

MEMORANDUM

92-e26

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To: Phil KauzLoric

From: Denis Erickson 
EILS

Subject: Summary of Ecology Dairy Lagoon Ground Water Assessments.

Environmental Investigations Program of Ecology is monitoring four dairy lagoons in Washington State to determine if lagoon leakage affects ground water quality. Two of the lagoons are in Whatcom County near Lynden, one is in Yakima County near Sunnyside, and one is in Lewis County near Chehalis. Monitoring wells were installed at each lagoon and sampled for a number of parameters (chloride, total dissolved solids, total organic carbon, chemical oxygen demand, total phosphorus, ammonia as N, nitrate+nitrite as N, and total and fecal coliform bacteria).

Table 1 summarizes lagoon construction, ground water conditions, and findings from the first year of monitoring. To date overall conclusions of the study are as follows:

1. Leakage from three of the four lagoons studied has affected ground water quality to varying degrees. The two lagoons in Whatcom County showed elevated concentrations for most parameters due to leakage. The lagoon in Yakima County showed elevated concentrations for chloride but long-term effects were probably not observed in the first year of monitoring. The lagoon in Lewis County has not affected ground water quality.
2. Long-term monitoring (2 to 5 years) is needed to understand ground water quality variations near lagoons because of seasonal variability of shallow ground water in agricultural areas.
3. Chloride appears to be a good indicator of leakage from lagoons to ground water.

The site conditions and the results for the first year of monitoring for each of the lagoon studies are discussed below in more detail. Also, detailed reports are available for each lagoon (See References attached to this memo).

Edaleen Dairy Lagoon (Whatcom County)

The Edaleen Dairy Lagoon is a new two-stage lagoon system consisting of a settling pond (2.4 million gallons) and a main lagoon (10.4 million gallons). The settling pond received wastewater in March 1990 and the main lagoon received wastewater in May 1990.

Table 1. Summary of Ecology Ground Water Assessments at Dairy Lagoons in Washington State.

Name	Capacity (million gallons)	Liner Type	Construction Meets SCS Guidelines	Month/Year First Used	Date Monitoring Began	Aquifer Material	Depth to Water Table (BGS ¹ , feet)	Evidence for Lagoon Leakage to Ground Water
Edaleen Dairy (Whatcom County)								
Settling Pond	2.4	Compacted	No	3/90	2/90	Sand and gravel	3 to 5	Yes
Main Lagoon	10.4	Topsoil		5/90				
Hornby Dairy (Yakima County)								
Settling Ponds	0.8	Unknown	Unknown	1/90	4/90	Silty sand	5 to 10	Yes
Main Lagoon	5.0			1/90				
Whatcom Dairy Lagoon #2	2.5	Unlined	No	1980 (widened 1989)	2/91	Sand and gravel	5 to 9	Yes
Sheridan Dairy (Lewis County)	1.1	Unlined	Unknown	1985	6/91	Gravel	5 to 10 ²	No

¹ BGS= Below Ground Surface.

²The aquifer is overlain by about 30 feet of silt and clay deposits. Water levels rise to within 5 to 10 feet of the surface when wells penetrate the aquifer.

Monitoring wells were installed before the lagoons were used. The lagoon is built over a shallow sand and gravel aquifer. The water table appears to contact the bottom of the lagoon during the winter.

Samples were obtained monthly the first year and intermittently thereafter. Ground water downgradient of the lagoon showed elevated concentrations for all parameters. For the first year concentrations for all parameters, with the exception of ammonia as N, increased to maximal levels and then began to decrease. Ammonia-N concentrations were still increasing at the end of the first year. Subsequent samples after the first year showed that concentrations again increased to levels similar to the maximums observed during the first year of monitoring. The degradation of water quality seems to be seasonal and is probably related to fluctuations of the water table which contacts the bottom of the lagoons during the winter.

Hornby Dairy Lagoon (Yakima County)

The Hornby Dairy lagoon system is a new two-stage system consisting of two settling ponds (0.4 million gallons each) and a main lagoon (5 million gallons). The lagoon system was constructed in fall 1989 and monitoring wells were installed in April 1990. The lagoons are constructed over a shallow alluvial aquifer consisting of silty fine sand.

Samples were obtained quarterly the first year and intermittently thereafter. Chloride concentrations in all wells downgradient of the main lagoon increased after the second and third quarters of monitoring (between four and ten months after the lagoon received wastewater). Other parameters downgradient of the main lagoon were not elevated relative to upgradient concentrations. At the onset of the study, one monitoring well downgradient of the settling ponds showed elevated concentrations of most parameters relative to upgradient concentrations. The cause of this degradation of ground water is unknown but may be related to the old lagoon that was replaced by the new lagoon system. Based on the estimated ambient ground water flow velocity (between 0.3 and 29 feet per year) the long-term effects of lagoon leakage on ground water quality were probably not observed in the first year of sampling.

Whatcom County Dairy Lagoon #2

The Whatcom County Dairy Lagoon #2 is a single-stage lagoon constructed in 1980 and widened in 1989. It has a capacity of 2.5 million gallons. It was constructed over a shallow sand and gravel aquifer. The water table fluctuates seasonally and may contact the bottom of the lagoon during winter.

Monitoring wells were installed February 1991 and sampled quarterly for one year and intermittently thereafter. In downgradient wells concentrations of total dissolved solids, chemical oxygen demand, total organic carbon, ammonia as N, total phosphorus, and chloride consistently exceeded upgradient concentrations, probably due to leakage from the lagoon. One downgradient monitoring well showed anomalously high concentrations for one sampling event, probably due to localized leakage from the lagoon.

Sheridan Dairy Lagoon (Lewis County)

The Sheridan Dairy Lagoon is a single-stage lagoon constructed in 1985 and has a capacity of 1.1 million gallons. The uppermost monitorable aquifer consists of a thin gravel layer at a depth of 30 feet. Silt and clay alluvial sediments separate the lagoon from the underlying aquifer. The water quality of the aquifer is poor. The cause of the degraded ground water quality is probably due to upgradient land uses (agriculture and septic tanks). The lagoon does not appear to have affected ground water quality. Nitrate+nitrite as N concentrations are elevated in two of three downgradient wells but no other parameters are elevated. It is unlikely that the nitrate+nitrite as N concentrations are the result of leakage from the lagoons.

REFERENCES

- Erickson, D.R., 1991. Edaleen Dairy Lagoon Ground Water Quality Assessment, February 1990 to February 1991. Washington State Department of Ecology Report, 32 pgs.
- Erickson, D.R., 1992a. Hornby Dairy Lagoon Ground Water Quality Assessment, Washington State Department of Ecology Report, 22 pgs.
- Erickson, D.R., 1992b. Whatcom County Dairy Lagoon #2 Ground Water Quality Assessment, Washington State Department of Ecology Report, 26 pgs.
- Erickson, D.R., 1992c. Sheridan Dairy Lagoon Ground Water Quality Assessment. Washington State Department of Ecology Report, in progress.