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Technical Memorandum

Prepared for: Morning Star

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Subject: Cooling and Settling Ponds Technical Evaluation and Recommendations

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Limitations:

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Section 1: Executive Summary

The Cooling Pond at the Morning Star Williams processing plant was expanded in 2015 and the Settling Pond in 2012. A Tentative Cease and Desist Order (CDO) issued in November 2015 alleged potential adverse impacts to groundwater and nuisance odor conditions as a result of these expansions.

Mineral water quality entering the Cooling Pond is better than upgradient shallow groundwater and the plant's water supply. Groundwater monitoring near both the Cooling Pond and Settling Pond has shown no adverse impacts from the expansions. Net seepage from the expanded Cooling Pond is likely much lower than initial estimates by Regional Board staff.

Dissolved oxygen (DO) concentrations in the Cooling Pond was low during periods in 2015, most likely due to the inherently low DO in condensate and additional biological oxygen demand due to misdirected plumbing associated with new evaporators. The plumbing issue was resolved, and additional supplemental aeration capacity is recommended for the 2016 season.

DO in the Settling Pond was also low during some periods in 2015, most likely due to greatly increased wastewater strength and longer hydraulic residence time. The increase wastewater strength and longer hydraulic residence time were both at least partially due to successful water conservation efforts. Additional supplemental aeration capacity and a variable elevation outlet are recommended for the 2016 season.

Section 2: Background

Morning Star Packing Company, L.P. owns and operates the Morning Star Tomato Packing Plant in Colusa County, California, which includes the Settling and Cooling Ponds, as well as about 485 acres of associated land application area (LAA) owned by Morning Star. The discharge of wastewater generated by the facility is regulated by the Central Valley Regional Water Board under Waste Discharge Requirements (WDR) Order No. R5-2013-0144. A map of the facilities and LAA is provided in Attachment A.

The facility was issued a Tentative Cease and Desist Order (CDO) on November 20, 2015, which is scheduled for Board action in February 2016. The Tentative CDO alleged that the Cooling Pond and Settling Pond had been expanded without notification to the Regional Board and that this had resulted in BOD loading, odor, and groundwater degradation problems. This Cooling and Settling Ponds Technical Report and Mitigation Plan was prepared to address those concerns and provide a formal response in anticipation of Board action on the Tentative CDO.

2.1 Cooling Pond

Morning Star utilizes evaporators to vaporize water from the tomato puree and produce concentrated tomato paste. The Cooling Pond is used to cool condensate process water from the evaporation process prior to recycle back to the factory for reuse in the condensate loops and flumes. The Cooling Pond reduces condensate water temperature from approximately 120 degrees F down to approximately 95 - 100 degrees F. Incidental overflow from the Cooling Pond enters the irrigation canal to the Land Application Area (LAA).

The Tentative CDO states that the streams identified as discharging to the Cooling Pond "According to the WDRs, the Cooling Pond does not receive any wastewater containing organic matter." However, as a matter of normal operation documented in the 1995 Report of Waste Discharge, the condensate contains "condensed vapors from the evaporation process" (Findings, item 3), i.e. not just water vapor. As is typical in the industry, condensed vapors include small amounts of organic compounds and aerosols in vapor carryover from the tomato paste in the evaporators.

The Cooling Pond was expanded from 60 acres in footprint to 100 acres in 2015 in proportion to the 65% factory process capacity expansion documented in the 2013 Waste Discharge Requirements (page 12, item 28). The expansion of the Cooling Pond and expanded open warehouse space resulted in a reduction in available Land Application Area (LAA) of about 90.5 acres.

Due to the high vacuum and temperature in the final condenser loop, the condensate water sent to the Cooling Pond likely has inherently low dissolved oxygen (DO). Two new evaporators installed prior to the 2015 season also had some improperly designed equipment plus misdirected plumbing, which allowed two relatively high BOD water streams to enter the condensate returning to the Cooling Pond, probably further reducing DO in the Cooling Pond. As a result, DO measured in the Cooling Pond was below the 1.0 mg/L required minimum for several periods during the 2015 season. The plumbing was corrected in August 2015 within a few days of Morning Star becoming aware of the issue.

Prior to 2006, the Cooling Pond used to receive small amounts (<1% total) of water softener reject, boiler blowdown and plant cleaning water. The boiler blowdown stream was redirected in 2006, and the water softener reject stream was also redirected a number of years ago. Small amounts of boiler blowdown water may still be sent to the Cooling Pond during rare upset conditions. The findings in the 2013 WDRs and the statements in the Tentative CDO regarding the boiler blowdown and water softener reject do not reflect these changes.

2.2 Settling Pond

The Settling Pond provides primary clarification treatment for process and flume wastewater. The Settling Pond gradually fills with silt and other solids during the processing season. The Settling Pond was expanded prior to the 2012 season from a footprint of about 0.92 acres to about 2 acres.

Because quiescent conditions are important for good settling performance, the Settling Pond has only one small aerator near the outlet. The measured Settling Pond DO dropped below the 1.0 mg/L minimum specified in the WDRs during much of the latter portion of the season in 2015.

Section 3: Cooling Pond Evaluation

The Tentative CDO alleges that the expansion of the Cooling Pond has potential to impact groundwater due to an increase in percolation from the Cooling Pond. The Tentative CDO also stated that “unpermitted discharge of tomato waste likely impacted groundwater.” The Tentative CDO also required Morning Star to complete a comprehensive review of the Cooling Pond and propose specific improvements to prevent odor generation.

3.1 BOD Loading Rates

The EPA recommended BOD design loading rates for naturally aerated facultative ponds for air temperatures above 60 degrees F and low algae (winter) conditions are 40 to 80 lbs BOD/ac/d (EPA, 1983). In mild climates, loadings on the primary cell of ponds can be up to approximately 100 lbs/ac/d. Even though Morning Star operates during the summer, the Cooling Pond typically does not have a significant amount of algae growth to produce oxygen. Therefore, the 40 – 80 lbs/ac*d design range is probably appropriate.

Cooling Pond BOD concentration measurements are not required as part of Morning Star’s permit. However, due to the issues with the new evaporators, BOD samples were taken for the Cooling Pond and for several locations in the condenser loops on three dates in 2015. The results are shown in Table 1.

The net condenser water flow (water extracted from the tomatoes) into the Cooling Pond in 2015 averaged 4.87 mgd. Applying this to the BOD concentration measurements gives the BOD loading rates to the pond. These calculated values are also shown in Table 1. As can be seen in the table, the net BOD loading rate to the ponds was on the order of 10 to 20 lbs/ac/d during the time when the high BOD sidestreams from evaporators 5 and 6 were still discharging to the Cooling Pond. These values are well within EPA recommendations for loading rates to naturally aerated ponds. Although no other BOD data is available for condensate sent to the Cooling Pond, it is likely that normal BOD concentrations and pond loading rates are considerably less than what was measured during the startup of the new evaporators, providing a further justification that expansion of the Cooling Pond has not impacted groundwater.

3.2 Dissolved Oxygen Levels

Maintaining a DO level over 1.0 in the Cooling Pond is required in the 2013 WDRs. As mentioned previously, the inherently low DO in condensate during times in 2015 may have been exacerbated by the plumbing misdirection in the installation of the two new evaporators. Although that issue has been corrected, it may be advisable to provide means for supplemental aeration for the Cooling Pond in 2016 to insure compliance with the WDRs.

To target low DO levels, the installation of floating brush or similar aeration means is recommended near the inlet end of the pond for the 2016 season. Approximately 15 hp of brush aeration would be required to raise the DO by 1 mg/L. Supplemental aeration may or may not be needed in future years depending on the results of DO and BOD measurements. It is recommended that DO measurements be taken twice weekly and BOD samples be taken once a week at the Cooling Pond inlet and outlet during the 2016 season.

Additional control measures to address low DO in the Cooling Pond that were recommended by Board staff for consideration included the installation of pre-screening or a cooling tower. Given the correction of misdirected plumbing from the new evaporators, these alternatives are not currently recommended for the Cooling Pond. Furthermore, these alternatives would not significantly reduce soluble BOD, which is likely the predominant form of BOD in the Cooling Pond.

3.3 Groundwater Gradient Effects

The Cooling Pond was extended north to within approximately 100 feet of MW6. Any increased contribution to groundwater from the Cooling Pond should have been seen as a rise in groundwater level in MW6 and an increase in gradient from MW6 to MW8 corresponding to increased groundwater flow. However, Morning Star installed a west-east interceptor drain along the north side of the Cooling Pond about 20 feet north of MW6. The interceptor drain flows to a pump station where the intercepted groundwater flow is pumped back into the Cooling Pond.

The groundwater elevation and gradient measurements for 2012 through the end of 2015 are shown in Figure 1. As can be seen, there was no discernable change in MW6 groundwater elevations or water table gradient in 2015 compared to prior years. This would imply that the net rate of seepage from the Cooling Pond in 2015 (including the effect of capture and recirculation of interceptor drain water) was not significantly greater than in prior years. The generally decreasing trends in groundwater elevations for other on-site monitoring wells in 2015 are shown in the Groundwater Manganese TM prepared by Robertson-Bryan, Inc. (2016a).

Table 1. Condensate Flow, Quality, and Cooling Pond Loading Rates

Parameter	Reporting Units	Evaporators T1-T6 (total)			Evaporators T5-T6 (partial flow)			Cooling Pond Inlet			Cooling Pond Outlet		
Date		8/11/15	8/12/15	8/14/15	8/11/15	8/12/15	8/14/15	8/11/15	8/12/15	8/14/15	8/11/15	8/12/15	8/14/15
BOD	mg/L	49.10	51.90	23.60	1,510.00	571.00	278.00	33.70	23.80	41.00	32.20	34.50	27.50
COD	mg/L	110.00	120.00	120.00	3,700.00	880.00	630.00	110.00	130.00	110.00	110.00	100.00	120.00
pH	Unit		7.03	7.24		5.56	5.57		7.10	7.20		6.99	7.18
EC	umhos/cm		363.90	365.30		221.80	237.40		366.10	361.80		365.20	368.30
Net Flow	gpm	3,397	3,397	3,397	n.a.	n.a.	n.a.	3,397	3,397	3,397	n.r.	n.r.	n.r.
Net BOD Load	lbs/d	1,996	2,110	959	n.a.	n.a.	n.a.	1,370	967	1,667	n.r.	n.r.	n.r.
Net Areal BOD Load	lbs/ac/d	19.96	21.10	9.59	n.a.	n.a.	n.a.	13.70	9.67	16.67	n.r.	n.r.	n.r.

Condensate Generated	1.7	million lbs/hr (equals net condensate flow added to the Cooling Pond)
Pond Volume	550	af
Pond Volume	179	Mgal
Pond Total Flow	91.8	Mgal
HRT	1.95	days
% Recycle	95%	

n.a. = not available

n.r. = not relevant

All water quality data is for single grab samples.

Samples for Evaporators T5-T6 were taken from sidestreams

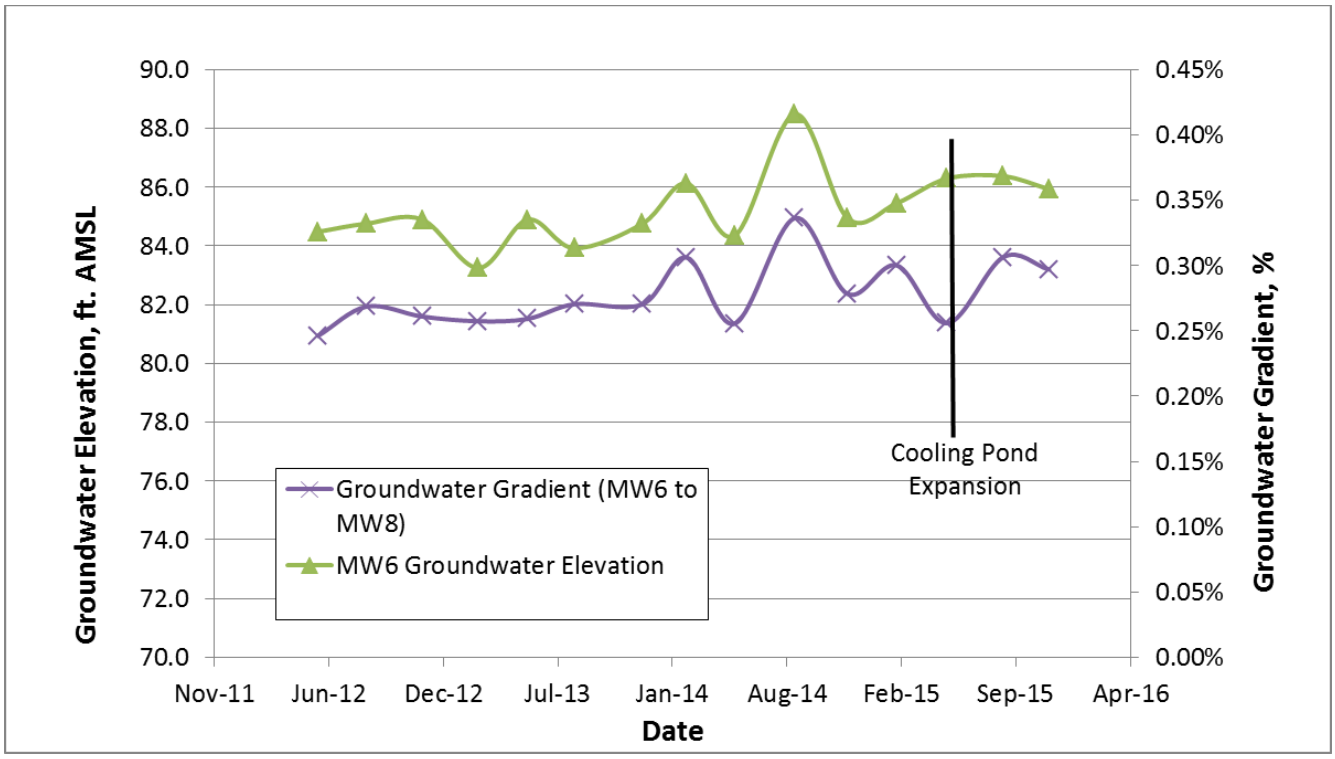

Figure 1. Groundwater Elevation Trends near Cooling Pond

3.4 Seepage Estimates and Groundwater Mounding

An estimate of the increase in seepage to groundwater due to the expansion of the Cooling Pond was prepared by Regional Board staff (RWQCB, 2016). The estimate was prepared using a Darcy Equation method that did not account for groundwater mounding. A method provided by the EPA for calculating mounding in the center of an infiltration basin (EPA, 2006) can be used to give a rough estimate of the magnitude of groundwater mounding under the Cooling Pond. Using a value of horizontal hydraulic conductivity of 1x10-4 cm/sec and assuming a 50 foot thick horizontal flow zone results in groundwater mounding up to the bottom of most of the Cooling Pond by the middle of the processing season. Groundwater mounding would be expected to substantially reduce the vertical groundwater gradient and subsequent seepage compared to the initial estimate by Regional Board staff.

3.5 Groundwater Quality Effects

The Tentative CDO attributed potential groundwater degradation to the Cooling Pond expansion. Since MW6 is now very close to the expanded Cooling Pond, the seepage from initial filling of the Cooling Pond could possibly have reached MW6. Salinity and manganese concentrations for 2013 through 2015 are shown in Figure 2. The August and November 2015 results show decreasing salinity in MW6, which could be a result of some influence from the low salinity water in the Cooling Pond. The manganese concentrations for those months are also lower than in 2014. Overall, it would appear from early results that the Cooling Pond may be improving groundwater quality. Further monitoring would be needed to establish any definitive trends. Given the normally high quality of water in the Cooling Pond, adverse effects on groundwater quality would not be expected. Additional details and comparisons over longer periods are provided in a separate TM by Robertson-Bryan, Inc. (2016b).

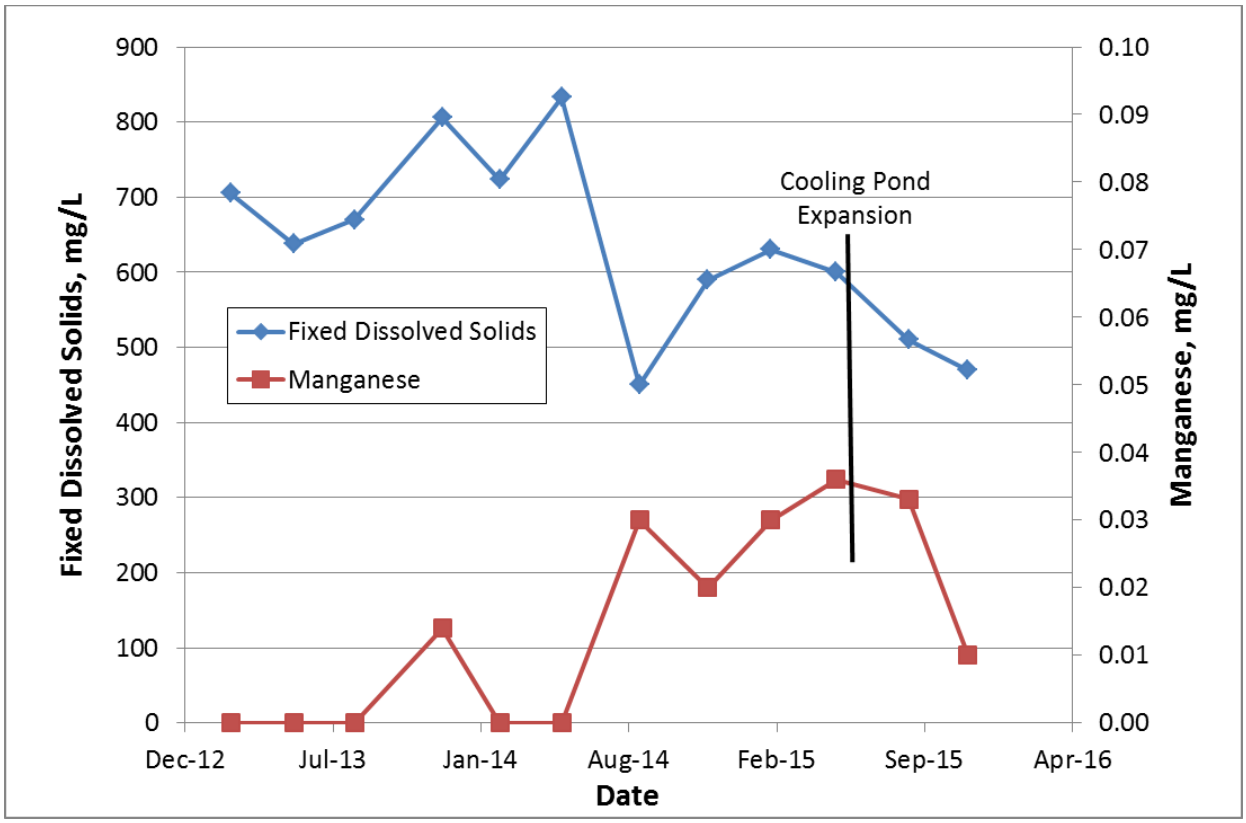

Figure 2. Groundwater Quality Trends in MW6

Section 4: Settling Pond Evaluation

The major two issues discussed in the Tentative CDO with regards to the Settling Pond and the effects its expansion were low DO levels and increased seepage. DO levels are used as a surrogate for conditions that could cause nuisance odors.

4.1 Dissolved Oxygen Levels

The expansion of the Settling Pond in 2012 did not result in any problems with dissolved oxygen levels or odors. In 2015, the dissolved oxygen levels in the Settling Pond likely was depressed due to the increased wastewater strength (2.5 times the 2014 concentration) and increased hydraulic retention time due to water conservation. Both of these factors would have increased the total oxygen demand in the pond.

The Settling Pond currently has one small aerator to increase DO. Additional aeration is warranted to insure compliance with the 1.0 mg/L DO limit. The design of supplemental aeration should be planned such that mixing effects are minimized for maintenance of good settling conditions.

Shorter hydraulic retention times would reduce total oxygen demand in the pond. Hydraulic retention time in the Settling Pond could be better tailored to flows if a variable elevation outlet were installed that still maintained sufficient pumping capability to the unloading flumes. This may not be possible prior to the 2016 season, but could be worth evaluating if additional aeration does not resolve the DO issue satisfactorily.

4.2 Groundwater Quality Effects

No groundwater quality impacts have been evident from data at MW2 and MW3 since the Settling Pond was expanded in 2012. The standard practice of drying and cleaning out the Settling Pond provides an opportunity for reaeration of the soil layer under the settling pond. Should groundwater monitoring show impacts in the future, the Settling Pond bottom could be converted into soil cement. Additional evaluation and comparison of historical groundwater quality around the Settling Pond is provided in a separate TM by Robertson-Bryan, Inc. (2016c).

Section 5: Summary

Based on the available data, expansion of the Cooling Pond does not appear to have adversely impacted groundwater quality or elevations. In fact, the expansion of the Cooling Pond may have improved groundwater quality in a localized area. Supplemental aeration should be made available for the 2016 season to assure that the 1.0 mg/L DO limit can be reliably met. Additional DO and BOD measurements should be taken at the Cooling Pond inlet and outlet in 2016.

The expansion of the Settling Pond does not appear to have adversely impacted groundwater. The increased wastewater strength in 2015 may have caused the Settling Pond DO to drop below the required 1.0 mg/L concentration during much of the latter portion of the season. Recommendations include adding supplemental aeration in 2016.

Section 6: References

EPA, 2006. Process Design Manual – Land Treatment of Municipal Wastewater Effluents. EPA/625/R-06/016. Cincinnati, OH. September.

Robertson-Bryan, 2016a. Groundwater Manganese in Land Application Areas. Prepared for Stoel Rives LLP Attorneys, January 2016.

Robertson-Bryan, 2016b. Cooling Pond Expansion Groundwater Impacts Evaluation. Prepared for Stoel Rives LLP Attorneys, January 2016.

Robertson-Bryan, 2016c. Settling Pond Expansion Groundwater Impacts Evaluation. Prepared for Stoel Rives LLP Attorneys, January 2016.

Attachment A: Map of Facilities and Land Application Area

Farm Grounds

Morning Star Packing - Williams

LEGEND

- Field Boundary
- Irrigation Supply
- Natural Drain
- Tailwater Drain
- Collection System

122°8'0"W 122°7'30"W 122°7'0"W 122°6'30"W

39°9'0"N 39°8'30"N 39°8'0"N 39°7'30"N

Abel

MW9

Field MS1

Field MS2

Field MS3

Field MS6

MW8

Field MS5

Field MS11

Field MS14

MW6

Field MS15

Field MS16

MW5

Cooling Pond
100 acres

Field MS18a

Field MS18b

MW7

Effluent Sample Location

MW3

MW2

Settling Pond
1.5 acres

MW4

MW1

Field MS24

5

122°8'0"W 122°7'30"W 122°7'0"W 122°6'30"W

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Map Scale 1:14,400 1 Inch = 1,200 Feet

0 300 600 1,200 1,800 2,400 Feet

N

Data Source:
Aerial Photography: Summer 2012
Projection: UTM Zone 10N, NAD 83
State of California: Colusa County

Map Source:
Custom Mapping Services, L.L.C.
Prairieville, LA (225) 677-7207
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