memorandum

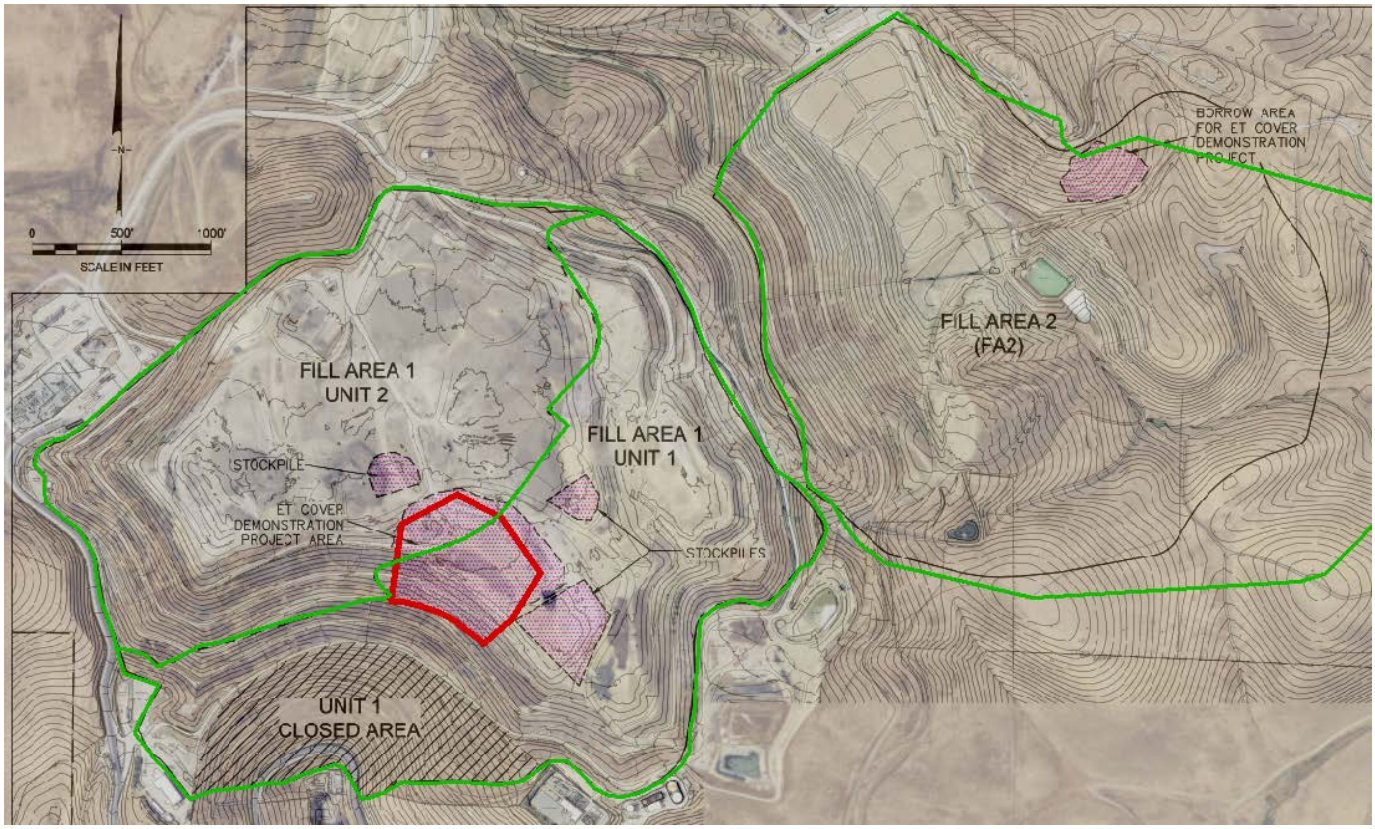
date July 11, 2017

to ALRRF Community Monitor Committee

from Kelly Runyon

subject CMC Meeting of 7/12/17 - Supplemental Information Regarding ET Cover System at ALRRF

Additional information about the proposed use of an evapotranspiration (ET) cover system at the ALRRF is presented below. This consists of an image showing the 10-acre ET cover test area as an overlay on an aerial image of the site, followed by an excerpt from the Findings section of the current Waste Discharge Requirements which provides further background on prior and current applications at the ALRRF.



have minimum plan dimensions of 3 meters (10 feet) square, a minimum thickness of 0.3 meters (one-foot), and a minimum volume of about 2.83 meters^3 (~100 cubic feet). The LCRS sump will contain drainage gravel and a minimum 0.45-meter (18-inch) diameter perforated HDPE collection pipe(s) for removal of any liquid from the leak detection system.

151. The LCRS geocomposite drainage layer will have a minimum transmissivity of 4 x 10^{-4} meters^2 per second (4 x 10^{-3} feet^2 per second). Assuming a hypothetical damage to the primary geomembrane liner equal to a 1 millimeter diameter hole for every acre of lined area (suggested standard value for modern liner construction & CQA) and a maximum permitted hydraulic head of 0.3m (e.g., 12-inch maximum), the LCRS geocomposite will have a flow capacity of 20 meters^3 per acre per day (e.g., >5,000 gallons per acre per day). The minimum 0.45-meter (18-inch) diameter perforated HDPE collection pipe(s) and LCRS sump will both have capacities of at least 21 meters^3 per acre per day (~5,550 gallons per acre per day). Given a recommended Action Leakage Rate of 7.57 meters^3 per acre per day (2,000 gallons per acre per day) for the Class II Impoundments, the proposed LCRS geocomposite drainage layer, sump, and pump system will exceed the volume of leachate by 2.5 times. This exceeds the minimum requirement of 2.0 times as required by Title 27.

152. For Fill Area 2 Unit 1, the Discharger has installed an approximately 1-mile long 8-inch inside diameter double-walled conveyance pipe to convey leachate collected via gravity to the 8-million gallon leachate storage pond. The pipeline and leachate pond are shown on Attachment C. The Discharger's sizing of the 8-inch conveyance pipe relied upon the Discharger diverting a majority of a 1000-year 24-hour storm event (design storm) falling on the WMUs when waste is initially placed. These WDRs require the Discharger to install stormwater diversion structures in accordance with Title 27 section 20365 in order to prevent inundation of the leachate conveyance pipe and exceedance of the 1-foot maximum head requirement on the LCRS primary liner.

153. The Discharger adequately demonstrated that construction of a Subtitle D prescriptive standard liner for all three Class II surface impoundments would be unreasonably and unnecessarily burdensome when compared to the proposed engineered alternative design. The Discharger demonstrated that the proposed engineered alternative is consistent with the performance goals of the prescriptive standard and affords at least equivalent protection against water quality impairment.

ENGINEERED ALTERNATIVE FOR LANDFILL CLOSURE COVER

154. Title 27 CCR Sections 21780(c)(3) and (d)(1) [sections promulgated by the CIWMB] require the Discharger to submit the final closure and post-closure maintenance plan, or for the closure of discrete units, the partial final closure and post-closure maintenance plan, at least two years prior to the anticipated date of closure.

155. Title 27, section 21090 provides the minimum prescriptive final cover components for landfills consisting of, in ascending order, the following layers:

a. Two-foot soil foundation layer.
b. One-foot soil low flow-hydraulic conductivity layer, no more than $1x10^{-6}$ cm/s or equal to the hydraulic conductivity of any bottom liner system or underlying natural geologic materials, whichever is less permeable.
c. One-foot soil erosion resistant/vegetative layer.

156. Title 27 allows engineered alternative final covers provided the alternative design will provide a correspondingly low flow-through rate throughout the post-closure maintenance period.

157. In 1989, the Discharger closed approximately 9 acres of Fill Area 1, Unit 1 with a soil cover. In 1992, the Discharger closed approximately 17.8 acres of Fill Area 1, Unit 1 with a soil cover consisting of a one foot vegetative soil layer over a one foot compacted clay soil layer over existing interim cover.

158. The Discharger submitted a December 2008 Alternative Final Cover (AFC) Design Report ((Dwyer, Valceschini, and Obereiner, December 2008 hereafter referred to as AFC Report) for the remainder of Fill Area 1 (Units 1 and 2). The proposed alternative final cover is an evapotranspirative (ET) cover, also known as a water balance cover. This type of cover functions by storing moisture between the soil particles during the rainy season, and releasing that moisture during the growing season and dry season through plant uptake and evaporation. The AFC Report states that this type of cover has advantages over a prescriptive cover that include better ability to accommodate settling and subsidence, increased rooting depth for native vegetation, better static and seismic slope stability, reduced complexity for long-term maintenance, better ecological diversity and density, and potentially increased end-use capabilities.

159. Federal regulations allow for alternative final covers that provide an "equivalent reduction in flux" to the prescriptive standard, and State regulations under Title 27 indicate that a "similar low through-flow rate" should be achieved. State regulations also say that alternatives can be approved that "will continue to isolate the waste in the Unit from precipitation and irrigations waters at least as well as would a final cover built in accordance with applicable prescriptive standards."

160. The AFC Report presented results from a five-year pilot study of a four-foot thick ET cover conducted under the Alternative Covers Assessment Project (ACAP), a US EPA program. The project was one of many ACAP projects conducted in California and the United States. The ACAP cover performed well until the third year of the study at which point increased percolation was measured in the underlying lysimeter. Moisture probe and lysimeter data indicated an immediate response to rainfall even at the deepest points in the cover. The Discharger concluded that preferential flow was occurring, and that it was caused by shrinkage of the soil away from the edges of the lysimeters and moisture probes. The Discharger also concluded that the cause was its placement at above-optimum moisture and with too much compaction that would cause the soil to shrink when it dried out during the summer.

161. The AFC Report also presented information from the examination of the existing final covers that were installed in 1989 and 1992. Several trenches were dug into the covers to examine the soil and rooting depths. The soil was found to be in generally good condition, with no evidence of preferential flow having developed during the almost 20 years since the covers were installed. The Discharger also conducted a borrow source investigation to verify the properties of the particular types of soil needed to complete the proposed final cover.

162. Based on the above information, the Discharger designed a proposed four-foot thick ET cover consisting of two feet of soil placed loosely at below-optimum moisture over two feet of compacted soil, a design similar to the cover placed in 1992. The cover would be vegetated using native annual and perennial species selected to maximize removal of moisture from the cover. The Discharger conducted extensive modeling of the proposed cover over a ten-year period, including the two wettest years on record (1982-83) using rainfall data from the nearby Livermore station. The cover was also modeled under conditions of five consecutive years of above average precipitation of 17.7 inches per year based on 2005 rainfall. Rainfall was measured at the ACAP test plot during the study and indicated rainfall at the site is similar to, but slightly less than that measured at the Livermore station that averages 14.8 inches per year. The modeling indicated that the proposed cover would allow percolation to a maximum depth of 23.2 inches into the cover over the ten year period under the above average precipitation conditions that included the wettest two years on record. The modeling also indicated that the proposed cover would allow percolation to a maximum depth of 20.1 inches over the five-year period of above-average rainfall. These results indicate that there would be negligible flux through the proposed four-foot (48-inch) cover under either scenario, and that it would therefore meet both the State and federal regulatory requirements.

163. This Order approves the proposed alternative ET final cover design for closure of the remainder of Fill Area 1, Unit 1, with a contingency that the Discharger can demonstrate that the ET cover isolates the underlying wastes from precipitation as required by Title 27 sections 20950(a)(2)(A)(1) and 21090(a) for correspondingly low through-flow rate in the case where there is the absence of a bottom liner system (unlined WMU). These WDRs require the Discharger to substantiate the correspondingly low through-flow rate through monitoring and other means of validation and verification. The Discharger shall implement an approved contingency plan if the installed ET cover over Fill Area 1 Unit 1 fails to meet the performance objectives described in the AFC Report for providing correspondingly low through-flow rate per Title 27 regulations in the case where there is the absence of a bottom liner system and known releases are occurring.

164. Prior to approval of an alternative final cover for Fill Area 1, Unit 2, or for Fill Area 2, this Order requires the Discharger to monitor the performance of a minimum 10-acre ET cover over Fill Area 1 Unit 1 for a maximum monitoring period of four years after it is installed on Fill Area 1, Unit 1. This Order requires that the Discharger provide a monitoring and contingency plan for review and approval by the Executive Officer to monitor the installed ET cover for the maximum period of four years. The purpose of the monitoring period is to provide additional data upon which to evaluate whether the ET

cover will perform as modeled, given that the ACAP cover did not perform as expected, prior to approval of an alternative ET cover for the remainder of the landfill WMUs. Once the four year monitoring period is completed and the Discharger demonstrates that the minimum 10-acre ET Cover meets the performance objectives described in the AFC Report and provides correspondingly low through-flow rate per Title 27 regulations for WMUs with a bottom liner system, the Discharger may install the alternative ET final cover over Fill Area 1, Unit 2, and if desired, over Fill Area 2 with any necessary adjustments to the proposed design based on the monitoring results and Central Valley Water Board staff approvals.

165. The Discharger proposes that side slopes for closed Fill Area 1 will be sloped at 2H:1V and will include 10-foot wide benches every 50 vertical feet with a top deck area having slope gradients of no less than 5% to promote drainage of precipitation from the WMU final closure cover. The Discharger's JTD indicates that final grading the top deck area with a minimum 5% slope gradient will account for settlement allowing the top deck area to continue to meet the 3% slope gradient requirement of Title 27 during the post closure maintenance period. Title 27 section 21090(a) also requires 15-foot wide benches every 50 vertical feet. These WDRs include specifications requiring the Discharger to construct 15-foot wide benches every 50 vertical feet on the side slopes of closed Fill Area 1 where the side slopes have not already been constructed with 10-foot benches at the time of adoption of these WDRs and the Discharger has indicated that the narrower bench will not prevent the Discharger from performing post closure maintenance in these areas.

166. Title 27 section 21090(a) requires that designs having any slopes steeper than 3H:1V, or having a geosynthetic component, shall have these aspects of their design specifically supported in the slope stability report required under Title 27 section 21750(f)(5). The Discharger has performed a slope stability analysis for the proposed final cover for Fill Area 1. The Discharger determined that for side slopes of 2H:1V the compatibility of the cover materials selected for construction must be evaluated prior to construction of the cover system by comparing site-specific laboratory interface shear strengths (obtained from tests performed at low normal stresses consistent with cover conditions) with the strengths presented in the slope stability analyses. The combination of cohesion or adhesion and friction angle must be sufficient to meet or exceed the minimum required strength envelope. The Discharger determined that given the slope inclinations, if the materials as tested do not meet the design strength envelopes for one or more of the scenarios, reinforcement or an engineered alternative cover system may be required to achieve an acceptable degree of stability and deformation control These WDRs in the specifications require the Discharger to perform the necessary laboratory tests and analysis required to ensure that the Discharger complies with the slope stability requirements of Title 27.

167. Based on the current site development plans in the 2015 JTD, the Discharger proposes that side slopes for closed Fill Area 2 will be sloped at 3H:1V and will include 20-foot wide benches every 50 vertical feet with a top deck area having slope gradients of no less than 5% to promote drainage of precipitation from the WMU final closure cover. The

Discharger's JTD indicates that final grading the top deck area with a minimum 5% slope gradient and in other areas at 8% (i.e., access roads) will account for settlement allowing the top deck area to continue to meet the 3% slope gradient requirement of Title 27 during the post closure maintenance period. While final closure configurations will vary, final design must conform to minimum slope stability and drainage standards.

168. Title 27 section 21090(a) requires that designs having any slopes steeper than 3H:1V, or having a geosynthetic component, shall have these aspects of their design specifically supported in the slope stability report required under Title 27 section 21750(f)(5). The Discharger's proposed final closure cover for Fill Area 2 includes a geosynthetic component and requires a slope stability analysis. The Discharger determined that the compatibility of the cover materials selected for construction must be evaluated prior to construction of the cover system by comparing site-specific laboratory interface shear strengths (obtained from tests performed at low normal stresses consistent with cover conditions) with the strengths presented in the slope stability analyses. The combination of cohesion or adhesion and friction angle must be sufficient to meet or exceed the minimum required strength envelope. These WDRs in the specifications require the Discharger to perform the necessary laboratory tests and analysis required to ensure that the Discharger complies with the slope stability requirements of Title 27.

169. This Order approves the proposed final cover(s) with provisions where required and also requires that a final closure and post-closure maintenance plan to be submitted at least two years prior to the anticipated closure date for review and approval, with the exception of Fill Area 1. This Order allows the Discharger additional time to conduct a demonstration of the ET cover; therefore, the final closure and post-closure maintenance plan may be submitted 6 months prior to closure. This Order also requires that design documents and associated CQA plan be submitted for review and approval at least 120 days prior to construction unless the Discharger chooses to proceed at their own risk.

CLOSURE OF FILL AREA 1

170. The Discharger submitted a 2015 Preliminary Closure and Postclosure Maintenance Plan for closure and post-closure maintenance of all the unlined and composite-lined landfill Units at the facility as part of its 2015 JTD. The Discharger in its July 2015 JTD provided a tentative schedule to construct a 10-acre ET demonstration project in 2017, monitor the demonstration project for four years, and then start closing Fill Area 1 in 20 to 30 acre increments over the next ten years. The starting closure date is contingent upon the remaining airspace in Fill Area 1 which, at the time of this revision, was equal to 4 to 5 million tons. Based on this information, these WDRs in Provisions H.8 require the Discharger to construct the 10-acre ET Demonstration Project by December 2017, monitor the effectiveness of the ET cover from 2018 to 2022, submit an updated plan to address closure of Fill Area 1 over the next ten years in 2023, and to initiate closure operations in 2023.