San Jacinto Dairy Salt Offset Groundwater Monitoring

Additional Control Measures Work Plan for Dairies with Potential Groundwater Impacts

April 1, 2016

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Introduction

In November 2014, the Western Riverside County Agriculture Coalition (WRCAC) submitted a report, San Jacinto Salt Offset and Dairy Impact Report (Salt Report), that fulfilled the provisions included in the National Pollutant Discharge Elimination System (NPDES) permit and Waste Discharge Requirements (WDRs) for Dairies and Related Facilities in the Santa Ana Region (Order R8-2013-0001). The Salt Report findings of no impact, potential impact, and inconclusive impact to groundwater TDS and nitrate quality for individual dairies or groups of neighboring dairies were based on comparison of available groundwater data from wells that are hydrologically upgradient and downgradient of each facility or group of facilities and wells that are on-site at each facility or group of facilities. The Santa Ana Regional Water Quality Control Board's (Regional Board) response letter, dated May 21, 2015, outlined the need for further investigation based on the findings of the Salt Report. The response letter categorized the specific needs for further investigation based on three possible outcomes of the Salt Report: no impact, potential impact, and inconclusive impact.

The Regional Board requires each dairy with a finding of Potential Impact to submit a work plan to the Regional Board for adoption of additional control measures to mitigate the potential impacts to groundwater quality. WRCAC subsequently conducted on-site investigations at 9 dairies for which the Salt Report found potential impacts for TDS to identify:

- On-site risks for groundwater nitrate or TDS loading and potential actions to mitigate risks.
- Nearby, non-dairy potential nitrate and TDS sources.
- Existing wells not monitored by EMWD or potential locations for new monitoring wells, as appropriate.

The 2014 Salt Report analysis found a potential impact for TDS for nine facilities (note that potential impact for nitrate was not identified at any of the dairies). In January, 2016, after consultation with the Regional Board, WRCAC initiated activities to conduct the first re-evaluation of groundwater monitoring data to incorporate updated data collected since the 2014 report was prepared and to reflect revisions to the selection of wells for individual dairies and groups of dairies based on new information on groundwater flow direction and to incorporate groundwater monitoring data collected since the 2014 analysis was concluded. The updated analysis was completed on April 1, 2016 and found potential impact for TDS for the nine dairies shown in Table 1. Consistent with the 2014 Salt Report, the updated analysis did not identify potential impact for nitrate for any of the dairies evaluated.

This Work Plan describes control measures to address and mitigate risks associated with the various risk factors identified during on-site investigations. Table 1 identifies the general areas for each dairy for which control measures should be proposed as described in this report. It should be noted that proposed individual control plans need not be limited to the areas identified in Table 1 and should be based on all available information including inspection reports and the operator's knowledge of the facility.

Note that this Work Plan does not establish individual control measures to be implemented by dairy operators. Each dairy operator is responsible for working directly with the Regional Board to identify specific control measures and implementation schedules to mitigate individual dairy risk.

Table 1. Dairies with a finding of "Potential Impact" for TDS in the April 1, 2016 updated Salt Report

Dairy	Source(s) of analytical uncertainty [a]	Areas with potential groundwater risk based on September 2015 site assessment [d]
Boersma Dairy	1-4, 6	Milking center wastewater treatment Land application sites
Gerben Hettinga Expressway Dairy	1-4, 6	Livestock yards management
Hollandia Dairy	1-4, 6	Livestock waste storage Milking center wastewater treatment
Marvo Holsteins Dairy #2	1-4, 6	Livestock yards management Land application sites
Dick Van Dam Dairy	1-4, 6 [c]	Livestock yards management
Cottonwood Dairy	1-4, 6 [c]	Milking center wastewater treatment Livestock yards management
Bootsma-Silva Farms/Ramona Dairy #2	1-4 6 [c]	Livestock waste storage Milking center wastewater treatment Livestock yards management Land application sites
Arie & Josh De Jong Dairy	1-6	Livestock waste storage Milking center wastewater treatment Livestock yards management
CBJ Dairy [b]	1-6	N/A – facility closed

a. Sources of uncertainty:
1) Unknown impact of non-dairy sources of nitrate and/or TDS.
2) Lack of groundwater samples collected over a similar time period.
3) Comparison of samples from wells with different perforated intervals.
4) Uncertainty of rate of groundwater movement.
5) Uncertainty in groundwater flow direction and/or impact of groundwater withdrawal on short-term flow patterns.
6) Close proximity of groups of dairies leads to uncertainty in impact of individual dairy.

b. Facility vacant as of March, 2016.

c. Low degree of confidence; no statistically significant increase, but raw values indicate potential impact.

d. Areas with a ranking of 2 or below for the general risk area or general areas with individual risk factors ranked 1, based on the draft site assessment report provided to the dairy operator. Note that as of April 1, 2016, the dairy operators have not commented on nor approved the results of the draft reports.

It should be noted that the Salt Report, including the April 1, 2014 update, is an attempt to compile readily available data for the exclusive purpose of presenting a regional snapshot of historical and present groundwater quality measurements in the San Jacinto River watershed. The data used in the analysis are from irrigation and supply wells. They are not monitoring wells and were not constructed or located with the objective to support monitoring and tracking groundwater impacts from specific sources. As such, a finding of "potential impact" is an indication that additional site-specific investigation is needed to determine the exact source of elevated constituent concentrations. In other words, the well network used for the analysis provides the only historic and current groundwater monitoring data available, but does not support definitive indications of "hotspots or impacts throughout the basin from CAFO discharges." As such, representatives of the Milk Producers Council (MPC) and its members, who are also WRCAC members, have voiced strong objections to the Regional Board's requirement for dairies to implement additional control measures based on the results of the Salt Report analysis.

Specifically, MPC has noted that the best management practices (BMPs) for CAFOs already required under the General Permit – including compliance with Engineered Waste Management

Plans, Nutrient Management Plans, regular facility inspections and regular reporting to the RWQCB, among other things – has been successful in mitigating negative impacts on groundwater, and the Salt Report identifies no definite hot spots or impacts to dispute that. Therefore, MPC continues to believe that the best way to protect our valuable groundwater resources is to continue enforcing the BMPs already in the General Permit, while also continuing to conduct monitoring from readily available sources that will continue to validate the success of those BMPs.

Additionally, in no way should the Salt Report, or this work plan, be used to legally associate any of the named farming operations to the water quality measurements from "upgradient" or "downgradient" wells. The use of the words "upgradient" or "downgradient" are merely an indication of general direction of groundwater flow, and in no way should be interpreted as a link between those water quality results and the dairy farms identified in the Salt Analysis report or this work plan. Many non-dairy factors can lead to elevated nitrate or TDS levels in monitored wells.

On-site Investigations

On-site investigations assessed management and physical conditions present on the visited CAFOs that could indicate risks to ground water quality in several general areas, including:

- Well condition;
- Livestock waste storage;
- Milking center wastewater treatment;
- Livestock yard management
- Fertilizer storage and handling (for facilities that include cropland) ; and
- Land application sites (for facilities that apply manure or wastewater to cropland or pasture)

The evaluation form used to identify specific risk factors at dairies is included in Attachment A. The evaluation form was developed by WRCAC in conjunction with the Regional Board and Milk Producers Council and is based on worksheets developed for USDA's Farm*A*Syst groundwater protection program. For each of the Farm*A*Syst risk areas included (well condition, livestock waste storage, milking center wastewater treatment, livestock yard management, and fertilizer storage and handling), the evaluation form lists specific risk factors with conditions that range from low risk (ranked 4) to high risk (ranked 1).

Farm*A*Syst, although designed for use by farm and ranch operators and rural homeowners, was the most comprehensive and readily-available risk assessment and ranking system to use as a basis for the dairy assessments for this project. Many state NRCS and Extension offices have adapted Farm*A*Syst to reflect conditions and requirements specific to their states. Because California has not published state-specific worksheets, the New Mexico Farm*A*Syst program worksheets were used as a starting point because they represent an area with similar climatic conditions and dairy production practices to those found in the San Jacinto basin. For dairies that apply manure to cropland, the California Nitrate Groundwater Pollution Hazard Index (NHI) was used to evaluate groundwater risk from land application areas. The NHI is specific to nitrate pollution; no index or other ranking or evaluation tool was identified to assess groundwater TDS risks. The assumption is made that many factors that contribute to elevated risk of nitrate movement to groundwater, such as soil physical characteristics and irrigation methods, also apply to groundwater TDS risk. The NHI crop factor is more specific to nitrate, but was retained in the analysis in case future groundwater monitoring data analyses identify dairies

with potential impacts for groundwater nitrate contamination. All risk categories, conditions, and rankings were reviewed in detail and approved by the Regional Board prior to use.

WRCAC is providing each dairy operator with a completed site assessment form that identifies that dairy's priority risk factors (those receiving a rank of very high risk [1] or high risk [2] on the assessment form), including notes describing the conditions that contributed to the ranking for each risk factor. Dairy-specific priority risks are not listed in this work plan, due to privacy concerns raised by some of the dairy operators during the process of planning for the on-site assessments.

As described above, each dairy operator is responsible for working directly with the Regional Board to identify specific risks present on their facility and control measures to be implemented.

Note that other investigations could be conducted to confirm potential impacts for specific dairies. Investigations could include site-specific geophysical investigations; analysis for parameters of groundwater quality other than nitrate or TDS (e.g., isotopes, trace metals) that could be more sensitive tracers of dairy influence, where necessary and feasible; and/or a targeted intensive groundwater sampling program to identify possible plumes of nitrate or TDS moving from specific sources, movement during wet vs. dry periods, annual rates of change in concentration, etc. To the extent possible and appropriate, such investigations will be coordinated with those conducted pursuant to the *Groundwater Investigations Work Plan.*

Control Measures to Mitigate Potential Impacts

Table 2 identifies control measures to address specific risk factors identified in each dairy's site assessment form. The table is organized into sections that correspond with the site assessment forms. The control measures identified in the last column in Table 2 include a reference (bracketed number) to design standards and implementation time frames in Table 3. Table 4 provides a brief description of each control measure including the mechanism for preventing or minimizing risk of groundwater contamination.

Note that measures specifically to protect individual wells (e.g., casing repair, relocation of sources, or separation distance) may protect that well, but may not be protective of overall ground water quality if the source(s) continues to generate and deliver TDS (or nitrate) loads that can reach ground water through other pathways.

In addition, control measures implemented on individual dairies will not address groundwater TDS and nitrate impacts from surrounding land uses. The Salt Report analysis and dairy site assessments identify neighboring land uses, including irrigated agriculture, other agricultural land uses, old landfills, and septic zones, that are potential groundwater TDS and nitrate sources and therefore contribute to uncertainty in the results of the analysis. Those surrounding land uses must be considered when identifying dairy control measures and evaluating their effectiveness.

Table 2. Control measures to mitigate potential groundwater impacts at dairy CAFOs.

Area of Concern	Risk Activity	Control Measure [Table 3 reference]
Well Condition		
Well location	Well at grade or downslope of source; surface runoff from livestock yard, manure storage, ag chemical mixing area, or fuel storage can reach well.	• Diversion [1] • Relocate source [2]
	Separation distance from source(s) inadequate for ≥50% of wells/sources	
Well construction	Well casing degraded, too shallow, or on/below grade	Contact EMWD and/or a licensed water well contractor to repair well. [3]
Abandoned well	Wellhead not maintained or sealed properly	Properly close/seal abandoned wells [4]
Livestock Waste Storage		
Livestock Waste Storage Structure	Manure stack or earthen waste storage pit less than 250 feet upslope from well. Manure storage structure (liquid tight) less than 100 feet upslope from well.	• Relocate waste storage to appropriate location [5] • Divert clean runoff away from manure storage piles [6] • Curbing to contain/direct yard runoff [7]
	Concrete waste storage cracked, over coarse-textured soils	• Repair structure [8] • O&M practices to protect existing manure seal [9] • Pond sealing [10] • Relocate structure [5]
	Earthen pit not maintained, over coarse textured soils	
	Evaporation lagoon unlined or poorly maintained, < 100 ‘ from well	• O&M practices to protect existing manure seal [9] • Pond sealing [10] • Relocate structure [5]
Short-term livestock waste storage	Short term manure stacked [in field] on high ground on medium to coarse textured soils, shallow water table	• Divert clean runoff away from manure storage piles [6] • Install curbing to contain/direct yard runoff [7] • Protect stacks from rainfall [11] • Relocate stacking area [12]
	Manure stacked in yard on medium to coarse textured soils over shallow water table	• Direct clean runoff away from manure storage piles. [6] • Pave stacking areas [13] • Curbing to contain/direct yard runoff [7] • Protect stacks from rainfall [11] • Improve corral maintenance/management [14] • Relocate stacking area [12]

Area of Concern	Risk Activity	Control Measure [Table 3 reference]
Milking Center Wastewater Treatment		
Milking center waste pretreatment	Limited or no milkhouse waste pretreatment; No storage or settling. Untreated wastewater discharged to soil.	• Waste Treatment [15] • Waste Separation Facility [16]
All wastewater to liquid storage with field application	Wastewater delivered to leaking storage.	• Repair storage [17] • Waste Storage Facility (313) [18] • O&M practices to protect existing manure seal [19] • Pond sealing (521 a-d) [20] • Apply at agronomic rate(s) according to NMP [21] • See specific NHI recommendations for field application, where applicable
Evaporation lagoon (no field application)	No liner, limited or no maintenance	• Waste Storage Facility (313) [18] • O&M practices to protect existing manure seal [19] • Pond sealing (521 a-d) [12]
Surface infiltration (no field application)	Applied in concentrated flow.	• Apply in even distribution across land surface [22] • Apply at agronomic rate(s) [21]
	Shallow soils above bedrock or high water table; Direct discharge on permeable soils	• Relocate infiltration area [23]
	Vegetation not removed	Harvest and remove vegetation [24]
	Discharge located <100' upslope of well	• Relocate discharge [25] • Diversion (362) [26]
Livestock yard management		
Location of yard(s)	Corrals <300' upslope from well	• Diversion (362) [27] • Install curbing to contain and redirect runoff [28]
Site characteristics	Corrals located on permeable soils and/or shallow water table	• Regrade corrals [29] • Relocate corrals [30] • Diversion (362) [27]
Site management	Infrequent corral scraping	Heavy Use Area Protection (561) [31] Routine Scraping/Grooming of Corrals [32]
Fertilizer storage and handling		
Fertilizer storage quantity	>1 ton of fertilizer stored >55 gal liquid fertilizer stored	• Ag Chemical Handling Facility (309) [33] • Reduce amount of fertilizer stored [34]

Area of Concern	Risk Activity	Control Measure [Table 3 reference]
Fertilizer storage management	Partial to no dry fertilizer cover, spills not collected	Ag Chemical Handling Facility (309) [33]
	Liquid fertilizer storage on permeable soils without secondary containment	
	Containers old/leaky	
	Fertilizer mixing <50' from well	
	Poor or no mixing/loading pad for fertilizer	
	Mixing water from or near well	Anti-backflow device [35]

For each control measure identified in Table 2, Table 3 references a design standard or other source of information describing construction requirements or other specifications. Table 3 also suggests implementation time frames for each control measure. The suggested implementation time frames are intended to reflect dairy production cycles, cost, planning horizons, and other feasibility considerations. Immediate and near-term activities are relatively inexpensive to implement and do not require substantial financial investment or changes in dairy practices. Immediate activities are operation and management changes that can be implemented within one year; near-term activities can be completed in under 2 years. Mid-term activities require more planning and may be more costly than near-term activities; this work plan anticipates a 2- to 5-year time frame for mid-term activities. Long-term activities are those that would require significant planning, identification of capital, and potential substantive changes in dairy operations or management. It should be noted that the long-term activities in many cases may be infeasible (e.g., relocating a potential TDS source to a lower-risk area) or so costly that dairy operators are not likely to include them in their individual dairy plans.

Table 3. Design standards, other information, and general time-frame for control measures to mitigate potential groundwater impacts at dairy CAFOs.

Control Measure	Source of Information, Design Standards, and Other Considerations	Time Frame for Implementation
Well Condition		
1. Diversion	USDA-NRCS Conservation Practice Standard: Diversion (362)	Mid-term
2. Relocate source	Title 27 Effectiveness to Protect Groundwater Quality (see specific references in subsections below)	Long-term
3. Repair well	• The TOP 10 Well Drilling Contractors in Riverside County CA • Eastern Municipal Water District	Near-term
4. Close/seal abandoned wells	USDA-NRCS Conservation Practice Standard: Well Decommissioning (351)	Near-term
Livestock Waste Storage		
5. Relocate waste storage to appropriate location	• Observe well setback requirements (Riverside Co. Dept. Health • Avoid soils identified as high risk (see site assessment form) • Title 27 Effectiveness to Protect Groundwater Quality (Section 4.3, Comparison of Title 27 Confined Animal Facility Requirements with Other Waste Management Facilities Regulated by Title	Long-term

Control Measure	Source of Information, Design Standards, and Other Considerations	Time Frame for Implementation
	27; reference to Class II and Class III sewage sludge construction and siting requirements as more protective than Title 27 requirements for Confined Animal Facilities [CAFs])	
6. Direct clean runoff away from manure storage piles.	USDA-NRCS Conservation Practice Standard: Diversion (362)	Mid-term
7. Install curbing to contain/direct yard runoff	• USDA-NRCS Conservation Practice Standard Waste Transfer (634) • Improving Livestock Waste Storage (1. Long-term storage [solid or semi-sold manure])	Mid-term
8. Repair waste storage structure	Depends on damage requiring repair. Should be repaired to meet accepted design specifications for structure: USDA-NRCS Conservation Practice Standard: Waste Storage Structure (313)	Near-term
9. O&M practices to protect existing manure seal	Title 27 Effectiveness to Protect Groundwater Quality (Section 4.1.2, Sealing Effect of Manure Solids in Wastewater Ponds)	Immediate
10. Pond sealing	USDA-NRCS Conservation Practice Standard: • Pond Sealing-Flexible Membrane (521A) • Soil Dispersant (521B) • Bentonite Sealant (521C) • Compacted Clay Treatment (521D)	Long-term
11. Protect stacks from rainfall	Improving Livestock Waste Storage (2. Short-term storage)	Mid-term
12. Relocate stacking area	• Avoid soils identified as high risk (see site assessment form) • Fact Sheet #7 Reducing the Risk of Groundwater Contamination by Improving Livestock Waste Storage (2. Short-term storage) • Title 27 Effectiveness to Protect Groundwater Quality (Section 4.3, Comparison of Title 27 Confined Animal Facility Requirements with Other Waste Management Facilities Regulated by Title 27)	Long-term
13. Pave stacking areas	USDA-NRCS Conservation Practice Standard: Waste Storage Structure (313)	Long-term
14. Improve corral maintenance/management	• USDA-NRCS Conservation Practice Standard: Heavy Use Area Protection (561) • Improving Livestock Yard Management	Immediate
Milking Center Wastewater Treatment		
15. Waste Treatment	USDA-NRCS Conservation Practice Standard: Waste Treatment (629)	Long-term
16. Waste Separation Facility	USDA-NRCS Conservation Practice Standard: Waste Separation Facility (632)	Long-term
17. Repair waste storage structure	California Regional Water Quality Control Board Santa Ana Region Order No. R8-2013-0001	Near-term
18. Waste Storage Facility	USDA-NRCS Conservation Practice Standard: Waste Storage Facility (313)	Long-term
19. O&M practices to protect existing manure seal	Title 27 Effectiveness to Protect Groundwater Quality (Section 4.1.2, Sealing Effect of Manure Solids in Wastewater Ponds)	Immediate
20. Pond sealing	USDA-NRCS Conservation Practice Standard: • Pond Sealing-Flexible Membrane (521A) • Soil Dispersant (521B)	Long-term

Control Measure	Source of Information, Design Standards, and Other Considerations	Time Frame for Implementation
	• Bentonite Sealant (521C) • Compacted Clay Treatment (521D)	
21. Apply at agronomic rate(s) according to NMP	• California Regional Water Quality Control Board Santa Ana Region Order No. R8-2013-0001 • USDA-NRCS Conservation Practice Standard: Nutrient Management (590)	Near-term
22. Apply in even distribution across land surface	California Regional Water Quality Control Board Santa Ana Region Order No. R8-2013-0001	Near-term
23. Relocate infiltration area	• Avoid soils identified as high risk (see site assessment form) • Title 27 Effectiveness to Protect Groundwater Quality (Section 4.3, Comparison of Title 27 Confined Animal Facility Requirements with Other Waste Management Facilities Regulated by Title 27)	Mid-term
24. Harvest and remove vegetation	USDA-NRCS Conservation Practice Standard: Nutrient Management (590)	Near-term
25. Relocate discharge	• Avoid soils identified as high risk (see site assessment form) • Title 27 Effectiveness to Protect Groundwater Quality (Section 4.3, Comparison of Title 27 Confined Animal Facility Requirements with Other Waste Management Facilities Regulated by Title 27)	Mid-term
26. Diversion	USDA-NRCS Conservation Practice Standard: Diversion (362)	Mid-term
Livestock yard management		
27. Diversion	USDA-NRCS Conservation Practice Standard: Diversion (362)	Mid-term
28. Install curbing to contain and redirect runoff	Improving Livestock Yard Management	Near-term
29. Regrade corrals	California Dairy Research Foundation, CDQAP Ruminations: Managing Mud on Dairies	Near-term
30. Relocate corrals	• Avoid soils identified as high risk (see site assessment form) • USDA-NRCS Conservation Practice Standard: Heavy Use Area Protection (561) • Title 27 Effectiveness to Protect Groundwater Quality (Section 4.3, Comparison of Title 27 Confined Animal Facility Requirements with Other Waste Management Facilities Regulated by Title 27)	Long-term
31. Heavy Use Area Protection	USDA-NRCS Conservation Practice Standard: Heavy Use Area Protection (561)	Mid-term
32. Routine Scraping/ Grooming of Corrals	California Dairy Research Foundation, CDQAP Ruminations: Managing Mud on Dairies	Immediate
Fertilizer storage and handling		
33. Ag Chemical Handling Facility	USDA-NRCS Conservation Practice Standard: Agrichemical Handling Facility (309)	Long-term
34. Reduce amount of fertilizer stored	Improving Fertilizer Storage and Handling (Section 5, Other management factors)	Near-Term
35. Anti-backflow device	Four Irrigation Backflow Preventers Approved for California	Near-term

Table 4 provides a brief description of each of the control measures listed in tables 2 and 3. The control measures are presented in alphabetical order with reference (bracketed number) to the control measure number(s) in Table 3.

Table 4. Control Measure Descriptions

Control Measure [Table 3 reference]	**Description**
Ag Chemical Handling Facility [32]	A facility with an impervious surface and a contained perimeter to provide an environmentally safe area for the storage, mixing, loading and cleanup of agrichemicals, retain incidental spillage, retain leakage, and to reduce pollution to surface water, groundwater, air, and/or soil from the handling of on-farm agrichemicals.
Anti-backflow device [34]	A mechanical device designed to prevent an irrigation well and well water from being contaminated by reverse flow during agrichemical mixing in the event of back pressure or back siphonage.
Apply in even distribution across land surface [22]	Where wastewater is applied to land, ensure that distribution is uniform to avoid ponding or heavy loading of small areas within the field.
Apply at agronomic rate(s) [according to NMP (for land application areas)] [21]	Apply wastewater to land to provide nitrogen (N) at a rate that will be utilized by a growing crop; avoid application of excess N and situations of high residual N after growing season to minimize N available for leaching to groundwater.
Close/seal abandoned wells [4]	Seal and permanently close an inactive, abandoned, or unusable water well to prevent contamination of groundwater by surface water inflow.
Direct clean runoff away from manure storage piles [6]	Use a diversion or other means to direct clean runoff from upgradient away from manure storage piles to reduce movement of contaminants to vulnerable areas.
Diversion [1, 26, 27]	Construct a channel and/or berm across the slope to intercept and redirect surface runoff in order to divert clean water away from farmsteads, agricultural waste systems, and other sources of contaminants or to divert contaminated runoff away from wells or other vulnerable receiving areas.
Harvest and remove vegetation [24]	Harvest and remove vegetation from land areas receiving wastewater application to remove nutrients and reduce residual nutrients available for leaching to groundwater.
Heavy Use Area Protection [31]	Measures used to stabilize a ground surface that is frequently and intensively used by people, animals, or vehicles to provide a stable, non-eroding surface and reduce risk of infiltration of nutrients and other pollutants.
Improve corral maintenance/management [14]	Increase the frequency of corral scraping and manure removal; eliminate manure stockpiles or reduce duration of stockpiling in corrals.
Install curbing to contain/direct yard runoff [7, 28]	Incorporate a low concrete wall around corrals to contain and direct runoff to a suitable outlet and/or filter area away from permeable soil areas.
O&M practices to protect existing manure seal [9, 19]	Discontinue disking, ripping, or otherwise disturbing solids that may provide some sealing at the wastewater/soil interface. Do not allow wastewater lagoon bottoms to dry completely. Minimize use of heavy equipment in lagoons.
Pave stacking areas [13]	Pave permanent manure or silage stacking areas with concrete or other impervious material to prevent soil infiltration.
Pond sealing [10, 20]	Take measures to restrict, impede, and control seepage of water and contaminants from wastewater impoundments, e.g., lining of a pond with a manufactured hydraulic barrier or reducing soil permeability by soil compaction, addition of a clay layer, or other soil treatment.

Control Measure [Table 3 reference]	Description
Protect stacks from rainfall [11]	Construct roof over permanent manure stacking areas to protect stacks from rainfall and reduce the volume of contaminated water available for runoff or infiltration.
Reduce amount of fertilizer stored [33]	Eliminate long-term fertilizer storage. Buy and store only the amount of fertilizer needed to apply during current crop year to risk of contamination in the event of a fertilizer spills. Keep records of fertilizer use and amount of fertilizer on hand to support purchasing decisions.
Regrade corrals [29]	Regrade all corral surfaces to create a 1.5 – 3 % slope from the feedline to the opposite side of the corral to ensure good drainage of runoff to a controlled area where it can be effectively captured and managed to protect ground water.
Relocate corrals [30]	Relocate corrals away from sensitive groundwater management areas or areas where corral runoff can reach areas of high infiltration rates.
Relocate discharge and/or infiltration area [23, 25]	Relocate wastewater applications away from sensitive groundwater management areas or areas with very high infiltration rates.
Relocate source/stacking area [2, 12]	Move a source such as a manure stack, corral, or temporary waste storage area to: a) an area of lower soil permeability where risk of infiltration of pollutants to ground water is reduced; or b) an area where the risk of surface runoff to a well or infiltration area is reduced.
Relocate waste storage to appropriate location [5]	Relocate a tank, pond, lagoon, or other waste storage structure to an area of low soil permeability to reduce risk of infiltration of pollutants to ground water.
Repair waste storage structure [8, 17]	Bring waste storage structures such as tanks, ponds, and lagoons into full compliance with Permit conditions by addressing fault conditions such as cracks, leaks, berm elevation, berm vegetation, rodent holes, etc.
Repair well [3]	Prevent surface water from entering the well by taking physical measures to be sure that well cap and casing are intact and sufficiently above grade to prevent surface waters to seep into or around casing.
Routine Scraping/ Grooming of Corrals [32]	Regular removal of the top layer of manure from corrals to decrease the water holding capacity and softening of the soil.
Waste Separation Facility [16]	A filtration or screening device, settling tank, settling basin, or settling channel used to partition solids and/or nutrients from a waste stream to improve or protect water quality or to improve manure handling methods or serve as a pre- or post-treatment for other processes.
Waste Storage Facility [18]	A waste storage impoundment made by constructing an embankment and/or excavating a pit or dugout, or by fabricating a structure to temporarily store wastes such as manure, wastewater, and contaminated runoff as a storage function component of an agricultural waste management system.
Waste Treatment [15]	The use of mechanical, chemical or biological technologies that change the characteristics of manure and agricultural waste to improve water quality by reducing the nutrient content, organic strength, and/or pathogen levels of manure and agricultural waste or facilitating desirable waste handling and storage characteristics.

Individual Dairy Control Measures

Each dairy operator will submit a report to the Regional Board identifying specific groundwater risks and proposed control measures within 60 days of the date that the updated Salt Report Analysis is completed, submitted, and accepted by the Regional Board. The groundwater risks identified in each dairy's proposed control measures plan will reflect those for which the final site assessment form resulted in a high-risk ranking. Control measures will be proposed for:

- Each individual risk condition (row in the form) with a ranking of 1

- Where an overall risk area ranking is 2 or less, each individual risk condition (row on the form) within that category with a ranking of 2 or less.

The example in Attachment B illustrates selection of risk conditions for proposed control measures. Where a site characteristic (e.g., soil type) or other risk condition that cannot be changed or controlled is ranked 2 or less, control measures should be proposed for other conditions in the same risk area to mitigate the risk posed by the unchangeable condition. For example, livestock yards at a dairy might be located on well-drained, coarse-textured soils. Moving the livestock yards at a dairy generally is not feasible because livestock yards need to be located near the barn and often occupy the majority of the site. In such a circumstance, the operator should propose control measures to address livestock yard management to mitigate the risk posed by the location of the yards themselves.

The reports will follow the format provided in Attachment B, and will include an identification of the specific risk factor (description/location) to be addressed, the control measure(s) proposed for each risk factor, and a proposed implementation target date. It is assumed that proposed control measures will be implemented in accordance with the design standards and/or guidance identified in Table 3; however, dairy operators may propose alternative design standards in their individual plans.

Control measures will be implemented according to the schedule approved by the Regional Board. Control measures will be maintained for the duration of permit coverage or until such time as monitoring data indicate that they are either ineffective or unnecessary.

Unofficial, anecdotal observations by EMWD indicate a relatively short lag time (perhaps under two years) from the time of infiltration to reach an aquifer in some areas of the basin (Daniel B. Stephens & Associates 2007, Michael Nusser, personal communication, November 18, 2015). In the San Jacinto Upper Pressure groundwater management zone a continuous clay confining layer ranges in thickness from 5 feet to 150 feet, with a vertical conductivity of approximately 1×10^{-8} centimeters/second, equal to approximately 0.1 inch/year (John Daverin, personal communication, January 28, 2016). Water infiltrating at the surface could take upwards of 500 to 1,000 years to reach the aquifer in those areas. The rate of groundwater flow also varies throughout the basin. EMWD's groundwater model uses flow rates ranging from 10 to 20 feet per day in the San Jacinto Upper Pressure groundwater management zone, for example (*id.*). Such time frames should be taken into account when making conclusions about the effectiveness of control measures. Changes in groundwater quality in on-site wells may not be seen for two years or more, depending on the depth of the well being monitored relative to the depth of the aquifer. For dairies in some areas, changes in groundwater quality from wells that are screened below an underlying clay confining layer might not be seen in a time frame that is meaningful to the current effort. Changes in groundwater quality for down-gradient wells might not be evident for 6 months to several years, depending on the well's distance from the dairy. Changes in downgradient water quality might not be seen at all if there are no improvements in groundwater protection practices for intervening land uses (e.g., irrigated agriculture).

Where data suggest existing control measures are ineffective, dairy operators will work individually with the Regional Board to identify additional control measures to mitigate impacts. Evaluations of control measure effectiveness must consider surrounding land uses such as irrigated agriculture, other agricultural land uses, septic systems, and abandoned landfills that contribute TDS and nitrate to groundwater. Where a dairy has implemented control measures to address all on site risk factors but no change in groundwater TDS and nitrate levels are

detected in the expected time frame, it may be reasonable to conclude that elevated groundwater TDS and nitrate levels are attributable to surrounding land uses.

References

Daniel B. Stephens & Associates. 2007. *Quantification of Nitrogen Removal under Recycled Water Ponds*. Prepared for Eastern Municipal Water District.

Attachment A. Site Assessment Form

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
I. Well Condition					**#DIV/0!**
A. Location					
1. Position of well relative to pollution sources	Upslope from all pollution sources. No surface water runoff reaches well. Surface water diverted from well.	Upslope from or at grade with pollution sources. No surface water runoff reaches well.	Downslope from most pollution sources. Some surface water runoff may reach well.	Settling or depression near casing. Surface water runoff from livestock yard, manure storage, pesticide and fertilizer mixing area, fuel storage or farm dump reaches well.	
2. Separation distances between well and farmstead contamination sources Per RCDH: - Cesspool or seepage pit 150' - Animal or fowl enclosures 100' - Any surface sewage disposal system disch. 2,000+ gal/day 200'	Meets or exceeds all state minimum required separation distances.	Meets minimum separation distances for more than half of contamination sources.	Meets minimum separation distances for less than half of contamination sources.	Does not meet any minimum separation distances for contamination sources.	
B. Condition (complete 1 - 3 only if well is downslope from, or does not meet separation distances for, contamination sources)					
1. Condition of casing and well cap (seal)	No holes or cracks. Cap tightly secured. Screened vent.	No defects visible. Well vented but not screened.	No holes or cracks visible. Cap loose.	Holes or cracks visible. Cap loose or missing. Can hear water running.	
2. Casing depth	Cased more than 100 feet below water level in well.	Cased 31–100 feet below water level in well.	Cased 10–30 feet below water level in well.	Cased less than 10 feet below water level in well. No casing.	

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
3. Casing height above land surface	More than 12 inches above grade.	8–12 inches above grade.	At grade or up to 8 inches above.	Below grade or in pit or basement.	
II. Livestock Waste Storage					**#DIV/0!**
A. Long-Term Storage					
1. Poured concrete (liquid-tight design)	Properly maintained.	Not maintained.	Concrete cracked, medium-textured soils (silt loam, loam). Water table deeper than 20 feet.	Concrete cracked, coarse-textured soils (sands, sandy loam). Water table or fractured bedrock shallower than 20 feet.	
2. Earthen waste storage pit (below ground)	Lined with clay or synthetic liner. Properly maintained.	Properly maintained.	Not maintained. Constructed in medium or fine-textured dense materials (silt loam, loam, clay loams, silty clay). Water table deeper than 20 feet. Earthen lining eroding.	Not maintained. Constructed in coarse textured materials (sands, sandy loam). Fractured bedrock or water table shallower than 20 feet. More than 10 years old. Earthen lining perforated.	
B. Short-Term Storage					
1. Stacked in field (on soil base)			Stacked on high ground. Medium- or fine-textured soils (silt loam, loam, clay loams, silty clay). Water table is deeper than 20 feet.	Stacked on high ground. Coarse-textured soils (sands, sandy loam). Fractured bedrock or water table shallower than 20 feet.	
2. Stacked in yard	Covered concrete yard with curbs, gutters, and settling basins.	Concrete yard with curbs and gutters. Grass filter strips installed and maintained.	Earthen yard with medium- or fine-textured soils (silt loam, loam, clay loams, silty clay). Water table deeper than 20 feet.	Earthen yard with coarse textured soils (sands, sandy loam). Fractured bedrock or water table shallower than 20 feet.	

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
C. Location					
1. Location of livestock waste storage in relation to well	Manure stack or earthen waste storage pit more than 250 feet downslope from well. Manure storage structure (liquid tight) more than 100 feet downslope from well.	Manure stack or earthen waste storage pit more than 250 feet upslope from well. Manure storage structure (liquid tight) more than 100 feet upslope from well.	Manure stack or earthen waste storage pit less than 250 feet downslope from well. Manure storage structure (liquid tight) less than 100 feet downslope from well.	Manure stack or earthen waste storage pit less than 250 feet upslope from well. Manure storage structure (liquid tight) less than 100 feet upslope from well.	
III. Milking Center Wastewater Treatment					**#DIV/0!**
A. Pretreatment					
1. Pretreatment method	Includes solids separator, slab stacking, and lagoon storage.		Some solids separation by storage and settling.	No storage or settling. Untreated wastewater discharged to soil.	
B. Manure Storage with Field Application					
1. All wastewater to liquid manure storage with field application	Wastewater delivered directly to liquid manure storage. No discharge expected.			Wastewater delivered to leaking manure storage.	
2. Field application	----------Use NHI to evaluate risk----------				
C. No Field Application					
1. Total evaporation lagoons	Lined lagoon. Regularly maintained. More than 100 feet from well.	Lined lagoon. Not maintained. More than 100 feet from well.	Lagoon lined but not maintained. Less than 100 feet from well.	No liner, no maintenance. Less than 100 feet from well.	

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
2. Surface infiltration	Combined with high level pretreatment. Applied in sheet flow to medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 10 feet to water table or bedrock. Extended rest period between loadings. Vegetation regularly harvested.	Combined with high level pretreatment. Applied in sheet flow to medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 3 feet to water table or bedrock. Extended rest period between loadings. Vegetation periodically removed or grazed.	Some pretreatment. Applied in sheet flow to medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 2 to 3 feet over bedrock or high water table. Vegetation not removed.	No pretreatment. Applied in concentrated flow. 1 foot of medium- or fine-textured soil (silt loam, loam, clay loams, clay) above bedrock or high water table. Vegetation not removed OR (regardless of above factors) Direct discharge on sandy loam or loamy sand soil.	
D. Location of Discharge (surface infiltration only)					
1. Distance from well	More than 100 feet downslope from well.	More than 100 feet upslope from well.	Less than 100 feet downslope from well.	Less than 100 feet upslope from well.	
IV. Livestock Yards Management					**#DIV/0!**
A. Location					
1. Distance from well	More than 200 feet downslope from well.	More than 300 feet upslope from well.	Less than 300 feet upslope from well.	Less than 100 feet from well.	
B. Site Characteristics					
1. Soil depth and permeability	Well-drained medium- or fine-textured soils (loam, silt loam, clay loams, clays). Depth to bedrock more than 40" (101.6 cm) deep with low permeability (silt and clay) [ksat 0.00-0.1].	Well-drained or moderately well-drained medium-or fine-textured soils (loam, silt loam, clay loams, clays). Depth to bedrock is 30 (76.2 cm) -40" deep with moderate permeability (loamy) [ksat 0.1-10].	Moderately well-drained coarse-textured soils (sands, sandy loam). Depth to bedrock is 20 (50.8 cm) to 30" and/or high permeability (sandy) [ksat 10-100].	Excessively well-drained coarse-textured soils (sands, sandy loam) to gravel, and/or somewhat poorly drained soil to poorly drained soils. Depth to bedrock is less than 20 inches and/or very high permeability (coarse sand) [ksat>100].	

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
C. Management					
1. Yard cleaning and scraping practice	No yard (animals confined in barn or under roof)	Once per week.	Once per month.	Not removed from site within 180 days of scraping.	
V. Fertilizer Storage and Handling *(only for dairies with cropland)*					**#DIV/0!**
A. Dry Formulation					
1. Amount stored	None stored at any time.	Less than 1 ton.	Between 1 and 20 tons.	More than 20 tons.	
2. Type of storage	Covered on impermeable surface (such as concrete or asphalt). Spills are collected.	Covered on clay soil. Spills are collected.	Partial cover on loamy soils. Spills not collected.	No cover on sandy soils. Spills not collected.	
B. Liquid Formulation					
1. Amount stored	None stored at any time.	Less than 55 gallons.	Between 55 and 1,500 gallons.	More than 1,500 gallons.	
2. Type of storage	Concrete or other impermeable secondary containment does not allow spill to contaminate soil.	Clay-lined secondary containment. Most of spill can be recovered.	Somewhat permeable soils (loam). No secondary containment. Most of spill cannot be recovered.	Permeable soil (sand). No secondary containment. Spills contaminate soil.	
C. Containers					
1. Containers	Original containers clearly labeled. No holes, tears or weak seams. Lids tight.	Original containers old. Labels partially missing or hard to read.	Containers old but patched. Metal containers showing signs of rusting.	Containers have holes or tears that allow fertilizers to leak. No labels.	
D. Mixing and Loading Practices					
Location of well in relation to mixing/loading area with no curbed and impermeable containment area	100 or more feet downslope from well.	50 to 100 feet from well.	10 to 50 feet from well.	Within 10 feet of well.	

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
E. Additional Mixing and Loading Practices for Liquid Fertilizer					
1. Mixing and loading pad (spill containment)	Concrete mixing/loading pad with curb keeps spills contained. Sump allows collection and transfer to storage.	Concrete pad with curb keeps spills contained. No sump.	Concrete pad with some cracks keeps some spills contained. No curb or sump.	No mixing/loading pad. Permeable soil (sand). Spills soak into ground.	
2. Water source	Separate water tank.	Hydrant away from well.	Hydrant near well.	Directly obtained from well.	

Attachment B. Individual Dairy Control Measures Template

Control Measures Proposed to Mitigate Potential Groundwater Impacts

Dairy Name:_____ WDID #:_____ Date:_____

Operator:_____ Telephone:_____

General risk area	Risk condition/ location	Control Measure	Implementation Date	Alternative Standard
Well condition				
Livestock waste storage				
Milking center wastewater treatment				
Livestock yard management				
Fertilizer storage and handling				

Instructions

1. For risk condition/location, please be specific and identify location. Provide latitude/longitude or attach facility map with locations marked and clearly cross-referenced to specific issues.
   Include risk conditions based on the facility site assessment form, as follows:
   - Include each individual risk condition (row in the form) with a ranking of 1
   - Where an overall risk area ranking is 2 or less, include each individual risk condition (row on the form) within that category with a ranking of 2 or less.

   Example:

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
III. Milking Center Wastewater Treatment					**3.3**
A. Pretreatment					
1. Pretreatment method	Includes solids separator, slab stacking, and lagoon storage.		Some solids separation by storage and settling.	No storage or settling. Untreated wastewater discharged to soil.	4
B. Manure Storage with Field Application					
2. Field application	----------Use NHI to evaluate risk----------				1
C. No Field Application					
2. Surface infiltration	Combined with high level pretreatment. Applied in sheet flow to medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 10 feet to water table or bedrock. Extended rest period between loadings. Vegetation regularly harvested.	Combined with high level pretreatment. Applied in sheet flow to medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 3 feet to water table or bedrock. Extended rest period between loadings. Vegetation periodically removed or grazed.	Some pretreatment. Applied in sheet flow to medium- or fine-textured soil (silt loam, loam, clay loams, clay) more than 2 to 3 feet over bedrock or high water table. Vegetation not removed.	No pretreatment. Applied in concentrated flow. 1 foot of medium- or fine-textured soil (silt loam, loam, clay loams, clay) above bedrock or high water table. Vegetation not removed OR (regardless of above factors) Direct discharge on sandy loam or loamy sand soil.	2
D. Location of Discharge (surface infiltration only)					
1. Distance from well	More than 100 feet downslope from well.	More than 100 feet upslope from well.	Less than 100 feet downslope from well.	Less than 100 feet upslope from well.	4

	Rank 4	Rank 3	Rank 2	Rank 1	Facility Rank
IV. Livestock Yards Management					**2**
A. Location					
1. Distance from well	More than 200 feet downslope from well.	More than 300 feet upslope from well.	Less than 300 feet upslope from well.	Less than 100 feet from well.	2
B. Site Characteristics					
1. Soil depth and permeability	Well-drained medium- or fine-textured soils (loam, silt loam, clay loams, clays). Depth to bedrock more than 40" (101.6 cm) deep with low permeability (silt and clay) [ksat 0.00-0.1].	Well-drained or moderately well-drained medium-or fine-textured soils (loam, silt loam, clay loams, clays). Depth to bedrock is 30 (76.2 cm) - 40" deep with moderate permeability (loamy) [ksat 0.1-10].	Moderately well-drained coarse-textured soils (sands, sandy loam). Depth to bedrock is 20 (50.8 cm) to 30" and/or high permeability (sandy) [ksat 10-100].	Excessively well-drained coarse-textured soils (sands, sandy loam) to gravel, and/or somewhat poorly drained soil to poorly drained soils. Depth to bedrock is less than 20 inches and/or very high permeability (coarse sand) [ksat>100].	3
C. Management					
1. Yard cleaning and scraping practice	No yard (animals confined in barn or under roof)	Once per week.	Once per month.	Not removed from site within 180 days of scraping.	1

For the above site assessment form excerpt, the dairy's proposed control measures should address field application (III.B.2) and yard cleaning and scraping practices (IV.C.1) because each is ranked 1 to indicate the riskiest condition. In addition, the proposed control measures should address livestock yards distance from well (IV.A.1), because it is ranked 2 or less in a risk area (IV. Livestock Yards Management) with an overall ranking of 2 or less.

2. For proposed control measure, please use categories shown in Table 3.
3. For proposed implementation date, please identify target date for full implementation, consistent with the time frames in Table 3 (Immediate: 1 year, Near-term: 1 – 2 years, Mid-term: 2 – 5 years, Long-term: 5 or more years).
4. For alternative standard, if left blank, it is assumed that the design standards and/or guidance identified for specific control measures in Table 3 will be followed. If you plan to use alternative design standards or guidance for a control measure, identify the standards/guidance in this column. Include the title, date, and author and provide a web link (URL) or attach a copy of the applicable standards or guidance.