

STAFF REPORT

**EVALUATION OF POTENTIAL WATER QUALITY IMPACTS FROM DAIRY
OPERATIONS AND DEVELOPMENT OF REGULATORY STRATEGY**

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Problem

Dairy operations produce wastewater and manure containing nutrients and salts. Other constituents of concern include heavy metals, pathogens, antibiotics, and hormones (Bradford et al, 2008). When not properly managed these wastes adversely affect surface and groundwater quality. In the southern watersheds of the Lahontan Region, several domestic supply wells located down gradient of dairy operations have exhibited nitrate and Total Dissolved Solids (TDS) concentrations that exceed drinking water standards. The purpose of this staff report is to outline and prioritize the steps needed to address these problems and to determine the most appropriate regulatory strategy for dairies in the region.

Background

There are eleven active dairies, two feed lots, two inactive dairies and six historical dairies known within the southern Lahontan Region in Los Angeles and San Bernardino Counties. An inactive dairy is one in which the dairy is currently not producing milk and there are no animals present at the site but the facilities that constitute the dairy still remain. A historical dairy is one in which the dairy facilities no longer exist and the land is available for other land uses (i.e. barns, corrals and other dairy apparatus are no longer present). While the location of a historical dairy operation may now support other land uses, past waste disposal practices may continue to degrade or pollute groundwater. Of the active dairies, seven are located near the Mojave River, two are in El Mirage, one is in Newberry Springs, and one is in the Antelope Valley (Figure 1).

In the Lahontan Region, dairies are regulated under the non-point source program using a three tiered approach: 1) voluntary implementation of best management practices (BMPs), 2) regulatory-based encouragement of BMPs, and 3) adoption of waste discharge requirements (WDRs). The Lahontan Water Board has taken a risk-based approach to determine which dairies to regulate under WDRs. Historically, dairies located within and immediately adjacent to the Mojave River floodplain or those exhibiting a groundwater pollution were issued WDRs. WDRs require each dairy to mitigate the impact to groundwater from their operations by directing them to limit manure disposal to 3.6 tons/acre/year and to implement BMPs for wash water disposal. While the Water Quality Control Plan for the Lahontan Region, (Basin Plan) contains the three tier non-point source program approach, the State of California has shifted away from voluntary implementation of BMPs and moved toward regulating discharges of wastes from dairy operations.

Residential Supply Wells

Water Board staff estimate that there may be over 200 residents drawing groundwater from private wells located within one half mile of an active dairy in the region. While groundwater monitoring is required of all dairies regulated under WDRs, some of these monitoring networks are less than ideal due to poor well location or dry well conditions. However, groundwater monitoring data from four dairies (A through D) as shown on Table 1, show nitrate and TDS pollution. Since there are no dedicated monitoring wells in the vicinity of domestic or agricultural supply wells and there is evidence of a potential release from a number of dairies, Water Board staff began sampling domestic wells near dairies in late 2009 to identify if there are receptors that could be affected by polluted groundwater. The limited water quality data suggest groundwater pollution extends beyond some dairy property boundaries and is present in nearby domestic water supply wells. Laboratory results have been provided to all residents and land owners whose supply wells were found to be affected. However, Water Board staff could not sample all domestic supply wells likely to be influenced by dairy contamination due to resources and well access issues. Depending upon the results of the limited groundwater data, the Water Board may require some dairies to conduct additional investigations and/or the Water Board may conduct additional sampling.

**Table 1 – Region 6 Dairies
Data Summary**

Dairy	WDR or CAO	Number of cows	Depth to ground water (ft)	Highest single nitrate as N sample result (mg/L)	Highest total dissolved solid (TDS) sample result (mg/L)	Sample date	No. of monitoring wells	Wash water disposal method
A	Yes	1500	88	95	4700	10/9/2008	15	Sprinkler
B	Yes	1550	26.5	33.9	3200	7/13/2009	3	Sprinkler
C	Yes	4645	30	32	3210	5/4/2009	4	Retention pond
D	Yes	3340	58	32	2510	5/4/2009	6	Flooding
E	No	1400	70	9.7*	560	2/24/10	NA	Unknown
F	No	900	85	9.4*	520	8/28/09	NA	NA
G	Yes	2280	63	3.8*	550	12/29/2008	None	Sprinkler
H	No	960	70	3.2*	430	7/8/2009 for N & 7/17/09 for TDS	NA	Unknown
I	Yes	3416	185	1.3	500	6/12/2009	1	Retention pond & Sprinkler
J	No	1300	170	0.91*	530	3/12/2008	NA	Retention pond
K	No	4500	307	0.75*	630	8/24/09	NA	NA

Note: 1. (*) denotes supply well

2. Water Board staff collected data from the dairies Self Monitoring Reports or from Field Sampling Data

Proposed Dairy Regulatory Program

The current regulatory approach for dairy operations in the Lahontan Region is to require WDRs and monitoring of BMP performance for dairy operations that have a high potential to affect water quality. Given the recent awareness of the influence of dairy operations on area domestic wells, Water Board staff recommends a change in our regulatory approach to one that is focused on identification of affected receptors, provides an alternate source of water to those affected, and emphasizes source control at dairies. The proposed program consists of short and long-term goals. These goals have been developed to address issues that may be dairy specific while still establishing a level regulatory program and would be implemented in a phased approach. Timing for implementation of these goals depends on resources available to the dairy owners and for regulatory oversight. Because of limited resources, activities must be prioritized with protection of receptors being the highest priority.

Staff recommends a regulatory program consisting of the following key components, shown in priority order:

1. Assess and address risk to downgradient receptors from exposure to polluted groundwater;
2. Identify appropriate source controls and require phased implementation of suitable waste minimization, control and disposal practices under WDRs or a Conditional Waiver;
3. Ensure adequate monitoring to evaluate the extent of affected groundwater and the effectiveness of source control measures implemented; and
4. Require groundwater remediation where groundwater beneficial uses are impaired.

This program would encompass all dairies and would not supercede requirements contained in existing waste discharge requirements or cleanup and abatement orders. Steps to implement these components are detailed further below.

Priority 1 – Assess Risk through Sampling of Residential Wells

Water Board staff have sampled a small subset of the private drinking water wells near dairies. However, once a single well is determined to have groundwater that exceeds or is approaching the drinking water standard for a constituent of concern, then further investigation of all nearby private wells that are likely to be exposed is warranted. It is recognized that other sources of nitrate and salts may also be present in the area including septic tanks and agricultural or similar land uses. Chemical and physical attributes of the groundwater will be evaluated to confirm or eliminate individual dairies as a potential source. Consistent with other groundwater pollution cases, as a first step in the overall strategy, the Water Board would require dairy owners participate in a program to sample residential wells near the dairies to ensure that the residents' drinking water is not affected by dairy operations. Investigative Orders will be issued to dairy owners to conduct further investigation if they are confirmed as the source of groundwater pollution. In cases where groundwater pollution is associated with dairy waste disposal then the Executive Officer

will issue a Cleanup and Abatement Order to require a dairy owner supply potable water to affected residents.

Priority 2 - Source Control

Source control is the most effective means of reducing the impact from all dairy operations on groundwater quality. Harter et al (2002) found that targeted manure management reduced nitrate concentrations by 50% in shallow groundwater within the first two years of implementation at dairies in the Central Valley of California. Source control may require significant changes in dairy operations and/or construction of additional facilities. Before undertaking such changes and making capital improvements, it is appropriate to evaluate existing dairy operations with regard to waste generation and disposal and threat to water quality. Water Board staff recommend that comprehensive nutrient management plans (CNMP) be required of all dairies. These CNMPs would address the exact acreage of croplands, crop type and the crop use of the nutrients in liquid and solid animal wastes to determine appropriate loading rates for available land at the dairy. As part of the overall strategy, the Water Board would require dairy owners pursuant to California Water Code Section 13267, Investigative Orders or revised WDRs to develop such plans for regulatory acceptance and implementation over the next three to five years. Successful CNMPs require a sound understanding of the nitrogen balance at a dairy. A dairy owner should consult with and obtain technical advice on developing an effective CNMP from agencies with this expertise such as the local Resource Conservation District.

Priority 3 - Compliance Monitoring

The Dairy Regulatory Strategy must consider the most effective means to monitor compliance with WDRs/Conditional Waivers and nutrient reduction through source controls. There is a large amount of spatial and temporal variability in groundwater data at dairies. Harter (2001) found that this variability severely limits the effectiveness of groundwater monitoring wells at dairies. Dairies in the Lahontan Region can occupy hundreds of acres and dense monitoring well networks are costly. Where applicable, compliance monitoring schemes should incorporate mutually supportive monitoring wells from external agencies and well owners. Moreover, compliance monitoring may need to focus on mechanisms to observe and track farm nutrient budgets in order to better evaluate effectiveness of source controls. Implementation of compliance monitoring will focus on dairies that are regulated under WDRs and have known groundwater pollution. Revision of associated Monitoring and Reporting Programs will be considered where appropriate. Investigative Orders will be employed to require groundwater monitoring networks at unregulated dairies where there is strong evidence of a pollution from the dairy.

Priority 4 - Groundwater Cleanup

In areas where groundwater is polluted, the strategy must include a requirement for replacement water to be provided if receptors are drinking affected water. Additionally, groundwater investigation and remediation is needed to address protection of the resource.

Feedback from Dairy Owners

Dairy owners have indicated that they are going through a period of economic hardship because the costs of dairy operations are higher than their revenue from the dairies. Given this situation, staff is taking the following steps to develop a considered and effective plan.

- Meet with dairy owners to get their input for the best approach to reduce and to contain further degradation of groundwater without placing an excessive burden on them;
- Meet with Western United Dairymen, Milk Producers Council, Natural Resources Conservation Service and counties to seek sources of grants or other financial aid available for pollution prevention programs for the dairies; and
- Detect water quality trends, identify problem areas, and determine the appropriate levels of action necessary to contain further degradation of groundwater.

Based on initial meetings Water Board staff received the following feedback from the dairy owners.

- Good science should be used to determine sources of pollution detected in drinking water well. Dairies should not be automatically assumed to be the source;
- Other potential sources of nitrates may exist in the area;
- Dairy owners do not have financial resources to implement all or parts of the proposed dairy regulatory program and the banks are not lending;
- Identify other resources or grants to do this work; and
- Dairy owners want to comply but need time to obtain resources to do the work.

Comparison to Other Nitrate Groundwater Pollution Cases

Nitrate pollution has been detected in groundwater at other sites in the Region, primarily from sewage treatment plants. In some cases this polluted water has affected private drinking water supply wells. The proposed Dairy Regulatory Program is consistent with the Water Board's approach to dealing with nitrate pollution from other dischargers. The Water Board has issued cleanup and abatement orders to dischargers including the City of Barstow, the Los Angeles County Sanitation District (Palmdale Wastewater Treatment Plant) for plumes with nitrate concentrations of up to 32 mg/L and 19 mg/L as N, respectively. These groundwater pollution cases exhibit nitrate concentrations that are of the same order of magnitude as concentrations observed at several dairies. Enforcement orders have required groundwater investigations and remediation. The Water Board has required dischargers to provide replacement water supply to residences where groundwater has been polluted by the discharge.

Challenges

The top three challenges in protecting water quality from dairy operations are:

1. Protecting the public from exposure to polluted water,

2. Determining the operational control measures necessary to protect water quality, and
3. Developing a regulatory strategy to implement the control measures in a reasonable timeframe while considering the economic constraints of the dairy owners.

Prioritization of dairies and problems is important to make sure that limited resources (private and public) are used most effectively. Developing an effective approach to protect water quality and address existing impacts, using the best science, along with a reasonable implementation schedule will take input from the dairy owners as well as scientists. Implementation will take financial assistance where available.

Recommendations

Staff intends to take the following steps to implement the proposed regulatory strategy.

1. Continue sampling of private wells downgradient of dairies where degradation has been detected or is reasonably suspected in groundwater.
2. Require dairy owners to provide replacement drinking water (e.g., bottled water) to residents with polluted water supply wells, where it is determined that groundwater has been affected and the dairy is the source.
3. Develop a process for dairy owners to prepare and follow a nutrient management plan to apply manure and wash water to land not to exceed agronomic rates.
4. Require dairy owners to develop and follow a waste minimization and BMP plan to control wash water and manure and reduce sources of groundwater pollutants.
5. Prioritize Water Board staff resources for dairy oversight based on threat to water quality and on site-specific environmental and operational conditions.
6. Develop an implementation schedule to implement the proposed dairy regulatory strategy.
7. Use GIS resources to track and manage groundwater and dairy operational data.

Staff will provide a follow-up status item as the strategy is further developed.

References

Bradford et al, 2008, Reuse of concentrated animal feeding operation wastewater on agricultural lands, *Journal of Environmental Quality*, V37, pp S-97 – S-115.

Harter, T., Meyer, R.D., and Mathews, M.C., 2001, Nonpoint source from pollution from animal farming in semi-arid regions: spatio-temporal variability and groundwater monitoring strategies: Proceedings, 3rd International Conference on Future Groundwater Resources at Risk, Lisbon, Portugal, p. 363-372.

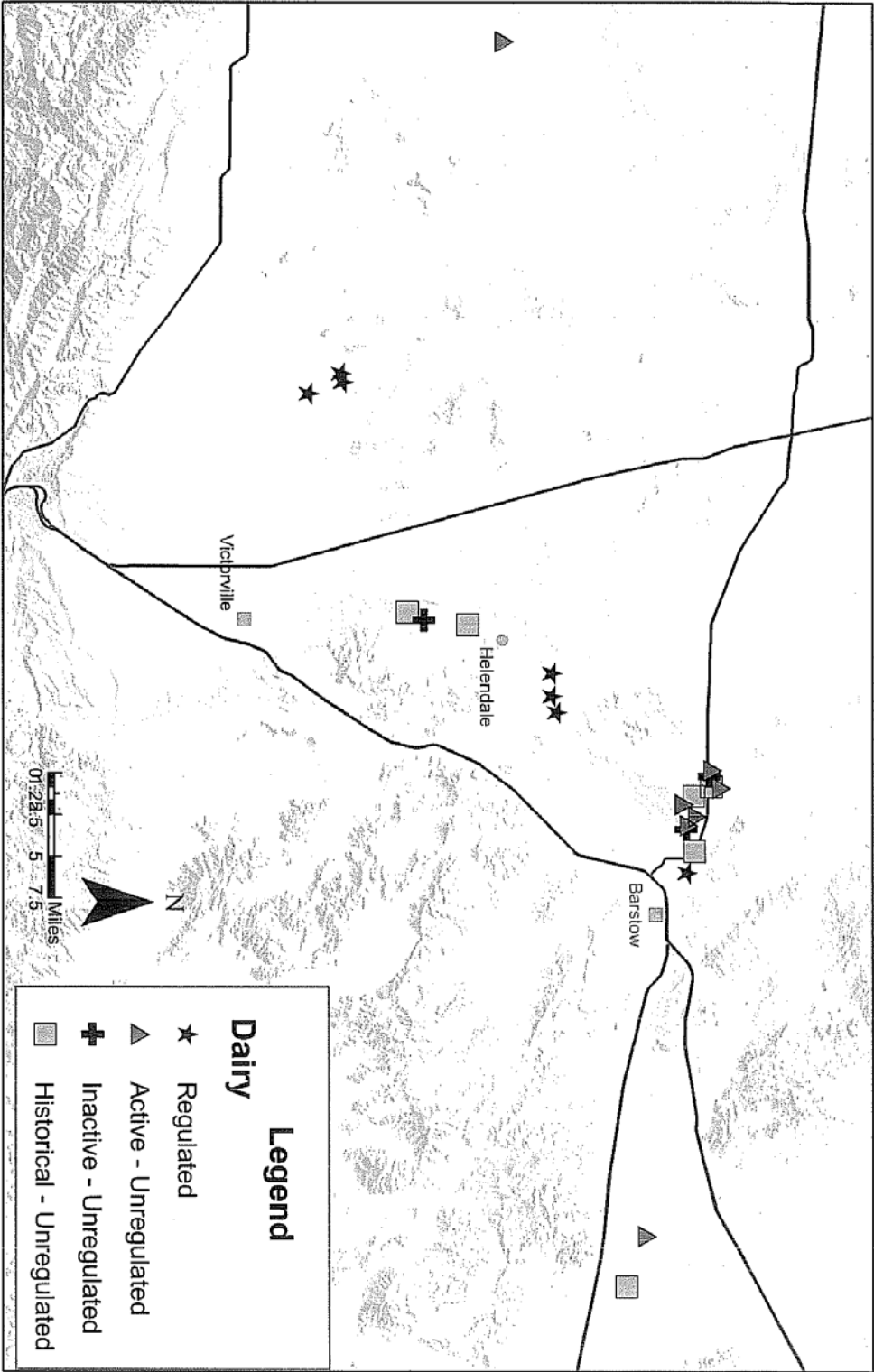
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Harter et al, 2002, Impact of dairy waste and nutrient management on shallow groundwater quality – Final Report, University of California, Davis, Kearney Agricultural Center, 25 p.

Figures: 1. Regional Dairy Map

Attachments: 1. Waste Characteristics
2. Summary of Dairy Regulations

Regional Dairy Map



DairyProj2010Regionaldairy_B_W

RWQCB - Lahontan Region March 30, 2010

Figure 1



Attachment 1

Waste Characteristics

Dairy waste primarily consists of waste wash water and manure. Dairy cows excrete approximately one pound of nitrogen per head per day and approximately 1.3 pounds of salts, primarily sodium, potassium and chloride (Harter, 2002). A dairy with 500 cows could generate roughly 1800 tons of dry manure containing 90 tons of nitrogen and 115 tons of inorganic salts and each year that must be properly managed to prevent impacts to water quality. Nutrients in the wastes (nitrogen, phosphorus and potassium compounds) can be utilized by crops, and wash water and manure is typically land applied for irrigation and fertilization of crops.

Waste Disposal

Wash Water

The volumes of wash and other waste water produced varies greatly based on individual dairy operations. Additionally, the methods of wash water disposal differ from one dairy to another. Disposal methods presently being used include:

- Using a separator to separate manure from wash water before disposal,
- Discharging wash water to unlined ponds, and
- Applying the wash water to cropland using sprinklers or flood irrigation.

Some of the disposal methods contribute to degradation of groundwater. Typically, dairies produce more wash water in the winter than in the summer. The evaporation rate is significantly less in the winter. Therefore, during the winter, corrals stay wetter and cleaning up the cows for milking requires more water. The crops uptake of water and nutrients is also lower in the winter time and may not be sufficient to protect groundwater from contaminants in the waste.

Manure

Another source that may cause pollution in the groundwater is inadequate management and over-application of manure to pasture lands. Many of the dairy owners do not have adequate acreage of croplands for generated manure. Therefore, they have to truck manure to other sites for agricultural usage. One of the regulated dairies generates more manure than it can use on its cropland and has difficulty in finding other places that will accept it, therefore, excess manure is stored at the site. This is a water quality problem because storm water and wash water come in contact with the manure and may percolate to groundwater.

Best Management Practices

Typical BMPs used at dairies includes disposing of wash water and solids on land by crop irrigation and use as a soil amendment. In order to not cause groundwater degradation this application must be done at agronomic rates. BMPs include growing winter crops and high nutrient crops where possible, controlling contact of storm water or wash water with manure, and using a digester to treat manure prior to applying to land. BMPs also include minimizing wash water generation where possible and separating solids from wash water for separate disposal.

Water is re-used several times at the dairies prior to disposal. One dairy in our region reduced wash water generation by washing cows with towels and disinfectant, generating minimal wash water.

Attachment 2

Summary of Dairy Regulations

California Regulations

Regulations for dairy operations are contained in California Code of Regulation, title 27. These regulations require existing milk cow dairies to minimize percolation of wastewater to groundwater in disposal fields, apply manure and wastewater to disposal fields at reasonable agronomic rates, and minimize infiltration of water into underlying soils in solid waste disposal areas. The regulations also require that dischargers locate retention ponds in, or line retention ponds with, soils of at least 10% clay and not more than 10% gravel. Title 27 minimum standards alone may not be adequate to protect groundwater in all cases and waste discharges also must comply with the California Water Code, the Water Quality Control Plan for the Lahontan Region (Basin Plan) and State Policy such as State Water Board Resolution No. 68-16.

Waste Discharge Requirements

There are 11 active dairies in the region. The Water Board has adopted waste discharge requirements (WDRs) for three dairies located within the Mojave River floodplain where groundwater is shallow and most vulnerable to degradation by dairy operations. WDRs were also adopted for two dairies in El Mirage where nitrates and salts were observed in local wells. The other six active dairies and two feed lots are not directly regulated.

The WDRs require each dairy to limit manure disposal to fields to 3.6 tons/acre/year, and implement BMPs for wash water disposal, manure management, and rainfall-runoff control. The WDRs require that waste disposal from dairy operations not cause a pollution or a nuisance.

Monitoring and Reporting Program

Dairy owners monitor and report the amount of manure applied to land. Limited groundwater monitoring data is currently being collected by most dairy owners.

Adequate groundwater monitoring programs are necessary to determine whether waste management BMPs are effective and to detect degradation of water quality. Some regulated dairies have as little as one groundwater monitoring well per facility and one of them has no monitoring well(s).

Storm Water

All of the regulated dairies implement some storm water BMPs voluntarily, but none have storm water permits.

Regulation by other Regions

To address water quality problems, Water Boards have implemented various regulatory strategies. The types of regulatory mechanisms presently in use in other regions are shown in Table 3, below.

Table 3

Permit Type	Water Board Region
Waiver	1,2
Individual	1,2, 6
General WDR	3,4, 5,9
NPDES	7,8

Regions 5, 8 and 9 have contracted for site-specific studies of contaminant transport and waste loading from dairy wastes. Water Board staff plan to further evaluate the results of these studies and mechanisms for applicability in the Lahontan Region and to recommend what approach will be most effective. Technical feasibility, economic feasibility, and political issues will be taken into account while considering the implementation of any recommendations.