STATE OF CALIFORNIA
CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL COAST REGION

STAFF REPORT FOR REGULAR MEETING OF FEBRUARY 6, 2003
Prepared on January 7, 2003

ITEM NUMBER: 13

SUBJECT: **Perchlorate Sites**

DISCUSSION:

Background

Perchlorate is both a naturally occurring and man-made chemical, although it is rarely found naturally in the United States. One-third of all perchlorate used in the United States is used in California and 90% of California's perchlorate use is related to the aerospace industry. There are three major sources of perchlorate in the United States: ammonium perchlorate has been and continues to be used as an oxidizer in solid rocket propellant, sodium perchlorate is used in slurry explosives, and potassium perchlorate is used in road flares and air bag inflation systems. Wastes from the manufacture and improper disposal of perchlorate-containing chemicals are increasingly being discovered in soil and water.

Health Effects

Perchlorate is known to interfere with the natural function of the thyroid gland by inhibiting the uptake of iodide. Because iodide is an essential component of thyroid hormones, perchlorate disrupts how the thyroid functions. Such an effect decreases production of thyroid hormones, which are needed for prenatal and postnatal growth and development, as well as for normal body metabolism. Potassium perchlorate was used until recently to treat hyperthyroidism related to Grave's disease, and is still used diagnostically to test thyroid hormone production in some clinical settings.

Regulatory Standards

Currently there is no state or federal drinking water maximum contaminant level (MCL) for perchlorate. Both the U.S. Environmental Protection Agency (USEPA) and the California Department of Health Services (DHS) are in the process of studying the occurrence and health effects of perchlorate.

California is mandated by SB 1822 to develop a drinking water standard for perchlorate by January 1, 2004. However, it appears that the standard may not be adopted by January 1st, as required. The DHS has experienced delays caused by lack of qualified individuals to serve on a scientific peer review panel and Governor Schwarzenegger's Executive Order to halt all regulation promulgation.

While the scientific peer review process has begun, the initial delay will postpone the drinking water standard issuance for several months. At this time, it is uncertain how Governor Schwarzenegger's Executive Order will affect drinking water standard issuance. The DHS will be determining how and to what extent the Governor's Order affects standard issuance in the coming months.

Until an MCL is in place, DHS uses a 4 microgram per liter (µg/L) advisory action level to protect consumers from perchlorate's adverse health effects. An action level is an advisory level and is not an enforceable standard. When it is exceeded, a water purveyor is required to notify local governing agencies and is recommended to issue a consumer notice. In addition, DHS recommends that a source of drinking water be

taken out of service if perchlorate contamination exceeds 40 µg/L.

Treatment Methods

Treatment of perchlorate contamination in water is complicated because the perchlorate anion does not respond to typical water treatment techniques due to its fundamental physical and chemical nature. The perchlorate tetrahedron itself is structured such that the four oxygen atoms surround the central chlorine atom, effectively blocking reductants from directly attacking the chlorine. Although perchlorate is thermodynamically a strong oxidizing agent, it is a kinetically sluggish species, making its reduction generally very slow and rendering common reductants ineffective. It can persist in the environment for many decades under typical groundwater and surface water conditions because of its resistance to react with other available constituents.

Perchlorate treatment technologies may be generally classified into categories of destruction or removal technologies. Destructive processes include biological reduction, chemical reduction, and electrochemical reduction. Physical removal processes include anion exchange, membrane filtration (including reverse osmosis and nanofiltration), and electrodialysis, which all require subsequent disposal of removed perchlorate. The optimum treatment technology for a given perchlorate occurrence may depend on several factors, including perchlorate concentration, the presence and concentration of co-contaminants, other water quality parameters and geochemical parameters. The presence of indigenous perchlorate-reducing microbes and substances inhibitory to their activity will also influence perchlorate treatment technology effectiveness. For in-situ treatment of perchlorate contamination, variables related to the site hydrogeologic setting, such as depth to and distribution of contaminants, soil permeability, groundwater flow velocity, etc. are also additionally important.

Updates on significant perchlorate sites within the region follow.

Olin Corporation Facility, 425 Tennant Avenue, Morgan Hill, Santa Clara County [David Athey 805-542-4644]

The former Olin Corporation site is a 13-acre parcel located in southern Morgan Hill. Olin manufactured signal flares at the facility for about 32 years from 1956 to 1988. Standard Fusee leased the site and manufactured signal flares for seven years from 1988 to 1995. Potassium perchlorate was used in the manufacture of flares by both Olin and Standard Fusee. Perchlorate contamination at the site may have occurred primarily from an unlined evaporation pond that received wastes from the cleaning of the ignition material mixing bowls, on-site incineration of cardboard flare coatings with residues on them, and accidental spills. The Regional Board never regulated waste disposal practices while the facility operated, but facility records do make reference to inspections by Regional Board staff.

Groundwater in the region typically occurs in alluvial sediments, at depths ranging from 7 to 400 feet below ground surface. The alluvial deposits are composed of heterogeneous layers of clay, silt, sand, and gravel. Interconnected multiple aquifers exists within the area. Groundwater underneath the site is generally unconfined, although there are identified confined zones within the sub-basin to the southeast of the property. A simplified geologic cross section is included at the end of this report.

Important milestones in the investigation of perchlorate contamination on and offsite of the former Olin facility are summarized below:

- Perchlorate was first detected at 21 and 55 µg/L in water samples at the site in August 2000 during a due diligence investigation by a potential buyer. The DHS action level for perchlorate at the time was 18 µg/L.

- October 2000 - Three shallow monitoring wells (MW-1, MW-2, and MW-3) were installed and sampled to verify perchlorate detections. These wells were installed to approximately 35 feet below ground

surface. Perchlorate was detected at 17 µg/L in MW-1, 37 µg/L in MW-2, and was not detected above 4 µg/L in MW-3.

- December 2000 – The three monitoring wells were again sampled. Perchlorate was detected at 15 µg/L in MW-1, 25 µg/L in MW-2, and 4.2 µg/L in MW-3.

- February 2001 - Olin made initial contact with Regional Board staff regarding the perchlorate contamination. Regional Board staff ordered Olin to submit previous investigation reports for the site and required additional testing of the onsite monitoring wells and the City of Morgan Hill Tennant Avenue well.

- December 2001 – Regional Board staff issued Monitoring and Reporting Program No. 01-161 requiring quarterly monitoring of the onsite monitoring wells and the City's Tennant Avenue well.

- January 2002 - DHS lowered the action level of perchlorate from 18 to 4 µg/L in response to the release of the USEPA External Draft Review Reference Dose for perchlorate of 0.00003 mg/kg/day. This translates into a drinking water concentration of approximately 1 µg/L.

- March 2002 - Olin conducted a soil and groundwater investigation to assess the source and extent of perchlorate, lead, and chromium. Results of the investigation indicated that lead was not a chemical of concern and additional investigation indicated that chromium and hexavalent chromium were not constituents of concern.

- October 2002 – Olin completed a Phase 2 soil and groundwater investigation to further determine the extent of perchlorate contamination and fill data gaps and the sampling of downgradient offsite domestic wells (Tier 1 wells) within one half mile of the site. Perchlorate was detected in four wells at concentrations ranging from 9.5 to 98.4 µg/L. The Regional Board ordered Olin to immediately expand the sampling area to include domestic wells located between one-half mile and one mile of the Olin site (Tier 2 wells). Olin submitted in December 2002 results of the Phase 2 soil and groundwater investigation.

- January 16, 2003 - Santa Clara Valley Water District (District) hosted a press conference, with participation of Regional Board staff, to announce results of the offsite domestic well sampling and to answer questions. The District also announced they would sample private wells, if requested, for perchlorate in the potentially contaminated area. The District provided bottled drinking water to residents who requested it until their wells were tested. The original area of potential perchlorate groundwater contamination was south of Tennant Avenue, north of Masten Avenue, east of Monterey Road, and west of Center Avenue (see Attachment 1).

- February 10, 2003 - The Regional Board directed Olin to expand the area of investigation to determine the lateral and vertical extent of perchlorate contamination in groundwater. Perchlorate was detected above 4 µg/l in numerous domestic and agricultural wells including the water supply wells operated by the West San Martin Water Works (250-plus connections) and the San Martin County Water District (200-plus connections).

- June 30, 2003, Olin submitted the Phase 3 Soil and Groundwater Investigation Report. According to the results of the Phase 3 soil and groundwater investigation and previous investigations, the Regional Board ordered Olin to conduct on-site soil and groundwater perchlorate remediation, submit a basin-wide alternative analysis for cleaning up offsite groundwater perchlorate contamination, quarterly groundwater sampling of onsite and offsite wells, and to submit a plan to determine whether perchlorate detections in groundwater northeast of the Olin site came from the Olin site.

- *As of November 3, 2003, the District has updated the sample results, as shown in Attachment 1.*

- August 7, 2003, the Regional Board revised Monitoring and Reporting Program No. 2001-161. The monitoring program requires quarterly monitoring of all onsite wells, the Tennant Avenue well, 42 offsite wells and all offsite domestic, agricultural or municipal wells with detections between 2 and 4 µg/L perchlorate. Olin is required to submit the 3rd quarter monitoring report by October 30, 2003.

- In September 2003 Olin installed wellhead ion exchange perchlorate removal systems at two supply wells of the West San Martin Water Works became operational. The wells produce about 600 gallons per minute, and serving about 250 homes and several county office buildings.

- September 12, 2003 – Regional Board meeting in Salinas. Numerous interested parties presented comments on Olin's perchlorate contamination. The comments and Regional Board staff responses were presented in the October 24, 2003, staff report.

- On September 30, 2003, the Regional Board sent a revised letter (originally sent to Olin on September 4, 2003) requiring Olin to submit a plan by October 10, 2003, for determining if detections of perchlorate found in wells between Olin's property and Morgan Hill's Nordstrom Park well are related to perchlorate releases at the subject site.

- On September 30, a revised letter was sent in September 30 (originally sent to Olin on September 19, 2003) by Regional Board staff in response to Olin's Development of Screening Levels for Perchlorate in Soil and Initial Design for Combined Full-Scale Remediation of Perchlorate-Impacted Soil & Onsite Groundwater reports. Detailed comments were provided by the Regional Board and Olin was required to comply with the following items:
  - Submit a Groundwater flow Assessment Plan by October 10th.
  - Submit a 90% Design Report for On-Site Containment and Treatment of Perchlorate in Groundwater by October 24th.
  - Submit a Soil Remediation Feasibility Study by November 21st.
  - By December 31, 2003, a report regarding startup of an on-site groundwater containment and treatment system.

- On October 10th, Olin submitted a Groundwater Flow Assessment Plan (Plan). Regional Board staff has received Plan comments from the Cities of Morgan Hill and Gilroy and the District. Regional Board staff have reviewed the plan and the interested parties comments and hope to prepared comments for Olin by early January 2004.

- October 24, 2003, Olin submitted the 90% Design Report for On-Site Containment and Treatment of Perchlorate (Report) in Groundwater. The Report documents the installation and hydraulic testing of wells at the site. Most importantly, the report contains the 90% design completion of Olin's proposed on-site groundwater containment and treatment system for perchlorate. The proposed containment and treatment system consists of two extraction wells screened in the A flow zone (10-52 feet bgs) and one extraction well in the B1 flow zone (82-102 feet bgs). A Performance Monitoring Program is proposed to verify that the extraction wells are providing full hydraulic containment in each of the targeted groundwater flow zones. If the performance monitoring program indicates that the extraction well network is not capable of providing full hydraulic containment, the flow rates or the number of extraction wells will be modified to achieve full hydraulic containment. The extracted groundwater will be treated using an ion-exchange treatment system.

The effluent will then be discharged to the City of Morgan Hill Butterfield Retention Pond.

- On October 28, 2003, the Regional Board, Olin, and the City of Morgan Hill staffs discussed the report. After the discussion, Regional Board staff informed Olin to proceed with the immediate implementation of the containment and treatment system to comply with the December 31, 2003, operational date.

- October 30, 2003, Olin submitted the 3rd Quarter Groundwater Monitoring Report. The report includes groundwater sampling results from onsite monitoring wells and offsite wells between July 1, 2003 and September 30, 2003. The report assesses the temporal and spatial variability of perchlorate concentration as well as the lateral and vertical extent of the perchlorate plume.

- As of November 3, 2003, the District has compiled the results of 1,169 samples collected by the District and Olin. The number of wells is slightly smaller than the number of samples collected because some wells serving multiple connections have samples collected from each connection. Results are broken down as follows:
  - Non-detect (< 4 µg/L) – 784 samples
  - 4-9.9 µg/L – 429 samples
  - 10-19.9 µg/L – 10 samples
  - 20-39.9 µg/L – 2 samples
  - 40-100 µg/L – 3 samples

- November 21, 2003, a study considering the effectiveness, feasibility, and relative costs of applicable soil cleanup alternatives in addition to the approach proposed in the Initial Design report, including the potential combinations of full or partial excavation coupled with on-site soil treatment or off-site soil disposal was submitted. The Soil Remediation Feasibility Study is currently being reviewed by Regional Board staff along with comment letters received from the District on December 19 and the Cities of Morgan Hill and Gilroy on December 23, 2003.

- *December 8, 2003, As a result of an office wide reorganization, Eric Gobler and David Athey assume the project oversight responsibilities from Harvey Packard and John Mijares. Eric Gobler is responsible for management of SLIC cases in the Northern reaches of Region 3, which include all perchlorate sites in the San Martin to Hollister areas. David Athey has assumed technical oversight for the perchlorate sites in the Morgan Hill and Hollister areas.*

- *December 9, 2003, the Regional Board staff and Executive Officer met with Olin to discuss long-term water replacement, offsite groundwater cleanup, and submittal of electronic data copies. At that meeting, it was agreed that Olin would submit a verbal outline by December 19, 2003, on long-term water replacement strategies. In addition Olin agreed to start formulating a plan for offsite cleanup (that is, the entire perchlorate affected ground water basin). Lastly, Olin agreed to submit electronic data copies, starting with the third quarter monitoring report by December 31, 2003.*

- *December19, 2003, Olin reports that the onsite Ion Exchange Treatment System is operational. However, the system will only be operated during the day because of a delay in getting permanent power to the site. Olin claims that PG&E has scheduled a power drop to occur around the end of February. Olin is working with PG&E to see if the power drop can be expedited.*

- *December 19, 2003, Olin verbally agreed to submit a written Outline for a long-term replacement water plan. The written outline will be submitted by January 16, 2004. A written report, based on the outline, will be submitted by April 16, 2004. The report will describe Olin's Plan to provide long term replacement water to affected parties. Olin will evaluate different alternatives based on*

location and will evaluate regional, district and individual treatment alternatives. Additionally, the Plan will evaluate replacement water alternatives for the following concentrations: 4.0, 6, 8, 10, 18, and 40 µg/l. In the meantime, Olin will continue to sample wells and provide bottled water for individuals with wells with perchlorate concentrations over 4 µg/l.

Perchlorate Community Advisory Group (PCAG) meetings are held monthly in San Martin. The advisory group is a forum for public discussion of the perchlorate problem and potential solutions. Regional Board staff will solicit advisory group input at key decision points in the investigation and cleanup process. The most recent PCAG meeting occurred on December 12, 2003. The next is scheduled on January 9, 2004.

On February 14, 2003, Regional Board staff received a letter from Sylvia Hamilton, Chair of the PCAG. The letter lays out six specific requests for inclusion in the Regional Board's cleanup requests to Olin. Regional Board staff is in the process of evaluating the letter and will be responding as appropriate. A copy of the letter is included at Attachment 5.

Follow up to a Regional Board Member question from the December 5, 2003 Regional Board Meeting

As follow up to a question from the Board, Regional Board staff contacted USEPA Region IX staff to find out their position on bioremediation of perchlorate. Mr. Wayne Praskins in the USEPA's Superfund Cleanup Division was contacted regarding this question. According to Mr. Praskin, the USEPA believes that biological treatment of perchlorate in groundwater is a good place to start. He mentioned that Biological treatment of perchlorate is a proven technology, is cost effective, and has been used at the Aerojet facility in Sacramento since 1998. Since USEPA has a statutory preference for destructive technology he said that this process is preferred over ion exchange with incineration. However, he also said this method poses public perception problems when proposed for use with potable water supply. Overall, USEPA is pleased with the results that Biological treatment of perchlorate provides.

Information regarding the Olin perchlorate contamination is on the Regional Board website. Currently, recent letters of the Board to Olin are posted. Eventually, reports received from Olin will also be posted.

McCormick Selph, 3601 Union Road, Hollister, San Benito County [David Athey 805-542-4644]

McCormick Selph, Inc., designs, develops, qualifies, and manufactures state-of-the-art controlled pyrotechnics (electric igniters, electric primers, explosive bolts, gas generators, etc.) for the aerospace and automotive industries. In May 1971, McCormick Selph completed the Hollister facility and started manufacturing operations at the 270-acre site. In 1993, McCormick Selph, which was then a subsidiary of Teledyne, Inc., was realigned with Ryan Aeronautical and became Teledyne Ryan Aeronautical/McCormick Selph Ordnance. Allegheny Teledyne Incorporated was formed in August 1996 through the business combination of Teledyne, Inc. and Allegheny Ludlum Corporation.

In late 1999, Allegheny Teledyne sold the business and assets of McCormick Selph but retained certain liabilities related to the business, including liability for certain environmental issues at the Hollister facility. Subsequently, as part of a spin-off of two new entities, Allegheny Teledyne changed its name to Allegheny Technologies and Teledyne Industries changed its name to TDY Industries. Consequently, TDY Industries is considered the responsible party for environmental issues at the facility.

Prior to the sale of McCormick Selph, the prospective buyer sampled all existing onsite monitoring wells for various potential contaminants. In June 1999, Teledyne staff informed Regional Board staff that perchlorate and volatile organic compounds (VOCs) had been detected in some monitoring wells.

Over the past ten years, total annual perchlorate use at the facility has averaged approximately 1,800 grams of potassium perchlorate and 300 grams of ammonium perchlorate with the following exceptions: (1) During a two-year period from 1998 through 2000, approximately 500 lbs (226,750 grams) of potassium perchlorate were used annually at the facility and (2) current projected use for 2003 includes approximately 5 lbs (2,260 grams) of ammonium perchlorate. Perchlorate wastes are thermally destructed at the facility.

TDY Industries, through its consultant PES Environmental, has conducted a series of soil and groundwater investigations to determine the source areas and extent of perchlorate and VOCs contamination at the site. These investigations found the geologic units underlying the site can be divided into two units: (1) sedimentary rocks of the Purisima Formation; and (2) recent alluvial deposits.

PES submitted a December 19, 2002 report titled *Corrective Action Plan, Soil and Water Investigation, McCormick Selph, Inc.* To clean up the perchlorate and VOCs contamination in groundwater, PES evaluated three remedial alternatives: monitored natural attenuation, groundwater extraction and treatment, and enhanced in-situ bioremediation. The criteria used in evaluating the remedial alternatives included effectiveness, feasibility, and cost. PES proposes to use monitored natural attenuation in areas with relatively low concentrations and limited extent of perchlorate and VOCs.

To clean up the perchlorate plume within the alluvial deposits in the vicinity of the TSU-3/Thermal Destruct Facility, PES proposes to use enhanced in-situ bioremediation because of the relatively elevated levels of perchlorate within this plume and the presence of downgradient water supply wells. Regional Board staff approved the cleanup plan on February 13, 2003. TDY will begin implementation by April 2003.

Three additional monitoring wells were installed on April 28 and 29, 2003. These monitoring wells were installed to monitor perchlorate concentrations along the margins of the perchlorate plume present within the alluvial deposits in the vicinity of the TSU-3/Thermal Destruct Facility area.

PES, on behalf of TDY Industries, submitted on September 4, 2003, an Enhanced In-Situ Bioremediation Pilot Study Workplan. The workplan describes the proposed design, methods and procedures for a pilot-scale enhanced in-situ bioremediation program to assess its effectiveness in remediating perchlorate in groundwater within the shallow alluvial aquifer at a portion of the site. Based on evaluation of several in-situ bioremediation technologies applicable to perchlorate, PES selected the injection of HRC as the preferred technology for the pilot study. A pilot-scale injection of HRC will be performed at the perchlorate plume located within the alluvial deposits in the vicinity of the Thermal Destruct Facility.

HRC is a proprietary, polylactate ester formulated for slow release of lactic acid upon hydration. HRC is typically used to stimulate or enhance reductive dechlorination processes occurring in perchlorate and VOC-contaminated groundwater. HRC is designed to generate anaerobic conditions in the aquifer and promote biomass generation by providing an easily assimilated carbon source via a time-release method. Initially, when in contact with subsurface moisture, HRC slowly releases lactic acid, which is metabolized by indigenous anaerobic microbes producing low concentrations of dissolved hydrogen. The resulting hydrogen is then used by other microbes (reductive dehalogenators) to strip off the chlorine atoms and allow for further biological degradation. On October 15, 2003, Regional Board staff approved the work plan for the implementation of the Enhanced In-Situ Bioremediation Pilot Study.

PES completed the HRC-injections on December 19, 2003. Approximately 5,500 pounds of HRC were applied to the perchlorate plume located within the alluvial deposits in the vicinity of the former Thermal Destruct Facility/TSU-3 area. The work was completed in accordance with the Enhanced In-Situ Bioremediation Pilot Study Work Plan

and the Regional Board letter dated October 15, 2003. A report describing the work activities related to the HRC-injection and results of the pre-injection groundwater monitoring event (performed November 4 and 5, 2003) will be submitted to the Regional Board by January 30, 2004. If the pilot study is successful, PES will submit a work plan by September 30, 2005, for a full-scale implementation of an enhanced in-situ bioremediation treatment technology. Regional Board staff will continue to provide the Regional Board with periodic updates on the status of the pilot study implementation.

Whittaker Ordnance Facility, 2751 San Juan Road, Hollister, San Benito County [David Athey 805-542-4644]

The Former Whittaker Ordnance Facility is located on an approximately 94-acre site near Hollister, surrounded by farmland (see Attachment 3). Historical uses of the facility consist of an operating dairy farm prior to 1957 and an ordnance manufacturing facility from 1957 to present. In 1957, the property was acquired by the Holex Company, Inc. and developed to produce small explosives. The property became a division of the Whittaker Corporation in 1980 and was operated as Whittaker Ordnance from 1980 to 1993. Quantic Industries, Inc. obtained the property in 1994 and continued to manufacture explosive devices used for vehicular safety products. In 2001, Pacific Scientific Energetic Materials (operating under PacSci-Quantic) acquired the property from Quantic and continues to manufacture explosive devices used for vehicular safety products.

Groundwater directly beneath and adjacent to the Property occurs in three separate aquifers. The Unit 1 aquifer consists of interbedded silty sands and clayey silts to a maximum depth of approximately 68 feet below ground surface (bgs), the Unit 3 aquifer consists of a second silty sand layer from 40 to 125 feet bgs, and the Unit 4 aquifer consists of a thick coarse sand layer located 160 to 270 ft bgs. The aquifer is encountered between depths of 120 to 160 feet bgs in the Middle Facility. A discontinuous aquitard exists between Unit 1 and 3, which is identified as Unit 2. The presence of groundwater at approximately the same elevation in the Unit 1 and 3 aquifer zones indicates some hydraulic connectivity. In addition, faulting running southwest to northeast in the vicinity of the Lower Facility may also provide conduits to the deeper Unit 4 aquifer. The lithology encountered in Units 1 to 3 consists of interbedded clayed silts, with the silty sand layers identified as the preferential pathways and water bearing units.

Environmental assessment activities were initiated in 1991 after detections of halogenated volatile organic compounds (HVOCs) in an onsite water supply well. Subsequent investigation activities identified several sources of soil and groundwater pollution throughout the property. Identified constituents of concern include trichloroethylene (TCE) and its breakdown products (e.g., vinyl chloride and 1,2-DCE), Freon 113, perchlorate, and hexavalent chromium. All of these constituents have been detected in soil and groundwater beneath and adjacent to the facility at concentrations above water quality standards. Table 1, below, summarizes relevant water quality data concerning the most significant constituents detected.

Table 1: Maximum Concentration Table

Constituent	Well	Maximum Conc.	MCL/ AL
TCE	MW-7	92,000	5
vinyl chloride	MW-3	3,800	0.5
hexavalent chromium	MW-20	260	50
perchlorate	MW-27	290,000	4 (AL)
Freon 113	MW-30	12,000	1,200

All units are parts per billion (ppb)
MCL – Maximum Contaminant Level
AL – Action Level

There are several likely source areas at the site. They include areas where perchlorate was stored, milled, and used in manufacturing process. Areas where explosive devices were test fired and burned are also likely sources. Wash water throughout the facility was either disposed of on ground surface or in dry wells.

Two separate perchlorate plumes are found within the Unit 1 aquifer, one near the Building 23 area (Lower Facility) and a second near the south side of the Building 5 area (Middle Facility). Both of these plumes are commingled with the Lower Facility TCE plume. Two more perchlorate plumes are found in perched groundwater within the Middle Facility. The most significant is located directly beneath the Burn Area. The other plume is directly beneath and adjacent to the Building 22A area. The Middle Facility perchlorate plume extends approximately 1,000 feet (northeast to southwest). The Lower Facility perchlorate plumes extend approximately 1,000 feet from the Building 5 area.

Detectable concentrations of dissolved HVOCs and perchlorate are also present in the Unit 3 and Unit 4 aquifers at significant concentrations. Groundwater containing HVOCs and perchlorate may have migrated into these deeper water-bearing units by way of a former water supply well, which was destroyed in May 1996, or in the area north and northwest (downgradient) of the Property where the shallow and deeper water-bearing units may be hydraulically connected. Down gradient to the north, the Riverside Irrigation Company well (screened within the Unit 3 aquifer) has reported TCE concentrations (1,200 ppb) exceeding drinking water standards. Perchlorate concentrations within the Unit 3 and 4 aquifer zones are much lower, but still above the action level of 4 ppb. The TCE plume's circumference within Unit 3 is approximately 1000 feet. TCE concentrations within Unit 4 are primarily restricted to areas near the Riverside and Christopher wells. The perchlorate plume within Unit 3 expands more than 1,000 feet in the northwest direction. Perchlorate detections in the Unit 4 aquifer zone are restricted to detections from the Riverside and Christopher wells, and the Burn Area. Detected contaminants within the Unit 4 aquifer zones are relatively low and significant plumes have not developed. Perchlorate has been detected in five off-site wells (Butler, Sanchez, Dike, Christopher, and Riverside) previously used for domestic or agricultural supply. Impacted wells are either treated before use or are no longer in service.
On July 9, 1999, the Regional Board issued Cleanup or Abatement Order (CAO) No. 99-006 to Whittaker. CAO No. 99-006 specifies cleanup actions that Whittaker must take to address soil and groundwater contamination at the site. A monitoring and reporting program ensures adequate sampling and monitoring of contaminated areas.

Whittaker is implementing several interim soil and groundwater remediation measures at various source areas throughout the facility. Regional Board staff approved a final risk assessment report addressing human health and safety throughout the site. On October 31, 2002, staff approved a final feasibility study report addressing all soil and groundwater remediation alternatives at all identified pollution source sites, including all groundwater plumes within each impacted water-bearing zone.

On March 17, 2003, Whittaker submitted a corrective action plan. (CAP). The CAP contains specific strategies for controlling groundwater plumes and restoring and protecting groundwater quality at seven contaminated source areas: North Building 5 Septic Tank Area, Building 23 Area, Lower Pond Area, Building 22A Area, Burn Area, South Building 5 Drywell Area, and the Waste Storage Pad Area. The proposed groundwater remedial actions were specifically designed to clean up groundwater impacted by HVOCs, perchlorate, and hexavalent chromium. The CAP further included proposed remedial actions for cleaning up perchlorate-impacted soils at five of the seven contaminated areas. Regional Board staff approved the CAP on May 7, 2003, and established timelines for implementation and submittal of compliance reports.

On September 15, 2003, Whittaker submitted a Corrective Action Plan Implementation Report. The report discusses the implementation status of the comprehensive soil and groundwater remediation strategies proposed in the CAP and approved by the Regional Board on May 7, 2003. Whittaker's consultant (Arcadis) uses the In-Situ Reactive Zone™ (IRZ™) Remediation

Program for treatment of perchlorate, hexavalent chromium, and HVOCs in groundwater at the site. The IRZ™ technology relies on the delivery of an organic carbon substrate mixture (corn syrup) to the subsurface via batch injections to stimulate microbial activity, thereby creating a reducing environment for in-situ bioremediation.

The status of remedial action at the site, based on the Third Quarter 2003 report submitted by Whittaker and its consultants, is discussed below.

North Building 5 Septic Tank Area (Perchlorate, Halogenated VOCs, and hexavalent chromium) *– Operation of an ozone-sparging system, groundwater extraction and treatment system (ion exchange), Riverside well stripper for removal of Halogenated VOCs (HVOCs), and private water supply well treatment system for HVOCs will continue until remediation is complete. Nine ozone-sparging wells are completed within the Unit 1A permeable zone, six within the Unit 1B aquifer, and three within the Unit 3 aquifer to enhance degradation of HVOCs. Groundwater monitoring results indicate that although the ozone sparging system has not been consistently on-line since March 9, 2003 because of electrical system malfunctions and ozone production rate deficiencies, enhanced aerobic conditions (elevated DO and ORP levels) have remained in the vicinity of the ozone-sparging wells. The ozone-sparging system can effectively achieve the desired enhanced aerobic groundwater conditions during normal continuous system operation. Analytical results between June 30 and September 30, 2003, indicate the groundwater extraction and treatment system is effectively removing perchlorate, hexavalent chromium, and HVOCs.*

Lower Pond Area (Perchlorate, HVOCs, and hexavalent chromium) *– Baseline injection events consisting of Two organic carbon substrate injections were conducted during the third quarter of 2003 on July 17, 2003 and August 25, 2003. The substrate consists of corn syrup diluted with water at a 1:15 ratio. Third quarter 2003 groundwater monitoring results indicate that groundwater conditions associated with establishing an IRZ™ are not yet apparent. This is to be expected since the downgradient monitoring well is approximately 30 feet downgradient of the injection points and the groundwater velocity in the area is approximately 9 feet per year.*

Building 22A Area (Perchlorate) *– Soil remediation pilot testing using ethanol is currently being implemented in this area. On September 26, 2003, 55 gallons of ethanol were applied to the uppermost compacted soil lift using the at-grade distribution piping. Biweekly soil gas monitoring is being conducted and ethanol is added when deemed appropriate. A work plan for remediating perched groundwater underneath this area will be prepared following review of data from the ethanol soil infiltration testing.*

Building 23 Area (Perchlorate, hexavalent chromium, Freon 113, and HVOCs) *– Two organic carbon substrate injections were conducted during the third quarter of 2003 on July 11 and August 29, 2003. Third quarter 2003 groundwater monitoring results demonstrate the successful progress of the Building 23 Area IRZ™ remediation conditions capable of simultaneously degrading perchlorate, hexavalent chromium, Freon 113, and TCE in groundwater throughout the targeted area.*

Burn Area (Perchlorate, hexavalent chromium, and HVOCs) *– The IRZ™ remediation program has been implemented in two areas of the former burn area: within the vicinity of the burn area former leach field (Upper Burn Area) and within the area southwest of the former leach field and in the vicinity of the local sand channel (Southwest Burn Area).*

One organic carbon substrate injection was conducted during the third quarter 2003 on July 10, 2003, at the Upper Burn Area. Third quarter groundwater monitoring results from monitoring wells located within the area surrounding the injection points continued to show elevated TOC and declining perchlorate concentration trends. Perchlorate concentrations have been reduced in MW-49 from 200,000 µg/l in September 2001 to 230

µg/l in September 2003 which correlates to a 99.9 percent reduction in perchlorate concentration.

Two organic carbon substrate injections were conducted during the third quarter 2003 event on July 11 through 15 and August 19 through 21, 2003. A total of six IRZ™ injection events have now been conducted in the Southwest Burn Area since September 2002. Results of groundwater monitoring indicate that elevated TOC concentrations and perchlorate-reducing conditions have been established within the immediate vicinity of the injection points. However, it does not appear that these conditions have sufficiently propagated to surrounding areas. The Discharger recommends evaluation of additional injection points within the southwest burn area to accelerate the distribution of organic carbon substrate within a low velocity area and porous stratum.

***Northwest Site Boundary Area (Perchlorate, HVOCs, and hexavalent chromium)** – Two organic carbon substrate injection events were conducted on July 15 through 17, 2003 and August 21 through 29, 2003. Third quarter groundwater monitoring results indicate that groundwater conditions pertinent to establishing an IRZ™ (elevated TOC concentrations, decreased DO concentrations, decreased ORP and reduction of target contaminants) have not progressed to the monitoring wells on the northwest boundary at this time. A response would not be expected at this time since these wells are approximately 35 feet downgradient of the injection point network and the groundwater velocity in the area is about 9 feet per year.*

***South Building 5 Drywell Area (Perchlorate, hexavalent chromium, and HVOCs)** Groundwater monitoring results show that the most successful concurrent reduction of TCE, perchlorate, and hexavalent chromium occurs in the immediate vicinity of monitoring wells MW-48 and P-6 following the one-time injection of the HRC material in November 2000. Results of the third quarter groundwater monitoring indicate that the rate of reduction of the contaminants and the available total organic carbon has diminished. Whittaker's consultant, recommends the design and installation of an IRZ™ to carry the reduction of the contaminants to completion.*

- ***Waste Storage Pad Area (Perchlorate and HVOCs)** – On December 18, 2003, Regional Board staff approved Whittaker's In-Situ Field Demonstration Work Plan for the former waste storage pad area. The Work Plan proposes to conduct a field demonstration using an anaerobic in-situ reactive zone remedial technology to remediate perchlorate-impacted soils within an area sized at 30 feet by 40 feet by 40 feet deep, approximately 1800 "in-place" cubic yards, in the vicinity of the former Waste Storage Pad Area. The field demonstration area was selected based on the relatively high perchlorate concentrations in soil compared to other areas of the Lower Facility and is readily accessible. ARCADIS proposes to inject easily degradable carbohydrate solutions, consisting of 52% ethanol and 35% corn syrup, into unsaturated soils to saturate the targeted zones. This should allow microbial populations to flourish in a relatively short time frame resulting in an anaerobic environment and the microbial degradation of target contaminants. ARCADIS reports this technology has already been successfully applied for the treatment groundwater in other portions of the facility.*

Whittaker is scheduled to submit the second semiannual report by January 30, 2004. The report will provide progress of soil and groundwater remediation at various source areas. This information will be provided to the Regional Board at the March 19, 2004, meeting.

ATTACHMENTS:

1. San Martin Area Perchlorate Investigation
2. Cross Section of Site Geology, Olin
3. Site Location Map of the former McCormick Selph Facility
4. Site Map of the former Whittaker Ordnance Facility
5. PCAG letter from Sylvia Hamilton