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September 1, 2008
M&A #02-059-60

Item No. 9 Doc. No. 16

Mr. Ronald Kemp
Deputy City Attorney
City of Carlsbad
1200 Carlsbad Village Dr
Carlsbad, CA 92008

Glenn Pruim
Public Works Director
City of Carlsbad
1635 Faraday Avenue
Carlsbad, CA 92008

Re: Buena Vista Lagoon Recovery Status Post-Discharge from the Buena Vista Force Main Rupture April 2007

Dear Mr. Kemp and Mr. Pruim,

This letter has been prepared at your request to review data related to the health of the lagoon following the April 2007 rupture of the Buena Vista Force Main.

To address this question, I would first like to refocus your attention to the prior monitoring and remediation submittals made as elements of the Investigative Order response submitted on April 23, 2007 and the November 30, 2007 sewage recovery memorandum that documents the residual unrecovered sewage as approximately 1.565 MG. These two documents provide underpinning information related to the early lagoon status and the present health conditions.

Sewage is a non-persistent contaminant that has its principal ecological affects immediately after release. Due to a high Biochemical Oxygen Demand (BOD) in sewage, a release results a rapid drop in oxygen levels until such time as BOD is consumed. This drop in oxygen levels as BOD scavenged oxygen from the lagoon system is what resulted in the early fish mortality associated with the discharge. The aeration that was undertaken as an element of the response was intended to serve two functions. First, it accelerated the BOD consumption and thus the recovery of the oxygen levels. Second, it provided small refuge areas within the far eastern portion of the east basin where oxygen levels were maintained at higher levels than elsewhere in this region of the lagoon. As such, it allowed survival of some fish in the eastern end of the lagoon. While BOD has rapid effects on oxygen levels, once consumed, oxygen levels recover rapidly. Dissolved oxygen levels in the lagoon returned to normal within 4 days of cessation of the discharge.

Bacteria are a second contaminant associated with sewage. However, like BOD, bacteria are rapidly killed off with high ultraviolet exposure such as occurs within the shallow open water of Buena Vista Lagoon. Longer persistence can occur within more sheltered areas of sediments and around plant materials. Early monitoring following the discharge showed water bacteria levels returned to normal within 17 days of the end of the discharge; however, sediment bacteria levels returned to normal only after 28 days.

Raw sewage is high in nitrogen and phosphorus and thus can result in a fertilization of the lagoon such that growth of macro and microalgae may be stimulated. Since Buena Vista Lagoon is already recognized as eutrophic, this issue was a substantive concern at the time of the discharge. However, the relative contribution of the sewage to eutrophication turned out to be fairly minor in the context of the overall watershed inputs.

The Buena Vista Lagoon Restoration Feasibility Analysis Report – Final Report, June 2004 (Everest International Consultants 2004) estimated the total nitrogen inputs from the watershed to be 71.6 tons/year, while total phosphorus was estimated at 6.7 tons/year. Nitrogen and phosphorus accumulated over the entire spill volume would translate into mass loading rates of approximately 0.61 tons of nitrogen and 0.03-0.12 tons of phosphorus assuming no benefits of atmospheric loss of ammonia and no reduction of sewage from the pump-back operation, both highly conservative assumptions. Even without discounting the loading by effluent recapture and atmospheric ammonia loss, the annual percentage of nitrogen loading contributed to the lagoon would be approximately 0.85% of the total annual load. For phosphorus, the load would be approximately 0.4%-1.8% of the annual loading. With recapture that was accomplished by the pump-back, the contribution of nitrogen to the lagoon would be estimated to be reduced to 0.2% of the annual watershed input while phosphorus would be reduced to 0.1%-0.4% of the watershed loading. Based on these low loading rates and the relatively dry winter of 2006-2007, it was not predicted that the discharge would result in a summer algal bloom being generated; and in fact, there were no substantial algal blooms in 2007. The absence of a summer 2007 bloom would indicate that the nutrient loading from the discharge was not substantial in the context of the broader loading to the system.

When accessing the lagoon for clean-up activities, care was taken to use already disturbed shorelines for launching vessels, staging aeration and pump back pumps, and to enter water for sample collection. For this reason, areas selected for use included a section of the shoreline where the California Department of Fish & Game (CDFG) mows cattail marsh for visual access from the observation area and a number of cuts through the cattails that are used by fishermen to gain access. This effort not withstanding, there was a minor amount of damage to freshwater marsh (152 square feet) associated with the clean-up. The damaged marsh recovered by early summer 2007.

Concerns were also raised that the repair and clean-up activities, along with the impact to the freshwater marsh and sewage damage to the lagoon, may result in adverse affects to listed birds in the lagoon; most particularly the light-footed clapper rail and the Belding's Savannah sparrow. Since there is no good way of completing definitive surveys for these species outside of the breeding season when they are most territorial and vocal, the first surveys possible after the discharge occurred during the spring of 2008.

The federal and state-listed endangered light-footed clapper rail is found within freshwater cattail marsh habitat throughout the lagoon. In 2006 and 2007, Dick Zembal, Orange County Water District Light-footed Clapper Rail Recovery Team Member, located an estimated 8 pairs of rails during each year throughout the lagoon. In March 2007, survey maps placed rails approximately 800-1,000 feet west of the repair site and on the southern and northern islands at the east end of the east basin. An additional single bird was detected at the northwestern portion of the east basin. The remaining birds were detected in the more western basins. In March and April 2008, Zembal along with Nancy Frost and Warren Wong completed the annual survey for Buena Vista Lagoon and found 9 pairs of birds with comparable distribution as prior surveys with one more pair being found than present in the 2007 pre-discharge surveys. This performance places Buena Vista Lagoon, along with Agua Hedionda Lagoon, as the top performers by percent population growth of all of the clapper rail populations statewide. Major populations found at Upper Newport Bay and Tijuana Estuary, as well as several smaller populations, took significant down turns such that statewide, clapper rail numbers have declined in 2008 (Zembal, pers. comm.).

Belding's Savannah sparrows were present around the east basin before, during, and after the discharge and clean-up operations. Sensitive nesting areas exist on the historic dredge material disposal islands at the far

eastern end of the basin. These areas were never accessed during the clean-up work. While we have not received any data from the CDFG surveys for Belding's Savannah sparrows, there were no activities conducted within this species habitat, and there would be no reason to suspect any affects on this species occurred. While not in possession of the current survey data, Zembal noted presence of Belding's during clapper rail surveys, and this species has been regularly observed in the area of the discharge during recent visits to the lagoon by M&A staff.

Relative to current conditions and achievement of beneficial uses, we would offer the following additional information based on observations made by Merkel & Associates staff following the April 2007 event and cessation of regular impact recovery monitoring associated with the discharge. M&A is part of consultant team implementing the San Diego Coastal Lagoon TMDL monitoring program for the Responsible Parties in the Carlsbad Hydrologic Unit. The purpose of the monitoring program is to address the principal data needs required to develop watershed loading and lagoon water quality models for the targeted contaminants of interest in the lagoons. These models will then be used for TMDL development and implementation in each of the lagoons. The objective of the monitoring program is to support the development of watershed loading and lagoon water quality models by: 1) Quantifying the loading of contaminants to the lagoons (e.g. watershed sources, storm drains, atmospheric deposition, and others) during wet and dry weather, and 2) Collecting data to calibrate and validate lagoon hydrodynamic and water quality models for each of the targeted contaminants (sediment, total dissolved solids, enteric bacteria, and nutrients). The monitoring duration is one year and started in October 2007, with completion scheduled for October 2008. Buena Vista Lagoon is one of four lagoons being monitoring under this program.

M&A is responsible for the collection of continuous monitoring data, post-storm sediment samples, and collection of receiving water samples during quarterly index sampling periods. Figure 1 shows the sampling locations for the various elements of the program (i.e., continuous monitoring, transect samples, autosamplers). M&A currently maintains and monitors three data sondes within Buena Vista Lagoon on a regular basis. In October 2007, a continuous monitoring station was established at the Mass Emissions (ME) location, which is under the bridge at El Camino Real. In January 2008, stations were placed at Segment 1 (East of I-5) and Segment 2 (west of I5). The data sondes record water quality parameters, such as dissolved oxygen, specific conductivity, pH, turbidity, and temperature every 15 minutes. Maintenance of these sondes occurs bi-weekly or more frequently if necessary and requires access throughout the lagoon. As a result, the observations of lagoon conditions are based on a trained biologist being in and on the lagoon extensively over the past 10 months, including over 30 visits to multiple areas of the lagoon at all different times of day.

Water quality data collected from the lagoon data sondes shows no indication of residual effect from the sewage discharge. The observed water quality parameters, particularly dissolve oxygen, persist within the range of natural variation within the lagoon. Fish and wildlife in all basins, including the far eastern end of the east basin, are notably abundant, and fish are regularly seen when servicing units or while on the water to conduct special sampling.

Public use is restricted to shore fishing, but can be heavy at times. Fishing appears to very popular, and conversations with many of the regulars indicate the Buena Vista is one of the best local fisheries (for largemouth bass). Fishing in the east basin is fairly intense today. Whereas most of the bass fishermen are generally practicing catch-and-release, there are others that appear to be more interested in panfish (*e.g.*, bluefill, sunfish), which suggests that they are being targeted for consumption.

Through visual inspection of sediment samples, it has been determined the east basin supports heavy organic deposits from terrestrial vegetation at the far east end where Buena Vista Creek enters the lagoon. In the central portion of the east basin, organic debris is lighter and principally dominated by the aquatic widgeon grass (*Ruppia maritima*). At the far western end of the east basin, very light organic debris exists. Observed organisms in benthic samples include insect larvae, freshwater snails, oligochaetes, and snail egg

masses. Water boatmen (*Trichocorixa*), scud (*Hyalella* sp.) and chironomid larvae were also present in samples reviewed. These species and higher groups are comparable to those found to be present during the Ambient Bay and Lagoon Monitoring Program 2003-2004 (MEC 2004).

During the 2008 summer, algal mats were detected within all basins of the lagoon, and cattail cover was noted to continue to increase. This condition mimics conditions observed following other wet winters when runoff to the lagoon has been elevated. This algal mat development is not believed to be related to the April 2007 discharge, which would likely have been fully manifested in the summer of 2008.

In summary, the present conditions at Buena Vista Lagoon do not appear to carry residual characteristics suggesting any prolonged adverse effects of the April 2007 discharge of raw sewage as a result of the rupture of the Buena Vista Force Main. Those beneficial uses that were adversely affected by the discharge have fully returned to the lagoon. This is not to say that the lagoon exists in a completely healthy state. As indicated, the system presently suffers from eutrophication and sedimentation from watershed stressors. The lagoon has achieved a point in its evolution that even correction of the upstream stressors will not preclude the open water areas of the lagoon from filling in with marsh vegetation and eventually declining substantially in aquatic function. Present restoration planning efforts to correct this course are underway at this time.

If you have any questions regarding this status report, please contact me.

Sincerely,

Keith W. Merkel
Principal Consultant

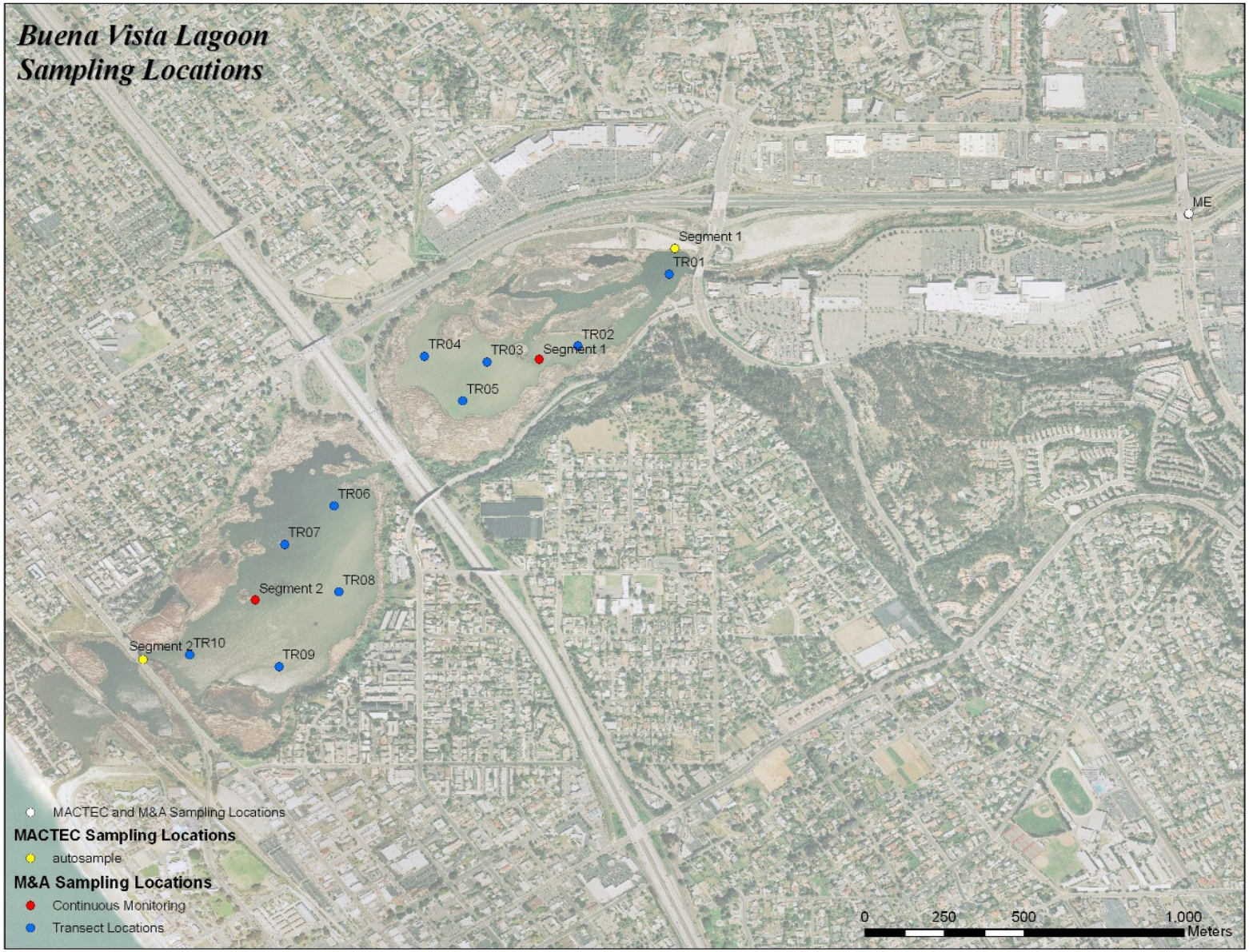

Figure 1. TMDL sampling locations within Buena Vista Lagoon