# California Regional Water Quality Control Board

## Central Coast Region

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October 6, 2006

Mr. Curt Richards
Olin Corporation
Environmental Remediation Group
P.O. Box 248
Charleston, TN 37310-0248

Dear Mr. Richards:

**SLIC: 425 TENNANT AVE, MORGAN HILL; LLAGAS SUBBASIN CLEANUP FEASIBILITY STUDY**

Central Coast Regional Water Quality Control Board (Central Coast Water Board) staff has reviewed the June 30, 2006 "Llagas Subbasin Cleanup Feasibility Study Olin/Standard Fusee Site, 425 Tennant Avenue Site, Morgan Hill, California" (Cleanup FS Report). The Cleanup FS Report was prepared by MACTEC Engineering and Consulting, Inc. on behalf of Olin Corporation. The Cleanup FS Report was submitted in accordance with ordering paragraph J. of Cleanup or Abatement Order No. R3-2005-0014 (Cleanup Order No. 0014). In conformance with State Water Resources Control Board's Resolution No. 92-49, "Policies and Procedures for Investigation and Cleanup and Abatement under the California Porter-Cologne Water Quality Control Act (Water Code) §13304" (Resolution No. 92-49), and as required by Cleanup Order No. 0014, the Cleanup FS Report proposes a cleanup level for perchlorate from the former Olin/Standard Fusee Site. The Cleanup FS Report addresses Llagas Subbasin groundwater cleanup alternatives and provides an analysis of alternatives for long-term, basin-wide groundwater cleanup to remediate perchlorate-impacted groundwater. Additionally, it contains an addendum to Olin's March 3, 2006 "Plume Migration Control Assessment Report," as required in our April 26, 2006 letter concerning Olin's migration control assessment report.

Our review considers written comments provided by the Santa Clara Valley Water District (Water District) and WorleyParsons-Komex consultants on behalf of the City of Morgan Hill. We concur with several comments received and have incorporated them into our comments. A copy of the comments received is attached for your reference.

The Cleanup FS Report does not fully meet the requirements of ordering paragraph J. of Cleanup Order No. 0014 and does not fulfill the cleanup objectives of Resolution No. 92-49. In order to comply with paragraph J., Olin must revise the Cleanup FS Report to ensure full compliance with Cleanup Order No. 0014 and the cleanup objectives of Resolution No. 92-49.

The following comments explain and clarify our cleanup expectations for the Llagas Subbasin. Specifically, our comments focus on objectives to achieve compliance with Cleanup Order No. 0014 and to ensure conformance with Resolution No. 92-49. In summary, Olin must take the following actions before we can approve the Cleanup FS Report:

1. Propose an appropriate and substantiated background level.
2. Propose reasonable and acceptable cleanup levels in groundwater within each of the affected aquifer zones of the Llagas Subbasin, if Olin wants the Water Board to consider cleanup levels above background.
3. Perform a thorough evaluation of groundwater remedial alternatives.
4. Complete and submit a revised Cleanup FS Report by **December 6, 2006**.
5. Expedite active remediation in Area I by:
   a. Completing a Plume Migration Control Feasibility Study by **December 6, 2006**.
   b. Preparing an Area I Cleanup Work Plan by **December 6, 2006**.

Our comments also include direction on the feasibility of implementing a groundwater remediation strategy in compliance with Cleanup Order No. 0014 and the applicable provisions of Resolution No. 92-49. The last portion of our letter includes our comments concerning the "Plume Migration Control Assessment Report Addendum," included as Appendix C to the subject Cleanup FS Report, and provides direction concerning our expectations for preparing and submitting a final Cleanup FS Report.

**GENERAL COMMENTS**

1. **Determination of a Background Concentration -** The Cleanup FS Report states that the background concentration of perchlorate in groundwater in the Llagas Subbasin is assumed to be less than 4.0 micrograms per liter (µg/L). Olin's background concentration assumption is based on suspected anthropogenic sources and results from localized groundwater concentration data. Olin concludes that other anthropogenic sources contribute perchlorate to the Llagas Subbasin, resulting in a background perchlorate concentration of up to 4.0 µg/L. Although the Cleanup FS Report states that background is assumed to be an indeterminate concentration of "less than 4.0 µg/L", the report actually assumes background is equal to 4.0 µg/L.

   Resolution No. 92-49 requires that all cleanup or abatement actions conform to the provisions of State Water Board Resolution No. 68-16 (Anti-Degradation Policy) and to applicable provisions of Title 27 or Title 23, Chapter 15, California Code of Regulations. In accordance with Resolution No. 92-49 and Cleanup Order No. 0014, the background concentration of perchlorate in groundwater within the Llagas Subbasin is the level of perchlorate that would exist in groundwater without regard to any discharges from the former Olin Site.[1] For the purposes of the Olin cleanup case, we consider the background concentration of perchlorate in groundwater throughout the Llagas Subbasin to be zero, or for practical purposes, less than the method detection limit (MDL), unless Olin provides specific data to support a higher concentration. The MDL for perchlorate using United States Environmental Protection Agency (USEPA) Method 314.0 is typically 1.4 µg/L.

   The Cleanup FS Report does not provide reasonable supporting evidence to substantiate Olin's assumed background level of 4.0 µg/L for the entire Llagas Subbasin. To date, Olin has not confirmed that any of the identified potential perchlorate sources[2] are viable contributors of long-term perchlorate concentrations to the entire Llagas Subbasin. Therefore, Olin has not demonstrated perchlorate concentrations exist within the entire

[1] In the case of commingled plumes from multiple dischargers, background is determined without regard to the commingled discharges.

[2] Olin has identified an elevated and localized concentration of perchlorate at a mushroom farm in Gilroy. Olin suggests that the reason for elevated perchlorate is due to a hypochlorinator. This may therefore be a potential short term and localized source of perchlorate in this area but cannot be applied to the entire Llagas Subbasin.

Llagas Subbasin up to 4.0 µg/L, either due to natural or anthropogenic sources in groundwater. Until Olin substantiates its assertion that a measurable anthropogenic or natural level of perchlorate exists within the entire Llagas Subbasin, we must assume that the background level for perchlorate in groundwater is less than the MDL of 1.4 µg/L. Given the large size of the plume, background may be higher in localized areas, such as areas of higher agricultural use. Olin may choose to characterize background concentrations of perchlorate for sub-areas of the Llagas Subbasin if the data support the characterization.

Applicable provisions of Title 27 Water Quality Monitoring Requirements apply directly to cleanup and abatement actions associated with the Olin Site. As such, Olin must use Title 27, Division 2, Subdivision 1, Chapter 3, Subchapter 3, Article 1, §20400 (Title 23, Chapter 15 §2550.4, for hazardous constituents) and §20415 (Title 23, Chapter 15 §2550.7, for hazardous constituents) in its development of a background perchlorate concentration in groundwater. The Title 27 methodology for calculating the background level of a constituent of concern (i.e., perchlorate, for this cleanup case) is most appropriate in this situation, since Olin contends that detectable concentrations of perchlorate in groundwater within the Llagas Subbasin are attributable to anthropogenic sources.

However, the Cleanup FS Report does not include any methodology for calculating a background concentration in accordance with applicable Title 27 water quality monitoring requirements nor does it suggest that any other methodology (other than the Water District's perchlorate background study) will be used to substantiate Olin's contention that detectable concentrations of perchlorate related to sources other than the Olin Site exist within the entire Llagas Subbasin.

We understand that Olin has taken the position that it will wait for the results of the Water District's study and depend on the results of the study to confirm that other perchlorate sources are contributing to the existing perchlorate groundwater impacts. You must understand, however, that in the interim and until data demonstrate that detected concentrations of perchlorate in groundwater within the Llagas Subbasin are attributed to anthropogenic sources, we must assume that the background concentration of perchlorate within the Llagas Subbasin is less than the MDL for each impacted aquifer zone. Therefore, unless you perform the Title 27 background calculations specified above, you must revise the Cleanup FS Report to include the premise that the background perchlorate concentration in groundwater is less than the MDL.

2. **Olin's Proposed Cleanup Level -** Olin's proposed groundwater cleanup level for perchlorate in the Llagas Subbasin is 6 µg/L. The basis for this level is the current public health goal (PHG) established by the California Office of Health Hazard Assessment (OEHHA). While the proposed cleanup level may be protective of human health, it is clearly inconsistent with the State Water Board's anti-degradation policy (Resolution No. 68-16). Order No. WQ 2005-0007 states that a PHG is not, in itself, enough to establish a cleanup goal. The State Water Board found that failure to use the PHG as a replacement water trigger "ignores the expertise of OEHHA and, in the case of contaminants for which MCLs have been developed, DHS. By contrast, cleanup levels for groundwater are a separate issue and are more appropriately within the expertise and professional purview of the water boards." (WQ 2005-0007, p. 6.) The State Water Board's Order was expressly inapplicable to cleanup levels under Resolution 92-49. (*Id.*, p. 7.) Olin's approach and basis for the proposed cleanup level are inconsistent with the Central Coast Water Board's goal to protect groundwater as a resource and its responsibility to prevent water quality degradation. The Cleanup FS Report does not provide adequate justification for proposing

an alternative cleanup concentration greater than background. The Cleanup FS Report does not demonstrate that the proposed cleanup level is adequately protective of actual and potential beneficial uses of groundwater, and does not provide supporting evidence to demonstrate that it is economically infeasible to achieve the background level.

In accordance with Resolution No. 92-49 (Section III.G), cleanup shall be conducted in a manner that promotes attainment of background water quality. If background levels of water quality cannot be restored, water quality must be restored to the best water quality, which is reasonable, considering all demands being made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible. Any alternative cleanup concentration greater than background shall:

- Be consistent with maximum benefit to the people of the state;
- Not unreasonably affect present and anticipated beneficial use of such waters;
- Not result in water quality less than that prescribed in the Water Quality Control Plans (Basin Plans) and Policies adopted by the State and Water Boards;
- Be allowed only if the constituent cannot be cleaned up to background;
- Be the lowest concentration that is technologically and economically achievable;
- Pose no present or potential future hazard to human health or the environment; and
- Not, under any circumstances, exceed the level needed to protect the beneficial uses designated in the Basin Plan.

Therefore, to comply with Resolution No. 92-49, the cleanup level of perchlorate-impacted groundwater in the Llagas Subbasin must range between the background concentration (i.e., 1.4 µg/L) and the applicable water quality objective specified in the Basin Plan. Since the Basin Plan does not include specific perchlorate objectives, and neither the state nor federal governments have established a Maximum Contaminant Level for perchlorate, the PHG (6 µg/L) is the least stringent level necessary to protect the municipal and domestic supply (MUN) beneficial use, and therefore the maximum allowable cleanup level. At this time, and until supporting data are provided to substantiate the establishment of an alternative cleanup concentration greater than background as the established cleanup level, groundwater remediation must proceed with the assumption that the cleanup level for the Llagas Subbasin is the background concentration.[3]

If Olin expects the Central Coast Water Board to consider a cleanup level above background at this time, Olin must revise the Cleanup FS Report to ensure that the feasibility of attaining background concentrations is appropriately evaluated in accordance with Resolution No. 92-49, as discussed herein. The reevaluation must specifically address all comments provided in this letter and provide thorough analyses and justification for all assumptions and conclusions made. The revised Cleanup FS Report must present all supporting data used in any analyses, evaluation, calculations, and the overall basis for proposing an alternative cleanup concentration greater than background as a cleanup level for perchlorate in groundwater. Olin's feasibility evaluation must evaluate the feasibility of attaining background conditions within each individual aquifer zone and throughout all affected portions of the Llagas Subbasin.

[3] If installed cleanup technology proves unsuccessful in achieving background in a technically and economically feasible manner, the Water Board may adjust cleanup goals at a later stage of the cleanup.

3. **Distribution of Perchlorate Concentrations** - The Cleanup FS Report divided the Llagas Subbasin into four Areas (Areas I – IV) based on the spatial distribution of perchlorate in relation to the Site and the perchlorate concentration trends monitored over time. The division of the plume into four areas is further defined in Olin's "Plume Migration Control Assessment Report."

   Dividing the plume based on the distribution of perchlorate concentrations may be appropriate when evaluating alternatives for implementing effective plume migration control measures and when the objective is to target the highest concentration areas. Such a strategy is encouraged particularly when the objective is to control further migration of the plume. Plume control is a critical action while a cleanup is pending. However, plume migration control is only acceptable as a final cleanup alternative when it meets the requirements for a containment zone under Resolution 92-49, Section III.H. Ordering paragraph J. of Cleanup Order No. 0014 requires Olin to evaluate the feasibility of long-term, basin-wide groundwater cleanup.

   Furthermore, dividing the plume based on the distribution of perchlorate concentrations gives the impression that certain parts of the plume will be ignored simply because the perchlorate levels are equal to, or only slightly above,[4] drinking water standards. Such divisions are not acceptable without appropriate justification, including adequate evaluation of cleanup feasibility. As discussed herein, groundwater cleanup must be consistent with the Anti-degradation Policy. This means that although certain parts of the plume may meet drinking water standards, Olin may still be required to implement active remediation (as feasible) until it meets the established cleanup level for the area in question or until the incremental benefit-to-cost ratio is no longer reasonable. The revised Cleanup FS Report must re-evaluate and compare the feasibility of implementing various remedial alternatives for groundwater cleanup for all areas of the Llagas Subbasin.

4. **Proposed Alternatives for Area I** - The Cleanup FS Report concludes that active remediation is only necessary within the "plume core." Olin defines the plume core as the area in which perchlorate concentrations are equal to or exceed 24.5 µg/L, which is USEPA's preliminary remediation goal (PRG[5]). The Cleanup FS Report indicates that groundwater in Area I contains the perchlorate plume core. Area I has concentrations of perchlorate in shallow, intermediate, and deep aquifers that exceed 24.5 µg/L. Based on the Cleanup FS Report's evaluation of potential remedial technologies, Olin proposes monitored attenuation (MA) for the shallow aquifer and groundwater extraction and re-injection using new (purpose-built) extraction/re-injection wells for the intermediate and deep aquifer zones. However, the Cleanup FS Report contends that active groundwater remediation cannot be implemented because additional characterization of the intermediate and deep aquifer in Area I remain to be completed. Thus, it is Olin's position that it is premature to select and implement a specific remedial alternative at this time. According to the Cleanup FS Report, the results of the additional characterization activities being implemented will be presented in Olin's annual update to the Characterization Report due in January 2007. Further, the forthcoming "Plume Migration Control Feasibility Study" will present the specific technologies and strategies for groundwater remediation developed.

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[4] "Ignoring" any area where levels are above MCLs would violate Resolution No. 92-49.

[5] The United States Environmental Protection Agency (USEPA) preliminary Remediation Goal (PRG) is a risk-based concentration, derived from standardized equations combining exposure information assumptions with toxicity data. PRGs are considered by the USEPA to be protective of human health (including sensitive groups), over a lifetime.

Cleanup Order No. 0014, ordering paragraph J. requires Olin to perform "an evaluation of alternatives for plume core remediation." Therefore, Olin must evaluate the remediation alternatives that may be suitable for implementation within the core of the plume (the highest concentration area). The plume core term was used to ensure that Olin identify the highest concentration areas and prioritize cleanup efforts in those areas. As you know, under most circumstances, targeting the highest concentration areas will produce the most effective cleanup results. Considering the extent of the perchlorate plume in question, we believe all plume areas with perchlorate concentration exceeding background levels ultimately must be addressed in a phased approach. Olin, through the revised Cleanup FS Report, must evaluate the feasibility of implementing remedial alternatives throughout the entire plume area to achieve background concentrations, as required by Resolution No. 92-49. Please refer to comment No. 1, 2 and 3, above.

We agree that continued plume characterization is necessary and appropriate to fully characterize the extent and degree of groundwater impacts within the highest concentration area (Area I), particularly with the deep aquifer zone. However, we do not agree that it is premature to select and implement a specific remedial alternative for Area I. Groundwater cleanup is an ongoing process that will require reevaluation and adjustments over time. Implementation of the groundwater extraction/injection system that Olin evaluated and proposed for Area I in the subject Cleanup FS Report will require significant tasks (system design, approvals, access agreements and construction) before implementation can occur. We believe there are sufficient data to design interim plume cleanup while characterization activities are being completed. Thus, we believe there is sufficient time to complete any additional characterization activities within the intermediate and deep aquifer zones of Area I that may be critical to effective implementation of groundwater remediation activities.

Therefore, while Olin is required to complete and submit a revised Cleanup FS Report, we hereby accept the Cleanup FS Report for Area I, with the exception of Olin's proposed 6.0 µg/L cleanup level. Olin must expedite all additional characterization work in Area I. Pursuant to ordering paragraph K., Olin shall prepare a groundwater cleanup work plan for Area I and submit it to the Central Coast Water Board for review and concurrence **no later than December 6, 2006**.[6] Following the Executive Officer's concurrence with the revised Cleanup FS Report, Olin will be required to prepare a similar cleanup work plan addressing all other perchlorate-impacted areas of the Llagas Subbasin where remediation activities are determined to be necessary.

5. **Irrigation of Crops -** The Cleanup FS Report fails to address the existing beneficial use of groundwater for agricultural purposes. The Basin Plan designates groundwater beneath and adjacent to the Olin facility as suitable for agricultural water supply, municipal and domestic water supply, and industrial use. While we understand the detected perchlorate concentrations at many well locations are presently below the PHG, the presence of perchlorate in underlying groundwater indicates that the quality of groundwater has been degraded. The Cleanup FS Report fails to address the potential damage to crops, agricultural economy and human health of consumers due to the exposure of crops to perchlorate-impacted groundwater. Research conducted by the Massachusetts Department of Environmental Protection documents that certain irrigated agricultural crops accumulate perchlorate at significant concentrations. The use of groundwater with perchlorate may be impacting, or threatening to impact irrigated agricultural crops in the plume vicinity.

[6] This directive does not constitute concurrence with the Cleanup FS Report, except that the Water Board concurs treating Area I separately in order to expedite cleanup of that area.

**SPECIFIC COMMENTS**

1. **The Executive Summary** states, "the background concentration of perchlorate in groundwater attributable to anthropogenic sources is assumed to be <4.0 µg/L based upon concentrations detected upgradient of the Olin/Standard Fusee site and known sources of perchlorate not related to the Olin site potentially associated with anomalous detections south of the Site."

   This is a vague and unsupported statement. Please refer to General Comment No. 1, above.

2. **The Executive Summary** implies that perchlorate concentrations up to 6.0 µg/L in groundwater should be acceptable.

   As discussed herein, Water Code §13304 authorizes the Central Coast Water Board to require complete cleanup of waste discharged and restoration of affected water to background conditions. Therefore, any suggestion that pollution is acceptable as long as the pollutant concentration remains below the applicable public health goal is unacceptable and in direct conflict with the Water Code and Resolution No. 92-49. Please refer to General Comment Nos. 1 and 2, above.

3. **Introduction Section 1.2** indicates that perchlorate-like chemicals tend to migrate at the same velocity as groundwater.

   Estimates of groundwater flow velocity are required to evaluate perchlorate plume migration rates. However, estimates of groundwater flow velocity are not available in the Cleanup FS Report. Section 3.6 of the Cleanup FS Report made reference to an apparent discontinuity in the distribution of perchlorate east of US 101. Section 1.2 of the Cleanup FS Report suggests that the potential discontinuity is due to:

   - Increases in hydraulic conductivities in aquifer units east of US 101,
   - Regional recharge diluting perchlorate where the plume crosses US 101,
   - A limited plume from the Olin site and a second source of perchlorate responsible for a regional plume.

   In the Cleanup FS Report, Olin must provide a technically supported estimated range of groundwater flow and perchlorate migration rates in the shallow, intermediate and deep aquifers in different portions of the Llagas Subbasin (i.e., Northeast Study Area bounded by Tennant, Railroad, Diana, and Murphy Avenues, and South Study Areas I, II, III, and IV south of Tennant Avenue).

4. **Section 3.6, Perchlorate Distribution**, This section indicates that the distribution of perchlorate concentrations within the shallow, intermediate and deep aquifer zones in Area I has not been completely characterized. According to the Cleanup FS Report, specific groundwater remediation strategies for the deep aquifer cannot be determined until additional data are collected and evaluated.

   The intent of the June 30, 2006 "Llagas Subbasin Characterization Report" was full evaluation of the extent and degree of perchlorate pollution resulting from past Olin operations. Since the characterization report concluded that additional characterization activities were necessary, we agree that additional data must be collected and evaluated to thoroughly characterize perchlorate in the deep aquifer. Olin must proceed promptly to

collect and evaluate the necessary data from the deep aquifer zone and present them as soon as they become available. Olin shall summarize the data and include specific conclusions and recommendations concerning the need for additional monitoring wells and further evaluation. We also agree that additional data are needed to determine the specific locations for any groundwater extraction and remediation systems. As explained herein, we aim to expedite implementation of groundwater remediation activities in Area I. Thus, Olin must expedite completion of the additional characterization activities being conducted and include all available results in the revised Cleanup FS Report, by **December 6, 2006** (Refer to General Comment No. 4, above). The need for concurrent cleanup activities is discussed in Specific Comment Nos. 16 and 17, below.

5. **Section 3.7 Status of Processes Requiring Further Study:**
   - This section summarizes several physical processes related to groundwater flow and perchlorate migration rates that require additional study to complete. These processes were identified and thoroughly discussed in Olin's "Llagas Subbasin Characterization Report."

     As addressed in our response letter to the referenced characterization report, we agree with all of the additional characterization activities identified. In response to the statement, "Characterization of perchlorate within Area I is on-going and the evaluation of specific groundwater remedial alternatives within this area would be premature at this time," we refer you to General Comment No. 4, above.

   - This section also states, "... groundwater with perchlorate concentrations above the current PHG is not currently used as a source of drinking water."

     As explained herein, the Central Coast Water Board cleanup approach assures compliance with the Anti-Degradation Policy and Resolution No. 92-49. Olin has not adequately demonstrated that there is a background level of perchlorate above 1.4 µg/L. Please refer to General Comments Nos. 1-4, above.

6. **Section 3.8 Groundwater Flow and Transport** does not include the flow velocity for groundwater within the Llagas Subbasin.

   Please refer to Specific Comment No. 3, above.

7. **Section 4.0 Cleanup Level for Perchlorate in Groundwater** indicates that the proposed Llagas Subbasin groundwater cleanup level is 6.0 µg/L. The Cleanup FS Report indicates the proposed cleanup level of 6.0 µg/L is the result of an evaluation of current regulatory levels, including the current PHG and PRG, and Olin's calculated health-based cleanup level (11 µg/L) presented in Olin's Cleanup Level Report. According to the Cleanup FS Report, this evaluation also includes the background perchlorate concentrations observed in the Llagas Subbasin, cleanup levels required by the Central Coast Water Board at other Water Board-lead sites, and the requirements for establishing cleanup levels specified in Resolution No. 92-49.

   While the PHG and USEPA's PRG may be conservative from a human health perspective, the use of these levels as groundwater cleanup levels is inconsistent with Resolution No. 92-49 and State Water Board and Central Coast Water Board policy and practice. In establishing cleanup goals, human health risk is only one of the factors to be considered under Resolution No. 92-49 and the Title 27 considerations it incorporates. In considering

human health risks, Olin may not disregard the more stringent California PHG in favor of the federal PRG. (Please refer to our response in General Comments No. 1, 2 and 4, above). While additional information is being collected and evaluated to complete the basin-wide characterization and a revised Cleanup FS Report, Olin must prepare and submit a Cleanup Work Plan for Area I. As described in General Comment No 4 above, the work plan shall be submitted by **December 6, 2006**, and at a minimum, include elements outlined in paragraph K of Cleanup Order No. 0014. Unless the Central Coast Water Board establishes an alternative cleanup level, the work plan must propose cleanup to the perchlorate MDL (1.4 µg/L).

8. **Section 4.4 Background Perchlorate in Groundwater** states, "Results of groundwater monitoring conducted by Olin and others indicate that anthropogenic sources contribute perchlorate concentrations to the Llagas Subbasin, which results in background perchlorate concentrations up to 4.0 µg/L." Further, this section indicates that several sources of anthropogenic perchlorate appear to exist within the Llagas Subbasin that have no relation to the former Olin Site, including detection in several wells from south of the foot of Anderson Reservoir, in domestic wells east of the City of Morgan Hill's municipal well field, and in the upper reaches of the Coyote Subbasin. Alternative sources are cited to include bleach used in well disinfection and other sanitary processes at mushroom farms, a rocket motor manufacturer, highway safety flares, and nitrate-based fertilizers.

   These statements are not adequately substantiated. Please refer to General Comment No. 1, above. The referenced potential sources have been identified for several years, yet to our knowledge, Olin has not provided supporting evidence to confirm whether any of the identified potential sources[7] are contributing to the perchlorate detected in groundwater within the entire Llagas Subbasin.

   As addressed in our July 24, 2006 response letter concerning the "First Quarter 2006 Monitoring Report," "To date, the other potential perchlorate sources identified have not been investigated to determine if any of them are contributing to the groundwater impacts. Therefore, it is premature to imply that a source(s) other than Olin must be the cause of the groundwater impacts detected when the other identified potential sources of perchlorate have not been investigated or confirmed to impact groundwater." Although this specific comment was intended for the area northeast of the Olin Site, it is also applicable throughout the Llagas Subbasin and south of the Olin Site. Therefore, at this time and until it is confirmed with data, we must assume that the former Olin Site is the primary source of perchlorate detections south of Tennant Avenue and immediately east and northeast of the Site.

9. **Section 4.4 Well Disinfection:** This section indicates that well disinfection practices are contributing to the existing perchlorate impacts in the Llagas Subbasin.

   The Cleanup FS Report does not provide evidence of long-term impacts from well disinfection practices. The only evidence provided is a finding that one hour following well disinfection with a sodium hypochlorite solution, a concentration of 7.5 µg/L and a duplicate sample of non-detect at the MDL of 1.4 µg/L was detected in groundwater from the well that

[7] Olin has shown that there are temporary concentrations of perchlorate introduced to groundwater after disinfection at one of its reinjection wells and that there may be localized elevated concentrations of perchlorate at City of Gilroy food processing facility due to a hypochlorinator.

was disinfected. Twenty-four hours after the well was disinfected, perchlorate was detected at 3.7 µg/L and a duplicate sample was non-detect at the MDL of 1.4 µg/L.

If Olin contends that well disinfection practices are contributing to the existing groundwater impacts, Olin must provide supporting evidence of the degree and extent of impact associated with well disinfection practices within the entire Llagas Subbasin. Olin could initiate a long-term study to confirm this theory.

10. **Section 4.4 Agricultural Businesses:** This section indicates that since agricultural businesses (e.g., wineries and mushroom farms) commonly use sodium hypochlorite for the control of bacterial growth, for the disinfection of water supplies, and to disinfect equipment, they are a source of perchlorate to groundwater. Olin believes this theory is supported because recent sampling at mushroom farms conducted by Central Coast Water Board staff detected perchlorate concentrations ranging from <0.46 µg/L to 39 µg/L.

    As stated in our response letter concerning Olin's "First Quarter 2006 Groundwater Monitoring Report," "To date, the investigation activities conducted by Central Coast Water Board staff have been limited to site inspections at several mushroom farms and the collection of water samples from wastewater ponds for perchlorate analysis. Although concentrations of perchlorate were detected at several of the wastewater ponds, there is no evidence to suggest that perchlorate is or has migrated vertically and impacted underlying groundwater. Investigation activities designed to confirm whether perchlorate detected in wastewater ponds are impacting underlying groundwater have not been performed." As a follow-up to on-going investigations and to determine whether food-processing facilities are contributing to the existing perchlorate impacts, Central Coast Water Board staff has required the collection of a groundwater sample at a mushroom farm. However, results from the groundwater investigation are pending. Without site-specific information verifying that other perchlorate sources exist and contribute to measurable perchlorate in the groundwater, it will be difficult to link "potential sources" to actual pollution. We support any investigations Olin might undertake to verify that other perchlorate sources exist and contribute to perchlorate-impacted groundwater.

11. **Section 4.4 UTC Site:** This section indicates that there are four potential pathways by which perchlorate from the United Technologies Corporation (UTC) site could have migrated into the Llagas Subbasin, including (1) advective groundwater flow from the Anderson Reservoir; (2) surface water that drains into the Anderson Reservoir which was subsequently used by the Water District to recharge the Main Avenue and Madrone Channel percolation ponds in the past; (3) groundwater flow from the percolation ponds; and (4) airborne fallout from the open burn facility.

    While we agree that the UTC Site could be a possible perchlorate source to specific areas of the Llagas Subbasin, additional investigation including supporting data (evidence) is necessary to confirm whether and to what extent the UTC Site has contributed to the perchlorate detections. Data that may help confirm that the UTC Site has contributed to the impacts include sampling data from the Anderson Reservoir and J-flag estimate data (trace detections) from wells located immediately south and southwest of the Anderson Reservoir. We also believe that the Water District's perchlorate background study may help determine whether any of the perchlorate used at the UTC Site has contributed to the existing groundwater impacts within the Llagas Subbasin. Nevertheless, and irrespective of the Water District's background study, evidence (i.e., data) must be provided that demonstrates that UTC is (or was historically) a source of the perchlorate concentrations presently being

detected near the Olin Site. We support any investigations Olin might undertake to verify that the UTC Site has contributed to perchlorate concentrations detected in groundwater.

12. **Section 4.4 Highway Safety Flares:** While we agree there is a potential for highway safety flares to contribute to groundwater, at this time no data is available to support this statement. As is the case with regards to the mushroom farms, the fact that perchlorate concentrations have been detected in surface water samples does not prove that highway flares are contributing to measurable groundwater impacts. If that were the case, widespread perchlorate detections would occur in all urban areas.

13. **Section 4.4 Perchlorate Detected Upgradient of the Olin Site:** This section concludes that Olin's evaluation of groundwater elevation data from the shallow and intermediate aquifer zones confirm that groundwater beneath the Site flows to the southwest or southeast, not the northeast.

    This section does not mention any evaluation concerning the deep aquifer zone northeast of the Site. As stated in our May 2, 2006 correspondence concerning responsibility determinations for perchlorate detections northeast of the Olin site, "We know a large mass of perchlorate discharged from the Olin Site and groundwater flow in the deep aquifer zone has been demonstrated to flow in a northerly direction under certain conditions." A northerly flow component occurs at certain times of the year, particularly as a reaction to heavy pumping from City of Morgan Hill water supply wells located north and northeast of the Site. This information has been reported in previous Olin reports. This indicates that Olin is a viable source of perchlorate detected in the deeper aquifer northeast of the Olin Site, although the contours of the plume have not been characterized.

14. **Section 4.5 Cleanup Levels at other Perchlorate Sites in California:** This section states that Olin's proposed cleanup level of 6.0 µg/L is consistent with other Water Boards' established cleanup levels for perchlorate at other sites in California as required by Resolution No. 92-49. Table 4.1 of this report lists several perchlorate sites that are presently implementing groundwater characterization or remediation activities. According to the Cleanup FS Report, several of the sites listed in Table 4.1 have an "established" cleanup level consistent with Olin's proposed cleanup level for the Site (6.0 µg/L).

    We reviewed Table 4.1 and have determined that for the majority of the listed sites, cleanup levels have not been established in a cleanup order. In fact, several of the sites listed are sites within the Central Coast Water Board region boundaries. It appears that all of the sites presently implementing groundwater remediation are using the PHG of 6.0 µg/L primarily as a cleanup guide in the absence of an alternative cleanup level. Most of the sites are using the PHG as a guide since the concentrations of perchlorate in groundwater are very high (several orders of magnitude higher than at the Olin Site) and appear to be many years away from being remotely close to the PHG. The final cleanup level at most of the listed sites is not critical at this time and will be established later.

    Therefore, your statement that the sites listed in Table 4.1 are using cleanup levels that are consistent with Resolution No. 92-49 is inaccurate and misleading. Even if the implications of Table 4.1 were correct, just because another site has an established cleanup level of 6.0 µg/L does not mean that the same cleanup level is appropriate for the Olin Site. Cleanup levels are site-specific, based on many considerations including, but not limited to:

    - Existing and potential beneficial uses,

- Hydrogeologic conditions,
- Extent and degree of impact,
- Water quality objectives,
- Impacts to municipal and domestic water supply wells, and
- Economic and technologic feasibility of attaining background levels.

Therefore, although the cleanup approach and goal may be the same for all sites, the actual cleanup levels that are established may not necessarily be the same.

15. **Section 4.6 Conformance with Resolution No. 92-49:** This section describes how the proposed cleanup level for perchlorate in groundwater conforms to requirements in Resolution No. 92-49. The section lists nine site-specific factors that must be taken into account in setting an alternative cleanup level that is less stringent than background.

    In accordance with Resolution No. 92-49, all of these factors must be considered and are critical in setting a cleanup level. Some of these factors have not been thoroughly evaluated. Please review Resolution No. 92-49 and Title 27, section 20400 carefully and make certain that all factors are thoroughly evaluated. Among other things, it is important that Section 4.6 of the Cleanup FS Report discuss the uptake of perchlorate by crops that are irrigated with perchlorate-impacted groundwater. Please refer to General Comment No. 5, above.

16. **Section 6.0 Identification and Evaluation of Potential Remedial and Process Technologies for Off Site Use:** In-situ and ex-situ treatment approaches for Areas II, III, and IV are not thoroughly evaluated in this section. Olin did not consider active treatment technologies for these areas because of lower perchlorate concentrations. According to the Cleanup FS Report, the existing perchlorate concentration within these areas is below 11 µg/L, which is the calculated drinking water standard and proposed health-risk-based cleanup level developed and presented in Olin's "Cleanup Level Report." Olin determined that groundwater in Areas II, III, and IV does not pose a risk to human health, including the most sensitive receptors. As such, Olin determined that no groundwater remediation technologies are required in Area II, III, and IV other than monitored attenuation (MA). Olin's selection of MA is also based on the assumption that dilution and mixing will continue uninterrupted on a long-term basis, along with active and aggressive implementation of groundwater remediation within the intermediate and deep aquifer zones in Area I.

    Olin's calculated drinking water standard cannot serve as the basis for making decisions concerning groundwater cleanup in accordance with Resolution No. 92-49. Protection of beneficial uses requires cleanup to at least 6.0 µg/L, within a reasonable period of time. (Resolution No. 92-49; Water Code Section 13307(a)(4).) Please refer to General Comment No. 4, above.

    The Cleanup FS Report does not include any information to support Olin's contention that active remediation is not necessary and appropriate for Areas II, III, and IV. Please refer to General Comments No. 1, 2, and 3, above.

    Furthermore, the Cleanup FS Report does not mention any discussions or agreements between Olin and the Water District to ensure that recharge of the Llagas Subbasin continue uninterrupted. Until a formal agreement between Olin and the Water District is available, Olin cannot assume that the Water District will continue implementing long-term and

uninterrupted management of the recharge ponds it uses to recharge the Llagas Subbasin. Thus, Olin must evaluate the feasibility of achieving background conditions within these areas without assuming that recharge from the ponds will continue uninterrupted. We suggest Olin evaluate the feasibility of implementing active remediation for a specific time period followed by MA (e.g., pump and treat with injection for 3-5 years, or until perchlorate levels reach a certain concentration, followed by monitored attenuation). Olin's revised Cleanup FS Report must outline a contingency plan in case an increase in perchlorate concentrations is observed (evidence of this is noticed in the last four quarters of replacement water monitoring) and in the event the recharge ponds are not recharging the Llagas Subbasin or recharging at different rates.

As Central Coast Water Board staff have discussed with Olin, we believe a joint remediation project between Olin and the City of Morgan Hill has significant value worth considering. At the September 7, 2006 Central Coast Water Board meeting, Morgan Hill officials mentioned their interest in a cooperative remediation project with Olin. Such a project should be evaluated and discussed in the Cleanup FS Report, particularly for cleanup actions needed in Area I.

17. **Section 6.0** also states, "...cleanup to background levels (as required by Resolution No. 92-49) would require remediation of infeasible volumes of groundwater in all three zones."

This statement implies that Olin would be required to operate a pump and treat remedy until the background level is achieved. We agree that because of the extremely large volumes of perchlorate-impacted groundwater within the Llagas Subbasin, an active remedial strategy would likely be costly and time extensive. However, it does not necessarily mean that the remedial system would be required to operate forever. As stated herein, the cleanup goal must be to achieve background concentrations. Whether the selected remedial action (e.g., pump and treat) alone would achieve the cleanup goal is another matter. A combination of remedial technologies is more likely to be successful.

Olin must evaluate various treatment strategies, including but not limited to the following possibilities. The incremental costs of achieving a more rapid cleanup at various cleanup levels must be considered:

- Pump and treat/injection only, for all areas;
- Pump and treat/injection only, for high concentrations areas only and long-term MA for rest;
- Pump and treat/injection for all areas during a specified time period or until a specified benchmark level is attained, followed by long-term MA;
- Pump and treat/injection for high concentration areas only during specified timeframe or until a benchmark level is attained, followed by long-term MA;
- Wellhead treatment of all or some impacted domestic and agricultural supply wells.

Olin must evaluate the economic feasibility of implementing each of these strategies and compare them against the no-action and MA-only options. Olin must evaluate the cost and feasibility of reducing existing perchlorate concentrations to background concentrations within a reasonable timeframe. If Olin concludes that background is not technically and economically achievable, then Olin must consider alternative levels and the associated incremental costs and benefits. For instance, if Olin determines that achieving 1.4 µg/L is unreasonably expensive, then Olin must calculate the cost of achieving 4.0 µg/L and 6.0

µg/L. Additionally, Olin must estimate how much faster the cleanup goal would be achieved with each cleanup goal evaluated. All assumptions must be reasonable and adequately supported.

18. **Section 6.2.1 Screening Criteria:** This section outlines the criteria used for screening and evaluation of remedial strategies/technologies and process options.

    The screening and evaluation of remedial strategies/technologies and process options does not conform to Resolution No. 92-49. All screening and evaluation is based on Olin's proposed cleanup level of 6.0 µg/L, not background, as required by Resolution No. 92-49. If necessary, the Cleanup FS Report must be revised to ensure that all screening and evaluation of remedial strategies are based on the goal of achieving background concentrations. It is this evaluation that determines the cleanup level; a pre-selected cleanup level cannot drive the selection of alternatives to evaluate.

19. **Monitored Attenuation (MA):**
    - **Section 6.3.2** indicates that perchlorate within the Llagas Subbasin is already being attenuated by processes that include both natural groundwater flow and induced processes such as infiltration from imported water, precipitation, and mixing by domestic wells. Much of the attenuation (mixing and dilution) appears to be due to recharge of imported water by the Water District. According to the Cleanup FS Report, operation of the recharge ponds and supply wells is anticipated to continue for the foreseeable future, which presumably means the 10-to-20 year assumed attenuation period.

      As addressed above, we are concerned that there is no guarantee that the operation of the recharge ponds and supply wells will continue for the foreseeable future. To ensure this is a viable option, you must reach agreement with the Water District for continued operation of the recharge ponds for the foreseeable future or develop a contingency plan in the event that operation of the recharge ponds is reduced or discontinued.

      Further, although MA may be capable of reducing the perchlorate concentrations to the cleanup level that may be established, Olin must perform an evaluation (including a modeling effort) to estimate how long it will take and how much it will cost to reach the background concentrations if a combination of alternatives is implemented (i.e., aggressive pump and treat for a specified time period or to achieve a specified concentration, followed by MA). Similarly, the cost of pumping and treating only the most contaminated areas must be considered. Such evaluation must be performed to demonstrate the technical and economic feasibility under different scenarios. Considering the current remediation technologies available for removing perchlorate from water, it is clear that it is technologically feasible to cleanup perchlorate to non-detect levels. However, because of the extremely large volume of impacted groundwater involved throughout the 9.5-mile long plume, within three aquifer zones, and the associated hydrogeologic complexities, it is reasonable to expect that the groundwater cleanup will be costly and lengthy. Nonetheless, although economic feasibility is a significant factor for cleanup implementation, Olin must perform all necessary and appropriate evaluations of different cleanup scenarios (cleanup strategies) to support a cleanup level above background. Olin must demonstrate through calculations and thorough evaluation whether it is feasible to clean up the affected areas to background conditions or not; and if not, whether active cleanup can feasibly reduce current concentrations to a lower level more quickly than MA.

- **Section 6.3.2** indicates that MA is appropriate for the shallow aquifer within Area I, and all aquifer zones within Areas II, III, and IV. The section states that MA is expected to be capable of achieving the proposed cleanup goal of 6.0 µg/L in shallow and intermediate aquifers of Areas II and III within 10-20 years based on initial groundwater fate and transport modeling. Therefore, MA is the proposed primary cleanup approach for Areas II, III, and IV. However, the proposed cleanup approach for Area I involves the installation of new (purpose-built) extraction wells. Olin anticipates that intermediate and deep aquifers extraction wells would be able to remediate groundwater within Area I. The extraction system design will depend on completion of characterization activities in both the intermediate and deep aquifers for Area I.

  According to the Cleanup FS Report, the implementation of groundwater remediation (groundwater extraction) in Area I should accelerate cleanup in downgradient areas so that groundwater extraction would be unnecessary for Area II, III, and IV. The Cleanup FS Report proposes to provide an analysis of applicable remedial technologies in the upcoming Area I Plume Migration Control Feasibility Study report.

  In general, we conceptually agree with the proposed cleanup strategy (i.e., groundwater extraction wells in the highest perchlorate concentration areas and aquifer zones and monitored attenuation at other locations), provided compliance with water practices and policies (described herein) are fully evaluated. While we acknowledge that characterization activities for the intermediate and deep aquifer zones for Area I remain to be completed, we believe that active groundwater cleanup must be expedited in Area I. Therefore, as described in General Comment No. 4 above, Olin must provide an Area I cleanup work plan. Our requirement for this work plan does not constitute approval of the entire Cleanup FS Report. The Area I cleanup work plan is needed to expedite cleanup of the most impacted area. As explained herein, following Executive Officer approval of the Cleanup FS Report, Olin will be required to prepare and provide an additional cleanup work plan addressing the remaining portions of the Llagas Subbasin. Ultimately, these two cleanup work plans will be combined and function as the Llagas Subbasin Cleanup Work Plan, in accordance with ordering paragraph K of Cleanup Order No. R3-2005-0014.

  Further, based on our review of USEPA's guidance document[8] concerning the use of monitored attenuation (MA) at groundwater cleanup sites, we believe MA may be appropriate as a remedial approach for certain areas of the Llagas Subbasin where it can be demonstrated capable of achieving remediation objectives within a timeframe that is reasonable compared to that offered by other methods. Considering that the perchlorate plume in certain areas is no longer increasing in extent, and appears to be shrinking, we agree that MA is appropriate in some portions of the overall remediation strategy. We believe MA will be most appropriate where it will be used in conjunction with other remediation measures (e.g., source control, groundwater extraction).

  Since MA is under consideration as a remedy component, source control measures must be evaluated as part of the remedy decision process. Source control measures include removal, treatment, or containment, or a combination of these approaches. However, due to the level of uncertainty associated with the MA remedial option, Olin must propose in its revised Cleanup FS Report a performance monitoring program and a

[8] United States Environmental Protection Agency, OSWER Directive Initiation Request, "Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites," April 21, 1999.

contingency remedy. The performance-monitoring program is necessary to evaluate whether the MA remedy option is performing as expected and is capable of attaining the remediation objectives within the anticipated (reasonable) timeframes. The contingency remedy is a cleanup technology or approach that will function as a backup remedy in the event that the selected remedial strategy (MA option) fails to perform as anticipated. A contingency remedy may specify a technology that is different, or simply call for modification of the selected remedy, if needed.

20. **Section 7.4.1.2. Incremental Benefit:** This section indicated that there is no incremental benefit of cleaning up the aquifer to background levels since groundwater polluted with perchlorate concentrations above the current PHG is not currently used as a source of drinking water. Furthermore, domestic wells with concentrations above the current PHG have already either been fitted with treatment at the wellhead or the associated resident is supplied with bottled water.

    We disagree with your interpretation of the incremental benefit of achieving background concentrations with the cost of meeting a background objective. The fact that the perchlorate pollution has eliminated a beneficial use does not justify failure to remediate within a reasonable period of time. Wellhead treatment may be considered as one factor in determining a reasonable time for cleanup, in terms of assessing public health risk. Replacement water may also eliminate some of the health risk. However, Olin is not providing replacement water for domestic irrigation or agricultural use, and any incremental cost/benefit analysis must consider the inconvenience to the well users.

    An ongoing benefit-to-cost analysis of the cleanup's efficacy will dictate the need for continued implementation and may provide justification for a modification of the remedial strategy or cleanup goals. The results of the ongoing evaluations will determine whether it is reasonable and feasible to continue implementation of remediation activities. Therefore, any cleanup goals that are determined at the design stage must be considered interim.

**APPENDIX C - PLUME MIGRATION CONTROL ASSESSMENT REPORT ADDENDUM**

As requested in our April 26, 2006 correspondence, Appendix C contains an addendum to the "Plume Migration Control Assessment" report (Addendum). The addendum summarizes data provided in the "Llagas Subbasin Characterization Report" and the "First Quarter 2006 Monitoring Report," including more recent data such as cone penetration testing (CPT) data from south of the Site within Area I. The Addendum concludes that Olin's original conclusions stating that MA processes are responsible for the observed decrease in perchlorate concentrations within Areas II, III, and IV remain valid. The Addendum concludes that plume migration control in Areas II, III, and IV is not necessary. According to the Addendum, plume migration control measures within Area I can be implemented as soon as additional characterization activities in the shallow, intermediate and deep aquifer zones are completed. Please refer to Specific Comment No. 20, above.

Migration control measures are necessary and appropriate within Area I. While we agree that additional characterization work remains to be conducted within Area I, there should not be a delay in preparation and submittal of a Plume Migration Control Feasibility Study and an Area I Cleanup Work Plan. As such, we hereby accept the Plume Migration Control Assessment report including the Addendum as complete and in compliance with Ordering Paragraph E of Cleanup Order No. 0014. In accordance with Ordering Paragraph F of Cleanup Order No. 0014, Olin is now required to prepare and submit a Plume Migration Control Feasibility Study within 60 days from the date of this letter (**December 6, 2006**).

As outlined in our April 26, 2006 correspondence, the required "Plume Migration Control Feasibility Study" must address the elements outlined in ordering paragraph F, and as summarized below:

1. Evaluate alternatives for plume migration control to prevent perchlorate migration toward the City of Gilroy or other aquifer zones that are not currently impacted by perchlorate.
2. Provide a time estimate for establishing plume migration control for each alternative evaluated. Include a time schedule for implementation of each alternative evaluated and select one or more alternatives as the preferred alternative(s).
3. Perform an evaluation to determine potential adverse impacts to existing surface or groundwater beneficial uses that may be caused by the proposed migration control strategy.
4. Submit a plume cutoff and remediation work plan within 60 days after Executive Officer approval of the plume migration control feasibility study.

We understand the plume migration control alternative will likely be implemented in conjunction with the overall cleanup strategy for the entire Llagas Subbasin. However, we request that the plume containment element of the selected groundwater cleanup strategy (plume migration control) be specifically addressed in the Plume Migration Control Feasibility Study, as this report is required by a separate ordering paragraph of Cleanup Order No. 0014.

**SUMMARY AND CONCLUSIONS**

By **December 6, 2006**, Olin is required to provide a revised Cleanup FS Report for Executive Officer approval. The revised Cleanup FS Report must address all comments and recommendations outlined in this letter. In analyzing groundwater cleanup alternatives, the revised Cleanup FS Report must include comparable alternatives that incorporate anti-degradation policy elements (i.e., consideration of remediation to background levels, or the lowest level that is technically and economically achievable). The revised Cleanup FS Report must be prepared on the premise that the background perchlorate concentration in groundwater is less than the MDL unless Olin can demonstrate a higher level consistent with Title 23, Section 2550.7 and Title 27, Section 20415. The Cleanup FS Report must be revised to remove or support Olin's contention that it is not economically feasible to achieve background conditions. All additional calculations, assumptions and supporting evidence that may be produced or revised (as necessary), must be presented for Central Coast Water Board consideration.

Furthermore, if Olin wishes the Central Coast Water Board to consider an alternative cleanup level, the revised Cleanup FS Report must include clear and appropriate justification (supporting evidence) for proposing an alternate concentration greater than background as the cleanup level. Such justification must be included for all areas of the Llagas Subbasin including individual aquifer zones. The economic evaluation must be in accordance with Resolution No. 92-49, as discussed in Items Nos. 1 and 2 above. Overall project costs and time to achieve the standards must also be included.

The revised Cleanup FS Report must reevaluate and compare the feasibility of implementing various remedial alternatives for groundwater cleanup for all areas of the Llagas Subbasin including individual aquifer zones. The revised Cleanup FS Report must include an evaluation of selected remedial strategy or strategies to ensure the site remediation objectives and the time needed to meet them are consistent with the regulatory expectations that polluted groundwater will be restored to beneficial uses within a reasonable timeframe. If these conditions cannot be met using the selected remedial strategy (purpose-built extraction wells and MA), a remedial alternative that more likely would meet these expectations should be selected.

Additionally, by **December 6, 2006**, you are required to provide a detailed Plume Migration Control Feasibility Study, pursuant to Cleanup Order No. 0014, ordering paragraph F, and a Work Plan addressing necessary Area I cleanup activities.

Expedient plume migration control and groundwater cleanup are extremely important. Our intent is to continue working with you and all interested parties closely to continue plume characterization and to expedite active remediation. Please call us immediately if you would like to meet and discuss our comments and recommendations.

The requirements for the revised Cleanup FS Report, the Plume Migration Control Feasibility Study, and the Area I Cleanup Work Plan are pursuant to Cleanup Order No. R3-2005-0014. Pursuant to Section 13350 of the Water Code, a violation of a cleanup order made pursuant to Water Code Section 13304 may subject you to civil liability of up to $5,000 per day for each day in which the violation occurs.

If you have any questions, please contact **Hector Hernandez at: (805) 542-4641** or via e-mail at: Hhernandez@waterboards.ca.gov, or Eric Gobler at (805) 549-3467.

Sincerely,

Roger W. Briggs
Executive Officer

ENCLOSURES:
1. August 1, 2006 Correspondence Titled, "Review of Olin Corporation June 30, 2006 Llagas Subasin Cleanup Feasibility Study Report", prepared by WorleyParsons Komex on behalf of the City of Morgan Hill.
2. August 28, 2006 Correspondence Titled, Comments on the June 30, 2006 Llagas Subasin Cleanup Feasibility Study – Olin/Standard Fuste Site, 425 Tennant Road, Morgan Hill, California," prepared by Santa Clara Valley Water District.

cc via E-mail:

Ms. Lori Okun
Office of the Chief Counsel
State Water Resources Control Board

cc via U.S. Mail:

Olin Correspondence IPL

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1 August 2006

Proj. No.: H0562C
File Loc.: Westminster

California Regional Water Quality Control Board
Central Coast Region
895 Aero Vista Drive, Suite 101
San Luis Obispo, CA 93401

Dear Mr. Hernandez:

## RE: REVIEW OF OLIN CORPORATION JUNE 30, 2006 LLAGAS SUBBASIN CLEANUP FEASIBILITY STUDY REPORT

On behalf of the City of Morgan Hill (City), WorleyParsons Komex has reviewed the report by Olin Corporation (Olin) titled "Llagas Subbasin Cleanup Feasibility Study Report, Olin/Standard Fusee Site, 425 Tennant Avenue, Morgan Hill, California" (the FS Report). As the FS Report is the result of a sequence of regulatory directives (including the March 10, 2005 RWQCB Cleanup and Abatement Order R3-2005-0014 [2005 CAO] Item J), and draws on other technical submittals by Olin, references to these other materials are made as they arise throughout this review. The main findings of our review are discussed below. For reader convenience, select cited regulatory materials are included as Attachment A of this document.

As a whole, the FS Report does not meet the requirements of the March 10, 2005 CAO Item J, or clarifying conditions issued in the March 2, 2006 RWQCB Letter regarding Olin's January 31, 2006 Cleanup Level Report.

The primary issues why the FS Report fails to meet the required objectives are:

1) State Water Resources Control Board (SWRCB) Resolution Number 92-49, which references the California Code of Regulations [CCR] Title 23, Division 3, Chapter 15, requires that when a cleanup level greater than background is proposed, that the background concentration of contamination must be defined by a very specific process (SWRCB, 1995, SWRCB 1996 [guidance attached] and Sections 2550.4 and 2550.7 of the CCR Title 23, Division 3, Chapter 15, hereafter referred to as Sections 2550.4 and 2550.7). Specific language from the 1995 SWRCB Guidance regarding this issue is quoted below:

   *<u>Question:</u> How is background determined as required by Resolution No. 92-49?*
   *<u>Answer:</u> Resolution No. 92-49 requires compliance with Title 23 CCR Section 2550.4 in determining cleanup levels less stringent than background. Section 2550.4 refers to Section 2550.7(e) which provides the methodology for determining background levels for ground water, surface water, and the unsaturated zone.*

2) No background level for perchlorate in the Llagas Subbasin has been determined by Olin and the FS Report does not include any methodology for performing this calculation. Considering that the development of background levels is codified in Sections 2550.4 and 2550.7, which Olin cites multiple times in the FS Report, the reason for this deficiency is unclear.

3) Until a background level is developed in accordance with Sections 2550.4 and 2550.7 the RWQCB should continue to hold Olin to a cleanup level of background, that is, 1.4 micrograms per liter (ug/L) as defined by the RWQCB in their June 29, 2006 letter to Olin. The concentration of 1.4 ug/L is the method detection limit of United States Environmental Protection Agency (USEPA) Method 314 for water samples reported by Olin in their March 29, 2006 Llagas Subbasin Characterization Report (Olin 2006).

4) Although no definitive background level of perchlorate is defined by Olin, Olin states in the FS Report that, *"Background concentration of perchlorate in groundwater attributable to anthropogenic sources is assumed to be < 4 µg/L based upon concentrations detected upgradient of the Olin/Standard Fusee site (425 Tennant Avenue, Morgan Hill, California [Site]) and known sources of perchlorate not related to the Olin site potentially associated with anomalous detections south of the Site."* The technical basis for this assumption, and rationale for deviating from the requirements of Sections 2550.4 and 2550.7, are not provided in the FS Report.

5) Given that the FS Report claims that perchlorate concentration less than 4 ug/L includes other anthropogenic sources (other than the Olin Site) and there is no evidence presented by Olin of naturally occurring perchlorate; any directive by the RWQCB should also address the fact that that there is certainly perchlorate in groundwater at concentrations less than 4 ug/L and greater than background, which is due to discharges from the Olin Site. Although there may be disagreement over the determination of background perchlorate concentrations, until background is defined satisfactorily, the RWQCB should require Olin to properly address the feasibility of remediation of groundwater in the Llagas Subbasin to a level of 1.4 ug/L in a revised FS Report.

6) As acknowledged by both Olin and the RWQCB and detailed in numerous reports, correspondence and in meetings, there is groundwater flow to the north/northeast of the Olin Site in the Deep Aquifer. The releases of perchlorate at the Olin Site and this northward/northeasterly flow have resulted in a perchlorate plume in groundwater north/northeast of the Site associated with perchlorate detections above 1.4 ug/L. Olin's discussion of groundwater flow patterns in Section 3.4, perchlorate distribution in Section 3.6 and assertions about hypothetical anthropogenic sources of perchlorate to groundwater in the Llagas Subbasin all over-simplify and incorrectly disregard the proven northward/northeasterly flow and perchlorate distribution. The lack of any discussion at the end of Section 4.4 (FS Report page 38) of northward/northeasterly hydraulic gradients and groundwater flow, which have been confirmed by Olin's own monitoring in both the Middle and Lower Deep Aquifer zones, is a clear deficiency in the FS Report.

7) The FS Report and data from Olin's onsite remediation system and off-site wellhead treatment systems clearly indicate that there are no technical limitations of ex-situ treatment to remove perchlorate from groundwater to below detectable concentrations.

8) In Section 6.1 of the FS Report, four technically feasible remedial measures are considered; however, only two are considered for Areas II through IV, while only cursory analysis of extraction with ex-situ treatment (*i.e*, pump and treat) is discussed in Section 6.3. There is no meaningful technical justification given for eliminating extraction with ex-situ treatment in Section 6. The options of extraction with ex-situ treatment and in-situ treatment should have been evaluated formally in FS Report Section 7.

9) The FS Report directly contradicts itself in Section 6.1 where it is declared that, "a perchlorate level of 11 ug/L is expected to be protective of human health including the most sensitive receptors based on current science. Therefore, no groundwater remediation technologies would be required in Areas II, II, and IV other than MA." This statement is in direct contradiction with the cleanup level of 6 ug/L which Olin sets earlier in the FS Report. It is not correct to have multiple cleanup levels. Only the background level of 1.4 ug/L should be used for purposes of evaluating remedial options.

10) Although the FS Report in Section 6 states that a formal evaluation of five screening criteria was used for comparing the four remedial options, there is no criteria-by-criteria screening included for all of the four technologies/strategies in Section 6. The lack of a formal screening indicates that arbitrary decisions were made in eliminating technologies/strategies prior to expanded evaluation in Section 7. In particular, the RWQCB should require that the formal criteria-based evaluation in Section 7 be performed on at least all of the four technologies/strategies proposed in Section 6.

11) It is difficult to understand how an FS Report for contamination with such a large magnitude impact as the Olin plume only included formal final screening for two remedial options (no further action [NFA] and monitored attenuation [MA]). Olin's discussion of groundwater extraction and ex-situ treatment associated with SWRCB Resolution Number 92-49, presented in Section 7.4, shows this remedial option to be well within the realm of technical and economic feasibility. Therefore, the RWQCB should require Olin to pass at least five remedial alternatives from Section 6 to Section 7 for thorough evaluation. These alternatives should include, but not be limited to:

    a. A true NFA option, where a baseline of absolutely no further action is taken;

    b. A MA option alone, with no wellhead treatment, evaluated within the context of achieving the remedial goal of background levels.

    c. A MA option with wellhead treatment, evaluated with the remedial goal of background levels.

    d. A combination of groundwater extraction with ex-situ treatment for a set duration followed by MA to cleanup to background levels; and,

e. A full analysis of groundwater extraction with ex-situ treatment to cleanup to background levels.

12) A time period of 20-30 years for MA to reach cleanup goals in the shallow and intermediate aquifers is presented in Section 6 of the FS Report, while in Section 7, a time period of 30 years is cited, without clarification as to which aquifer this applies (or what the numerical clean up goal is). In Section 7, a time estimate of 75 years for reaching cleanup levels is used in dismissing extraction and ex-situ treatment. It is difficult to understand how all of the attenuation processes that Olin contends are occurring and which enable MA to be completed in 20-30 years would somehow not be at least as effective if groundwater extraction was also occurring at the same time. At a minimum, the rationale as to why extraction would extend the time to reach cleanup levels beyond that for MA should be given. This obvious deficiency in Olin's analysis further justifies the RWQCB in requiring re-submittal of the FS Report in a form that more rigorously follows the USEPA (USEPA, 1988) or RWQCB guidance. An FS Report which follows a more exacting format would help in limiting the arbitrary exclusion of remedial options and provide a means for the RWQCB and interested parties to impartially compare and contrast the potential remedial options.

13) As implied in comments 11 and 12, if extraction and ex-situ treatment is combined with MA, it is likely that the 30 year timeframe for MA alone might be significantly reduced. This combined option should be evaluated since it could represent a more cost-effective and timely way to reach cleanup levels, and is likely more acceptable than NFA or MA to the RWQCB and stakeholders.

14) Beyond the unsupported elimination of extraction and ex-situ treatment in Section 6, the assertions in Section 7.4.1.1 that: 1) 600,000 acre-feet of groundwater is impacted, and, 2) groundwater pump and treat would require extraction of five pore volumes, are completely unsupported. If these estimates are erroneous towards the high end, they carry such a bias forward to the conclusions derived in the FS Report and thus do not serve the purpose of FS Reports, which is to provide a sound and thoroughly reasoned foundation for analyses of options.

15) The statement by Olin with regard to extraction and ex-situ groundwater treatment that, *"Assuming five pore volumes would be required to restore groundwater to background conditions, costs associated with remedial activities are estimated to exceed $250 million. It is economically infeasible to treat this volume to background or lower concentrations,"* is not valid, even if the estimated cost is correct. There are a number of Superfund and/or state-regulated perchlorate and/or chlorinated solvent sites in California and the United States where cleanup costs have exceeded this hypothetical amount. At a perchlorate site in the Sacramento area, a mass of perchlorate of over 150 million pounds in one aquifer was estimated, and cleanup costs of one preferred alternative for the Record of Decision for just one of four Operable Units was estimated as high as $120 million (USEPA, 2001). Estimates for the cost of perchlorate cleanup for the Baldwin Park Operable Unit in the San Gabriel Valley exceed $200 million over just a 15 year period (USEPA, 2006).

16) Olin appears to have selectively chosen when and where in the FS Report to follow RWQCB, or USEPA technical guidance for feasibility studies. Given the magnitude of the impact of groundwater contamination from the Olin Site, a rigorous process, such as the USEPA *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA – Interim Final, EPA540/G-89/004* [USEPA, 1988] (which was cited, but only selectively followed by Olin) should be strictly followed for all of the FS Report. The primary aspects of USEPA guidance, which were not followed in the FS Report include, but are not limited to:

    a. Development of remedial action objectives (RAOs). Two RAOs that the RWQCB should require are: 1) cleanup of the groundwater basin to background levels; and 2) achievement of RAOs within the lifetime of residents in the groundwater basin.

    b. Complete evaluation of applicable and relevant regulations (ARARs), e.g. drinking water requirements for public water supplies such as DHS regulations on reporting perchlorate detections, local planning or development constraints regarding water supplies, such as county, city or local master plans.

    c. Formal development of general response actions.

    d. Complete identification and screening of remedial technologies.

    e. Detailed evaluation of process options based on effectiveness, implementability and relative cost.

    f. Screening of alternatives.

    g. Detailed analysis of alternatives.

17) Language from the Santa Clara Valley Water District (SCVWD) perchlorate source and background study cited by Olin has absolutely no relevance as to whether or not -Olin must establish background levels in accordance with SWRCB Resolution Number 92-49. The RWQCB is requiring cleanup per CAO R3-2005-0014 and in doing so explicitly directed Olin to comply with SWRCB Resolution Number 92-49. By direct extension, this includes development of background levels. A well documented and commonly applied procedure as outlined in Section 2550.7, exists and has been followed state-wide for development of background levels. Therefore, Olin should be held to this standard and conduct all work accordingly, regardless of the SCVWD study.

WorleyParsons Komex hopes this review is helpful to the RWQCB in your ongoing efforts to cleanup perchlorate released from the Olin Site. We are at your disposal to discuss any of the comments above. If you have any questions or need additional information please call Jon Rohrer at extension 241 or Mark Trudell at extension 161.

Sincerely,
WorleyParsons Komex

Jon Rohrer, PG, CHG.
Senior Hydrogeologist

Mark Trudell, Ph.D., PG, CHG
Senior Groundwater Modeler

cc: Mr. Jim Ashcraft, City of Morgan Hill
Mr. Steven Hoch, Hatch and Parent

## REFERENCES

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# ATTACHMENT A

## CITED REGULATIONS AND GUIDANCE (SELECTED)

*QUESTIONS AND ANSWERS*

# *STATE WATER RESOURCES CONTROL BOARD*

# *RESOLUTION NO. 92-49*

## I. PURPOSE

The purpose of this Memorandum is to provide information to Regional Water Quality Control Board (RWQCB) and State Water Resources Control Board (SWRCB) staff concerning the implementation of SWRCB Resolution No. 92-49 (•Policies and Procedures for Investigation and Cleanup and Abatement of Discharges Under Water Code Section 13304•). In 1994, the SWRCB adopted Resolution No. 92-49 under California Water Code (CWC) Section 13307. Resolution No. 92-49 establishes procedural and substantive requirements that apply to cleanups of waste. This Memorandum provides answers to frequently asked questions concerning the implementation of Resolution No. 92-49. This Memorandum also provides answers to questions concerning the application of Resolution No. 92-49 at cleanup sites subject to federal law, particularly the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

## II. DESCRIPTION OF SWRCB RESOLUTION NO. 92-49

SWRCB Resolution No. 92-49 is a state policy that establishes policies and procedures for investigation and cleanup and abatement of discharges under CWC Section 13304. See Resolution No. 92-49 (Attachment 1). The Resolution establishes the basis for determining cleanup levels of waters of the State and soils that impact waters of the State. Dischargers are required to clean up and abate the effects of discharges "in a manner that promotes attainment of either background water quality, or the best water quality which is reasonable if background levels of water quality cannot be restored, . . ." Alternative cleanup levels less stringent than background must, among other things, not unreasonably affect present and anticipated beneficial uses of waters of the State. The Resolution also includes procedures to investigate the nature and horizontal and vertical extent of a discharge and procedures to determine appropriate cleanup and abatement measures. Resolution No. 92-49 is consistent with CWC Sections 13000 and 13304.

SWRCB Resolution No. 92-49 is applied by the RWQCBs and the SWRCB primarily by issuing cleanup and abatement orders under CWC Section 13304 and

monitoring and investigation orders under CWC Section 13267. The Resolution was adopted following all procedures required by state law and is legally binding on dischargers and other state agencies. (CWC Section 13146 and Government Code Section 11353.)

## III. SWRCB RESOLUTION NO. 92-49 QUESTIONS AND ANSWERS

1. **Q. How does Resolution No. 92-49 apply to the determination of in situ cleanup levels of contaminated ground water?**

   A. Resolution No. 92-49 establishes the policy that dischargers are required to cleanup and abate the effects of discharges in a manner that promotes attainment of either background water quality or the best water quality which is reasonable if background levels of water quality cannot be restored. In determining any cleanup level that is less stringent than background all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible are considered. In addition, Title 23 California Code of Regulations (CCR) Section 2550.4 applies in determining cleanup levels less stringent than background. Cleanup levels less stringent than background must attain the following requirements in Paragraph III.G. of the Resolution:

   "1. Be consistent with maximum benefit to the people of the state;

   2. Not unreasonably affect present and anticipated beneficial uses of such water; and

   3. Not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards."

   To comply with this Resolution, the cleanup level of polluted ground water would range between background and the applicable water quality objective specified in water quality control plans.

2. **Q. Does Resolution No. 92-49 apply to cleanup of soils?**

   A. Yes. Resolution No. 92-49 requires discharges to clean up and abate the effects of discharges of waste to waters of the state and discharges of waste that threaten waters of the state, which may include discharges to soil. As

described in Question and Answer No. 1, dischargers are required to clean up and abate the effects of the discharge in a manner that promotes attainment of either background water quality or the best water quality which is reasonable if background levels of water quality cannot be restored. For soils, the effects of waste in the soil on water quality must be addressed. The soil cleanup level would range between the level that would achieve background in the affected water and the alternative level that would comply with Title 23 CCR Section 2550.4 and the three factors listed in Paragraph III.G. of the Resolution, i.e., the level that would achieve the applicable water quality objectives specified in water quality control plans.

3. **Q. How does Resolution No. 68-16 apply to cleanup of ground water and soils under Resolution No. 92-49?**

A. Resolution No. 92-49 requires actions for cleanup and abatement to conform to Resolution No. 68-16. Resolution No. 68-16 would apply if discharges to high quality waters of the State were occurring or would result from the cleanup. See Questions and Answers, State Water Resources Control Board Resolution No. 68-16.

4. **Q. Under what circumstances does Resolution No. 92-49 apply to cleanup actions?**

A. Resolution No. 92-49 applies to cleanup and abatement actions under CWC Section 13304. Section 13304 authorizes the RWQCB to order cleanup or abatement where a person has discharged or discharges waste into waters of the state in violation of waste discharge requirements or other orders or prohibitions issued by an RWQCB or the SWRCB. CWC Section 13304 also authorizes the RWQCBs to require "any person who has discharged or discharges waste" or who has

> "caused or permitted, causes or permits, or threatens to cause or permit any waste to be discharged or deposited where it is, or probably will be, discharged into the waters of the state and creates, or threatens to create, a condition of pollution or nuisance . . ."

to cleanup or abate such discharge.

Persons subject to Resolution No. 92-49 include present or past owners or operators and any other person who "caused or permitted . . ." discharges of waste. See SWRCB Order Nos. WQ 85-7, WQ 86-2, WQ 86-16, WQ 87-1, WQ 89-13, WQ 90-2, WQ 90-3.

5. **Q. Does Resolution No. 92-49 require cleanup to zero or background?**

A. No. Resolution No. 92-49 requires cleanup to occur in a manner that promotes attainment of either background water quality or that level that is reasonable if background levels of water quality cannot be restored.

6. **Q. What does the term "be consistent with maximum benefit to the people of the state" mean as used in Section III.G. of Resolution No. 92-49?**

A. Resolution No. 92-49 requires alternative cleanup levels less stringent than background to, among other factors, "be consistent with maximum benefit to the people of the state" and requires consideration of •all demands being made and to be made on the waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible.• As with Resolution No. 68-16, this determination is made on a case-by-case basis and is based on considerations of reasonableness under the circumstances at the site. Factors to be considered include (1) past, present, and probable beneficial uses of the water (specified in Water Quality Control Plans); (2) economic and social costs, tangible and intangible, of the proposed discharge compared to the benefits, (3) environmental aspects of the proposed discharge; and (4) the implementation of feasible alternative treatment or control methods. See SWRCB Order No. WQ 92-09.

7. **Q. What do the phrases "not unreasonably affect present and anticipated beneficial uses of such water" and "not result in water quality less than that prescribed in the Water Quality Control Plans and Policies adopted by the State and Regional Water Boards" mean as used in Section III.G. of Resolution No. 92-49?**

A. The CWC requires the SWRCB and RWQCBs to specify the beneficial uses of each water body in Water Quality Control Plans. Such beneficial uses include past, present, and probable future uses and include domestic, municipal, agricultural and industrial supply, power generation, recreation, aesthetic enjoyment, navigation, and preservation and enhancement of fish, wildlife, and other aquatic resources or preserves. (CWC Section 13050(f).) Waters are designated for particular beneficial uses if they are suitable for that use even if they are not currently being used. Such probable uses must also be protected to ensure future usability of the water. See e.g., CWC Sections 13000 and 13241.

The CWC generally requires the SWRCB and RWQCBs to establish water

quality objectives in water quality control plans to ensure the reasonable protection of beneficial uses. Compliance with Resolution No. 92-49 would ordinarily require compliance with the water quality objectives in order to ensure the reasonable protection of beneficial uses.

The SWRCB and the RWQCBs have the authority under the CWC to adopt policies, including water quality control plans, for the protection of waters of the State. Such policies establish beneficial uses (e.g., SWRCB Resolution No. 88-63, "Sources of Drinking Water Policy"), water quality objectives (e.g., California Ocean Plan, RWQCB Water Quality Control Plans), antidegradation policy (e.g., Resolution No. 68-16), and other requirements for protection of waters of the State. To comply with Resolution No. 92-49, a cleanup and abatement action must comply with these other plans and policies of the SWRCB or the RWQCBs where applicable to the situation.

Cleanup levels should result in the protection of the designated beneficial uses and compliance with the relevant water quality objectives, implementation plans, and discharge prohibitions.

8. **Q. How is background determined as required by Resolution No. 92-49?**

A. Resolution No. 92-49 requires compliance with Title 23 CCR Section 2550.4 in determining cleanup levels less stringent than background. Section 2550.4 refers to Section 2550.7(e) which provides the methodology for determining background levels for ground water, surface water, and the unsaturated zone.

9. **Q. How does Title 23 California Code of Regulations, Division 3, Chapter 15 ("Chapter 15") apply to cleanup and abatement actions under Resolution No. 92-49?**

A. Chapter 15 applies primarily in three types of circumstances:

1. If cleanup and abatement involves corrective action at a waste management unit regulated by waste discharge requirements, all applicable requirements of Chapter 15 apply. For example, if the waste management unit is an "existing" waste management unit to be closed, Article 5 (Water Quality Monitoring and Response Programs for Waste Management Units) and Article 8 (Closure and Post-Closure Maintenance) would apply to the unit. See Title 23 CCR Section 2510(d) and Resolution No. 92-49 Section III.F. If the waste management unit is a "closed, abandoned, or inactive" waste

management unit, Article 5 would be applicable and Article 8 would be considered in determining appropriate closure methods. See Title 23 CCR Section 2510(g) and Resolution No. 92-49 Section III.F.

2. If cleanup and abatement of discharges of waste resulting from unintentional or unauthorized releases of waste involves the removal of the waste from the immediate place of release for treatment, storage, or disposal of waste to land, the new discharge must comply with Chapter 15. Article 2 specifies the method for classifying the waste to determine appropriate management. See Title 23 CCR Section 2511(d) and Resolution No. 92-49 Section III.F.

3. If cleanup and abatement of discharges resulting from unintentional or unauthorized releases involves actions other than removal, such as containment or in-situ treatment, the applicable provisions of Chapter 15 apply to the extent feasible. See Title 23 CCR Section 2511(d) and Resolution No. 92-49 Section III.F.

**Application of Resolution No. 92-49 at sites subject to CERCLA.**

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) is the federal law that establishes requirements for the cleanup of sites containing hazardous substances. It establishes cleanup standards that are in part based on state cleanup requirements. Specifically, CERCLA Section 121(d)(2) requires remedial actions at CERCLA sites listed on the National Priorities List (NPL) to at least attain federal and more stringent state "applicable or relevant and appropriate" requirements (ARARs) upon completion of the remedial action. The 1990 National Contingency Plan (NCP), which are the federal regulations that implement CERCLA, requires compliance with ARARs during remedial actions as well as at completion, and mandates attainment of ARARs during removal actions to the extent practicable. See NCP, 40 CFR Section 300.435(b)(2) and 300.415(i). CERCLA establishes criteria necessary for a state requirement to be considered an ARAR and therefore be applicable to a cleanup at a site listed on the NPL. The following questions and answers discuss Resolution No. 92-49 as an ARAR.

10. **Q. Is Resolution No. 92-49 a potential ARAR at CERCLA sites?**

A. Yes. CERCLA Section 121 requires remedial actions to attain state requirements that qualify as ARARs. State ARARs must be promulgated (legally enforceable and of general applicability) and more stringent than federal ARARs. Resolution No. 92-49 meets CERCLA's requirements since it is legally enforceable and of general applicability. It is legally enforceable

because it was adopted in conformance with the procedural requirements of state law. The SWRCB adopted Resolution No. 92-49 under CWC Section 13140 and 13307. Resolution No. 92-49 was adopted properly following notice and several public hearings and was approved by the Office of Administrative Law in accordance with applicable state law. Upon adoption by the SWRCB and approval by the Office of Administrative Law, the Resolution became legally enforceable under the CWC. Resolution No. 92-49 is of general applicability. It applies to all discharges of waste to waters of the state or that threaten waters of the state.

ARARs include only those requirements that are substantive,not procedural. The substantive, but not the procedural requirements of Resolution No. 92-49 are potential ARARs at CERCLA sites. Sections III.F. And III.G. Of Resolution No. 92-49 contain substantive requirements.

11. **Q. How is Resolution No. 92-49 incorporated into cleanups at CERCLA sites?**

A. Resolution No. 92-49 is usually implemented when the RWQCB issues a cleanup and abatement order or monitoring order. At sites subject to CERCLA, the substantive requirements of Resolution No. 92-49 should be incorporated into the decision document (either a Record of Decision or Removal Action Memorandum) for the site. CERCLA and the federal National Contingency Plan (40 CFR Part 300) establishes an iterative process for identifying substantive requirements as early as possible in the remedial investigation/feasibility study and remedy selection process.

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August 28, 2006

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Mr. Roger Briggs
Central Coast Water Board
895 Aerovista Place, Ste. 101
San Luis Obispo, CA 93401

Subject: Comments on the June 30, 2006 Llagas Subbasin Cleanup Feasibility Study – Olin/Standard Fusee Site, 425 Tennant Road, Morgan Hill, California

Dear Mr. Briggs:

The Santa Clara Valley Water District (District) has reviewed the Central Coast Regional Board's CAO No. R3-2005-0014 Ordering Section J – Llagas Subbasin Cleanup Feasibility Study, and Olin's "Cleanup Feasibility Study Report" submitted on June 30th 2006. The District recommends that the Water Board reject Olin's submittal as non-responsive.

Olin's submittal does not evaluate basinwide cleanup alternatives as required, nor does the report address all relevant beneficial uses of groundwater. Olin has prepared a detailed analysis of only two possible alternatives -- no further action at all or only monitoring of perchlorate attenuation – while summarily rejecting any active remedial measures by Olin. Olin has not identified or presented a detailed analysis of an adequate number of active remedial alternatives. On the basis of this inadequate feasibility study, it is unacceptable to propose a "do-nothing" approach for perchlorate occurring in drinking water wells at concentrations up to four times in excess of the current operative water quality criterion. The report contains a great many deficiencies, omissions, and unsupported arguments and does not satisfy the requirements or intent of the Water Board's Feasibility Study process.

Olin gives the Water Board an all-or-nothing approach, concluding that because Olin finds it too expensive to treat all the groundwater, it will therefore do nothing more than periodically monitor wells in the basin, a task which Olin is already required to do. Even in the maximum effort alternative, Olin does not propose to restore basin groundwater conditions to the background conditions that preceded the perchlorate contamination from its facility. The District recommends that the Water Board direct Olin to prepare a report in a manner that follows the CAO requirements, contains a detailed analysis of a range of feasible alternatives employing active remedial measures, and identifies feasible solutions to the contamination it has caused, which has affected the property owners, growers and groundwater resources in the Llagas subbasin. The District believes that the Regional Board's feasibility study process will only be served once Olin provides details on several feasible alternatives that address the optimum remedial effort, based upon a Cleanup Level that meets the requirements of State Board Resolutions 92-49 and 68-16, i.e., cleanup to Background.

The District's review comments for the Cleanup Feasibility Study are attached.

Sincerely,

Walt Wadlow
Chief Operating Officer
Water Utility

Cc: Suzanne Muzzio, Santa Clara County Environmental Health Department
Greg van Wassenhove, Santa Clara County Agricultural Commissioner
Jim Ashcraft, City of Morgan Hill Public Works Director
Carla Ruigh, City of Gilroy Community Services Director
Sylvia Hamilton, Perchlorate Community Advisory Group
B. Ahmadi, M. Richardson, K. Whitman, T. Mohr

**District's review comments for the Cleanup Feasibility Study**

The June 30, 2006 Cleanup Feasibility Study Report (CFS) submitted by Olin Corporation (Olin) does not provide for Background Concentration as it is required by State Water Board Resolution 92-49. Absent a substantive effort to quantitatively establish the background concentration, the Central Coast Water Board should consider using an Interim Background level, until a better definition of Background becomes available. The District recommends that the Water Board consider using 2 parts per billion as the Interim Background Concentration, since that is the level to which the Department of Health Services requires treatment for distribution of treated groundwater to the City of Morgan Hill's water system.

Olin's submittal does not evaluate basinwide cleanup alternatives as required, nor does the report address all relevant beneficial uses of groundwater. Olin has prepared a detailed analysis of only two possible alternatives – no further action at all or only monitoring of perchlorate attenuation – while summarily rejecting any active remedial measures by Olin. Olin should be required to submit a new Cleanup Feasibility Report that contains a detailed analysis of several feasible alternatives that address the optimum remedial effort and all relevant beneficial uses of groundwater, based upon a Cleanup Level that meets the requirements of State Board Resolutions 92-49 and 68-16, i.e., cleanup to Background.

SWRCB Resolution 92-49

In the CFS, Olin interprets State Water Resources Control Board (SWRCB) Resolution 92-49 to allow a cleanup level greater than background for its release of perchlorate into the Llagas groundwater subbasin. A cleanup level higher than background concentrations pertains to those situations where contaminants would not impair beneficial uses such as the "Containment Zone" provisions of 92-49. The circumstance of Olin's release of perchlorate into a sole-source drinking water aquifer is definitely not one of the situations where the "Containment Zone" provisions can be applied.

Olin has not yet begun cleaning up the basin, but is already seeking to obtain a Cleanup Level higher than background. Olin arbitrarily uses the US EPA Preliminary Remediation Goal (PRG) of 24.5 parts per billion (ppb) to define the "Plume Core", and then proposes an as-yet unspecified remedy for areas where perchlorate exceeds 24.5 ppb. Olin's proposed use of the EPA PRG is unsupported and inappropriate for a number of reasons, including the fact that the current Public Health Goal (PHG) in the State of California is 6 ppb.

SWRCB Resolution 92-49 provides detailed interpretation of the State Board's earlier Resolution 68-16, which is more commonly known as the California Antidegradation Policy. The SWRCB Resolution 92-49 requires that the Regional Water Boards adopt Orders and render decisions in a manner that maintains the highest water quality consistent with the maximum benefit to the people of the State:

> §4. *Regional Water Boards [are authorized] to require complete cleanup of all waste discharged and restoration of affected water to background conditions (i.e., the water quality that existed before the discharge);*
>
> §14. *Environmental damage may increase when a poorly conceived investigation or cleanup and abatement program allows pollutants to spread to previously unaffected waters of the state;*
>
> §26. *It is not the intent of the State or Regional Water Boards to allow dischargers, whose actions have caused, permitted, or threaten to cause or permit conditions of pollution, to avoid*

*responsibilities for cleanup. However, in some cases, attainment of applicable water quality objectives for ground water cannot reasonably be achieved. In these cases, the State Water Board determines that establishment of a containment zone is appropriate and consistent with the maximum benefit to the people of the State if applicable requirements contained in the Policy are satisfied. The establishment of a containment zone does not limit or supersede obligations or liabilities that may arise under other laws;*

Resolution II.A.9. *[The Regional Board shall] Prescribe cleanup levels which are consistent with appropriate levels set by the Regional Water Board for analogous discharges that involve similar wastes, site characteristics, and water quality considerations;*

III.H. *A containment zone is defined as a specific portion of a water bearing unit where the Regional Water Board finds, pursuant to Section III.H. of this policy, it is unreasonable to remediate to the level that achieves water quality objectives. . . . Examples of sites which may qualify for containment zone designation include, but are not limited to, sites where either strong sorption of pollutants on soils, pollutant entrapment (e.g. dense non-aqueous phase liquids [DNAPLS]), or complex geology due to heterogeneity or fractures indicate that cleanup to applicable water quality objectives cannot reasonably be achieved.*

III.H.1. *In establishing a containment zone, the following procedures, conditions, and restrictions must be met:*

*b. Economic feasibility is an objective balancing of the incremental benefit of attaining further reductions in the concentrations of constituents of concern as compared with the incremental cost of achieving those reductions. The evaluation of economic feasibility will include consideration of current, planned, or future land use, social, and economic impacts to the surrounding community including property owners other than the discharger. Economic feasibility, in this Policy, does not refer to the discharger's ability to finance cleanup. Availability of financial resources should be considered in the establishment of reasonable compliance schedules;*

III.H.2. e. *The proposed management plan must provide reasonable mitigation measures to substantially lessen or avoid any significant adverse environmental impacts attributable to the discharge. At a minimum, the plan must provide for control of pollutants within the containment zone such that water quality objectives are not exceeded outside the containment zone as a result of the discharge.*

III.H.3. a. *In no event shall the size of a containment zone or the cumulative effect of containment zones cause a substantial decline in the overall yield, storage, or transport capacity of a ground water basin;*

III.H.3. d. *A containment zone shall not be designated in a critical recharge area.*

These and other provisions of SWRCB Resolution 92-49 are similar to and consistent with the District Board of Directors' Ends Policy 2.1.6., which states, *"The groundwater basins are aggressively protected from contamination and the threat of contamination."*

The District has weathered significant groundwater contamination cases. The District teamed with the San Francisco Bay Water Board and US EPA to pursue identification and cleanup of solvent contamination from electronics, heavy industry, and military facilities throughout Santa Clara County beginning in the 1980's, the most notable examples of which include:

- the Fairchild case, in which a three mile plume of chlorinated solvents has been completely remediated except for a source area within a slurry cut-off wall;

- the IBM case, in which a four mile plume of chlorinated solvents has been entirely cleaned up in the period 1979 through 2006, with only a small area and some source zones remaining;
- the ongoing and well-known large-scale cleanup cases Moffett Field, Middlefield-Ellis-Whisman, Hillview-Porter, California-Olive-Emerson, Mohawk Chemical, Jones Chemical, Great Western Chemical, Jasco Chemical, Van Waters and Rogers, United Defense, United Technologies, Raytheon, Lockheed, Westinghouse, Northrup Grumman, National Semiconductor, Intel, NEC Electronics, Philips Electronics, Applied Materials, Advanced Micro Devices, Signetics, Intersil, American Micro Devices, TRW Microwave, Varian, Teledyne-Singer, Ampex, Anadite, twelve Hewlett Packard Sites, Magnetic Peripherals, Micrel/Litronix, Siliconix, and a number of major landfill sites.

The District's experience with these cases provides evidence that groundwater cleanup is an achievable goal. The IBM and Fairchild cases, which involved recalcitrant and elusive contaminants in the DNAPL[1] category, have achieved complete removal of many square miles of off-site contamination. The Water Board aggressively pursued cleanup, and ensured that further damage to drinking water supplies was prevented. These cases serve as proof that perchlorate can be effectively remediated to background in the Llagas groundwater subbasin. Cleanup of perchlorate may be somewhat easier because of its high solubility and low affinity to adsorb to the mineral framework of aquifer sediments, i.e., perchlorate is more easily removed from the aquifer than chlorinated solvents.

The above sections of SWRCB Resolution 92-49 indicate that the Water Board should reject Olin's request to establish a Cleanup Level higher than Background. Olin presents its arguments for a 24.5 ppb Cleanup Level in Section 4 of the CFS. In the following paragraphs, a partial list of the incorrect and/or unsupported statements and conclusions in Olin's CFS report is provided:

1. Olin initially presents four cleanup alternatives, two of which involve active remediation. Based on an inadequately supported screening process, Olin concludes that one of these is technically infeasible (in situ bioremediation for Areas I, II, III, and IV), and the remaining proposal for active cleanup, pump and treat, is presented as a full-scale build-out including 80 pumping wells, miles of piping, tanks, multiple treatment units, and recharge ponds, and costing $285 million over 75 years. Olin dismisses this option as economically infeasible without offering any detailed analysis of this alternative. Olin fails to identify and provide a detailed analysis of a range of active remedial alternatives that would be economically feasible and otherwise comply with applicable requirements. Olin's summary dismissal of any active remedial measures does not present the Water Board with a choice of the optimal level of cleanup effort required to make a material improvement to basin water quality.

   Additionally, Olin has presented no remedial baseline, i.e., the rate at which perchlorate can be expected to diminish if no action is taken. With an acceptable analysis of remedial baseline, the Water Board could weigh cleanup options with a reference frame for how much faster cleanup could be achieved than the passive long-term dispersion and dilution approach provided by Olin's preferred Monitored Attenuation option for Areas II, III, and IV.

   **Recommendation**: The District recommends that the Water Board require Olin to (1) identify and conduct a detailed analysis of a range of feasible remedial

[1] *"DNAPL" = Dense Non-Aqueous Phase Liquids, which are difficult to remediate because of their limited solubility and tendency to descend deep into aquifers because they are heavier than water.*

alternatives that employ active remedial measures by Olin, and (2) provide a remedial baseline by which the cleanup options can be objectively analyzed and evaluated.

2. Olin states that the Cleanup Level should be 6 ppb, however the report indicates that remediation will only be implemented in locations where concentrations exceed 24.5 ppb. For all intents and purposes, Olin proposes no cleanup action below 24.5 ppb. Furthermore, neither concentration level is the Background or an acceptable cleanup level for the Llagas groundwater subbasin.

   **Recommendation:** The District requests that the Water Board establish a Cleanup Level equivalent to the perchlorate Background concentration.

3. Olin proposes that "*Monitored Attenuation*" will address the areas where perchlorate is less than 24.5 ppb, based upon Olin's interpretation that concentrations of perchlorate may be decreasing, as described in Olin's March 30th Basin Characterization Report. The Second Quarter 2006 Monitoring report filed by Olin on July 30th indicates that, of 362 wells in which a majority of the test results in the last four quarters exceed 6 ppb, 74 percent had stable, unchanging, or indeterminate trends, while 20% had decreasing or probably decreasing trends, and 6 percent had increasing or probably increasing trends. Therefore, Olin's assertion, that Monitored Attenuation will achieve a decrease in perchlorate concentrations, is supported by only 20% of the wells and thus contradicted by 80% of the wells.

   Olin's basis for concluding that there are decreasing trends is rather mixed. Figure 1, presented in the list of omissions, below, shows that on an areal basis, about 13% of the area within which enough monitoring has been done to establish trends is apparently decreasing, while trends are indeterminate in up 81% of the area. We refer to the trends as "*apparent*" because the number of data points used to determine trend varies by well. While the trend over the last three years may be decreasing, in some wells, each of the last three data points has been higher than the previous data point. Using only Olin's trend determinations, no conclusions regarding trend can be drawn for three quarters of the monitored wells. The premise that Monitored Attenuation will result in lowering of perchlorate concentrations is based upon interpretive statistics. No mechanism or rate for perchlorate elimination has been proposed, and no quantitative estimate is provided for the time it will take for perchlorate to dissipate under current conditions.

   **Recommendation:** The District requests that the Water Board require Olin to provide a quantitative analysis validating the basis for the "Monitored Attenuation" approach.

4. The California Anti-degradation Policy, as enumerated in SWRCB Resolution 92-49, calls for consideration of all applicable and relevant water quality objectives. The CFS report does not address agricultural water quality objectives. The report does not acknowledge that perchlorate accumulates in numerous crops, and that the presence of perchlorate in irrigation water pumped out of Olin's plume may limit growers' crop options and marketing opportunities. Resolution 92-49 calls for "considering all demands being made and to be made on those waters and the total values involved, beneficial and detrimental, economic and social, tangible and intangible".

According to the Santa Clara County Agricultural Commissioner's 2005 Crop Report, the direct economic value of Santa Clara County's crops was more than $250 million. Most of this value was derived from crops produced in the area impacted by Olin's perchlorate plume. This figure does not include agriculture's indirect economic value in the perchlorate-impacted portions of the Llagas groundwater subbasin, such as the farm labor employment, supporting businesses, and downstream markets.

**Recommendation:** The District requests that the Water Board require Olin to provide an analysis that identifies the Cleanup Level that will not impair agricultural beneficial uses.

5. The CFS report does not address ecological water quality objectives. Recent studies suggest that perchlorate has an endocrine disrupting effect on aquatic organisms (see e.g. Environmental Toxicology and Chemistry: No. 25, pp. 2087–2096).

   **Recommendation:** The District requests that the Water Board require that Olin review available ecotoxicological studies to analyze and support selection of protective Cleanup Levels that will not harm aquatic ecosystems in the streams, creeks, and wetlands in the Llagas Valley and points downstream. Olin should perform a risk assessment to address the narrative toxicological water quality objectives in the Basin Plan.

6. Olin's discussion of the 6 ppb PHG, the pending MCL, the 24.5 ppb federal PRG, and its earlier submittal of an 11 ppb Cleanup Level does not support its determination of a proposed Cleanup Level within the guidelines of SWRCB Resolution 92-49. The appropriate determination must be made in the context of Background levels of perchlorate. In Section 4.4, Olin states, "*anthropogenic sources contribute perchlorate to the Llagas Subbasin, which results in background perchlorate concentrations up to 4 µg/L.*" Olin provides several examples of how perchlorate from other sources could be introduced to the groundwater basin; however, Olin fails to establish a cause and effect relationship through either calculation or sampling evidence to prove that these sources have contributed perchlorate to the Llagas Subbasin. While Olin has sampled wells and detected perchlorate at locations north of the site, it has not shown that the source of that perchlorate originates elsewhere, nor has it shown that the detections could not have originated from its facility.

   **Recommendation:** The District recommends that the Water Board cause Olin to investigate and provide quantitative sampling evidence (not calculations) for its claims that roadside flare residuals, bleach, or other potential sources of perchlorate have actually caused perchlorate groundwater contamination.

7. Olin cites (at page 34) a sentence in a District draft document that refers to staff opinion about the RWQCB's ability to require Olin to conduct a basin-wide study of background concentrations of perchlorate. This has no bearing on the RWQCB's authority in the Olin case. The District's study is intended to produce information that will ultimately be useful to the District for groundwater management and operational considerations, and that may also be useful to RWQCB's administration of the Olin case. However, the District's study is proceeding independently from the regulatory timeline. Olin must therefore continue investigating background conditions. Olin's groundwater flow measurements show northeast flow in the deep zone, and therefore Olin needs to expand its investigations to the north, west, and east to

establish background conditions relevant to determining the Background Level to which perchlorate must be remediated.

**Recommendation:** The District requests that the Water Board cause Olin to perform a quantitative analysis of the Background concentration of perchlorate for use in establishing the Cleanup Level. The District requests that the Water Board establish an Interim Cleanup Level equal to the lowest detected perchlorate concentrations in wells that the Water Board has confirmed are not contaminated by perchlorate originating from the Olin site, until Olin can provide a reasonable and acceptable analysis of Background concentration levels. The District understands that these detections are less than 2 parts per billion.

8. In Section 4.5, Olin describes cleanup levels established by Water Boards, US EPA, or the Department of Toxic Substances Control. The cleanup levels established at other sites are not applicable to the Olin case and are inappropriate under these circumstances. Olin's release of perchlorate has impacted more private drinking water wells than any other known perchlorate release in the entire United States. Table 4.1 reveals that none of the sites where drinking water wells have been impacted had the cleanup level equal to the PHG for the drinking water wells. Some sites have used the PHG as a property line cleanup level to protect downgradient drinking water wells. Most of the sites have not yet reached the point of establishing a cleanup level. At the site nearest to the Olin Case, the San Francisco Bay Water Board has set the cleanup level within the Pratt and Whitney/Rocketdyne property to 6 parts per billion. However, for all off-site groundwater and surface water, the cleanup level is "non-detect" to ensure protection of beneficial uses of surface water and groundwater.

   **Recommendation**: The District recommends that the Water Board consider the specifics of this case and its impact on drinking water wells and long term water supply reliability when establishing the Cleanup Level appropriate for the Llagas subbasin and all the associated beneficial uses.

9. Throughout the CFS report, Olin identifies the District's groundwater recharge program as the key factor contributing to reduction of perchlorate levels in the Llagas subbasin, upon which it relies for the "Monitored Attenuation" alternative. The unarticulated premise for "Monitored Attenuation" is that District recharge operations will continue indefinitely at a constant and beneficial level. Numerous factors related to operational requirements, budgets, capital costs, and water supply availability affects the artificial recharge operations in the Llagas subbasin. Moreover, Olin has not approached the District or reached any agreement with the District for continued operation of artificial recharge to benefit cleanup of perchlorate. It is therefore inappropriate for Olin to propose a remedy that relies entirely on operations that it does not control or has not sought to collaborate on.

   **Recommendation**: The District recommends that the Water Board require Olin to provide a supportable basis for the cleanup of perchlorate by "Monitored Attenuation".

## UNSUPPORTED REGULATORY INTERPRETATIONS:

1) Olin has made much of the CAO's Ordering Paragraph J Item 7: "An evaluation of alternatives for plume core remediation". This is the only place in the CAO where the phrase "core" is used; it is not a defined term. Olin has capitalized on the absence of an official definition of this term to assert that the core of the plume is everything greater than EPA's Preliminary Remediation Goal (PRG), 24.5 ppb. The PRG is a federal guidance level that has no bearing on a Regional Board case.

2) Olin has arbitrarily and capriciously decided that it can map the plume core for the rest of this year, and then submit a report in January 2007. The time and place to submit a plume map was in the Characterization Study, CAO Ordering Section D, which was due March 30th, 2006. By submitting an incomplete and substandard Plume Characterization Work Plan, Olin obtained significant delay, so that there was little time between the date that the Water Board was provided with enough of a plan to issue partial approval, and the due date.

   The current report was to include a Cleanup Feasibility Study for the whole plume including the core. Olin submitted the Feasibility Study in two parts, with the second part addressing the plume core, which by Olin's arbitrary definition includes Area I. The Area I Feasibility Study is due August 30th by arrangements between Olin and the Water Board that were not shared with the Perchlorate Community Advisory Group, the Perchlorate Working Group, or the public. Olin must include a map of the plume core and a remedial feasibility analysis in that report. However, the plume core may not be limited to Area I if the Water Board decides that another basis for defining the plume core is more appropriate.

   **Recommendation:** The Water Board should determine the basis for establishing the Plume Core and require that the Area I Cleanup Feasibility Study report address all areas where perchlorate has been found in excess of the Water Board's Plume Core threshold.

## OMISSIONS

**#1** Olin has made reference to an apparent discontinuity in the distribution of perchlorate east of US 101. The CFS speculates that this feature may be due to:

- increased hydraulic conductivities in aquifer units east of US 101,
- regional recharge diluting perchlorate where the plume crosses US 101,
- a second source of perchlorate.

These possibilities could be further elucidated by bracketing the limits to perchlorate migration based on hydrogeologic constraints to groundwater flow rates. Olin has completed an extensive effort to obtain hydraulic conductivities from innovative slug tests performed during sonic drilling of fourteen new multi-port wells. The multi-port wells have yielded high resolution head profiles at different intervals within the aquifer, and Olin is collecting quarterly head data over an extensive network of private wells selected for their construction features. Nevertheless, Olin has thus far refrained from advancing an estimate of possible groundwater flow and perchlorate migration rates in either the Basin Characterization report or the CFS.

Table 1, below, approximates groundwater flow velocities based on Olin's conductivity, porosity, and gradient data. The data presented are taken from Olin's Basin Characterization Report.

The following flow velocity calculations apply simplifying assumptions, while also ignoring 1) the effects of variable downward vertical gradient near the site and 2) discharging conditions toward the southern end of the currently mapped extent of perchlorate occurrence.

| Region | Shallow | Upper Int | Lower Int | Deep | Representative Inferred Conductivity, K, ft/day | Approximate Horizontal Gradient, ft/ft (dh/dl) | Effective Porosity, $n_e$, from Table 5.2 | Apparent Groundwater Flow Velocity, **v** ft/day (rounded to nearest foot/day) |
|---|---|---|---|---|---|---|---|---|
| Morgan Hill | ● | | | | 200 ft/day | 0.002 | 0.10 | 4 ft/day |
| San Martin | ● | | | | 200 ft/day | 0.004 | 0.13 | 6 ft/day |
| Gilroy | ● | | | | 200 ft/day | 0.002 | 0.13 | 3 ft/day |
| Morgan Hill | | ● | | | 300 ft/day | 0.0014 | 0.08 | 5 ft/day |
| San Martin | | ● | | | 300 ft/day | 0.0039 | 0.08 | 15 ft/day |
| Gilroy | | ● | | | 300 ft/day | 0.0029 | 0.20 | 4 ft/day |
| Morgan Hill | | | ● | | 50 ft/day | 0.0014 | 0.06 | 1 ft/day |
| San Martin | | | ● | | 50 ft/day | 0.0039 | 0.10 | 2 ft/day |
| Gilroy | | | ○ | | 50 ft/day | 0.0029 | 0.06 | 2 ft /day |
| Morgan Hill | | | | ● | 20 ft/day | 0.002 | 0.07 | 0.6 ft/day |
| San Martin | | | | ● | 20 ft/day | 0.004 | 0.05 | 2 ft/day |
| Gilroy | | | | ● | 20 ft/day | 0.002 | 0.03 | 1 ft day |

$v = (K \times dh/dl)/n_e$ ○ = data not obtained from this zone; value interpolated from adjacent zones

We submit the above "back of the envelope" review of the data to profile the importance of advancing groundwater flow velocity estimates using simple, verifiable calculations.

Taking the geometric mean of roughly interpreted groundwater flow velocities in <u>all</u> aquifers, a regional groundwater flow velocity of 2.6 feet per day can be obtained. Taking the geometric mean of only the shallow and upper intermediate zones, a groundwater flow velocity of about 5.3 feet per day can be obtained.

For the former value, assuming perchlorate releases began in the first year of operations in 1956 and perchlorate continues to be released from fine grained soils in aquitard units to the present day, we get a plume length of about nine miles. For the latter value, under the same assumptions, perchlorate could potentially migrate a substantial distance south of Highway 152, i.e., further than the ten-mile plume mapped in Olin's reports.

Olin identifies an apparent discontinuity in perchlorate concentrations. However, Olin has detected perchlorate at concentration of close to 2,000 ppb in an off-site aquitard, which suggests an ongoing source. All of the currently mapped plume extent could originate from the Olin site, and it remains possible that perchlorate from the Olin site occurs south of Highway 152.

**Recommendation:** The Water Board should cause Olin to produce a verifiable calculation supported by field data to estimate reasonable groundwater flow and perchlorate migration rates in different portions of the basin.

**#2** Olin has not estimated the remedial baseline. The Cleanup Feasibility Study has not provided an answer to the question, "What happens to the perchlorate that is now being pumped out of the aquifer and used for irrigation, domestic plumbing, household uses, etc.?" Instead, it assumes that mixing, dispersion or dilution is and will be responsible for all concentrations declines.

The approximate amount of perchlorate abstracted from the aquifers beneath the Areas II, III and IV discussed in the CFS Report can be calculated to a total approximating 70 pounds per year:

| Area | Pumping | Pounds Perchlorate Removed Per Year |
|---|---|---|
| II | ~220 Acre-Feet/yr | ~2 pounds per year |
| III | ~1,350 AF/yr | ~15 pounds per year |
| IV | ~5,200 AF/yr | ~50 pounds per year |

The perchlorate pumped out of the aquifer may all recirculate and infiltrate back into the aquifer, or some may be eliminated through biologic reduction in septic tanks, soils, or in pockets of anaerobic groundwater. The CFS posits that perchlorate in the shallow zone will be reduced through continuing irrigation, but does not describe the mechanism by which that reduction is achieved. Although uptake in crop biomass is one fate that will eliminate perchlorate from the aquifer, it may also complete a route of exposure. The CFS has failed to evaluate the fate of perchlorate in septic tanks, or whether any vadose zone processes might eliminate perchlorate.

The one instance in which perchlorate elimination from extracted groundwater is assured is on the treatment systems. Olin's monthly status reports only state the total gallons of water treated, without reporting the mass of perchlorate removed. From Olin's figures, the inference can be made that the West San Martin Water Works treatment units have removed only about five pounds of perchlorate ion since they were first equipped with treatment systems in 2003, while the San Martin County Water District Treatment units removed only about four pounds since startup.

It would be helpful to estimate the amount of perchlorate now being removed from the aquifer through all the ion exchange treatment systems installed on private wells and the two small water systems by Olin, and especially the treatment systems installed on municipal wells installed by the City of Morgan Hill, where the greatest mass removal is likely to occur.

**Recommendation**: 1) The Water Board should consider directing Olin to produce estimates of the remedial baseline, so that alternatives compared in a future, properly executed Cleanup Feasibility Study can be rated against a baseline.

2) The Water Board should consider directing Olin to revise its monthly reports to list the mass removed by each treatment unit.

**#3** Olin has not estimated how much perchlorate is in the aquifer. Olin issued a memo to US EPA in November 1978, in which they report that annual usage of potassium perchlorate was 149,600 pounds per year. A September 1978 Olin staff memo explains that from 1955 until 1970, waste material, including potassium perchlorate, was buried in pits on the property. From 1970 until 1973, waste material was placed in an unlined trench and burned. Olin has a much more detailed knowledge of the site operating history, and is well-positioned to make a more accurate estimate of the probable mass of perchlorate released to the Llagas groundwater subbasin.

This year, Olin discovered from their investigations that aquitards near the site harbor large masses of perchlorate, producing the highest off-site concentrations found to date. Fine-grained materials may still hold a substantial reservoir of perchlorate that will sustain the plume for many years to come. In the District's December 19, 2003 Letter to the Water Board, the District indicated the importance of ascertaining the properties of aquitards with respect to fine-

grained storage and back-diffusion to produce long-term 'plume-tailing'.[2] When a heterogeneous aquifer assemblage exhibits dual porosity effects, with the bulk of the pore volume residing in less conductive fine-grained sediments that are adjacent to more porous flow channels, perchlorate can be stored and act as a static contaminant reservoir for an extended period of time, resulting in plume longevity that may rival that of a chlorinated solvent release.

**Recommendation**: 1) The Water Board should consider directing Olin to produce estimates of the mass of perchlorate released to the Llagas groundwater subbasin through all pathways, based on knowledge of the facility's operating history.

2) The Water Board should consider directing Olin to produce estimates of the mass of perchlorate residing in the transmissive aquifer materials as well as the mass of perchlorate stored in the fine-grained deposits, and to provide an analysis of whether perchlorate residing in the fine-grained deposits will act as a long term source.

**#4** Olin has omitted the wells with perchlorate detections located outside Areas I, II, III, and IV. Wells in the Northeast Study Area, and wells located to the east and west of the designated areas, are arbitrarily excluded from consideration for cleanup. There are more than 150 wells with perchlorate detections outside Olin's designated areas. In the results *reported in the 2nd Quarter 2006 Monitoring report,* more than 30 wells located outside Olin's designated areas have a detection of 4 ppb or greater.

Olin's basis for designating Areas I, II, III, and IV is the concentration of perchlorate in wells in each area. Perchlorate concentration is a transient parameter. Defining areas based on results at a single point in time will invariably lead to those areas failing to account for some wells outside the areas.

Instead of designating areas based on concentrations, a more appropriate approach would be to determine a cleanup plan based on which technologies are best-suited for different concentration ranges. It is unlikely that all the wells within Areas I, II, III, and IV (1 square mile, 1.4 square mile, 5 square miles, and 6.3 square miles, respectively) can appropriately be addressed using a one-size fits all remedy, unless the selected remedy removes all perchlorate.

The CFS should evaluate the alternative of eliminating perchlorate from all ongoing groundwater pumping by installing wellhead treatment on all affected wells. This approach could protect existing beneficial uses of water and between 60 and 70 pounds of perchlorate per year could be removed. The cost of equipping all impacted wells with treatment units could be less than $45 million in a 30 year operating timeframe (assuming $15,000 initial capital costs per well and $2,000 per year operating costs, based on figures presented by Olin to the Perchlorate Community Advisory Group). This remedy would need to be augmented by targeted extraction in areas with higher perchlorate mass to accelerate basin restoration.

**Recommendation:** 1) The Water Board should consider directing Olin to abandon the Area designations, and instead devise a Cleanup Feasibility Study that addresses all of the perchlorate plume as delineated by the sum of all monitoring performed to date. The Water Board should prohibit Olin from carving out some portions of the plume and abandoning others. 2) The Water Board should consider directing Olin to prepare a detailed analysis of the "Treat All Wells" remedial alternative, in a future, properly prepared Cleanup Feasibility Study.

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[2] The District's letter cited the reference, *In Situ* Remediation Engineering, *Suthan Suthersan and Fred C. Payne, CRC Press,* 2004.

**#6** The CFS Report neglects to account for agricultural pumping in the feasibility analysis (Chapter 7). While the report elsewhere mentions that agricultural pumping is the greatest portion of all pumping, for the feasibility analysis, the report states:

"*The current volume extracted from all supply wells in the Llagas Subbasin is approximately 20,000 AF.*"

This figure only accounts for domestic, municipal, and industrial pumping, and neglects agricultural pumping, which comprises at least an additional 20,000 acre-feet.

**#7** In its statements summarizing concentration trends in wells, Olin has neglected to account for how much plume area each monitored well represents. The premise for "Monitored Attenuation" is that perchlorate concentrations appear to be decreasing in the majority of wells for which Olin has done a statistical analysis of trend. However, the majority of the plume area occupied by wells for which trend analysis can be completed does not have a decreasing trend.

Olin states the following in the CFS Report at page C-3:

6 wells have increasing or probably increasing perchlorate concentration trends
95 wells have decreasing or probably decreasing perchlorate concentration trends
201 wells have either no trend or are stable.

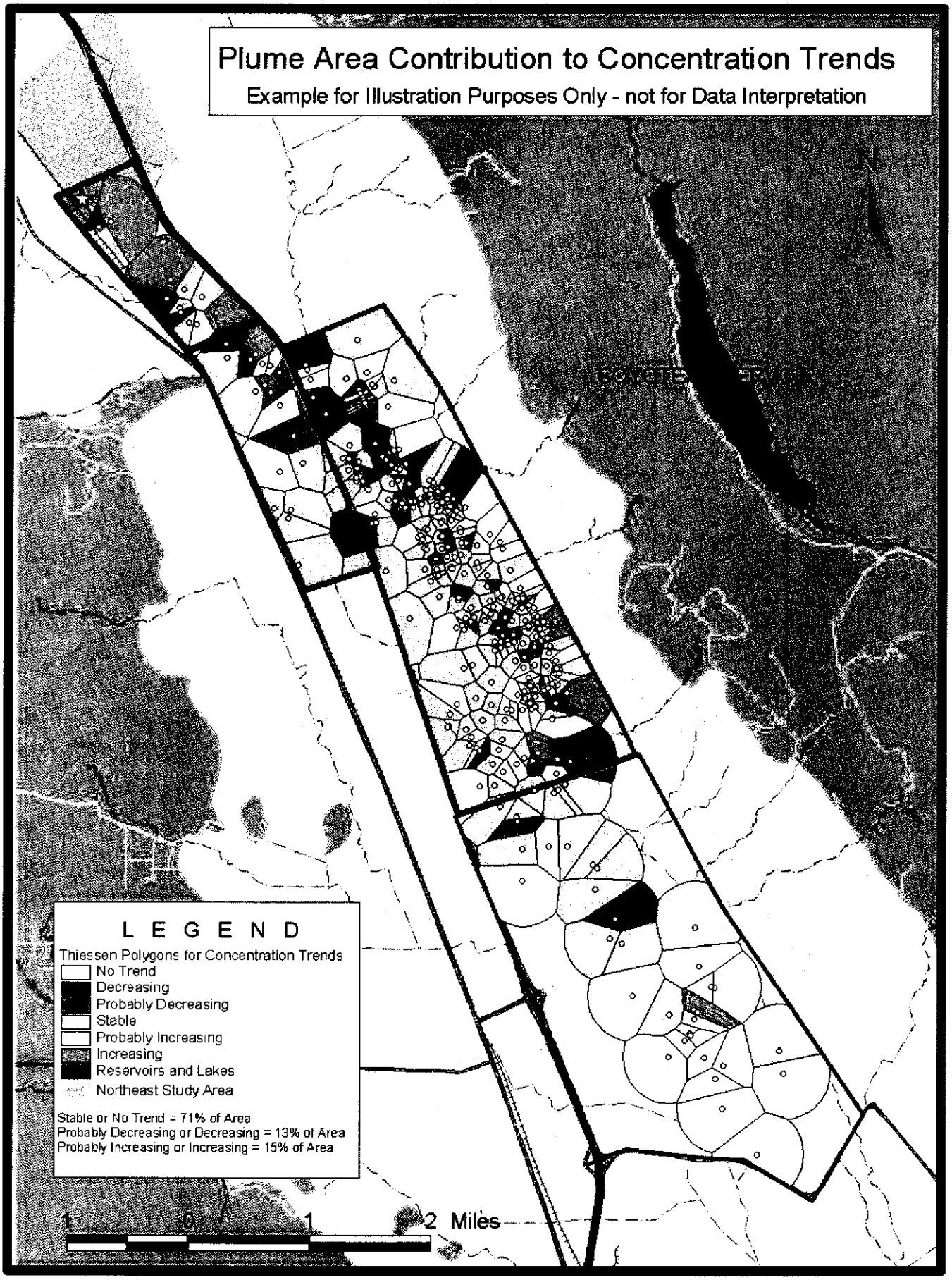
A review of the map reveals that counting a group of wells that are spaced close together and apparently decreasing should not carry the same weight as wells spaced further apart. If the data are "declustered", a different picture emerges (see Figure below.) In the declustered data for the Second Quarter Monitoring Report, the majority of wells have stable trends or no discernible trends, as was found by counting the raw data. However, when accounting for area, perchlorate concentrations in approximately 13% of wells in the declustered data are decreasing, while concentrations in approximately 15 % of the wells in the declustered data are increasing

For illustration purposes, the Figure below presents a simplistic method to decluster the data using Thiessen Polygons.[3] This allows viewing the trends by the number of acres represented by each well for which trend analysis was executed by Olin.

This example does not account for variations in depth, pumping, concentration range, or statistical features; nor does it present an error-free or complete analysis. However, this alternative way to view the trends suggests that Olin's practice of counting wells without consideration of area may introduces a significant bias.

**Recommendation:** The Water Board should consider directing Olin to present the concentration trend data for purposes of plume analysis in a manner that accounts for the effects of data clustering.

[3] A Thiessen or Voronoi polygon is formed by drawing a line from a well to each surrounding well. The midpoints of the lines are found and lines perpendicular to those lines are drawn at their midpoints and extended until they intersect the perpendicular to the adjacent line. In this rough example, areas may be exaggerated by clipping to the Area I, II, III and IV boxes or a fixed distance buffer zone around the wells with available trends. This example should not be used for data interpretation – it is for illustration purposes only.


Plume Area Contribution to Concentration Trends
Example for Illustration Purposes Only - not for Data Interpretation
LEGEND
Thiessen Polygons for Concentration Trends
No Trend
Decreasing
Probably Decreasing
Stable
Probably Increasing
Increasing
Reservoirs and Lakes
Northeast Study Area
Stable or No Trend = 71% of Area
Probably Decreasing or Decreasing = 13% of Area
Probably Increasing or Increasing = 15% of Area
1 0 1 2 Miles