

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. R5-2009-xxxx

WASTE DISCHARGE REQUIREMENTS

FOR
ALEXANDER J. MISTAL AND VIRGINIA C. MISTAL,
BEHELLI CLEANERS,
AND BEHELLI CLEANERS, INC.
GROUNDWATER REMEDIATION
REDDING, SHASTA COUNTY

The California Regional Water Quality Control Board, Central Valley Region, (hereafter Regional Water Board) finds that:

1. Alexander J. Mistal and Virginia C. Mistal (hereafter Dischargers) are current fee title owners of Shasta County Assessor's Parcel Number (APN) 107-080-050, less than one acre. There, the Dischargers owned and operated a dry-cleaning business at 2572 Bechelli Lane. See the vicinity map as Attachment A, a part of this Order.
2. From 1960 until 1976, Sig Kriegsman, Jr. and Porter Jacobs (hereafter Kriegsman and Porter) each owned an undivided one-half interest in the subject parcel, and there operated Kleensville, a dry-cleaning business. From 1976 to 1981, Michael W. Banahan, and Charmain Ann Banahan, his wife (hereafter Banahan) operated Kleensville as joint tenants to Kriegsman and Porter. While prior title records on file at the Regional Water Board are currently incomplete; in 1981 Banahan granted the parcel to Virginia C. Yee, an unmarried woman. Also in 1981, Banahan transferred fixtures, equipment, and cleaning supplies to Yee, who in turn changed the business name to Bechelli Cleaners. In 1988, Alexander J. Mistal and Virginia C. Mistal, who acquired title as Yee, granted the parcel to the Dischargers (themselves) as joint tenants. In 1990, the Dischargers filed California Corporation No. C1674572, Bechelli Cleaners, Inc. In 2004, the Dischargers ceased on-site dry-cleaning, and began a clothing pick-up and drop-off operation. In 2008, Sunset Cleaners, Inc. (California Corporation No. C2717874) DBA Bechelli Cleaners began business on the subject parcel, and continues clothing pick-up and drop-off.
3. Chlorinated ethenes are the primary constituents of concern. Based on current mapping, Perchloroethene (PCE) has dispersed southwest off-site. Some PCE has dechlorinated reductively, largely to Trichloroethene (TCE), and cis-1,2-Dichloroethene (c-DCE). Limited 1,1-Dichloroethene (1,1-DCE) occurs near-source. Ethenes have dispersed in groundwater, within moderately permeable alluvial silty gravels and gravelly silts. PCE slightly above its Public Health Goal of 0.06 microgram/Liter ($\mu\text{g/L}$) has impacted a private domestic well at 2721 Lowden Lane, about 800 feet southwest. Therefore, on 20 January 2009, under State Health and Safety Code §25180.7 the Assistant Executive Officer issued a Proposition 65 Disclosure to the Shasta County Board of Supervisors. Also, preliminary human

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health screening suggests that ethenes could potentially cause excess lifetime cancer risk $>10^{-6}$ due to indoor air intrusion in single family homes within about 400 feet southwest of the subject parcel.

4. While Kriegsman (believed residing in San Mateo County), Porter (deceased), and Banahan (wife deceased, husband whereabouts unknown) are also potentially responsible, the Dischargers have to date solely addressed pollution. Beginning in 2007, the Dischargers have operated an on-site soil vapor extraction (SVE) system to mitigate threats to on-site indoor air quality and lower maximum identified pollutant concentrations. To date, SVE has removed over 200 pounds of volatile organic compounds, predominantly chlorinated ethenes.
5. On 18 July 2008 the Dischargers submitted a Remedial Action Plan (RAP). The RAP in part proposes to inject emulsified soybean oil substrate into groundwater to treat off-site ethenes. On 20 August 2008, staff concurred with the RAP. On 9 December 2008, the Dischargers applied for Waste Discharge Requirements (WDRs) under General Order No. R5-2008-0149. On 21 January 2009, staff declared the application complete pending enrollment under the General Order. However, due to threats to sensitive receptors staff finds site-specific WDRs more appropriate.
6. The intent of injection is bio-stimulation, to locally increase serial, first order, reductive, microbe-mediated decay rates of dechlorinating ethenes. Therefore, within the treatment zone staff expects, and concurs with, local temporary increases of TCE, c-1,2-DCE, 1,1-DCE, and vinyl chloride (VC). However, these de-chlorinated daughters of PCE can become increasingly mobile in groundwater. Also, daughters could increase threats to off-site indoor air quality; see the following table. Relatively high Henry's Law Coefficient (K_H) and low molecular weight of ethene/molecular weight of nitrogen gas (MW/MW_{N_2} , \sim weight of ethene/weight of air) indicates relatively high threats to indoor air. Therefore, relatively greatest potential threat to indoor air is from most de-chlorinated PCE daughters. Also note the relatively low organic carbon partition coefficient (K_{oc}) of most PCE daughters; low K_{oc} generally indicates increased mobility in groundwater.

Table 1: Key Physical Parameters of Identified Chlorinated Ethenes

| | PCE | TCE | c-1,2-DCE | 1,1-DCE | VC |
|-------------------------------|-------|-------|-----------|---------|------|
| K_H (dimensionless) | 0.754 | 0.422 | 0.167 | 1.07 | 1.11 |
| MW/MW_{N_2} (dimensionless) | 5.92 | 4.70 | 3.46 | 3.46 | 2.23 |
| K_{oc} (Liters/Kilogram) | 155 | 166 | 35.5 | 58.9 | 18.6 |

Source for K_H and K_{oc} : Weiner, Eugene, R. (2000). *Applications of Environmental Chemistry, A Practical Guide for Environmental Professionals*. ISBN 1-56670-354-9, 276 pages. Information on Table 4.6.

This warrants appropriate groundwater, soil gas, and indoor air monitoring, and contingencies for confirmed threats to sensitive receptors. Within the treatment zone, staff also expects, and concurs with, local short-term increases of total dissolved

solids (TDS), chemical oxygen demand (COD), biological oxygen demand (BOD), sulfides, fatty acids, and dissolved metals such as manganese and arsenic. Likewise, staff expects, and concurs with, short-term variations in pH and Eh, and exceedances of Water Quality Objectives for taste and odor. Due to the limited treatment zone volume, within highly ethene-polluted groundwater, staff does not expect persistent, long-term collateral impacts to water quality due to the proposed treatment. However, these potential issues likewise warrant monitoring and appropriate contingencies.

Phase I Injection Event

7. Typical factors that can affect successful anaerobic bio-stimulation include, but are not limited to; substrate delivery, ambient geochemistry (e.g., dissolved oxygen, nitrate, sulfate, bio-available iron, pH, and naturally occurring organic carbon), and microbial sufficiency; see http://costperformance.org/remediation/pdf/principles_and_practices_bioremediation.pdf. Therefore, the Discharger ran a carbon substrate demand model to design a Phase I injection event based on adequate ethene pollutant, hydrogeological, and baseline geochemical data from the near-source and mid-plume. The RAP includes this model. Given typical factors, largely infeasible to replicate in the laboratory, staff finds the demand model sufficient in lieu of bench testing. See the demand model as Attachment B, a part of this Order.
8. Ambient background general groundwater geochemistry data are available from the Discharger's farthest up-gradient monitoring well TW-10; where measurements are available. The following tables summarize typical ranges of selected analytes. Table 2 gives electron acceptor and related data from TW-10. Table 3 gives California Code of Regulations (CCR) Title 22, priority pollutant metals.

Table 2: Background General Groundwater Geochemistry; Electron Acceptors and Related Parameters

| pH** | ORP (mV)** | DO (mg/L)** | Fe ²⁺ (mg/L)* | SO ₄ ²⁻ (mg/L)* | NO ₃ ⁻ (mg/L)* | CH ₄ (µg/L)* | Alkalinity as CaCO ₃ * (mg/L) | TDS (mg/L) | Temp. °C** |
|------|------------|-------------|--------------------------|---------------------------------------|--------------------------------------|-------------------------|--|------------|------------|
| 7.4 | 15.1 | 5.3 | <100 | 15.4 | 1.07 | 0.75 | 112 | 133 | 21.0 |

Notes:

°C, degrees Centigrade

mV, millivolts

mg/L, milligrams/Liter

*, average of three samples from TW-10, February through August, 2008.

** , average of four samples from TW-10, February through October, 2008.

ORP, oxidation-reduction potential in millivolts, mV.

DO, dissolved oxygen

Fe²⁺, soluble iron, in milligrams/Liter, mg/L.

SO₄²⁻, sulfate, in mg/L.

NO₃⁻, nitrate as nitrogen, in mg/L.

CH₄, Methane, in micrograms/Liter, µg/L. Two of three results, averaged, are J-flagged, below Method Reporting Limits.

Alkalinity as calcium carbonate, CaCO₃, in mg/L

TDS, total dissolved solids, in mg/L.

Temperature, in degrees Centigrade, °C.

**Table 3: Background General Groundwater Geochemistry;
 Dissolved CCR-17 Priority Pollutant Metals; all data in mg/L**

| Sb | As | Ba | Be | Cd | Cr | Co | Cu | Pb | Hg | Mo | Ni | Se | Ag | Th | V | Zn |
|------|------|----|------|------|-----|------|------|------|-------|-----|-----|------|-----|------|----|-----|
| <4.0 | <4.0 | 22 | <1.0 | <1.0 | 2.0 | <1.0 | <1.0 | <3.0 | <0.07 | 1.0 | 1.0 | <4.0 | 1.0 | <5.0 | 16 | 6.0 |

Notes: Sb, Antimony, As, Arsenic, Ba, Barium, Be, Beryllium, Cd, Cadmium, Co, Cobalt, Cr, Chromium (total), Cu, Copper, Pb, Lead, Hg, Mercury, Mo, Molybdenum, Ni, Nickel, Se, Selenium, Ag, Silver, Th, Thallium, V, Vanadium, Zn, Zinc

Staff will require appropriate statistical analyses and updates of ambient background general geochemistry prior to, during, and following injections. Staff will also require periodic comparisons of up-gradient and treatment zone geochemistry and accompanying predictions of time until aquifer restoration to background. Staff will further require appropriate periodic analysis of metal mobilities in terms of pH and oxidation reduction potential (ORP), for example as Pourbaix Diagrams.

9. During Phase I, the Dischargers will inject about 500 pounds of soybean oil emulsified into about 600 gallons of water into the treatment zone. The Discharger will distribute the injection between nine and eleven injection wells on a nominal 15-foot lateral spacing, each to about 25 feet below grade surface, to form a near-source permeable reactive barrier. Monitoring wells TW-1 and TW-2 are within the treatment zone, well TW-3, slightly up-gradient, wells TW-14 and TW-15, slightly down-gradient. The Discharger proposes wells TW-14 and TW-15 as compliance wells, however staff will require appropriate monitoring for general geochemistry and VOCs in compliance wells farther down-gradient, at minimum including TW-7. Additional compliance wells (TW-6, TW-8, and TW-9) will be included in the monitoring and sampling program, if results of compliance samples collected from TW-7 indicate elevated levels of general geochemistry and VOCs. Staff will also require similar appropriate monitoring in up-gradient well TW-10. See the injection plan as Attachment C, a part of this Order.

10. On 27 February 2009, the Dischargers submitted a site investigation and human health screening report. This includes a work plan for further site investigation. On 9 March 2009, staff conditionally approved the enclosed plan, and requested appropriate further site investigation, and contingency plans in the event of confirmed threats to sensitive receptors. While staff has approved the RAP to allow the Dischargers to prepare for the Phase I injection event, staff also considers the Dischargers' response to our 9 March 2009 request important to the adoption of these WDRs. Specifically, appropriate soil gas, indoor air, and down-gradient monitoring are essential to protect human health and the environment. Therefore, staff will concur with an expanded monitoring network, and contingencies as warranted based on threats to receptors, as a condition to these WDRs. Further, discharge shall comply with Discharge Prohibitions, Specifications, and Groundwater Limitations in these WDRs and the attached Monitoring and Reporting Program (MRP R5-2009-xxxx), which is part of this Order.

Additional Injection Events

11. Pending results from Phase I, the Dischargers may add further substrate as necessary to remediate VOC impacted groundwater. Staff concurs with this general approach provided additional injection events comply with Discharge Prohibitions, Specifications, and Groundwater Limitations in these WDRs; and MRP R5-2009-xxxx. However, if results from Phase I indicate the need for other in-situ treatments, for example anti-biofouling agents, or oxidants to treat persistent VC, staff will require a work plan and appropriate technical justification to continue operating under these WDRs.

Basin Plan, Beneficial Uses, and Regulatory Considerations

12. *The Water Quality Control Plan, Fourth Edition, for the Sacramento and San Joaquin River Basins, Fourth Edition*, (hereafter Basin Plan) designates beneficial uses, establishes water quality objectives (WQOs), contains implementation plans and policies for protecting waters of the basin, and incorporates by reference plans and policies adopted by the State Water Resources Control Board (State Board). Pursuant to Section 13263(a) of the California Water Code (CWC), waste discharge requirements must implement the Basin Plan.
13. The Basin Plan designates the beneficial uses of the groundwater underlying the former Kleensville and Bechelli Cleaners dry-cleaning facility as municipal and domestic supply, industrial service supply, industrial process supply, and agricultural supply.
14. The Basin Plan establishes numerical and narrative WQOs for surface and groundwater within the basin, and recognizes that WQOs are achieved primarily through the Regional Water Board's adoption of waste discharge requirements and enforcement orders. Where numerical WQOs are listed, these are limits necessary for the reasonable protection of beneficial uses of the water. Where compliance with narrative WQOs is required, the Regional Water Board will, on a case-by-case basis, adopt numerical limitations in orders, which will implement the narrative objectives to protect beneficial uses of the waters of the state.
15. The Basin Plan identifies numerical WQOs for waters designated as municipal supply. These are the maximum contaminant levels (MCLs) specified in the following provisions of Title 22, California Code of Regulations: Tables 64431-A (Inorganic Chemicals) and 64431-B (Fluoride) of Section 64431, Table 64444-A (Organic Chemicals) of Section 64444, and Table 64449-A (Secondary Maximum Contaminant Levels-Consumer Acceptance Limits) of Section 64449. The Basin Plan's incorporation of these provisions by reference is prospective, and includes future changes to the incorporated provisions as the changes take effect. The Basin Plan recognizes that the Regional Water Board may apply limits more stringent than MCLs to ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses.

16. The Basin Plan contains narrative WQOs for chemical constituents, tastes and odors, and toxicity. The toxicity objective requires that groundwater be maintained free of toxic substances in concentrations that produce detrimental physiological responses in humans, plants or animals. The chemical constituent objective requires that groundwater shall not contain chemical constituents in concentrations that adversely affect beneficial uses. The tastes and odors objective requires that groundwater shall not contain tastes or odors producing substances in concentrations that cause nuisance or adversely affect beneficial uses. 22. State Board Resolution No. 92-49 (hereafter Resolution No. 92-49) requires the Regional Water Board to require actions for cleanup and abatement of discharges that cause or threaten to cause pollution or nuisance to conform to the provisions of State Board Resolution No. 68-16 (hereafter Resolution No. 68-16) and the Basin Plan. Pursuant to Resolution No. 92-49, the Regional Water Board shall ensure that dischargers are required to clean up and abate the effects of discharges in a manner that promotes attainment of either background water quality, or if background levels of water quality cannot be restored, the best water quality which is reasonable and which complies with the Basin Plan including applicable WQOs.
17. Section 13241 of the Water Code requires the Regional Water Board to consider various factors, including economic considerations, when adopting WQOs into its Basin Plan. Water Code Section 13263 requires the Regional Water Board to address the factors in Section 13241 in adopting waste discharge requirements. The State Board, however, has held that a Regional Water Board need not specifically address the Section 13241 factors when implementing existing WQOs in waste discharge requirements because the factors were already considered in adopting WQOs. These waste discharge requirements implement adopted WQOs. Therefore, no additional analysis of Section 13241 factors is required.
18. Resolution No. 68-16 requires the Regional Water Board in regulating discharges to maintain high quality waters of the State until it is demonstrated that any change in quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and potential beneficial uses, and will not result in water quality less than that described in plans and policies (e.g., quality that exceeds WQOs). Temporal degradation of groundwater may occur at this site within the defined treatment zone due to the injection of the amendments and resulting reactions. The temporary degradation allowed by this Order is consistent with Resolution No. 68-16 since (1) the purpose is to accelerate and enhance remediation of groundwater pollution and such remediation will benefit the people of the State; (2) the discharge facilitates a project to evaluate the effectiveness of cleanup technology in accord with Resolution No. 92-49; (3) the degradation is limited in scope and duration; (4) best practicable treatment and control, including adequate monitoring and hydraulic control to assure protection of water quality, are required; and (5) the discharge will not cause WQOs to be exceeded beyond the treatment zone. A slight residual increase in TDS may occur, but will be limited to concentrations defined in the Groundwater Limitations of this Order.

19. These waste discharge requirements deal with water quality as it relates to the chemicals being injected, as well as the byproducts and breakdown products produced by the reactions of the amendments, chemicals being treated and geological materials. As discussed above, chemicals are injected to stimulate reduction in concentrations of the target pollutants. The target pollutant may undergo a series of transformations to other pollutants as it degrades. The injected chemical itself may leave residuals of its components or cause changes in groundwater chemistry that liberate metals found in the formation materials. Background/baseline concentrations of metals and total dissolved solids have been established or will be established pursuant to the attached MRP No. R5-2009-XXXX. The applicable WQOs are the narrative toxicity objective, Primary and Secondary Maximum Contaminant Levels, and the taste and odor objective as found in the Basin Plan. Numerical limits in this Order implement those Objectives. The following are the numerical WQOs for potential pollutants of concern that may be byproducts of the groundwater treatment:

| Constituent | WQO (µg/L) | Reference |
|---------------|--------------------------------|---|
| TCE | 0.8 | California Public Health Goal, Human Toxicity Objective |
| c-1,2-DCE | 6 | California Department of Health Services Primary Maximum Contaminant Level, Chemical Constituents Objective |
| 1,1-DCE | 6 | California Department of Health Services Primary Maximum Contaminant Level, Chemical Constituents Objective |
| VC | 0.05 | California Public Health Goal, Human Toxicity Objective |
| CCR-17 metals | <150% Background Concentration | Background Concentrations are outlined in Table 3 of this Order. |

20. Section 13267(b) of California Water Code provides that: "In conducting an investigation specified in subdivision (a), the Regional Water Board may require that any person who has discharged, discharges, or is suspected of discharging, or who proposes to discharge within its region, or any citizen or domiciliary, or political agency or entity of this state who has discharged, discharges, or is suspected of discharging, or who proposes to discharge waste outside of its region that could affect the quality of the waters of the state within its region shall furnish, under penalty of perjury, technical or monitoring program reports which the Regional Water Board requires. The burden, including costs of these reports, shall bear a reasonable relationship to the need for the reports and the benefits to be obtained from the reports. In requiring those reports, the Regional Water Board shall provide the person with a written explanation with regard to the need for the reports, and shall identify the evidence that supports requiring that person to provide the reports." The technical reports required by this Order and the attached MRP No. R5-2009-XXXX is necessary to assure compliance with these waste discharge requirements.

21. The California Department of Water Resources sets standards for the construction and destruction of groundwater wells (hereafter DWR Well Standards), as described in *California Well Standards Bulletin 74-90* (June 1991) and *Water Well Standards: State of California Bulletin 94-81* (December 1981). These standards, and any more stringent standards adopted by the Dischargers or county pursuant to CWC Section 13801, apply to all extraction and monitoring wells.
22. Issuance of this Order is an action to assure the restoration of the environment and is, therefore, exempt from the provisions of the California Environmental Quality Act (Public Resources Code, Section 21000, et seq.), in accordance with Section 15308 and 15330, Title 14, California Code of Regulations (CCR).
23. This discharge is exempt from the requirements of *Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste*, as set forth in Title 27, CCR, Division 2, Subdivision 1, Section 20005, et seq., (hereafter Title 27). The exemption pursuant to Section 20090(b), is based on the following:
 - a. The Regional Water Board is issuing waste discharge requirements,
 - b. The requirements implement the Basin Plan, and
 - c. The wastewater does not need to be managed according to Title 22 CCR, Division 4.5, and Chapter 11, as a hazardous waste.

Section 20090(d) allows exemption for a project to cleanup a condition of pollution that resulted from an unauthorized release of waste based on the following:

- d. The discharge of amendments to groundwater is at the direction of the Regional Water Board to cleanup and abate conditions of pollution or nuisance resulting from the unauthorized release of pollutants.
 - e. Wastes removed from the immediate place of release will be discharged according to the Title 27 regulations; and
 - f. The remedial actions intended to contain wastes at the place of release shall implement the Title 27 regulations to the extent feasible.
24. Section 3020(b)(2) of the Resource Conservation and Recovery Act (RCRA) states that prior to injection into or above an underground source of drinking water, contaminated groundwater shall be "...treated to substantially reduce hazardous constituents prior to such injection." In a letter dated 10 December 1999, the United States Environmental Protection Agency, Office of Solid Waste and Emergency Response (OSWER) states, "if extracted groundwater is amended at the surface (i.e., "treated") before re-injection, and the subsequent in situ bioremediation achieves a substantial reduction of hazardous constituents the remedy would satisfy Section 3020(b)(2). "Therefore, the injection of groundwater within the treatment zone, with or without the treatment for VOCs, complies with Section 3020(2)(b) of RCRA.31.

25. The injection of soybean oil into the groundwater is a discharge of waste as defined by the California Water Code.
26. Pursuant to California Water Code Section 13263(g), discharge is a privilege, not a right, and adoption of this Order does not create a vested right to continue the discharge.

Public Notice

27. The Regional Water Board considered all the above and the supplemental information and details in the attached Information Sheet, which is incorporated by reference herein, in establishing the following conditions of discharge.
28. The Regional Water Board will notify the Dischargers and interested persons of its intent to prescribe waste discharge requirements for this discharge, and will provide them with an opportunity to submit their written views and comments.
29. The Regional Water Board, in a public meeting, will hear and consider all comments pertaining to the discharge.

IT IS HEREBY ORDERED, that the Dischargers, their agents, successors and assigns, in order to meet the provisions contained in Division 7 of the California Water Code and regulations adopted there under, shall comply with the following:

[Note: Other prohibitions, conditions, definitions, and some methods of determining compliance are contained in the attached "Standard Provisions and Reporting Requirements for Waste Discharge Requirements" dated 1 March 1991, incorporated herein.]

A. Discharge Prohibitions:

1. Discharge of wastes to surface waters or surface water drainage courses is prohibited.
2. Discharge of waste classified as 'hazardous' under Section 2521, Chapter 15 of Title 23 or 'designated', as defined in Section 13173 of California Water Code is prohibited.
3. The discharge of waste at any location or in a manner different from that described in Findings No. 9 and 11 is prohibited.
4. The discharge of materials into groundwater is prohibited, except for the following: emulsified soybean oil; Regional Water Board-approved chemicals to control bio-fouling or to act as tracers for chemical amendments; and water.

5. Creation of a pollution, contamination, or nuisance, as defined by Section 13050 of the California Water Code (CWC), is prohibited.

B. Discharge Specifications

1. The Dischargers shall not cause the permeability of the aquifer, either inside or outside of the in situ treatment area, to be affected to such a degree that the Discharger is unable to effectively operate extraction wells for the purpose of containing the amendment(s) or its byproducts.
2. The Dischargers will limit the injection of amendments to the extent practicable.
3. The discharge shall not cause the high quality groundwater unaffected by the current plume under going cleanup to be degraded by the treatment amendments listed in Discharge Prohibition A.4.

C. Groundwater Limitations:

1. The Dischargers shall not cause the groundwater to contain taste and odor producing substances in concentrations that cause nuisance or adversely affect beneficial uses.
2. The discharge shall not cause the groundwater at the compliance wells listed in Finding 9 to contain concentrations of chemical constituents (i.e., the amendments and by-products of the in situ treatment process, including CCR-17 metals, and total dissolved solids greater than 10% above background, BOD and COD greater than 5 mg/L above background, and ORP and pH within 10% of background.
3. Within two years of the conclusion of the in situ treatment, the Dischargers shall demonstrate based on serial first order rate constants of remaining PCE and all daughters, that the site will meet numerical Water Quality Objectives for ethenes within fifteen further years. The Discharger shall also demonstrate no remaining exceedances of taste and odor objectives, or statistically significant differences with respect to background of pH, ORP, TDS, CCR-17 metals, BOD, and COD within five further years.

D. Provisions:

1. The Dischargers shall notify the Regional Water Board a minimum of two weeks prior to the start of any injection of chemical amendments.
2. The Dischargers shall comply with the attached MRP No. R5-2009-XXXX, which is part of this Order, and any revisions thereto as ordered by the Executive Officer.

3. The Dischargers shall obtain Regional Water Board approval prior to implementing additional injection events of the in situ groundwater treatment remedy (see Finding 11 for a description of the implementation process). This is to ensure that the treatment remedy is not causing adverse water quality impacts. If such impacts occur, the treatment remedy will be postponed until the impacts are remediated.
4. The Dischargers shall operate the existing SVE system to control the chlorinated ethene plume until system shutdown is approved by the Executive Officer.
5. The Dischargers shall provide an alternate water supply source for any municipal, domestic or other water use, if affected by the Discharger's wastes.
6. The Dischargers shall comply with the "Standard Provisions and Reporting Requirements for Waste Discharge Requirements," dated 1 March 1991, which are by reference, a part of this Order. This attachment and its individual paragraphs are commonly referenced as "Standard Provision(s)."
7. The Dischargers shall comply with all conditions of this Order, including timely submittal of technical and monitoring reports as directed by the Executive Officer. Violations may result in enforcement action, including Regional Water Board or court order requiring corrective action or imposing civil monetary liability, or in revision or rescission of this Order.
8. Should the evaluation of the implementation data for the full-scale groundwater treatment reveal adverse effects on groundwater quality at the points of compliance due to chemical amendment injection, the Dischargers shall notify the Regional Water Board within 24 hours, followed by a written summary within two weeks. Within 60 days following notification, the Dischargers shall submit a corrective action plan, including a time schedule for implementation, for Executive Officer approval. The corrective action plan shall detail how the Dischargers will clean up and abate these effects, including extraction of any byproducts.
9. Prior to any modifications at the site that would result in material change in the quality or quantity of the chemical amendments, or any material change in the character, location, or volume of the discharge, the Dischargers shall report all pertinent information in a Report of Waste Discharge to the Regional Water Board for review. This Order may be revised prior to implementation of any modifications.
10. The Dischargers shall maintain records of all monitoring information including all calibration and maintenance records, copies of all reports required by this Order, and records of all data used to complete the application for this Order. Records shall be maintained for a minimum of three years from the date of the

sample, measurement, or report. This period may be extended during the course of any unresolved litigation regarding this discharge or when requested by the Executive Officer.

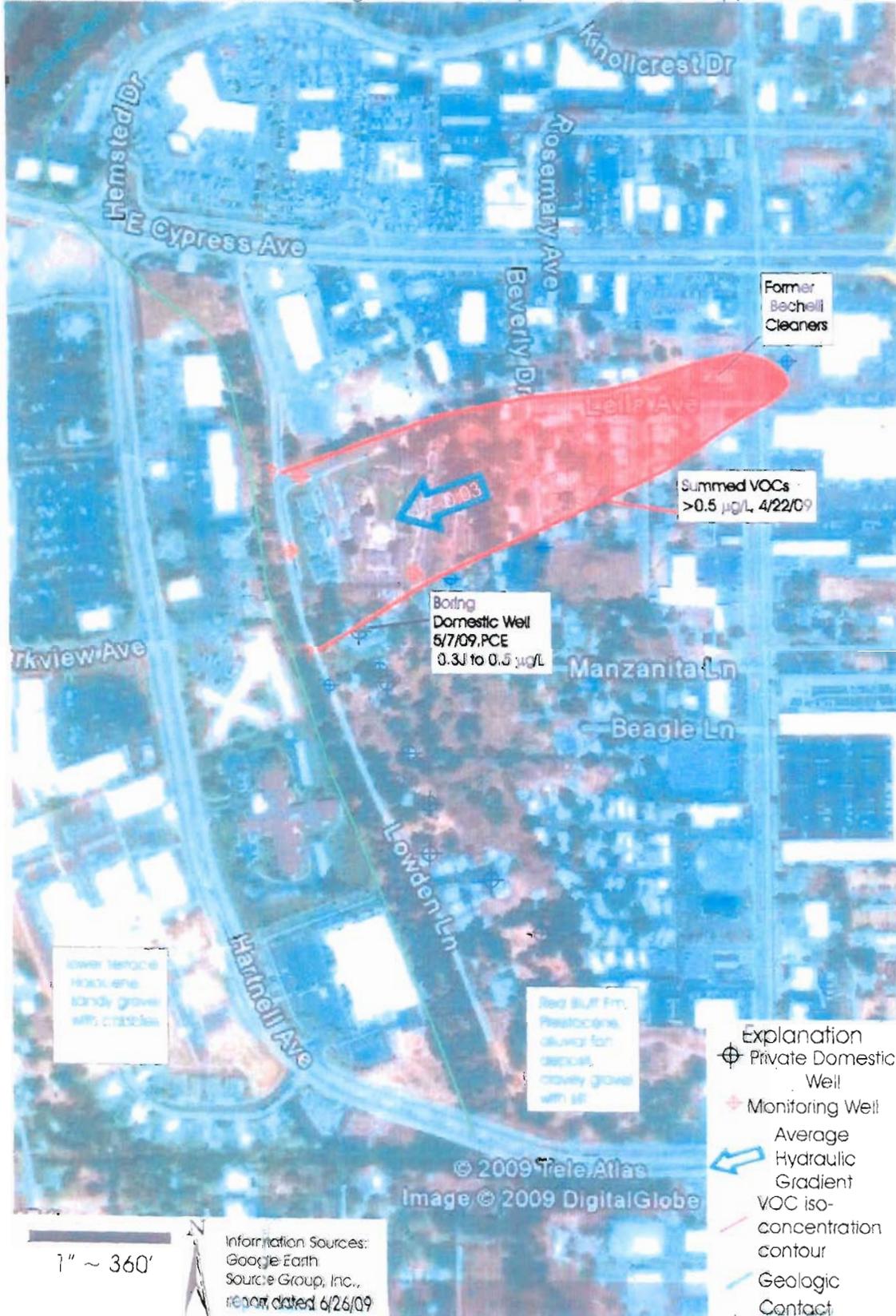
11. While this Order is in effect, and prior to any change in ownership of the Site or management of this operation, the Dischargers shall transmit a copy of this Order to the succeeding Owner/Operator, and forward a copy of the transmittal letter and proof of transmittal to the Regional Water Board.
12. The Dischargers shall allow the Regional Water Board, or an authorized representative, upon presentation of credentials and other documents as may be required by law, to:
 - a. Enter upon the premises regulated by the Regional Water Board, or the place where records must be kept under the conditions of this Order;
 - b. Have access to and copy, at reasonable times, any records that shall be kept under the conditions of this Order;
 - c. Inspect at reasonable times any facilities, equipment (including monitoring and control equipment), practices, or operations regulated or required under this Order; and
 - d. Sample or monitor, at reasonable times, for the purpose of assuring compliance with this Order or as otherwise authorized by the California Water Code, any substances or parameters at this Site.
13. A copy of this Order shall be kept at the discharger facility for reference by operating personnel. Key operating personnel shall be familiar with its contents.
14. The Regional Water Board may review this Order periodically and may revise requirements when necessary.

I, PAMELA C. CREEDON, Executive Officer, do hereby certify the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on _____.

PAMELA C. CREEDON, Executive Officer

ATTACHMENT A

VICINITY MAP



ATTACHMENT B

CARBON SUBSTRATE DEMAND MODEL



EOS® BARRIER DESIGN WORKSHEET

U.S. Version 2.1g, Rev. Date: December 7, 2008
www.EOSRemediation.com

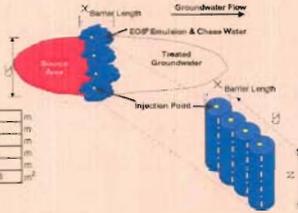
Help

Site Name: _____
Location: _____
Project No.: _____

Step 1: Select a Substrate from the EOS® Family of Bioremediation Products

Substrate Selected [\(click from drop-down list\)](#)
For Product Literature [Click Here](#)

EOS® 598B-G2 (Preferred for Chlorinated)



Step 2: EOS® Consumption During Contaminant Biodegradation / Biotransformation

Section A: Treatment Area Dimensions

Length of treatment area parallel to groundwater flow, "X"
Width of treatment area perpendicular to groundwater flow, "Y"
Minimum depth to contamination
Maximum depth of contamination
Treatment thickness, "Z"
Treatment zone cross-sectional area, A = y * z

| | | | |
|-------|-----|-------|----|
| 20 | ft | 6.1 | m |
| 150 | ft | 47.2 | m |
| 13 | ft | 4.0 | m |
| 25 | ft | 7.6 | m |
| 12 | ft | 3.7 | m |
| 1,862 | ft² | 172.8 | m² |

Section B: Groundwater Flow Rate / Site Data

Soil Characteristics
Nominal Soil Type [\(click from drop-down list\)](#)
Total Porosity (accept default or enter n)
Effective Porosity (accept default or enter n_e)
Soil bulk density (1-m³/2.65 g/cc (accept calculated or enter dry bulk density))

| | | | |
|------------|-----------|-----|----------|
| Silty Sand | | | |
| 0.28 | (decimal) | | |
| 0.17 | (decimal) | | |
| 1.91 | g/cc | 119 | lb / ft³ |

Hydraulic Characteristics
Hydraulic Conductivity (accept default or enter K)
Hydraulic Gradient (accept default or enter i)

| | | | |
|------|--------|---------|--------|
| 1.7 | ft/day | 6.0E-04 | cm/sec |
| 0.03 | ft/ft | | |

Note: Since the hydraulic gradient $i = \Delta h / \Delta L$ is negative, we ask you to enter i in the EOS® Design Tool so that you can enter a positive number for convenience

Non-Reactive Transport Velocity, $V_r = -K \times i / n_e$
Groundwater flow rate through treatment zone, $Q = A \times V_r$

| | | | |
|--------|-------------|----------|--------|
| 0.30 | ft/day | 0.001 | cm/day |
| 709.55 | gallons/day | 2,695.14 | L/day |

Section C: Calculated Contact Length

Contact time (t) between oil and contaminants (accept default or enter t)
Calculated Contact Length (x) = z * t *

| | | | |
|------|--|-----|---|
| 60 | typical values 60 to 180 days, see comment | | |
| 18.0 | ft | 5.1 | m |

Treatment zone volume
Treatment zone groundwater volume (volume * effective porosity)

| | | | |
|--------|---------|---------|----|
| 37,200 | ft³ | 1,053.4 | m³ |
| 47,304 | gallons | 175,975 | L |

Section D: Design Lifespan For One Application

Estimated total groundwater volume treated over design life

| | | | |
|-----------|---------|------------------------------|---|
| 5 | year(s) | typical values 5 to 10 years | |
| 1,342,237 | gallons | 5,081,274 | L |

Section E: Electron Acceptors

| Inputs | Typical Value | GW Conc (mg/L) | MW (g/mole) | e ⁻ equiv / mole | Stoichiometry Contaminant / H ₂ (m ³ /m ³ H ₂) | Hydrogen Demand (g H ₂) |
|--|---------------|----------------|-------------|-----------------------------|---|-------------------------------------|
| Dissolved Oxygen (DO) | 0 to 8 | 3 | 32.0 | 4 | 7.84 | 1920.60307 |
| Nitrate Nitrogen (NO ₃ -N) | 1 to 10 | 6 | 62.0 | 5 | 12.30 | 2477.908743 |
| Sulfate (SO ₄ ²⁻) | 10 to 500 | 50 | 96.1 | 8 | 11.91 | 21326.438 |
| Tetrachloroethene (TCE), C ₂ Cl ₄ | | 25 | 166.8 | 8 | 20.57 | 6178.557433 |
| Trichloroethene (TCE), C ₂ HCl ₃ | | 0.5 | 131.4 | 6 | 21.73 | 116.9371871 |
| 1,1,2-trichloroethane (1,1-DCE), C ₂ H ₃ Cl ₃ | | 0.5 | 96.9 | 4 | 24.05 | 105.6574047 |
| Vinyl Chloride (VC), C ₂ H ₃ Cl | | 0.5 | 62.5 | 2 | 31.00 | 81.9436247 |
| Carbon tetrachloride, CCl ₄ | | | 153.8 | 8 | 19.05 | |
| Chloroform, CHCl ₃ | | | 119.4 | 6 | 19.74 | |
| sym-tetrachloroethane, C ₂ H ₂ Cl ₄ | | | 167.8 | 8 | 20.82 | |
| 1,1,1-Trichloroethane (TCA), CH ₃ CCl ₃ | | | 133.4 | 6 | 22.09 | |
| 1,1-Dichloroethane (DCA), CH ₃ CHCl ₂ | | | 99.0 | 4 | 24.55 | |
| Dibromoethane, C ₂ H ₄ Br ₂ | | | 84.9 | 2 | 32.18 | |
| Pentachloro, CCl ₅ | | | 96.4 | 8 | 12.33 | |
| Hexavalent Chromium, Cr(VI) | | | 52.0 | 3 | 17.20 | |
| User added | | | | | | |
| User added | | | | | | |
| User added | | | | | | |

Section F: Additional Hydrogen Demand and Carbon Losses

| Generation (Potential Amount Formed) | Typical Value | GW Conc (mg/L) | MW (g/mole) | e ⁻ equiv / mole | Stoichiometry Contaminant / H ₂ (m ³ /m ³ H ₂) | Hydrogen Demand (g H ₂) | DOC Released (mole/g) |
|--|---------------|----------------|-------------|-----------------------------|---|-------------------------------------|-----------------------|
| Estimated Amount of Fe ²⁺ Formed | 10 to 100 | 50 | 55.8 | 1 | 55.41 | 4585.38466 | |
| Estimated Amount of Manganese (Mn ²⁺) Formed | | 2.5 | 54.9 | 2 | 27.25 | 466.1087159 | |
| Estimated Amount of CH ₄ Formed | 5 to 20 | 10 | 16.0 | 8 | 1.99 | 25539.08262 | |
| Target Amount of DOC to Release | 60 to 100 | 60 | 12.0 | | | | 25363.10 |

Design Safety Factor: 1.0 typical values 1 to 3

Calculations assume:
1) all reactions go to completion during passage through equivalent eddies of treated zone; and
2) perfect reaction stoichiometry.

EOS® Requirement Calculations Based on Hydrogen Demand and Carbon Losses

Stoichiometric Hydrogen Demand: 135.3 pounds
DOC Released: 1,466.2 pounds

EOS® Requirement Based on Hydrogen Demand and Carbon Loss: 2,979 lbs

Step 3: EOS® Requirement Based on Attachment by Aquifer Material

Soil Characteristics

Effective treatment thickness, "Z" (typically less than 40%)
For Additional Information on Effective Thickness, [Click Here](#)

| | |
|------|----|
| 0.25 | ft |
|------|----|

Weight of sediment to be treated

| | |
|-----------|-----|
| 1,107,747 | lbs |
|-----------|-----|

Absorptive Capacity of Soil (accept default or enter site specific value)

| | |
|--------|-----------------------|
| 0.0020 | lb EOS® / lb sediment |
|--------|-----------------------|

EOS® Attachment by Aquifer Material

- Fine sand with some clay 0.001 to 0.002 lb EOS® / lb soil
 - Sand with higher silt/clay content 0.002 to 0.004 lb EOS® / lb soil
- *Default values provided based on laboratory studies completed by HCSB
For Additional Data, [Click Here](#)

EOS® Requirement Based on Oil Entrapment by Aquifer Material: 2,215 lbs

Summary - How much EOS® do you need?

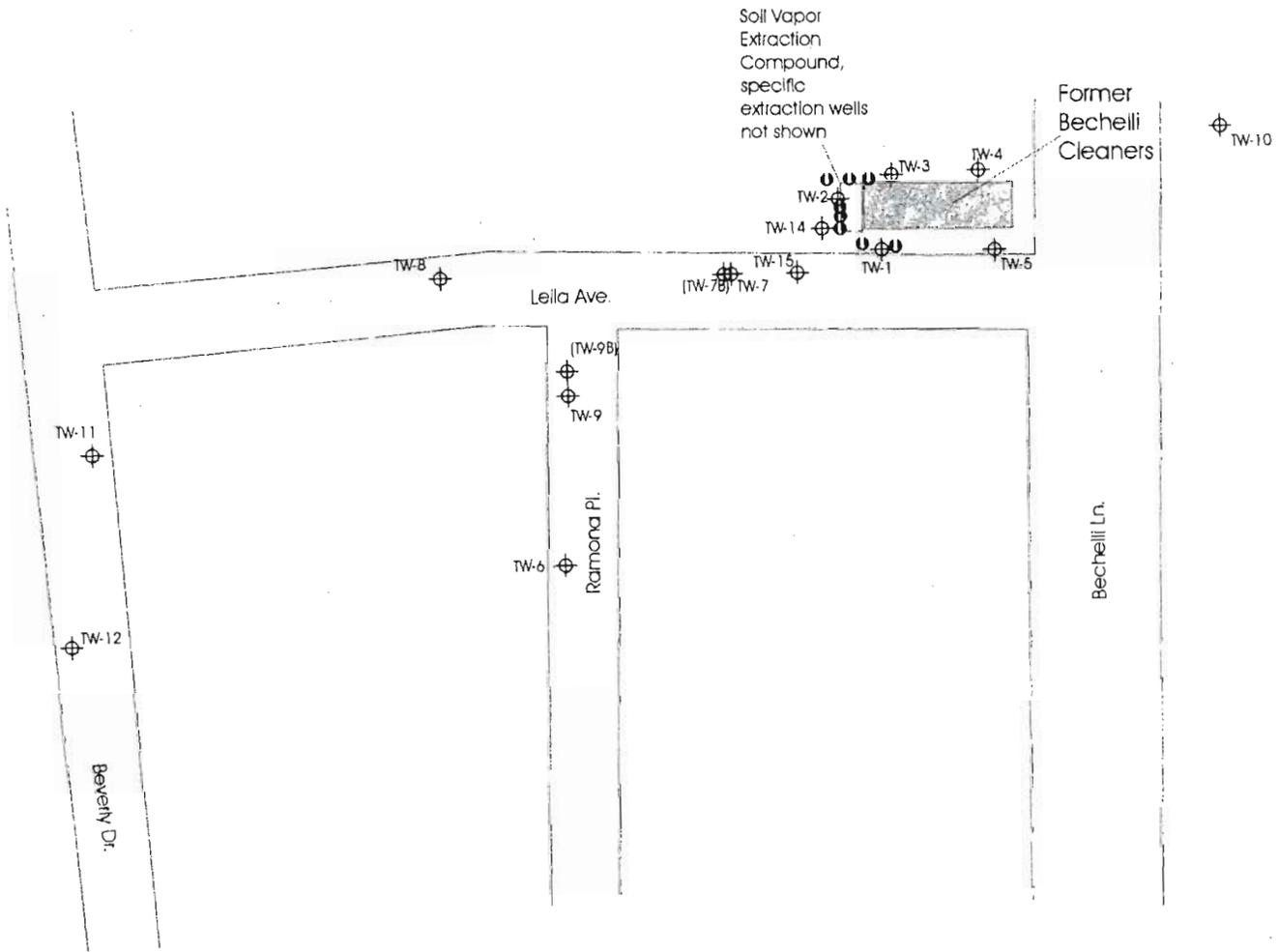
Suggested Quantity of EOS® for Your Project: 6 drums

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†Exclusive license agreement with Solutions-IES under U.S. Patent #RE-40448, E.U. Patent # EP 1,315,675 and several other pending international patents.
‡EOS® is a registered trademark of EOS Remediation, LLC

ATTACHMENT C

INJECTION PLAN



Explanation

- Phase One Soybean Oil Injection Well Location
- ⊕ Groundwater Monitoring Well Location. Note, wells with B notation are deeper completions, shown however not part of this permit.

1" ~ 120'



Information Sources:
 Source Group, Inc.,
 report dated 6/26/09