

Phase 5: Regulatory Action Selection

Final Project Report

Total Maximum Daily Load for Dissolved Oxygen in Dairy Creek, San Luis Obispo County, California

October 2004

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1. INTRODUCTION

Dairy Creek was included on California's section 303(d) list of impaired waters for dissolved oxygen. The Clean Water Act requires a Total Maximum Daily Load (TMDL) be developed to restore impaired waterbodies to their full beneficial uses. This report presents the dissolved oxygen TMDL for Dairy Creek. This section presents background information on the creek's 303(d) listing, describes the watershed and summarizes this report's outline and content.

1.1. Project Definition

Dairy Creek was listed as impaired for dissolved oxygen on the 2002 303(d) list. Review of available water quality monitoring data from the Morro Bay National Monitoring Program (NMP) and the Morro Bay Volunteer Monitoring Program (VMP) (1993-2004) indicate that dissolved oxygen is falling below the numeric water quality objectives at one of the three stations in Dairy Creek.

To further characterize the impairments in the creek and identify potential causes, data analyses were conducted to examine relationships between nutrient levels, algal growth, water temperature, and dissolved oxygen. Results of evaluating the effectiveness of implementing Management Practices (MPs) in improving water quality (i.e. dissolved oxygen, nutrients, and temperature) were also reviewed.

The conclusions that can be drawn from available data include:

- The water quality objective for the freshwater habitat beneficial use (COLD) of 7 mg/l and the general dissolved oxygen water quality objective (that median values should not fall below 85 percent saturation as a result of controllable water quality conditions) are not being met in portions of Dairy Creek where MPs have been implemented.
- Significant increases in dissolved oxygen levels have been observed as a result of MP implementation.
- Nutrient levels are typically low; nitrate levels do not exceed the water quality objective for the municipal and domestic water supply (MUN) use of 10 mg/L.
- No significant reductions in nitrates or phosphates were observed as a result of MP implementation; the relationship to dissolved oxygen levels is indeterminate.
- Limited algae has been observed, and, insufficient algal growth information are available to determine if it is contributing to depressed dissolved oxygen levels.
- Significant decreases in water temperature have been observed as a result of MP implementation, however, the relationship to dissolved oxygen levels is indeterminate.
- Multiple factors (canopy, temperature) are likely to have contributed to the dissolved oxygen impairment
- While data coverage is insufficient to derive an explicit linkage between dissolved oxygen levels and other environmental conditions (e.g., canopy); improvements as a result of implementing MPs are occurring.

Based on the review of available information the TMDL approach is as follows:

1. Develop a dissolved oxygen TMDL to attain the current numeric water quality objectives.
2. Continue to implement existing MPs. Improvements in dissolved oxygen levels are already occurring as a result of implementation and are expected to result in TMDL achievement.
3. The solution to the impairment being addressed by the TMDL is being implemented by a non-regulatory agency, the County, and the solution will correct the impairment. Recommend that the Regional Board approve a resolution indicating that existing efforts will implement the Dairy Creek TMDL and ultimately result in attainment of the associated water quality objectives.

1.2. Watershed Description

Dairy Creek is located in San Luis Obispo County on the central coast of California. The watershed is in a Mediterranean climate, with warm dry summers and cool wet winters. The geology of the watershed is a mix of igneous, metamorphic and sedimentary rock less than 200 million years old. Average temperature is about 12°C (54°F). Average annual rainfall ranges from 45 cm (18 inches) at the coast to 89 cm (35 inches) on the ridge; most of this rainfall occurs between November and April (sources: Department of Water Resources, 1958; Ernstrom, 1984).

Dairy Creek is tributary to Chorro Creek and drains to the Morro Bay estuary (Figure 1). Land use in the Dairy Creek watershed is primarily rangeland, with a golf course and park draining to the lower portions of the creek. Dairy Creek flows through El Chorro Regional Park, and is the site of a Management Practice implementation project (Figure 1). The land has a history of grazing without creek corridor protection, and in many areas the riparian vegetation was damaged. The Natural Resources Conservation Service, in partnership with the County of San Luis Obispo (County), and land managers voluntarily implemented MPs in 1994 and 1995. MPs implemented at Dairy Creek included cattle exclusionary fencing with water gaps and riparian revegetation. Improvements to approximately one mile of Dairy creek were completed during the summer of 1994, with an additional half-mile of the creek fenced during the summer of 1995.

In the past, approximately twenty head of cattle grazed along Dairy Creek on the County property (pers comm. J. Guidetti, 2002). The new fencing encloses the riparian corridor on both sides of the creek, excluding it from the grazing areas. Two water gaps were left between the lower and upper cattle fencing and just below the upper Dairy Creek site (DAU) to allow cattle access to the creek for water. The number of acres available for grazing has been reduced from 750 to less than 400. Of the 750 acres previously grazed, 150 acres have been designated as a botanical area. The lower portion of El Chorro Regional Park was developed as a golf course beginning in 1995 and completed in 1997.

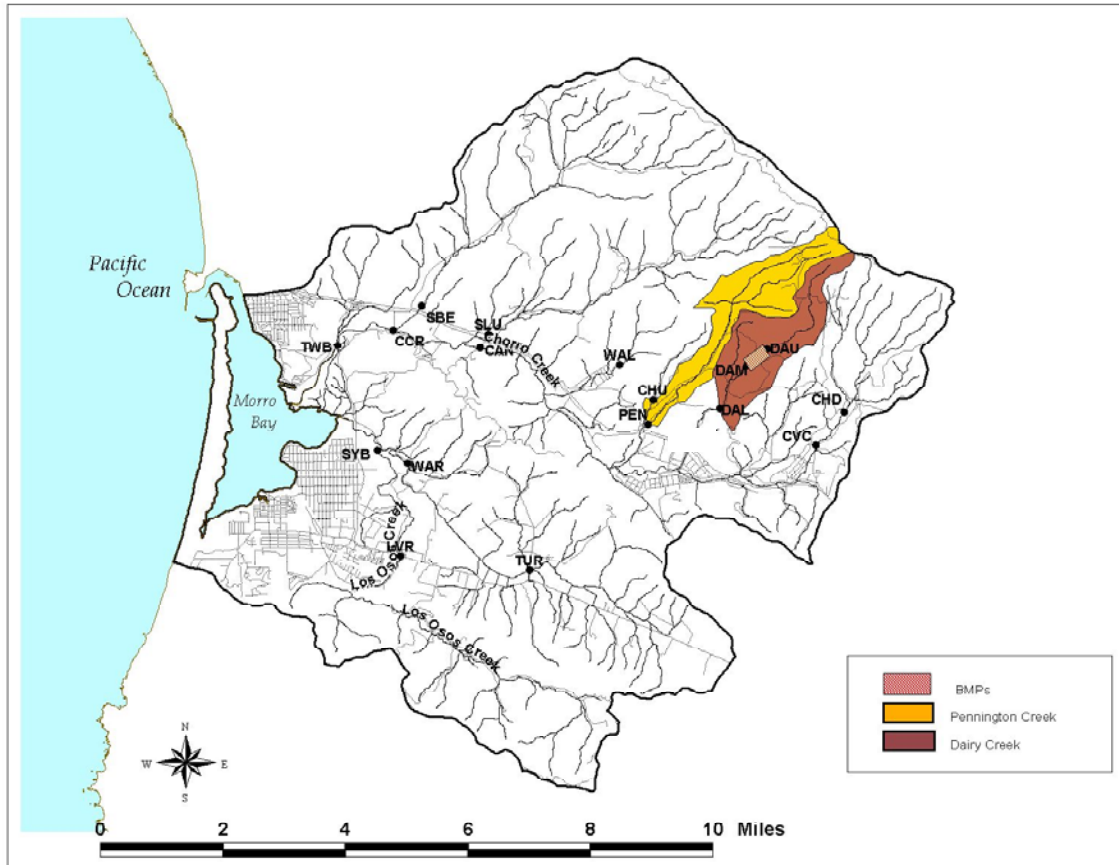


Figure 1. Watershed and monitoring sites within Dairy Creek and MP project boundaries

1.3. Structure of Document

The following sections are included in this TMDL report:

- **Project Definition:** Identifies the 303(d) listing for Dairy Creek and summarizes available information to characterize impairment.
- **Water Quality Standards:** Identifies the water quality standards applicable to the listing.
- **Data Review:** Provides an inventory and analysis of available water quality data.
- **Source Analysis:** Identifies potential sources of dissolved oxygen impairment in the watershed.
- **Dissolved Oxygen TMDL:** Identifies the dissolved oxygen TMDL for the Dairy Creek watershed, including allocations and considerations of seasonality and margin of safety.
- **Monitoring:** Discusses follow-up monitoring to track water quality improvements from the dissolved oxygen TMDL.
- **Implementation:** Discusses existing implementation activities for the dissolved oxygen TMDL, including plans for tracking the progress of implementation and the timeline for TMDL achievement.

2. WATER QUALITY STANDARDS

Regional Water Quality Control Boards (Regional Boards) define beneficial uses for waterbodies in their Water Quality Control Plans (Basin Plans). Also included in the Basin Plan are numeric and narrative objectives to be protective of the beneficial uses designated for each waterbody. The following sections discuss the applicable beneficial uses and water quality objectives related to the 303(d) listings in Dairy Creek.

2.1. Beneficial Uses

Table 1 summarizes the beneficial uses of Dairy Creek

Table 1. Beneficial uses for Dairy Creek.

Waterbody	Dairy Creek
Municipal and Domestic Supply (MUN).	X
Agricultural Supply (AGR)	X
Industrial Process Supply (PROC)	
Industrial Service Supply (IND)	
Ground Water Recharge (GWR)	X
Water Contact Recreation (REC-1)	X
Non-Contact Water Recreation (REC-2)	X
Wildlife Habitat (WILD)	X
Cold Fresh Water Habitat (COLD)	X
Warm Fresh Water Habitat (WARM)	
Migration of Aquatic Organisms (MIGR)	X
Spawning, Reproduction, and/or Early Development (SPWN)	X
Preservation of Biological Habitats of Special Significance (BIOL)	
Rare, Threatened, or Endangered Species (RARE)	X
Estuarine Habitat (EST)	
Freshwater Replenishment (FRSH)	
Navigation (NAV)	
Hydropower Generation (POW)	
Commercial and Sport Fishing (COMM)	X
Aquaculture (AQUA)	
Inland Saline Water Habitat (SAL)	
Shellfish Harvesting (SHELL)	

2.2. Water Quality Objectives

Water quality objectives applicable to the 303(d) listing Dairy Creek include numeric objectives for dissolved oxygen. Numeric objectives for dissolved oxygen are listed in Table 2.

Table 2. Water quality objectives for dissolved oxygen.

Beneficial Use	Dissolved Oxygen Objective
General Objective	Median values should not fall below 85 percent saturation as a result of controllable water quality conditions.
AGR	Minimum of 2 mg/L
COLD	Minimum of 7 mg/L
SPWN	Minimum of 7 mg/L

3. DATA REVIEW

This section summarizes the data collected by the Regional Board and volunteers as part of the Morro Bay National Monitoring Program (NMP) and the Volunteer Monitoring Program (VMP). Data include dissolved oxygen, nutrient concentrations, temperature, and anecdotal information on algal growth in Dairy Creek. Figure 1 shows the locations of monitoring stations on Dairy Creek (DAU, DAM, and DAL).

3.1. Dissolved Oxygen

Tables 3 and 4 summarize available dissolved oxygen data and Figure 2 shows the observed dissolved oxygen at stations on Dairy Creek. At one of the monitoring sites, DAM, 24% of dissolved oxygen data collected between 1993 and 2004 fell below the COLD water quality objective. Median percent saturation values also fell below the percent saturation water quality objective of 85 at DAM. Because dissolved oxygen levels are meeting WQOs at DAU and DAL, the upstream and downstream reaches of Dairy Creek are not considered impaired for dissolved oxygen.

Table 3. Summary of dissolved oxygen data for Dairy Creek (concentration).

Year	DAU			DAM			DAL		
	No. of Samples	No. of Exceedances	% of Samples Exceeding	No. of Samples	No. of Exceedances	% of Samples Exceeding	No. of Samples	No. of Exceedances	% of Samples Exceeding
1993	16	0	0%	16	10	63%	3	1	33%
1994	31	4	13%	35	24	69%	20	5	25%
1995	35	0	0%	34	10	29%	1	0	0%
1996	37	0	0%	38		0%	37	0	0%
1997	35	0	0%	34		0%	30	0	0%
1998	25	0	0%	25		0%	16	0	0%
1999	16	0	0%	20	1	5%	14	0	0%
2000	21	1	5%	21	12	57%	21	0	0%
2001	20	0	0%	20	2	10%			
2002							7	0 ¹	0%
2003				8	1 ¹	13%	7	1 ¹	14%
2004				3	0	0%	4	0	0%

¹ measurements taken in stagnant flow conditions omitted from analysis and are not displayed as exceedances

Table 4. Summary of Dissolved Oxygen Data for Dairy Creek (concentration and percent saturation).

Station	Start Date	End Date	Applicable WQO	No. of Samples	No. Below WQO	% Below 7 mg/l	Applicable WQO	No. of Samples	Median (%)
DAU	6/08/93	5/15/01	7 mg/l	236	5	2%	≥85%	236	86
DAM	6/08/93	4/20/04	7 mg/l	254	60	24%	≥85%	252	82
DAL	12/14/93	4/20/04	7 mg/l	168	8	5%	≥85%	163	86

The monitoring site, DAM, was established because this segment of Dairy Creek was targeted for a MP implementation project, as it was heavily impacted by cattle grazing. Dairy Creek was included in the Morro Bay National Monitoring Program (NMP), a ten-year MP implementation and monitoring project (RWQCB, 2003). Two control sites were established as comparisons to DAM, including DAU on Dairy Creek and PEN on Pennington Creek (Figure 1).

According to the NMP, an increase in dissolved oxygen was detected at DAM following MP implementation. Before MP implementation, dissolved oxygen at DAM was on average 1.75 mg/l lower than at a control site on Pennington Creek (PEN). Following MP implementation, dissolved oxygen (mg/l) concentrations at DAM on average increased by 0.90 ppm and were found to be statistically significant ($p < 0.0001$). Comparisons between DAM dissolved oxygen

(ppm) concentrations and another upstream control site (DAU) yielded similar results. After MP implementation, DAM dissolved oxygen concentrations increased on average 0.85ppm.

While dissolved oxygen levels are improving at DAM as a result of MP implementation, dissolved oxygen levels do not yet meet WQOs. As shown previously in Table 3, dissolved oxygen levels continue to fall below water quality objectives at DAM following MP implementation. Median values at DAM following MP implementation also continue to fall below 85 percent saturation.

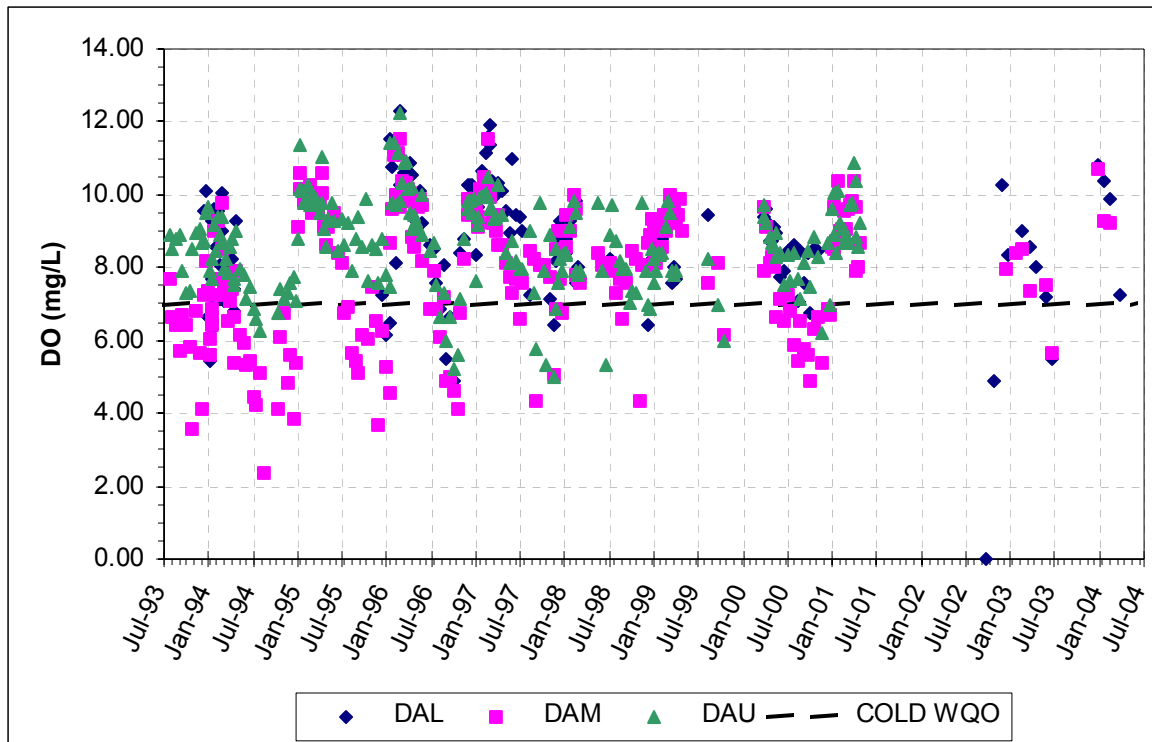


Figure 2. Dissolved oxygen levels at Dairy Creek

3.2. Nutrients

Figures 3 and 4 show the observed nitrate and phosphate concentrations at stations on Dairy Creek. Nutrient levels are typically low; nitrate levels do not exceed the water quality objective for the municipal and domestic water supply (MUN) use of 10 mg/L. Nitrate levels are typically less than 5 mg/l and phosphate levels less than 0.5 mg/l.

The National Monitoring Program (NMP) study in the Morro Bay watershed demonstrated that nutrients in the creek were not reduced significantly even though rangeland MPs were implemented. This suggests that rangeland nutrient loading is not causing increases in nutrient concentrations and therefore rangeland loading is not treated as a source of impairment in this TMDL analysis.

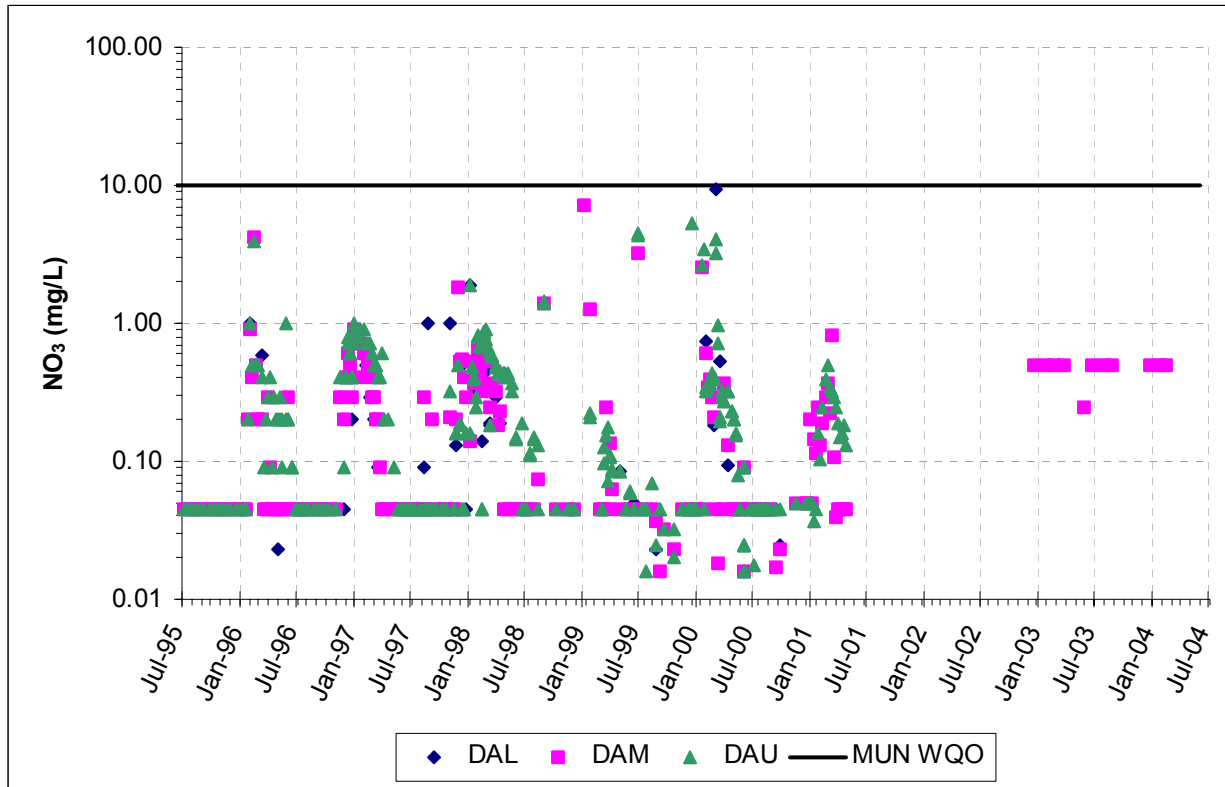


Figure 3. Nitrate (NO₃-N) levels at Dairy Creek

Note: non-detectable, or lower limit levels vary depending on laboratory methods

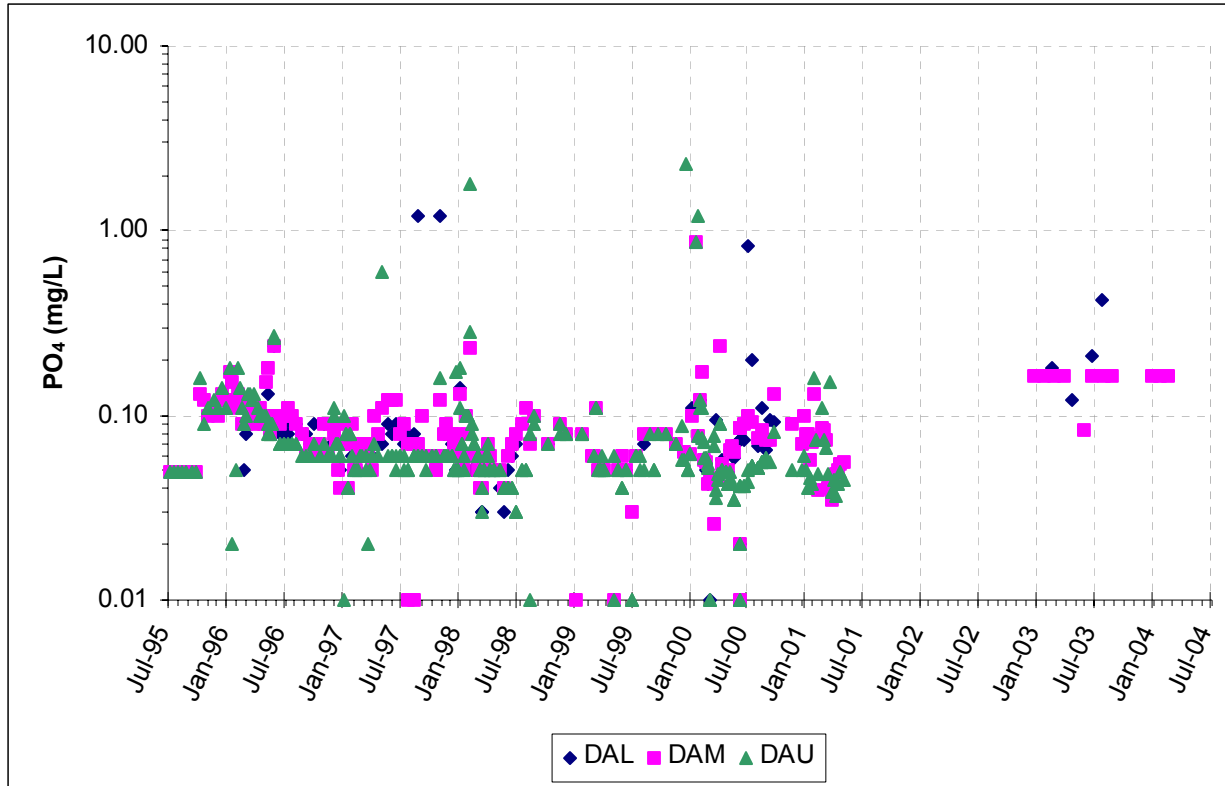


Figure 4. Phosphate (PO₄-P) levels at Dairy Creek

Note: non-detectable, or lower limit levels vary depending on laboratory methods

3.3. Algal Growth

Algal growth has been observed in Dairy Creek; however, documentation between 1993 and 2003 is very limited. Algal data are primarily anecdotal and do not provide consistent documentation on severity and extent of coverage and effect on use, making it difficult to clearly identify the impact of algal growth on uses in Dairy Creek. Information documents the presence of algal growth, but does not demonstrate a connection to depressed oxygen levels.

3.4. Water Temperature

According to the NMP study on Dairy Creek, significant decreases in water temperatures were observed as a result of MP implementation, however the relationship between temperature and dissolved oxygen levels is indeterminate.

3.5. Data Summary

Dissolved oxygen levels do not meet WQOs at one station in Dairy Creek (DAM) and support WQOs at the other stations (DAU and DAL). MPs implemented along Dairy Creek (at DAM) are resulting in improvements to dissolved oxygen, however; dissolved oxygen levels do not yet

meet WQOs. The segment of Dairy Creek downstream of the Dairy Creek Golf Course (DAL) and upstream (DAU) are not considered as impaired.

Multiple factors (canopy, temperature) are likely to have contributed to the dissolved oxygen impairment. While data coverage is insufficient to derive an explicit linkage between dissolved oxygen levels and other environmental conditions (e.g., canopy); improvements as a result of implementing MPs are occurring. Because data suggest a continued impairment by dissolved oxygen, a TMDL has been developed for dissolved oxygen in Dairy Creek.

4. SOURCE ANALYSIS

This section identifies potential sources of the dissolved oxygen impairment in Dairy Creek.

The land use along Dairy Creek upstream of DAM, where the impairment exists, is rangeland. Rangeland MPs installed along Dairy Creek have resulted in significant improvements in dissolved oxygen, according to the NMP study. As a result, staff determines that the source of impairment, rangeland, is being corrected, and anticipates that ultimately the WQOs in Dairy Creek will be met. The Dairy Creek Golf Course does not appear to be contributing to the impairment of dissolved oxygen in Dairy Creek as the WQOs at DAL are being met.

5. DISSOLVED OXYGEN TMDL

The TMDL represents the loading capacity of a waterbody—the amount of a pollutant that the waterbody can assimilate and still support beneficial uses. The TMDL is the sum of allocations for nonpoint and point sources and any allocations for a margin of safety. TMDLs are often expressed as a mass load of the pollutant but can also be expressed as a unit of concentration (40 CFR 130.2(i)).

The dissolved oxygen TMDL for Dairy Creek is set at 1) a minimum concentration for dissolved oxygen of 7 mg/l to protect the COLD beneficial use and 2) a median value equal to or greater than 85 percent saturation. The allocations, which include background levels, are also equal to the numeric targets. The County of San Luis Obispo Parks Department (County) is given a load allocation equal to the two numeric targets. Monthly concentrations may not fall below 7 mg/l and annual median values may not fall below 85 percent saturation.

Staff has not identified any point source discharges that contribute to the impairment so no wasteload allocation is necessary.

Expressing the TMDL as a dissolved oxygen concentration in receiving water equal to the WQO provides a direct measure of the dissolved oxygen levels in the watershed to compare with water quality objectives and provides a measurable target for sources to monitor and with which to comply. Requiring the responsible parties to maintain minimum dissolved oxygen levels at the

numeric target of 7 mg/l and median percent saturation values at or above the numeric target of 85% establishes a direct link between the TMDL target and sources.

Seasonality is not a determining factor in the TMDL because the TMDL is equal to the dissolved oxygen WQOs, which must be met at all times. In addition, while dissolved oxygen levels are typically less in the summer and fall months, existing data indicate that WQO violations occur during both wet and dry seasons.

The margin of safety for this TMDL is implicitly included through the use of the dissolved oxygen WQO as the TMDL. The WQO was established using conservative assumptions, translating to an implicit margin of safety.

No reasonable alternatives exist for either the TMDL or the implementation plan. The “no project” alternative would not provide a plan of action for the Regional Board to ensure that the County’s activities resolve the impairment and would not comply with the Clean Water Act. Staff does not believe that more stringent numeric targets are necessary to protect beneficial uses or to comply with water quality objectives. This complies with Clean Water Act requirement to develop TMDLs for listed waterbodies to the extent possible based on available information.

6. MONITORING

This section discusses the planned monitoring in the Dairy Creek watershed. Monitoring will include continued water quality monitoring to measure the progress of the creek in meeting the dissolved oxygen TMDL targets.

Monitoring will be performed by the Morro Bay Volunteer Monitoring Program (VMP) in Dairy Creek to ensure that the numeric targets are met. Volunteer monitors will measure dissolved oxygen concentrations at Dairy Creek (DAM) on a monthly basis. The County will coordinate with the VMP to allow access for continued monitoring. If VMP monitoring efforts cease, the Executive Officer will require the County to monitor pursuant to Clean Water Act Section 13267 or 13225(c). Regional Board staff will conduct additional dissolved oxygen monitoring at pre-dawn hours to obtain information relative to diurnal fluctuations.

7. IMPLEMENTATION

The County partnered with the NRCS and land managers to implement MPs along a mile-long corridor through County owned, El Chorro Regional Park that was impacted by grazing practices. Funding was provided by federal, state, and local entities through the United States Department of Agriculture’s Hydrologic Unit Area Project. Completion of the cattle exclusionary fencing and riparian revegetation occurred in 1995. The County is committed to maintaining the MPs.

The solution to the impairment being addressed by the TMDL is being implemented by a non-regulatory agency, the County, and the solution will correct the impairment. Staff is confident

that existing efforts will implement the Dairy Creek TMDL and ultimately result in attainment of the associated water quality objectives.

The implementation plan will not have any adverse environmental impacts so no mitigation measures are necessary.

7.1. Measuring Progress

The County will submit a technical report that includes an inventory of existing MPs and annual reports to the Regional Board. The annual reports will identify any proposed changes to MPs along Dairy Creek and include VMP monitoring data that Regional Board staff will use to confirm that progress is made towards TMDL achievement.

Regional Board staff will conduct a review of Dairy Creek to evaluate implementation efforts every three years. Regional Board staff will utilize information submitted by the County and the VMP to evaluate MP implementation efforts and dissolved oxygen conditions. Regional Board staff will review data collected by the VMP and/or Regional Board staff in order to report attainment or number of exceedances of water quality objectives, if any, and ultimate achievement of the TMDL.

If the Regional Board does not receive a technical report and annual report within one year, staff will request reporting pursuant to California Water Code Section 13267 or 13225(c). Section 13267 states that the Regional Board may investigate the quality of a waterbody when establishing or reviewing a water quality control plan or waste discharge requirement. The Section provides the Regional Board the authority to 1) require any person who has, is, proposes to, or is suspected of discharging to furnish a technical or monitoring program report and/or 2) to inspect the facilities of any person to ascertain water quality conditions. If the Regional Board does require a person to furnish a report, as in 1) above, failure to produce the report by the date required subjects the person to monetary penalties. Section 13225(c) provides that the Regional Board shall Require as necessary any state or local agency to investigate and report on any technical factors involved in water quality control or to obtain and submit analyses of water; provided that the burden, including costs, of such reports shall bear a reasonable relationship to the need for the report and the benefits to be obtained therefrom.

Regional Board staff may conclude and articulate in the review that ongoing implementation efforts may be insufficient to ultimately achieve the allocations and numeric target. If this occurs, Regional Board staff will recommend revisions to the implementation plan. Regional Board staff may conclude and articulate in the three-year review that, to date, implementation efforts and results are likely to result in achieving the allocations and numeric target, in which case existing and anticipated implementation efforts should continue.

7.2. Timeframe

Regional Board staff will confirm that tracking and reporting mechanisms are in place in one year, and evaluate progress towards achieving the water quality objective every three years. Staff

will review annual reports submitted by the County, along with monitoring information collected by the VMP relative to the numeric target.

The implementation period to meet the allocation and verify TMDL achievement is 6 years. This schedule is reasonable because MPs are in place and, while water quality objectives are not yet being met, improvements as a result of MP implementation are already occurring. Staff is confident that as riparian vegetation becomes further established, dissolved oxygen levels will continue to improve, and the water quality objectives will be attained.

If the allocated loads are not met within this timeframe, staff will re-evaluate the implementation plans and schedule, and if necessary recommend a more stringent approach to the board. If allocations and numeric targets are being met, Regional Board staff will recommend the waterbody be removed from the 303(d) list.

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