APPENDIX F-6

ADAPTIVE MANAGEMENT PROGRAM FOR WATER QUALITY REGARDING IRON

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TECHNICAL MEMORANDUM

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From: Andy Kopania

Subject: **Adaptive Management Program to address the potential for elevated iron concentrations to occur in reclaimed silt ponds and mining excavations at the Eliot Facility and to prevent potential impacts to water quality in the Upper and Lower Aquifers**

Impact Analysis

The presence of elevated iron concentrations is relatively common in silt ponds and reclaimed aggregate mining excavations with substantial vegetation growth. Seasonal die-back of the vegetation and subsequent decay at the bottom of the ponds scavenges the dissolved oxygen in the water and creates reducing conditions1. The reducing conditions increase the mobility of naturally-occurring iron within the silts and clays present in the ponds. In the Zone 7 Water Agency 2016 Alternative Groundwater Sustainability Plan for the Livermore Valley Groundwater Basin, iron is not identified as a constituent that could cause undesirable results. Thus, Zone 7, as the local Groundwater Sustainability Agency (GSA), has not established a maximum threshold for iron. However, the secondary maximum contaminant level (MCL) for drinking water and the typical National Pollutant Discharge Elimination System (NPDES) discharge limit is 300 µg/L.

Based on the 2020 evaluation by Kleinfelder of water quality data provided by Zone 7

1 Reducing conditions form when there is a lack of oxygen in the water, preventing further oxidation and decay of organic material. The reducing conditions are identified by a negative oxidation-reduction potential value when measured with an appropriate meter in the field. The reducing conditions can change the form of iron in the fine-grained sediments from one that is not soluble (i.e. ferric iron, or Fe^{+3}) to another form that is soluble (i.e. ferrous iron, or Fe^{+2})

for surface water and groundwater at and near the Eliot facility, average iron concentrations exceed 300 µg/L in P40 (Pond C; 549 µg/L) and in P45 (southern Freshwater Pond; 437.5 µg/L.) on the Eliot site2. The average iron concentration does not exceed 300 µg/L in any wells evaluated for the Kleinfelder study, but approaches the limit in Upper Aquifer well 13P6 (224 µg/L), located between Pond D, the Main Silt Pond, and the northern Freshwater Pond (Pond A) on the Eliot site. It should be noted that the average iron concentration exceeds 300 µg/L in three ponds at the Vulcan and former Kaiser sites north of Stanley Blvd. (R24, R28, and R3). Maximum iron concentrations exceed 300 µg/L. at P11 (old mining pond in Arroyo del Valle on the Eliot site; 350 µg/L), P12 (old mining pond in Arroyo del Valle downstream from the Eliot site; 510 µg/L), P28 (west part of Lake A; 520 µg/L), P40 (Pond C; 2,100 µg/L), P42 (Lake B; 1,160 µg/L), P44 (northern Freshwater Pond A; 660 µg/L), and P45 (southern Freshwater Pond; 890 µg/L), in addition to all of the monitored ponds at the Vulcan and former Kaiser sites north of Stanley Blvd.

Given the duration of the proposed mining activities at Eliot, and the phased reclamation, it is not possible with the existing data to determine if elevated iron concentrations in any of the reclaimed ponds or excavations would exceed water quality standards. If such exceedances were to occur due to reducing conditions in the ponds, iron concentrations are likely to decrease relatively rapidly if the water from the ponds migrated into the Upper Aquifer and/or Lower Aquifer, with different redox conditions than the ponds. This would be a favorable condition. However, the potential for an impact to water quality due to iron may exist. Any potential impact would be addressed through an adaptive management strategy that includes monitoring, comparison of monitoring results with action levels, and subsequent implementation of mitigation measures if the action levels are exceeded.

Monitoring Program and Action Levels

The monitoring component of the adaptive management strategy would begin in a specific pond or mining excavation once it is reclaimed. Every six months, based on seasonal changes in vegetation growth and die-back, field measurements would be conducted for the parameters listed in Table 1 below. These parameters are general indicators of water quality and the potential for reducing conditions to form. The field measurements would be conducted at two depths using a multi-parameter hand-held probe: just below the water surface and near the bottom of the water column in the pond. Care should be taken to ensure that the field monitoring probe remains within the water column such that the bottom measurement is not taken within the upper layer of soft sediment.

2 The concentrations discussed in this paragraph do not include outliers identified by Kleinfelder.

TABLE 1. Semiannual Field Indicator Parameters	
Parameter	*Action Level*
pH	>8.5
Conductivity	>700 mg/L
Dissolved oxygen (DO)	<8 mg/L or <70% of saturation
Oxidation-reduction potential (ORP)	<0

If any of the action levels shown in Table 1 are exceeded for two successive monitoring events, then water samples should be collected from that specific pond and submitted to an analytical laboratory for analysis of iron. Water samples should be collected from the same depth interval at which the field parameters that exceed the action levels were measured If the laboratory results show that the iron concentration exceeds its secondary MCL and NPDES discharge limit of 300 µg/L, then the laboratory testing should be completed again in six months to assess whether there are potential seasonal influences. If the iron level persists above its water quality standard of 300 µg/L in the second sample round, then the following corrective measures would be implemented to mitigate the elevated iron levels in a specific pond. However, if the iron level does not exceed the water quality standard in the second sample round, then the semiannual field monitoring would continue.

Corrective Measures

Lowering of the iron level in a reclaimed pond where the water quality standard is consistently exceeded would be accomplished through a combination of actions. Reducing conditions that favor high pH values and low dissolved oxygen (DO) values, resulting in higher concentrations of iron, typically form at the bottom of ponds due to the breakdown of organic matter, such as dead aquatic or riparian vegetation. Aeration or mechanical circulation of the water from the bottom of the pond to the surface of the pond would better distribute DO throughout the water column and would minimize the formation of reducing conditions. If substantial amounts of submerged aquatic vegetation form within the pond, or riparian vegetation such as reeds and cattails form around the perimeter of the pond, and aeration or water circulation alone is insufficient to eliminate the reducing conditions, then appropriate measures to minimize the vegetation would be implemented. Such measures may include physical removal by hand or mechanical equipment (e.g. dredging), growth prevention using physical barriers (e.g. tarps or bottom barriers) in areas of heavy growth, or use of approved terrestrial or aquatic herbicides if other methods are not feasible or effective.

Reporting

Monitoring results would be reported to the County on an annual basis. The annual report would also describe any additional measures that have been or are planned to be

taken based on the monitoring results. If persistently elevated iron levels occur, the annual report would also describe the corrective actions that have been or are planned to be implemented under the adaptive management program.