CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

ORDER NO. R5-2010-0126

WASTE DISCHARGE REQUIREMENTS
THE BOEING COMPANY
SIGMA COMPLEX IN-SITU GROUNDWATER BIOREMEDIATION PROJECT
INACTIVE RANCHO CORDOVA TEST SITE
SACRAMENTO COUNTY

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

1. On 18 October 2010 The Boeing Company (hereafter Discharger) submitted a Report of Waste Discharge (RWD) and supplemental information for revisions to a bioremediation project operating under Order No. R5-2007-0110. The bioremediation project is designed for in-situ treatment of groundwater containing significant concentrations of perchlorate and low concentrations trichloroethylene (TCE) at the Sigma Complex at the Inactive Rancho Cordova Test Site (IRCTS). The Discharger constructed as is operating the project and the Aerojet-General Corporation (Aerojet) is the current owner of the land on which the project takes place. The Discharger has proposed modifications to allow discharging a portion of the extracted groundwater over soils containing perchlorate at depth in order to flush the perchlorate to the groundwater and be extracted. The water discharged to the ground will first be treated to remove perchlorate and low concentrations of volatile organics as described further below.

2. The project site location is shown on Attachment A, which is attached hereto and made part of this Order by reference.

3. The project is located in the eastern central portion of the IRCTS property in Rancho Cordova, in Sections 6 and 7, T8N, R7E MDB&M. Agricultural and light industrial activities border the project location. The project site plan is shown on Attachment B, which is attached hereto and made part of this Order by reference.

4. The project is on Assessor's Parcel No. 072-0370-070.

5. Over two years of operation of the project confirmed the ability of the indigenous bacteria within the groundwater along the western side of the Sigma Complex to biodegrade perchlorate to treatment goals through electron donor addition, and quantified the rate and extent of perchlorate biodegradation by these indigenous bacteria. Furthermore the project has assessed the impacts of the in-situ bioremediation process on secondary groundwater quality, the ability of the active extraction system to provide the required level of hydraulic control for plume containment and treatment, identified design and operational factors that influence the successful performance of the in-situ bioremediation approach, and optimized the system operation with respect to these factors. The project consistently met the requirements of Order No. R5-2007-0110.

6. Aerojet-General Corporation has previously conducted several pilot studies using a similar process as that proposed at its Superfund site to the north of the IRCTS and along the

western boundary of the IRCTS. Those pilot studies have shown that remediation of perchlorate in the manner proposed successfully reduced perchlorate concentrations to less than 4 µg/L (micrograms per liter).

Initial Project Layout and Operation

7. Groundwater beneath the IRCTS contains the pollutants perchlorate and TCE. Perchlorate is a component of solid rocket propellant and has a draft Maximum Contaminant Level (MCL), or Primary Drinking Water Standard, for drinking water proposed by the California Department of Health Services of 6 micrograms per liter (µg/L). TCE is a solvent used primarily in cleaning operations and has a Maximum Contaminant Level (MCL) of 5 µg/L. In addition, the California Office of Environmental Health Hazard Assessment has established Public Health Goals for TCE and perchlorate in water of 1.7 µg/L and 6 µg/L, respectively. Historically, groundwater beneath the project area contains up to 4100 µg/L perchlorate and 9.9 µg/L TCE.

8. The project targets groundwater in the uppermost water-bearing zone. This unconfined water-bearing zone consists of sands and gravels extending from approximately 122-182 feet below ground surface. The groundwater is flowing west-southwest underneath the project area. The estimated groundwater velocity is 300 feet per year. To date the project appears to capture concentrations of perchlorate exceeding 10 µg/L at the Sigma Complex.

9. One extraction well, one recharge well, and at least seven groundwater monitor well nests were, constructed for the project. As shown on Attachement B, the extraction well is located on the western edge with the recharge well upgradient of the perchlorate plume along the eastern edge. Groundwater monitor wells are positioned between the injection and extraction wells and downgradient from the injection well. Groundwater is extracted from the extraction well at up to a total of 120 gallons per minute (gpm) and amended with an electron donor/carbon source and discharged back into the aquifer via the recharge well. The electron donor is either citric acid or acetic acid, though acetate, lactate or ethanol could be used. The project has primarily used an acetic acid solution at an average rate of 4.5 gallons per day in a total extacted flow of 90-95 gpm.

10. Prior to adding the amendments, aquifer tests were conducted to evaluate the capture of the ability of the extraction well to capture the water injected in the recharge well. The results of the aquifer tests were used to adjust the flow of the extraction well to assure that capture occurs. The aquifer tests used bromide as a tracer. The bromide concentration in the short-duration aquifer during the tests ranged between 100 and 1000 µg/L, well below the National Academy of Sciences Health Advisory Level for bromide of 2300 µg/L.

11. The electron donor stimulates the growth of bacteria in a small portion of saturated subsurface to degrade the perchlorate into chloride and oxygen atoms. It is also hoped that the low concentrations of TCE will be degraded by the bacteria to ethene and thence to carbon dioxide. Nitrate concentrations are also reduced by the bacteria. The electron donor dosage is balanced with the amount of electron receptor (oxygen, nitrate, perchlorate, and sulfate) present in the extracted groundwater. This minimizes the potential adverse impacts on groundwater quality. Based on the concentrations of oxygen, nitrate, sulfate, perchlorate and TCE in the groundwater, the citric acid dosage in the

injected groundwater is approximately 1,300 mg/L for a period of one hour per day. If degradation of perchlorate is not complete at that dosage, the concentration is increased incrementaly. If excess donor exists at the extraction well, then the donor flow-rate is decreased.

12. Within the treatment zone, the area between the extraction well and the recharge well, concentrations of dissolved iron and manganese have increased over background concentrations due to the reducing conditions. Following termination of the addition of amendments, the reducing conditions will revert to pre-operation conditions with the dissovled oxygen and oxidation/reduction potential returning to ambient values. The iron and manganese will, over time, return to the pre-operation concentrations. The extraction and injection wells may continue to operate in a modified manner until the pre-operation conditions are substantially restored in the aquifer.

13. Based on past evaluations on the Aerojet facility, the estimated half-life for reduction of perchlorate is approximately 1 day. Thus, to reduce perchlorate concentrations from 4000 µg/L to less than 4 µg/L will take approximately10 days wihin the reactive zone. With an average groundwater velocity of approximately 300 feet/year, the perchlorate would be expected to be removed within nine feet of the recharge well. However, the groundwater velocity at the recharge well will be greater than the average velocity in the aquifer. At the Aerojet facility, the reduction took place within 25 to 75 feet of the recharge well.

14. If needed, chlorine dioxide is added periodically to reduce biological growth around the recharge well to maintain the permeabilty of the recharge zone.

15. Groundwater is monitored downgradient from the extraction and recharge wells to provide information to assess the biodegradation of perchlorate and TCE, evaluate the capture and recharge fields, and monitor changes in groundwater chemistry. Since commencement of operation of the project, concentrations of perchlorate in a monitor well within the treatment zone have decreased from 23,000 µg/L to less that 160 µg/L. Iron and manganese concentrations have had significant increases in the treatment zone, but so far have sufficiently attenuated within the treatment zone.

16. The area downgradient from the test area is degraded by perchlorate for a distance of over two miles. The Discharger, along with Aerojet, are in the process of constructing a cleanup action to halt the downgradient migration of the perchlorate plume. This cleanup is being undertaken pursuant to Cleanup and Abatement Order No. 97-012. After achieving containment of the perchlorate plume, the Discharger and Aerojet may undertake additional actions to clean up the plume by installing additional extraction wells within the plume. Thus, waters beneath and downgradient from the project area covered under this permit, will be included in a cleanup action that will be have construction completed in the near future.

Changes to the Project

17. The Discharger proposed several changes to the project in order to enhance the remediation of the perchlorate in the vadose zone at the Sigma Complex. The perchlorate continues to be a source of pollution to the groundwater. The Discharger has evaluated the feasibility of applying water into the vadose zone within the capture area of the

extraction well to mobilize the perchlorate and speed up the transport to the groundwater. The extraction well would then extract the perchlorate for above ground treatment and/or discharge back into the existing recirculation system for in-situ biodegradation.

18. The water applied to the vadose zone is first treated to remove perchlorate and any low concentrations of trichloroethylene. The perchlorate will be removed by a bioremediation process that has undergone successful column testing at the Aerojet site. The treatment system is similar to ones being constructed by Aerojet for operation at the Propellant Burn Area on the IRCTS and operated under Order NO. R5-2010-0069. The extracted groundwater is passed through granular activated carbon (GAC) vessels to remove VOCs and then through a modular biotreatment cell (MBC) to remove perchlorate. The MBC consists of either a tank filled with crushed rock and the addition of a carbon substrate such as acetic acid or glycerol, or the tank will be filled with a mixture of elemental sulfur granules and crushed walnut shells. The crushed rock/walnut shells serve as a media to support the growth of indigenous bacteria. The sulfur or carbon doneor stimulate the bacteria growth which in turn will breakdown the perchlorate in a manner similar to that achieved by the exisiting in-situ system.

19. The initial flow will be approximately 5 gallons per minute. The Discharger may eventually increase the flow to utilize the entire flow from the extraction well and discontinue the in-situ remediation system. Prior to increasing the flow to the vadose zone, the Discharger will provide sufficient treatment capacity to reduce the concentrations of perchlorate to less than 4 µg/L and TCE to less than 0.5 µg/L. Surplus flow not used in the vadose zone will continue to be added to the groundwater, maintaining the in-situ bioremediation system. If the perchlorate removal system sufficiently eliminates the low concentrations of TCE, the use of GAC might be eliminated.

20. The perchlorate treatment system that utilizes sulfur and the bacteria that grow within the system can cause sulfate to be formed. It has been determined from the column studies conducted by Aerojet that the proposed system could generate up to 13 mg/L sulfate. The discharge of sulfate back to the vadose zone is limited to 75 mg/L, which is significantly below the 250 mg/L Secondary Drinking Water Standard and Taste and Odor Threshold value. Background values for sulfate are approximately 50 mg/L.

REGULATORY CONSIDERATIONS

21. *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 ¶ 13263(a) of the California Water Code (CWC), waste discharge requirements must implement the Basin Plan.

22. Surface water drainage is to Morrison Creek, tributary to Stone Lakes, tributary to the Sacramento River. The beneficial uses of the Sacramento River are municipal and domestic supply; agricultural irrigation and stock watering supply; process and service industrial supply; contact recreation, other noncontact recreation; warm and cold

freshwater habitat; warm and cold migration; warm water spawning; wildlife habitat; and navigation.

23. The designated beneficial uses of underlying groundwater include:

    a. Municipal and domestic water supply (MUN);
    b. Agricultural water supply (AGR);
    c. Industrial service supply (IND); and
    d. Industrial process supply (PRO).

24. The Basin Plan establishes numerical and narrative water quality objectives for surface and groundwater within the basin, and recognizes that water quality objectives are achieved primarily through the Board's adoption of waste discharge requirements and enforcement orders. Where numerical water quality objectives are listed, these are limits necessary for the reasonable protection of beneficial uses of the water. Where compliance with narrative water quality objectives is required, the 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.

25. The Basin Plan identifies numerical water quality objectives 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 Board may apply limits more stringent than MCLs to ensure that waters do not contain chemical constituents in concentrations that adversely affect beneficial uses.

26. The Basin Plan contains narrative water quality objectives 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.

27. Section 13241 of the Water Code requires the Regional Board to consider various factors, including economic considerations, when adopting water quality objectives into its Basin Plan. Water Code Section 13263 requires the Regional Board to address the factors in Section 13241 in adopting waste discharge requirements. The State Board, however, has held that a Regional Board need not specifically address the Section 13241 factors when implementing existing water quality objectives in waste discharge requirements because the factors were already considered in adopting water quality objectives. These waste

discharge requirements implement adopted water quality objectives. Therefore, no additional analysis of Section 13241 factors is required.

28. State Board Resolution No. 92-49 (hereafter Resolution No. 92-49) requires the Regional 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 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.

29. Resolution No. 68-16 requires the 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 treatment zone due to the amended groundwater injection. 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 salts or some dissolved metals may occur but will be limited to a maximum 10 percent increase over background and less than the Water Quality Objective (WQO) listed below in Finding No. 30. See Groundwater Limitation C.2.

30. 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 injectants, chemicals being treated and geological materials. Cleanup criteria for groundwater at this site will be established in a forthcoming Cleanup and Abatement Order and/or Remedial Action Plan and are not discussed further as a part of this order. 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, as well as, cause changes in groundwater chemistry that liberates metals found in the formation materials. Background/baseline concentrations of metals and total dissolved solids will be established pursuant to the attached Monitoring and Reporting Program. 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 at the site:

Constituent	WQO	Reference
trichloroethylene	0.7 µg/L	California Public Health Goal
tetrachlorethylene	0.06 µg/L	California Public Health Goal
vinyl chloride	0.05 µg/L	California Public Health Goal
cis 1,2-dichlorethylene	6 µg/L	Primary Maximum Contaminant Level
1,2-dichlorethylene	10 µg/L	Primary Maximum Contaminant Level
1,2-dichloroethane	0.4 µg/L	California Public Health Goal
1,1-dichloroethylene	6 µg/L	Primary Maximum Contaminant Level
1,1-dichloroethane	3 µg/L	California Public Health Goal
iron	300 µg/L	Secondary Maximum Contaminant Level
manganese	50 µg/L	Secondary Maximum Contaminant Level
total dissolved solids	450 mg/L	Food and Agricultural Organization – Sensitive Crop Protection
bromide	2300 µg/L	National Academy of Sciences Health Advisory Level
sulfate	250,000 µg/L	Secondary Drinking Water Standard

31. Several of the electron donors that can and have been used to stimulate degradation of perchlorate in groundwater have a salt component (generally sodium or potassium). Upon completion of the degradation process the salt component remains. The groundwater in the Central Valley is severely impacted by salts and the Regional Board is intent on minimizing the discharge of salts to the groundwater. The use of non salt-containing injectants is preferred and the Discharger is required to demonstrate that there are no non salt-containing injectants alternatives that will cost-effectively promote the degradation of the target pollutant before being allowed to use a salt-containing injectant. Currently, the Discharger is using acetic citric acid, a salt-free electron donor. See Discharge Specification B.1.

32. The action to adopt these Waste Discharge Requirements for the Boeing Company is exempt from the provisions of the California Environmental Quality Act (Public Resources Code Section 21000, et seq.) (CEQA) because it: (1) authorizes activity that will result in a minor modification to land pursuant to Title 14, California Code of Regulations, Section 15304; (2) consists of an action by a regulatory agency authorizing actions for the protection of the environment pursuant to Title 14, California Code of Regulations, Section 15308; and (3) authorizes minor cleanup actions costing $1.5 million or less that are taken to prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of a hazardous waste or substance pursuant to Title 14, California Code of Regulations, Section 15330. In addition, as part of the Remedial Action Plan (RAP) process, the Department of Toxic Substances Control determined that the RAP project of which this a component, would not have a significant effect on the environment and certified a Negative Declaration on 22 January 2008.

33. The discharge is exempt from the requirements of *Consolidated Regulations for Treatment, Storage, Processing, or Disposal of Solid Waste,* set forth in the Title 27, California Code of Regulations (CCR), section 20005 *et seq*. (hereafter Title 27), which

allows a conditional exemption from some or all of the provisions of Title 27. The exemption, pursuant to Title 27 CCR Section 20090(b), is based on the following:

a. The Regional Water Board is issuing Waste Discharge Requirements.
b. The discharge is in compliance with the applicable Basin Plan.
c. The wastewater does not need to be managed according to Title 22CCR, 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 citric acid, ethanol or lactate 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.

34. Section 13267(b) of the California Water Code provides that:

"In conducting an investigation specified in subdivision (a), the Regional Board may require that any person who has discharged, discharges, or is suspected of having discharged or 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 having discharged or 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 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 these reports, the Regional 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. R5-2010-xxxx are necessary to assure compliance with these WDRs. The Discharger operates the facility that discharges the waste subject to this Order.

35. The California Department of Water Resources sets standards for the construction and destruction of groundwater wells, as described in *California Well Standards Bulletin No. 74-90* (June 1991) and *Water Well Standards: State of California Bulletin No. 94-81* (December 1981). These standards, and any more stringent standards implemented by the Regional Water Board or adopted by Sacramento County pursuant to California Water Code Section 13801 apply to all monitoring and injection wells.

36. 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 reinjection, 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 at this site, with or without the treatment for VOCs, complies with Section 3020(2)(b) of RCRA.

37. 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

38. All the above and the supplemental data and information and details in the attached Information Sheet, which is incorporated by reference herein, were considered in establishing the following conditions of discharge.

39. The Regional Water Board has notified the Discharger and interested agencies and persons of its intent to prescribe waste discharge requirements for the in-situ treatment technology discussed in this Order, and has provided them with an opportunity to submit their written comments and recommendations.

40. In a public meeting, all comments pertaining to these Waste Discharge Requirements were heard and considered.

IT IS HEREBY ORDERED that, pursuant to Sections 13263 and 13267 of the California Water Code, The Boeing Company, in order to meet the provisions contained in Division 7 of the California Water Code, and regulations and guidelines adopted thereunder, shall comply with the following:

A. DISCHARGE PROHIBITIONS

1. The discharge of any amendment or other materials not specifically regulated by this Order is prohibited.

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

3. The discharge of wastes or treated groundwater to surface water or surface water drainage courses is prohibited.

4. The discharge of amendments in areas other than that proposed for remediation is prohibited.

5. 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.

6. The discharge of citric acid, ethanol or lactate, and/or any other groundwater amendments used by the Discharger, or any chemical by-products of the in-situ treatment into any surface water or surface water drainage course is prohibited.

B. DISCHARGE SPECIFICATIONS

1. The daily average flow shall not exceed shall not exceed 360,000 gallons per day (gpd). This is the total flow proportioned between recharge to the groundwater via the injection well and to the vadose zone.
2. The recharged groundwater shall not be amended with materials other than ethanol, acetic acid, citric acid, lactate, glycerol, bromide or chlorine dioxide.
3. Prior to the injection of any amendments, the Discharger shall submit information required in Monitoring and Reporting Progam No. R5-2010-0126 regarding the chemical content of the amendment and receive approval of Regional Board staff to use the amendment.

4. The discharge shall not cause pollution or nuisance as defined by the California Water Code.

5. During any single injection, the Discharger shall not add more than three times the stoichemetric-derived demand for organic substrate.

6. The Discharger will limit the injection of amendments to the extent practicable.

7. The discharge from the treatment system to the vadoze zone, or other uses listed in Discharge Specfication B.9, shall not contain concentrations of perchlorate exceeding 4 µg/L, trichloroethylene exceeding 0.5 µg/L nor sulfate exceeding 75 mg/L.

8. The discharge to the vadose zone shall only be to areas that have been demonstrated to be upgradient and within the capture area of the extraction well system.

9. The treated groundwater meeting the specifications listed above in Discharge Specification B.7, may be used on the Inactive Rancho Cordova Test Site for construction and dust control purposes, sand/gravel mining, infiltration and landscape irrigation watering.

C. GROUNDWATER LIMITATIONS

1. The discharge shall not cause the groundwater at the compliance wells listed in Table 1 of Monitoring and Reporting Program No. R5-2010-0126 to contain concentrations of chemical constituents, including the amendments and by-products of the in-situ treament process, in amounts that exceed the Water Quality Objectives listed in Finding No. 30.

2. The discharge shall not cause the groundwater at the compliance monitor wells to contain concentrations of metals, total dissolved solids, sulfate and electrical conductivity that are more than 20% greater than their respective background concentrations, as established by Monitoring and Reporting Program No. R5-2007-0110, and any modifications to those values established by Monitoring and Reporting Program No. R5-2010-0126.

3. The discharge shall not cause the groundwater to contain taste and odor producing substances that cause nuisance or adversely affect beneficial uses at the compliance monitor points designated in Table 1 of Monitoring and Reporting Program No. R5-2010-0126.

D. PROVISIONS

1. The Discharger shall comply with all applicable Standard provisions and Reporting Requirements for Waste Discharge Requirements, dated 1 March 1991, which are attached hereto and by reference are a part of this Order. This attachment and its individual paragraphs are commonly referenced as Standard Provisions.

2. The Discharger may be required to submit technical reports pursuant to California Water Code Section 13267 as directed by the executive Officer. The technical reports required by this Order are necessary to assure compliance with this Order.

3. All technical reports required herein that involve planning, investigation, evaluation, or design or other work requiring interpretation or proper application of engineering or geologic sciences, shall be prepared by or under the direction of persons registered to practice in California pursuant to California Business and Professions Code, sections 6735, 7835 and 7835.1. To demonstrate compliance with Title 16, CCR, Sections 415 and 3065, all technical reports must contain a statement of the qualifications of the responsible registered professional(s). As required by these laws, completed technical reports must bear the signature(s) and seal(s) of the registered professional(s) in a manner such that all work can be clearly attributed to the professional responsible for the work.

4. **At least 30 days prior to the commencement of operation**, the Discharger shall submit an Operation and Maintenance (O&M) Plan for the groundwater biotreatment facilities. The O&M Plan shall instruct field personnel on how to manage the day-to-day

discharge operations to comply with the terms and conditions of this Order and how to make field adjustments, as necessary. A copy of the O&M Plan shall be kept at the facility for reference by operating personnel. Key personnel shall be familiar with its contents.

5. The Discharger shall comply with the Monitoring and Reporting Program No. R5-2010-0126, which is part of this Order, and any revisions thereto as ordered by the Executive Officer.

6. A copy of this Order shall be maintained at the project site and be available at all times to operating personnel.

7. The discharger shall maintain in good working order and operate as efficiently as possible any facility or control system installed by the discharger to achieve compliance with these Waste Discharge Requirements.

8. The discharger shall promptly report to the Regional Water Board any violation of this Order, material change in the character, location, or volume of the discharge.

9. In the event of any change in control or ownership of land or waste discharge facilities presently owned or controlled by the discharger, the discharger shall notify the succeeding owner or operator of the following items by letter, in advance of the transfer of ownership or control, and a copy of the notice must be forwarded to the Regional Water Board:

    a. existence of this Order; and
    b. the status of the dischargers' annual fee account

10. This Order does not convey any property rights of any sort or any exclusive privileges. The requirements prescribed herein do not authorize the commission of any act causing injury to persons or property, nor protect the discharger from his liability under Federal, State, or Local laws, nor create a vested right for the discharger to continue the waste discharge.

11. Chemical, bacteriological, and bioassay analyses must be conducted at a laboratory certified for such analyses by the State Department of Health Services.

12. All reports, or other documents required by these WDRs, and other information requested by the Regional Board shall be signed by a person described below or by a duly authorized representative of that person.

    a. for a corporation: by a responsible corporate officer such as: (a) a president, secretary, treasurer, or vice president of the corporation in charge of a principal business function; (b) any other person who performs similar policy or decision making functions for the corporation; or (c) the manager of one or more manufacturing, production, or operating facilities if authority to sign documents

has been assigned or delegated to the manager in accordance with corporate procedures.

b. Reports required by this Order, other information requested by the Regional Water Board, and NOI's may be signed by a duly authorized representative provided:

i. the authorization is made in writing by a person described in paragraph (a) of this provision;

ii. the authorization specifies either an individual or a position having responsibility for the overall operation of the regulated facility or activity such as the position of plant manager, operator of a well or a well field, superintendent, position of equivalent responsibility, or an individual or position having overall responsibility for environmental matters for the company; and

iii. the written authorization is submitted to the Regional Water Board prior to or together with any reports, information, or applications signed by the authorized representative.

c. Any person signing a document under paragraph (a) or (b) of this provision shall make the following certification: "I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted, is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

13. The discharger shall permit authorized staff of the Regional Water Board:

a. entry to the project site covered by these Waste Discharge Requirements or in which any required records are kept;

b. access to copy any records required to be kept under terms and conditions of this Order;

c. inspection of monitoring equipment or records; and

d. sampling of any discharge.

14. In the event the discharger is unable to comply with any of the conditions of this Order due to:

    a. breakdown of any facility or control system or monitoring equipment installed by the Discharger to achieve compliance with this Order;

    b. migration or application of substances, pollutants or byproducts outside the specified treatment area;

    c. accidents caused by human error or negligence; or

    d. other causes such as acts of nature;

    the discharger shall notify the Regional Water Board by telephone as soon as he or his agents have knowledge of the incident and confirm this notification in writing within two weeks of the telephone notification. The written notification shall include pertinent information explaining reasons for the noncompliance and shall indicate the steps taken to correct the problem and the dates thereof, and the steps being taken to prevent the problem from recurring.

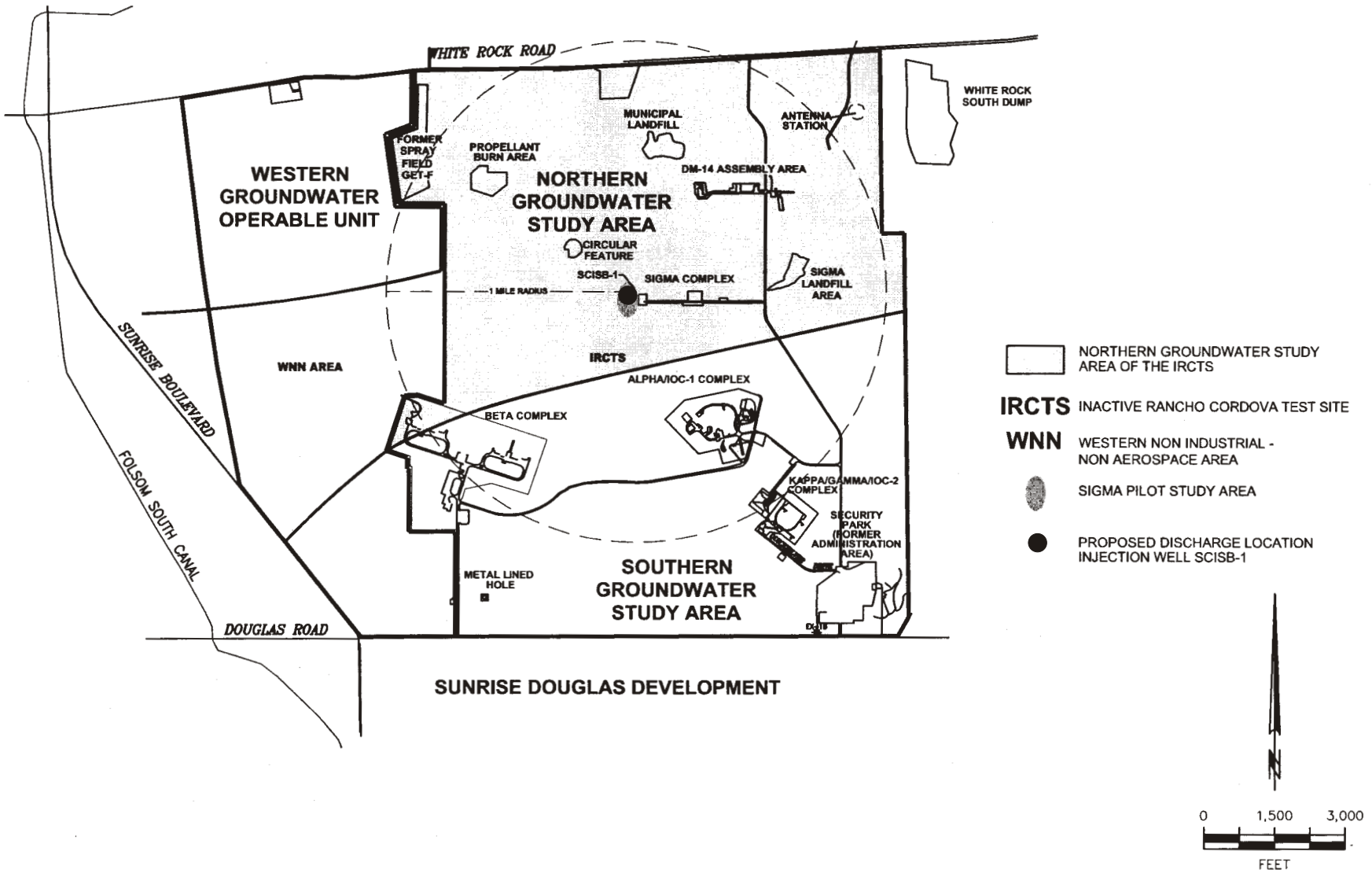
15. The Regional Water Board may review this Order periodically and may revise requirements when necessary. In addition, the discharger shall file a report of waste discharge with the Executive Officer at least 120 days before making any material change or proposed change in the character, location, or volume of the discharge.

16. Project coverage under these Waste Discharge Requirements may be terminated, by the Executive Officer at any time upon giving reasonable notice to the Discharger.

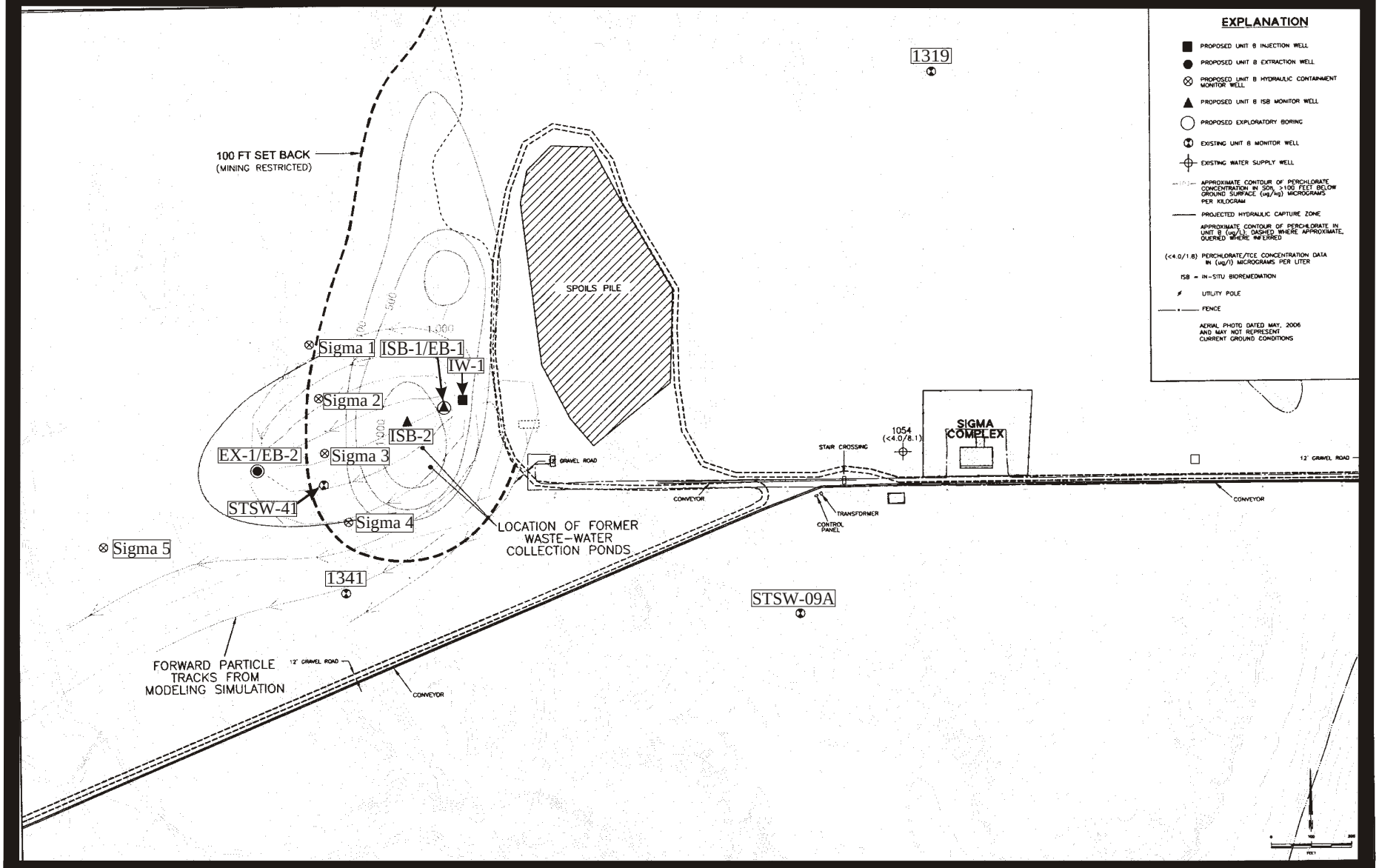
I, Pamela C. Creedon, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Central Valley Region, on 10 December 2010.

_____Original Signed by:_____
PAMELA C. CREEDON, Executive Officer

10/18/10:AMM



Attachment A
The Boeing Company
Insitu Groundwater Bioremediation Project
Inactive Rancho Cordova Test Site
Sacramento County



Attachment B
The Boeing Company
Insitu Groundwater Bioremediation Project
Inactive Rancho Cordova Test Site
Sacramento County

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
CENTRAL VALLEY REGION

MONITORING AND REPORTING PROGRAM NO. R5-2010-0126

FOR
THE BOEING COMPANY
SIGMA COMPLEX IN-SITU GROUNDWATER BIOREMEDIATION PROJECT
INACTIVE RANCHO CORDOVA TEST SITE
SACRAMENTO COUNTY

This Monitoring and Reporting Program (MRP) describes requirements for monitoring a groundwater extraction and treatment system. This MRP is issued pursuant to Water Code Section 13267. The Discharger shall not implement any changes to this MRP unless and until a revised MRP is issued by the Executive Officer. Regional Board staff shall approve specific sample station locations prior to implementation of sampling activities.

All samples should be representative of the volume and nature of the discharge or matrix of material sampled. The time, date, and location of each grab sample shall be recorded on the sample chain of custody form.

Groundwater Monitoring

As shown on Attachment B, there are 13 monitor wells, 1 extraction well, and 1 injection well associated with this site. The groundwater monitoring program for these wells and any wells installed subsequent to the issuance of this MRP, shall follow the schedule below. Monitor wells with free phase petroleum product or visible sheen shall be monitored, at a minimum, for product thickness and depth to water. The volume of extracted groundwater also shall be provided in quarterly monitoring reports. Sample collection and analysis shall follow standard EPA protocol.

The monitor wells, extraction wells and/or injection wells shall be sampled according to the schedule in Table 1 and the samples analyzed by the methods in Table 2, as follows:

Table 1: SAMPLING FREQUENCY AND CONSTITUENT SUITE[1]

Well[1] Number	Quarterly[2]	Semi-Annually[3]	Annually[4]	Monitoring Objective
1319	Field, Suite A	Suite B, C		Upgradient
STSW-09A	Field, Suite A	Suite B, C		Upgradient
IW-1	Field, Suite A	Suite B, C		System Evaluation[5]
ISB-1/EB-1	Field, Suite A		Suite B, C	System Evaluation[5]
ISB-2	Field, Suite A		Suite B, C	System Evaluation[5]
EX-1/EB-2	Field, Suite A, D	Suite B, C		System Evaluation[5]
1341	Field, Suite A, D	Suite B, C		Compliance[6]
STSW-41	Field, Suite A		Suite B, C	System Evaluation[5]

Well[1] Number	Quarterly[2]	Semi-Annually[3]	Annually[4]	Monitoring Objective
Sigma-1	Field, Suite A		Suite B, C	System Evaluation[5]
Sigma-2	Field, Suite A		Suite B, C	System Evaluation[5]
Sigma-3	Field, Suite A		Suite B, C	System Evaluation[5]
Sigma-5	Field, Suite A, D	Suite B, C		Compliance Well[6]
Sigma-4	Field, Suite A		Suite B, C	System Evaluation[5]
New Wells	Field, Suite A	Suite B, C		Various

1 Well numbers as shown on Figure B Note that some wells, once constructed, may be given an alternate designation than that shown on Figure B to go with the overall site monitor well numbering scheme.
2 Wells shall be sampled quarterly.
3 Wells shall be sampled semi-annually during the second and fourth quarters following project startup.
4 Wells shall be sampled annually commencing with the first quarter of the project startup.
5 Wells sampled to evaluate in-situ bioremediation progress inside the treatment zone.
6 Wells sampled to evaluate potential migration of pollutants outside of treatment zone.

Table 2: ANALYTICAL METHODS

Constituent	Method[1]	Maximum Practical Quantitation Limit (µg/L)[2]
Suite A		
Perchlorate	EPA 314.1	4.0
Suite B		
Total Dissolved Solids	EPA 160.1	10,000
Total Organic Carbon	EPA 415	300
Chloride	EPA 6500	300
Sulfate	EPA 6500	200
Sulfide	Hach Method 8131	30
Suite C		
Iron, Total and Dissolved	EPA 200.7	100
Manganese	EPA 200.7	25
Arsenic, Total and Dissolved	EPA 200.7, 200.8	Various
Suite D		
Electron Donor		

1 Or an equivalent EPA Method that achieves the maximum Practical Quantitation Limit.
2 All concentrations between the Method Detection Limit and the Practical Quantitation Limit shall be reported, and reported as an estimated value.

Field Sampling

In addition to the above sampling and analysis, field sampling and analysis shall be conducted each time a monitor well or extraction well is sampled. The sampling and analysis of field parameters shall be as specified in Table 3.

Table 3: FIELD SAMPLING REQUIREMENTS

Parameters	Units	Type of Sample
Groundwater Elevation	Feet, Mean Sea Level	Grab
Oxidation-Reduction Potential	Millvolts	Grab
Electrical Conductivity	µhmos	Grab
Dissolved Oxygen	mg/L	Grab
pH	pH Units (to 0.1 units)	Grab

Field test instruments (such as those used to test pH and dissolved oxygen) may be used provided that:

1. The operator is trained in proper use and maintenance of the instruments;
2. The instruments are calibrated prior to each monitoring event;
3. Instruments are serviced and/or calibrated by the manufacturer at the recommended frequency; and
4. Field calibration reports are submitted as described in the "Reporting" section of this MRP.

Treatment System Monitoring

The treatment system used to treat the extracted groundwater prior to infiltration in the source area shall be as specified in Table 4. The analysis shall be by the analytical methods listed in Table 2.

Table 4: TREATMENT SYSTEM MONITORING

Constituent	Monthly	Quarterly	Location
Volatile Organic Compounds	First Three Months	After first three months	Influent and Effluent
Perchlorate	First Three Months	After first three months	Influent and Effluent
pH	First Three Months	After first three months	Influent and Effluent
Sulfate	First Three Months	After first three months	Influent and Effluent
Flow	Average Gallons per minute		Efffluent
Electron Donor	Gallons per month		Influent

Discharge Monitoring

The Discharger shall monitor the average daily discharge of water and amendments that are injected into the groundwater according to the requirements specified in Table 5. The dates of amendment additions shall be recorded and reported.

Table 5: DISCHARGE MONITORING REQUIREMENTS

Parameters	Units	Type of Sample
Injected Volume	gallons per day	Meter
Extracted Volume	gallons per day	Meter
Volume Infiltrated	gallons per day	Meter
Electron Donor Added	kilograms per day	Grab
Chlorine Dioxide Added	kilograms per day	Grab

Electron Donor Analysis

Prior to use, the electron donor shall be analyzed for the constituents listed in Table 5. The analysis should be done on the pure donor and on a mixture of the donor and deionized water at the estimated concentration that would be injected during the pilot project.

Table 4: ELECTRON DONOR ANALYTLICAL REQUIREMENTS

Constituent	Method[1]	Maximum Practical Quantitation Limit (µg/L)[2]
Volatile Organic Compounds	EPA 8020 or 8260B	0.5
General Minerals		
Metals, Total and Dissolved[3]	EPA 200.7, 200.8	Various
Semi-Volatile Organic Compounds	EPA Method 8270	5.0
Total Dissolved Solids	EPA 160.1	10,000
pH	Meter	NA
Electrical Conductivity	Meter	NA

[1] Or an equivalent EPA Method that achieves the maximum Practical Quantitation Limit.

[2] All concentrations between the Method Detection Limit and the Practical Quantitation Limit shall be reported, and reported as an estimated value.

[3] Metals include arsenic, barium, cadmium, calcium, total chromium, copper, iron, lead, manganese, magnesium, mercury, molybdenum, nickel, selenium and silica.

Establishment of Background Concentration Values

The Discharger shall develop background values for concentrations of dissolved iron, dissolved manganese, total dissolved solids and electrical conductivity in groundwater following the procedures found in CCR Section 20415(e)(10). The Discharger shall submit a proposal to develop the background concentrations by **no later than 30 days prior to commencement of operation**.

REPORTING

When reporting the data, the Discharger shall arrange the information in tabular form so that the date, the constituents, and the concentrations are readily discernible. The data shall be summarized in such a manner as to illustrate clearly the compliance with this Order. In

addition, the Discharger shall notify the Regional Board within 48 hours of any unscheduled shutdown of any soil vapor and/or groundwater extraction system. The results of any monitoring done more frequently than required at the locations specified in the Monitoring and Reporting Program shall also be reported to the Regional Board.

As required by the California Business and Professions Code Sections 6735, 7835, and 7835.1, all reports shall be prepared by a registered professional or their subordinate and signed by the registered professional.

The Discharger shall submit quarterly electronic data reports, which conform to the requirements of the California Code of Regulations, Title 23, Division 3, Chapter 30. The quarterly reports shall be submitted electronically over the internet to the Geotracker database system by the 1st day of the second month following the end of each calendar quarter by **1 February, 1 May, 1 August, and 1 November** until such time as the Executive Officer determines that the reports are no longer necessary.

Quarterly reports shall be submitted to the Regional Board by the **1st day of the second month following the end of each calendar quarter (i.e., by 1 February, 1 May, 1 August, and 1 November**). Each quarterly report shall include the following minimum information:

(a) a description and discussion of the groundwater sampling event and results, including trends in the concentrations of pollutants and groundwater elevations in the wells, how and when samples were collected, and whether the pollutant plume(s) is delineated;

(b) field logs that contain, at a minimum, water quality parameters measured before, during, and after purging, method of purging, depth of water, volume of water purged, etc.;

(c) groundwater contour maps for all groundwater zones, if applicable;

(d) isocontour pollutant concentration maps for all groundwater zones, if applicable;

(e) a table showing well construction details such as well number, groundwater zone being monitored, coordinates (longitude and latitude), ground surface elevation, reference elevation, elevation of screen, elevation of bentonite, elevation of filter pack, and elevation of well bottom;

(f) a table showing historical lateral and vertical (if applicable) flow directions and gradients;

(g) cumulative data tables containing the water quality analytical results and depth to groundwater;

(h) a copy of the laboratory analytical data report;

(i) if applicable, the status of any ongoing remediation, including cumulative information on the mass of pollutant removed from the subsurface, system operating time, the effectiveness of the remediation system, and any field notes pertaining to the operation and maintenance of the system; and

(j) if applicable, the reasons for and duration of all interruptions in the operation of any remediation system, and actions planned or taken to correct and prevent interruptions; and

(k) A log of GAC replacement, if applicable, along with transportation date(s) and destination of disposal.

An Annual Report shall be submitted to the Regional Board by **1 February (1 November for semi-annual monitoring)** of each year. This report shall contain an evaluation of the effectiveness and progress of the investigation and remediation, and may be substituted for the fourth quarter **(or second semi-annual)** monitoring report. The Annual Report shall contain the following minimum information:

(a) both tabular and graphical summaries of all data obtained during the year;

(b) groundwater contour maps and pollutant concentration maps containing all data obtained during the previous year;

(c) a discussion of the long-term trends in the concentrations of the pollutants in the groundwater monitoring wells;

(d) an analysis of whether the pollutant plume is being captured by an extraction system or is continuing to spread;

(e) a description of all remedial activities conducted during the year, an analysis of their effectiveness in removing the pollutants, and plans to improve remediation system effectiveness;

(f) an identification of any data gaps and potential deficiencies/redundancies in the monitoring system or reporting program; and

(g) if desired, a proposal and rationale for any revisions to the groundwater sampling plan frequency and/or list of analytes.

A letter transmitting the self-monitoring reports shall accompany each report. Such a letter shall include a discussion of requirement violations found during the reporting period, and actions taken or planned for correcting noted violations, such as operation or facility modifications. If the Discharger has previously submitted a report describing corrective actions and/or a time schedule for implementing the corrective actions, reference to the previous correspondence will be satisfactory. The transmittal letter shall contain the penalty of perjury

statement by the Discharger, or the Discharger's authorized agent, as described in the Standard Provisions General Reporting Requirements Section B.3.

The Discharger shall implement the above monitoring program on the first day of the month following adoption of this Order.

Ordered by: original signed by:
PAMELA C. CREEDON Executive Officer

10 December 2010
(Date)

10/18/10:AMM

INFORMATION SHEET

ORDER NO. R5-2010-0126
THE BOEING COMPANY
SIGMA COMPLEX IN-SITU GROUNDWATER BIOREMEDIATION PROJECT
INACTIVE RANCHO CORDOVA TEST SITE
SACRAMENTO COUNTY

Background

The Boeing Company (Boeing), along with Aerojet-General Corporation (Aerojet), as directed by the Central Valley Regional Water Quality Control Board (Regional Board) and the Department of Toxic Substances Control (DTSC), are initiating cleanup of groundwater beneath the Inactive Rancho Cordova Test Site (IRCTS). The IRCTS consists of approximately 4000 acres in eastern Sacramento County to the east of Sunrise Boulevard, south of White Rock Road, and north of Douglas Road. Past rocket testing operations and disposal practices by The McDonnell-Douglas Corporation and/or Aerojet, have caused the groundwater beneath the IRCTS to have become polluted with volatile organic contaminants (VOCs) and perchlorate. Several plumes of contaminants originate on the IRCTS with the largerst plume extending approximately 2.7 miles west of the IRCTS.

Groundwater beneath the IRCTS is contaminated by VOCs and perchlorate. The primary VOCs in the groundwater are trichloroethylene (TCE) and cis-1,2-Dichloroethylne (cis-1,2-DCE) at concentrations up to 710 micrograms per liter (µg/L) and 25 µg/l, respectively. Concentrations of perchlorate have been measured up to 32,000 µg/L. Boeing and Aerojet have completed an Engineering Evaluation/Cost Analysis (EE/CA) for the containment of the plume of perchlorate contaminated groundwater extending west from the IRCTS and across Mather Field. Boeing and Aerojet are in the process of constructing facilities to control the plume by extracting groundwater at the plume boundaries, treating the extracted water to remove the pollutants, and discharging the treated water. In addition, Aerojet and Boeing are evaluating alternatives for remediation of the contaminant plumes, both on and off of the IRCTS.

One of the alternatives being evaluated by Boeing and Aerojet for cleaning up the contaminated groundwater is in-situ bioremediation. This process uses a carbon substrate to provide food for the indigeneous bacteria to grow. The bacteria will, through reduction processes, remove perchlorate and, hopefullly, the VOCs. Aerojet has tested several variations of the in-situ biodegradation process on its own property and conducted a pilot test along the western edge of the IRCTS under Waste Discharge Requirements Order NO. R5-2003-0026. The process has shown significant success in reducing the perchlorate concentrations in the aquifer to below the detection limit of 4 µg/L (the current Action Level established by the California Department of Health Services). Reduction of the VOCs was not as successful without the addition of bacteria (KB-1) known to be able to reduce TCE to ethene and ethene. Boeing proposed to test the bioremediation concept at the Sigma Complex on the IRCTS as described below.

Bio-Barrier Pilot Project

Since 2007, The Boeing Company has operated an in-situ bio-barrier project under waste discharge requirements contained in Order No. R5-2007-0110. The objectives of the pilot project are to confirm the ability of the indigenous bacteria beneath the Sigma Complex on the IRCTS to biodegrade perchlorate to treatment goals through electron donor addition, quantify the rate and extent of perchlorate biodegradation by these indigenous bacteria; assess the impacts of the in-situ bioremediation process on secondary groundwater quality; assess the ability of the active containment system to provide the required level of hydraulic control for plume containment and treatment; identify design and operational factors that influence the successful performance of the in-situ bioremediation approach, and optimize system operation with respect to these factors, and generate performance, design and cost data that can be used for a full-scale system.

The pilot project targets groundwater in the uppermost water-bearing zone. This unconfined water bearing zone consists of sands and gravels extending from approximately 122-182 feet below ground surface. The groundwater is flowing west-southwest underneath the project area. The estimated groundwater velocity is 300 feet per year. One extraction well, one recharge well, and at least seven groundwater monitor well nests have been constructed for the project. The extraction well is located on the western edge with the recharge well upgradient of the perchlorate plume along the eastern edge. Groundwater monitor wells are positioned between the injection and extraction wells and downgradient from the injection well. Groundwater is extracted from the extraction well at up to a total of 120 gallons per minute (average flow is 90-95 gpm) and amended with an electron donor/carbon source and discharged back into the aquifer via the recharge well. The electron donor being used is acetic acid.

The electron donor stimulates the growth of bacteria in a small portion of saturated subsurface to degrade the perchlorate into chloride and oxygen atoms. It is hoped that the TCE will be degraded by the bacteria to ethene and thence to carbon dioxide. Nitrate concentrations are also being reduced by the bacteria. The electron donor dosage is balanced with the amount of electron receptor (oxygen, nitrate, perchlorate, and sulfate) present in the extracted groundwater. This minimizes the potential adverse impacts on groundwater quality.

Based on past evaluations on the IRCTS and the Aerojet facility, the estimated half-life for reduction of perchlorate is approximately 1 day. Thus, to reduce perchlorate concentrations from 4100 µg/L to less than 4 µg/L will take 10 days wihin the reactive zone. With an average groundwater velocity of approximately 3 feet/day, the perchlorate would be expected to be removed within thirty feet of the recharge well. However, the groundwater velocity at the recharge well will be greater than that of the aquifer in general. At the Aerojet facility, the reduction took place within 25 to 75 feet of the recharge well. The data from the operation of the bio-barrier shows that perchlorate is consumed within 100 feet, and likely much less than that.

The area downgradient from the test area is degraded by perchlorate for a distance of over two miles. Boeing and Aerojet are in the process of constructing a cleanup action to halt the downgradient migration of the perchlorate plume. This cleanup is being undertaken pursuant to Cleanup and Abatement Order No. 97-012. Thus, waters beneath and downgradient from the test area covered under this permit, are included in a cleanup action that will be construction completed in the near future.

Operational Changes

Boeing has requested that a portion of the extracted groundwater be allowed to infiltrate through the perchlorate source area in the vadose zone upgradient and within the capture are of the extraction well. This is proposed in order to enhance the cleanup of the vadose zone. Initially, 5 gpm from the extraction well would be treated to remove the perchlorate and TCE prior to application to land. The remaining flow would continue to be amended with acetic acid and injected into the treatment zone to maintain the bio barrier.

TCE would be removed by passing the water through vessels filled with granular activated carbon. The perchlorate will be removed by a bioremediation process that has undergone successful column testing at the Aerojet site. The treatment system is similar to ones being constructed by Aerojet for operation at the Propellant Burn Area on the IRCTS and operated under Order NO. R5-2010-0069. The extracted groundwater is passed through granular activated carbon (GAC) vessels to remove VOCs and then through a modular biotreatment cell (MBC) to remove perchlorate. The MBC consists of either a tank filled with crushed rock and the addition of a carbon substrate such as acetic acid or glycerol, or the tank will be filled with a mixture of elemental sulfur granules and crushed walnut shells. The crushed rock/walnut shells serve as a media to support the growth of indigenous bacteria. The sulfur or carbon donor stimulate the bacterial growth which in turn will breakdown the perchlorate in a manner similar to that achieved by the exisiting in-situ system.

In column studies, Aerojet has shown sulfer and limestone capable of providing an environment to allow bacteria to sufficiently degrade perchlorate to concentrations less than 4 µg/L. There is the potential for sulfate to be produced in the reducing environment witihin the perchlorate treatment tank. Monitoring for sulfate is required and an effluent limitation of 75 mg/L has been established, well below the Secondary Drinking Water Standard of 250 mg/L. Background concentrations at the project site are approximately 50 mg/L.

The ex-situ treatment system will be designed to utilize the entire flow from the extraction well in the event that it is determined that the in-situ biobarrier should be eliminated and all of the perchlorate will be removed by the ex-situ MBC.

Basin Plan, Beneficial Uses, and Regulatory Considerations

Surface water drainage from the project area is to Morrison Creek, tributary to the Sacramento River. The *Water Quality Control Plan for the California Regional Water Quality Control Board Central Valley Region, Fourth Edition* (Basin Plan), designates beneficial uses, establishes

water quality objectives, and contains implementation plans and policies for all waters of the Basin. Beneficial uses often determine the water quality objectives that apply to a water body. For example, waters designated as municipal and domestic supply must meet the maximum contaminant levels (MCLs) for drinking waters. The Basin Plan sets forth the applicable beneficial uses (industrial, agricultural, and domestic supply in this instance) of groundwater, procedure for application of water quality objectives, and the process for and factors to consider in allocating waste assimilation capacity.

Antidegradation

The antidegradation directives of Section 13000 of the California Water Code require that waters of the State that are better in quality than established water quality objectives be maintained "consistent with the maximum benefit to the people of the State." Waters can be of high quality for some constituents or beneficial uses and not others. Policies and procedures for complying with this directive are set forth in the Basin Plan (including by reference State Water Board Resolution No. 68-16, "Statement of Policy With Respect to Maintaining High Quality Waters in California," or "Antidegradation" Policy).

Resolution 68-16 is applied on a case-by-case, constituent-by-constituent basis in determining whether a certain degree of degradation can be justified. It is incumbent upon the Discharger to provide technical information for the Board to evaluate that fully characterizes:

- All waste constituents to be discharged;
- The background quality of the uppermost layer of the uppermost aquifer;
- The background quality of other waters that may be affected;
- The underlying hydrogeologic conditions;
- Waste treatment and control measures;
- How treatment and control measures are justified as best practicable treatment and control;
- The extent the discharge will impact the quality of each aquifer; and
- The expected degradation to water quality objectives.

In allowing a discharge, the Board must comply with CWC section 13263 in setting appropriate conditions. The Board is required, relative to the groundwater that may be affected by the discharge, to implement the Basin Plan and consider the beneficial uses to be protected along with the water quality objectives essential for that purpose. The Board need not authorize the full utilization of the waste assimilation capacity of the groundwater (CWC 13263(b)) and must consider other waste discharges and factors that affect that capacity.

As stated above, groundwater will be extracted, amended with a carbon source and recharged back to the aquifer. The biological activity will reduce the concentrations of VOCs and perchlorate and the carbon source will be completely consumed in the process. Groundwater quality will be monitored to assess the impacts due to the project. The groundwater flowing from

the project area will be captured by the extraction system being installed by Aerojet and Boeing. Any residual pollutants remaining from the pilot project will be captured and removed by that extraction system. No degradation should occur as a result of the discharge.

Title 27

Title 27, CCR, section 20380 et seq. ("Title 27"), contains regulations to address certain discharges to land. Title 27 establishes a waste classification system, specifies siting and construction standards for containment of classified waste, requires extensive monitoring of groundwater and the unsaturated zone for any indication of failure of containment, and specifies closure and post-closure maintenance requirements. Generally, no degradation of groundwater quality by any waste constituent is acceptable. The proposed discharge will not degrade groundwater quality.

Proposed Order Terms and Conditions

Discharge Prohibitions and Specifications

The proposed Order establishes a discharge flow limit of 360,000 gallons per day. The proposed Order's discharge specifications for the electron donor are designed to minimize residual salts and to maintain all beneficial uses of the groundwater.

Monitoring Requirements

Section 13267 of the CWC authorizes the Board to require monitoring and technical reports as necessary to investigate the impact of a waste discharge on waters of the state. In recent years there has been increased emphasis on obtaining all necessary information, assuring the information is timely as well as representative and accurate, and thereby improving accountability of any discharger for meeting the conditions of discharge. Section 13268 of the CWC authorizes assessment civil administrative liability where appropriate.

This Order requires effluent and groundwater monitoring requirements, including flow rates. In order to adequately characterize its discharge, Boeing is required to monitor for VOCs, perchlorate, electron donor, dissolved metals, dissolved oxygen, total dissolved solids and pH.

AMM:10/18/10