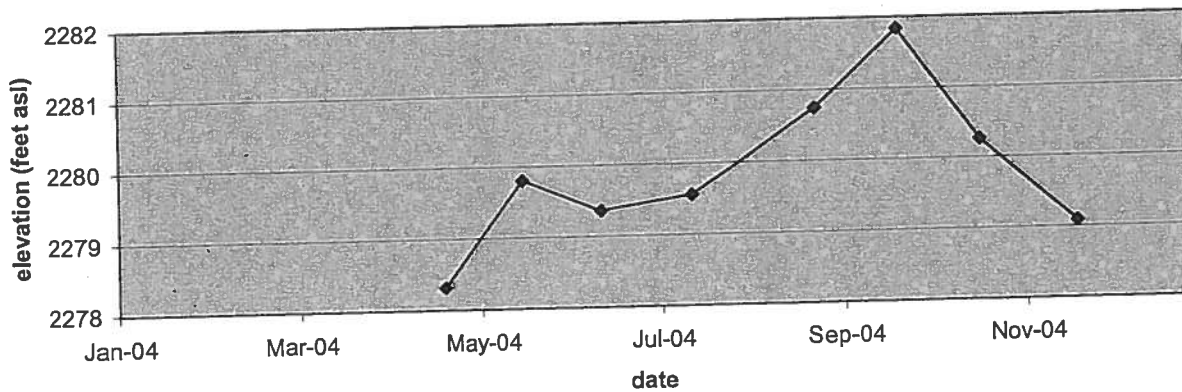
UTM coordinates: 512048.0 4822439.7

stddev:	0.01	10.92	4.82	11.10				
avg:	0.01	31.72	3.48	52.84				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT elev.:	WT change:
4/21/2004	0.02	51.0	12.1	72.4	absent	22.1	2278.31	
5/18/2004		29.8	1.56	50.2	absent	20.61	2279.8	1.49
6/14/2004		25.2	1.21	45.2	absent	21.05	2279.36	-0.44
7/15/2004		25.9	1.17	47.2	absent	20.85	2279.56	0.20
8/26/2004						19.67	2280.74	1.18
9/23/2004						18.57	2281.84	1.10
10/21/2004						20.15	2280.26	-1.58
11/23/2004	0.005	26.7	1.34	49.2	absent	21.32	2279.09	-1.17

Nederend Dairy Well MW-6 Water Quality



**Nederend Dairy Well MW-6
Potentiometric Surface Elevation**



1/31/2005

MW-7 West end of lagoons at Dairy #2

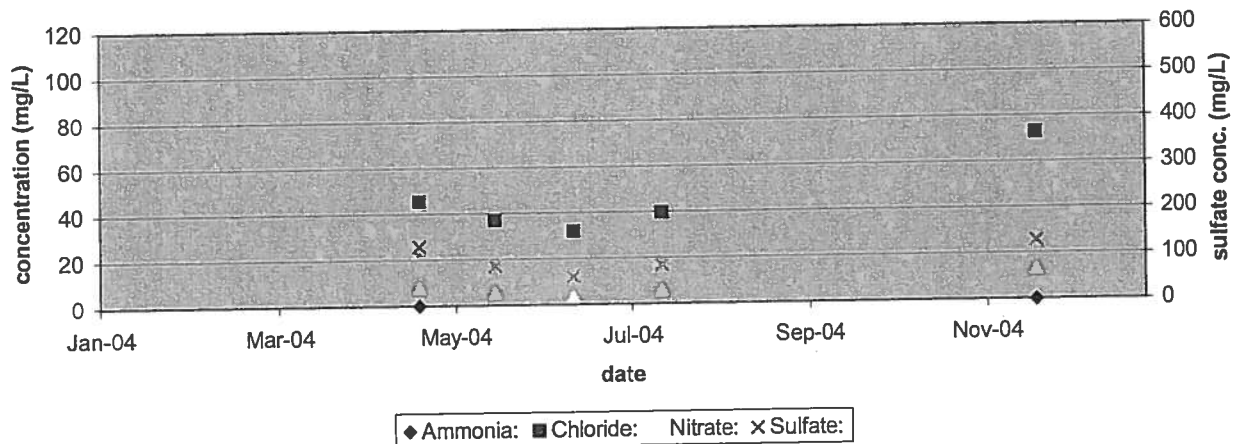
2300.23 mp elevation

UTM coordinates: 512061.9

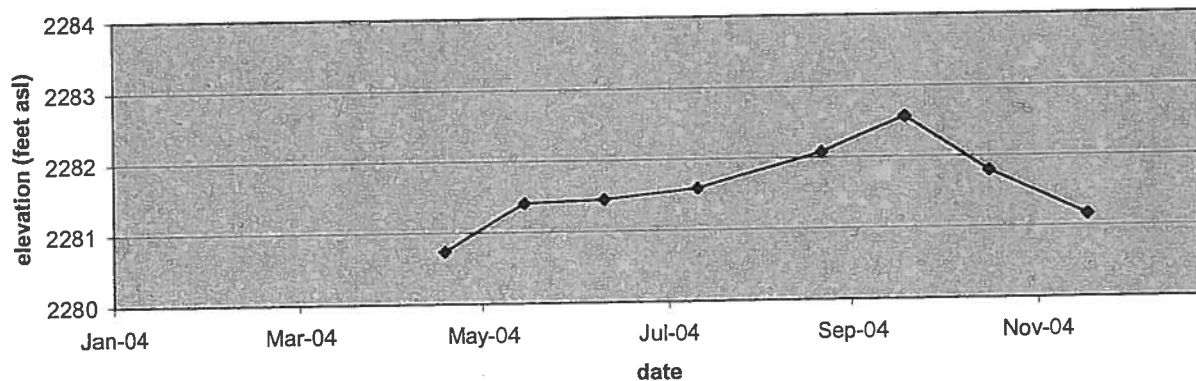
4822237.0

stdev:	0.02	15.98	3.71	29.81				
avg:	0.02	45.56	7.18	98.12				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT elev.:	WT change:
4/21/2004	0.03	45.6	7.91	129	absent	19.49	2280.74	
5/18/2004		37.2	5.51	85.9	absent	18.82	2281.41	0.67
6/14/2004		32.2	3.46	61.7	absent	18.78	2281.45	0.04
7/15/2004		40	5.84	85	absent	18.64	2281.59	0.14
8/26/2004						18.15	2282.08	0.49
9/23/2004						17.66	2282.57	0.49
10/21/2004						18.43	2281.8	-0.77
11/23/2004	0.001	72.8	13.2	129	absent	19.06	2281.17	-0.63

Nederend Dairy Well MW-7 Water Quality



**Nederend Dairy Well MW-7
Potentiometric Surface Elevation**



1/31/2005

Nederend Domestic

2290.13 mp elevation

UTM coordinates (NAD27): 511236.4 4823140.2

stdev:	0.01	5.20	4.07	13.94				
avg:	0.01	70.26	34.73	215.09				
Date:	Ammonia:	Chloride:	Nitrate:	Sulfate:	Coliform:	DTW:	WT Elev:	WT change:
1/19/2004	0.01	68.8	38.5	204	Absent	25.77	2264.36	-0.67
2/12/2004		67.3	38.4	203	Absent	26.24	2263.89	-0.47
3/15/2004		70.2	35.2	217	Absent	26.78	2263.35	-0.54
4/21/2004		69.2	34.7	220	Absent	27.26	2262.87	-0.48
5/18/2004		71.1	33.5	236	Absent	26.09	2264.04	1.17
6/14/2004		64.2	32.6	208	present	25	2265.13	1.09
7/15/2004		64.9	28.9	198	present	23.7	2266.43	1.3
8/26/2004		81.9	40.9	244	present	23.77	2266.36	-0.07
9/23/2004		72.1	37.2	212	Absent	23.43	2266.70	0.34
10/21/2004		76.6	34.7	211	Absent	23.9	2266.23	-0.47
11/23/2004	0.001	66.6	27.4	213	Absent	24.38	2265.75	-0.48

