EPA

AEROJET SUPERFUND SITE
RANCHO CORDOVA, CA

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY • REGION IX • NOVEMBER 2000

EPA Proposes a Plan to Address Groundwater Contamination in the Western Area of the Aerojet Site

About the Proposed Plan

The Environmental Protection Agency (EPA), the California Department of Toxic Substances Control (DTSC), and the California Regional Water Quality Control Board (RWQCB) are jointly responsible for the Aerojet Superfund site under a 1989 Partial Consent Decree (PCD). Under the PCD, Aerojet-General Corporation agreed to conduct a remedial investigation and feasibility study (RI/FS) to specify the nature and extent of contamination at the site and to identify alternatives for cleaning up the contamination. EPA has developed this proposed plan in consultation with DTSC and RWQCB to allow the public to review and comment on all of the clean-up alternatives evaluated in the RI/FS, in accordance with section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The function of the proposed plan is to (1) provide basic background information; (2) identify the preferred alternative for remedial action for the operable unit and reasons for the preference; (3) describe the other clean-up options considered; (4) solicit pubic review and comment on all alternatives described; (5) provide information on how the public can be involved in the remedy selection process; (6) explain the relationship of the RI/FS to the proposed plan; and (7) describe the importance to the remedy selection process of public input on all alternatives.

This fact sheet presents the U.S. Environmental Protection Agency's proposed plan for addressing health risks presented by contaminated groundwater in the western area of the Aerojet Superfund site, known as operable unit 3 (OU-3), in the Rancho Cordova unincorporated area of Sacramento County, California (see Figure 1, to right). The Environmental Protection Agency (EPA) is seeking public comments on this proposed plan.

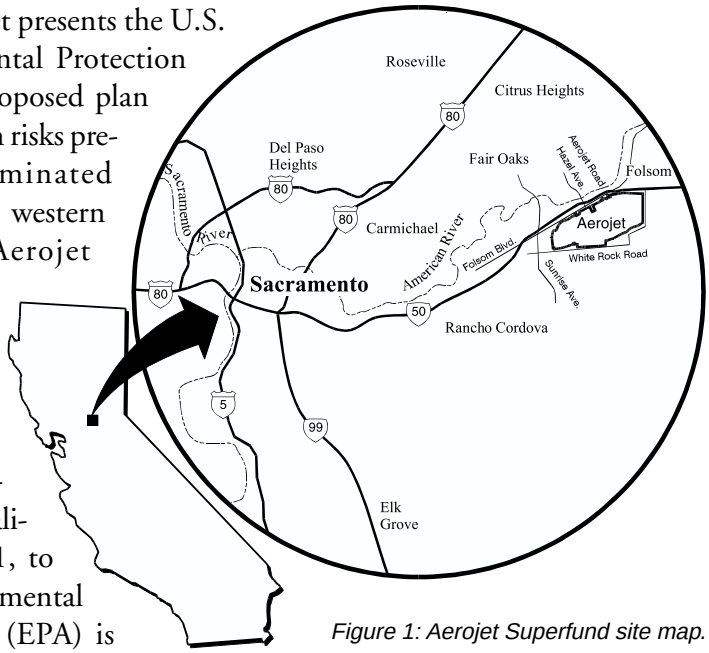

Figure 1: Aerojet Superfund site map.

The feasibility study for OU-3 evaluated ten alternative approaches as potential remedies for this contamination. To be considered as a possible remedy for a hazardous waste problem, an alternative must meet EPA's two threshold criteria. These criteria stipulate that the remedy must (1) protect human health and the environment and (2) comply with the applicable or relevant and appropriate requirements (ARARs) of the various government entities with authority over the site. Of the ten alternatives developed during the Feasibility Study (FS), this proposed plan presents and compares the seven alternatives that meet EPA's threshold criteria. (See box "EPA's Remedy Selection Criteria" on page 6).

PUBLIC COMMENT PERIOD
December 1, 2000 - January 30, 2001

COMMUNITY MEETING

Thursday, December 7, 2000
7:00 to 9:00 pm
Mills Middle School
10243 Coloma Road
Rancho Cordova, CA 95670

After evaluating these seven cleanup alternatives according to eight of the nine mandated evaluation criteria (see Table 3 on page 11), EPA prefers alternative 4C as the remedy that provides the best balance of the trade-offs among the criteria. Alternative 4C calls for modifying the existing groundwater extraction and treatment (GET) system on the Aerojet property and installing additional extraction wells off-property near the leading edge of the plume in the affected layers. EPA believes that alternative 4C provides the best overall containment, extraction, treatment, and monitoring of OU-3's contaminated groundwater. EPA identifies its preferred remedy so that the public can comment on it along with the other alternatives considered. EPA will consider and respond to significant comments on this proposed plan before selecting the remedy for OU-3 at Aerojet.

Since EPA began work on the site in 1988, EPA has provided fact sheets (the latest in July 2000) and other notifications to the public. The RI/FS report, EPA fact sheets, and all documents relevant to OU-3 are available in the administrative record at the local records repository and at the EPA regional office in San Francisco (see Public Comment and Community Meeting box on front page for details).

The EPA encourages the public to review the RI/FS for OU-3 and other detailed information in the Administrative Record, in order to gain a more comprehensive understanding of OU-3, and then to comment on any of the alternatives presented in this proposed plan. The public comment period is from December 1, 2000 to January 30, 2001. ***The EPA invites the public to a meeting scheduled for December 7, where the EPA will present this plan and receive verbal comments*** (see Public Comment Period and Community Meeting box on front page for details). After EPA reviews and responds to public comments, we will formally announce the selected remedy in a document called a Record of Decision (ROD) for OU-3. The ROD, to be completed in 2001, will include a summary of public comments with EPA's responses. The remedy specified in the ROD for OU-3 may differ from the preferred alternative in this plan as a result of these comments. Once the remedy is selected, EPA intends to negotiate an agreement with Aerojet-General Corporation for performing the work.

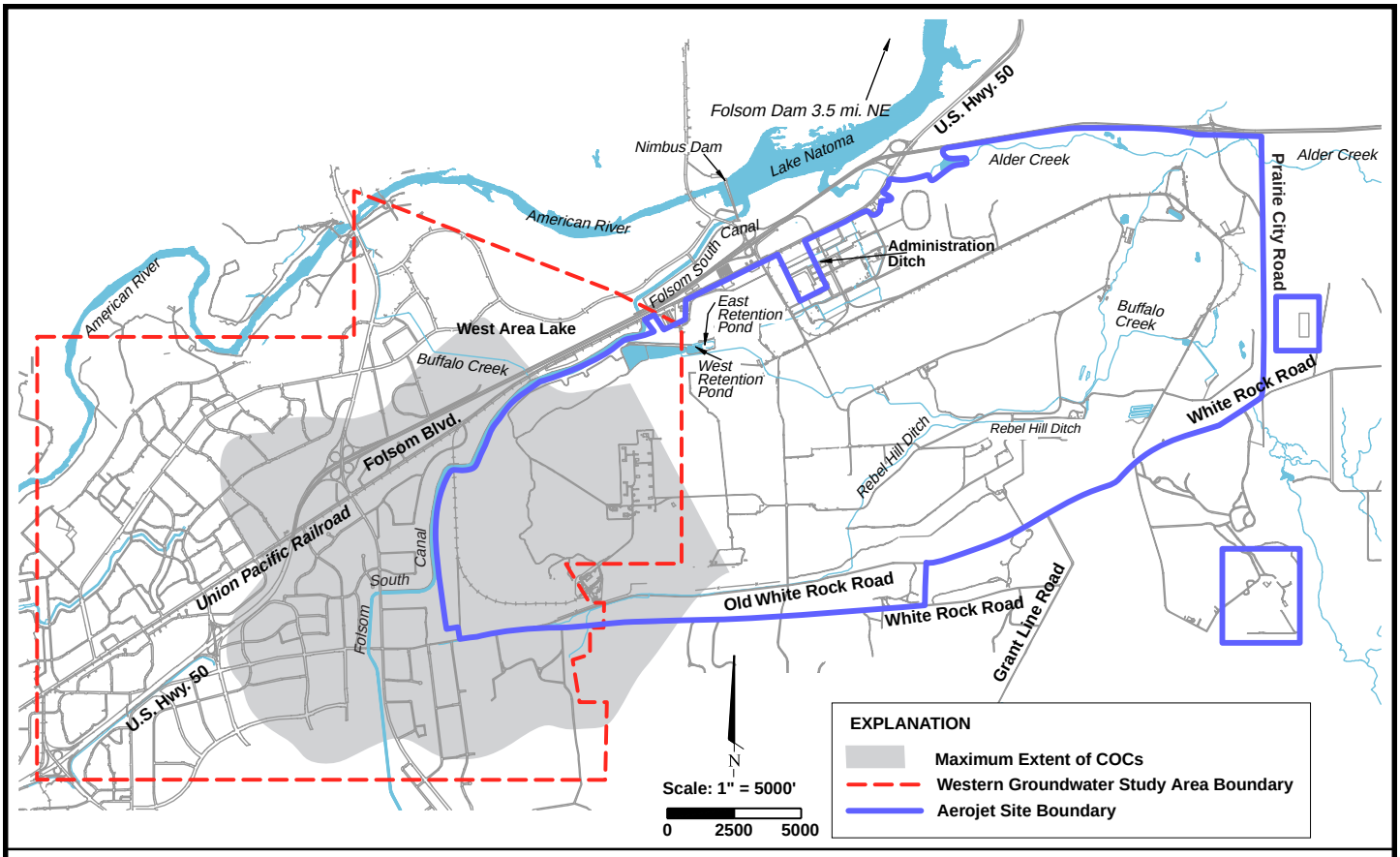

Figure 2: Maximum extent of COCs.

SITE HISTORY

Aerojet-General Corporation (Aerojet) has operated at the Rancho Cordova site since 1953. Its operations included manufacturing liquid and solid propellants for rocket engines for military and commercial use, and formulating chemicals including rocket propellant agents, agricultural pesticides, pharmaceuticals, and other industrial chemicals. Currently Aerojet produces pharmaceuticals and other chemicals at the site. Also, the Cordova Chemical Company operated chemical manufacturing facilities on the Aerojet property from 1974 to 1979.

Some wastes from these manufacturing activities on the Aerojet-General property were disposed of in surface impoundments, landfills, deep injection wells, leachate fields, and open burn areas. As a result of these former disposal practices, contamination of groundwater extends off the Aerojet property. The Western Groundwater Operable Unit (OU-3) remedial investigation and feasibility study (RI/FS) addressed groundwater on the western side of the Aerojet site that contains detectible levels of several chemicals of potential concern (see Table 1 on page 7 for details), primarily perchlorate, trichloroethylene (TCE) and other volatile organic compounds (VOCs), and N-Nitrosodimethylamine (NDMA).

In the mid 1980s, Aerojet installed two groundwater extraction and treatment (GET) facilities (designated as GET E and GET F) on the western side of its property to contain and treat VOCs (primarily TCE) on-property. Treated water was reinjected back into the aquifer. Wellhead treatment removed low-level TCE in the few off-property drinking water wells where it was found.

Perchlorate was first detected off the Aerojet property in 1997 when the ability to measure perchlorate significantly improved. NDMA was first detected off-property in 1998 when its measurability similarly improved. Due to the discovery of these contaminants in drinking water, local water purveyors had to shut down several drinking water supply wells in the area to protect the public. In response, Aerojet developed a first-of-its-kind biological process to treat perchlorate to non-detection levels and added this process to GET F in 1998. In 1999, Aerojet combined GETs E and F to provide for the full treatment of perchlorate from all western extraction wells using the new biological system, and also added NDMA treatment using ultra-violet light.

In October of this year, Aerojet completed an RI/FS for the Western Groundwater Operable Unit, under the oversight of the California Department of Toxic Substances Control (DTSC), the Regional Water Quality Control Board (RWQCB), and EPA, resulting in this proposed plan for clean-up.

To reinject or not to reinject . . .

Reinjection, or the pumping of treated water back into the ground, is an issue because of the history of remediation at the Aerojet site. Perchlorate and NDMA were returned to the aquifer on the western side of the Aerojet property, after the removal of VOCs until 1999, further contaminating the aquifer. Some stakeholders, especially local water purveyors, fear contaminated water could again be returned to the aquifer, prolonging the cleanup.

The advantage of reinjection is that it would prevent groundwater extraction from lowering the water table and make more groundwater available for pumping down-gradient. However, reinjection would not dilute any potential residual contaminants, while discharging into surface waters would. Reinjection could also help direct groundwater to existing extraction wells, making those wells more effective at containing the plumes of contamination. However, because the geological strata underlying the site are complex, additional extraction wells would likely be more effective than reinjection at controlling the plumes.

SITE CHARACTERISTICS

Land Use

The Western Groundwater Operable Unit (OU-3) at Aerojet is partly on the western side of the Aerojet property and partly extends off the Aerojet property into developed areas of Rancho Cordova (see Figure 2 on page 2). Currently the on-property portion of OU-3 contains the combined GET E/F treatment facility with extraction and monitoring wells, as well as an explosive storage area, access roads, and a few other structures associated with Aerojet operations. However, under the Sacramento County Land Use Master Plan, a large portion of the on-property part of OU-3 could be used for residential development in the future. Off-property, the land immediately adjacent to Aerojet is entirely zoned as heavy and light industrial. Other surrounding areas are developed with a combination of industrial, office, commercial, residential, and recreational uses (the American River flood plain and the edges of the adjacent bluffs are designated as recreational zones). Because the Rancho Cordova area is fully developed, current land use will likely continue.

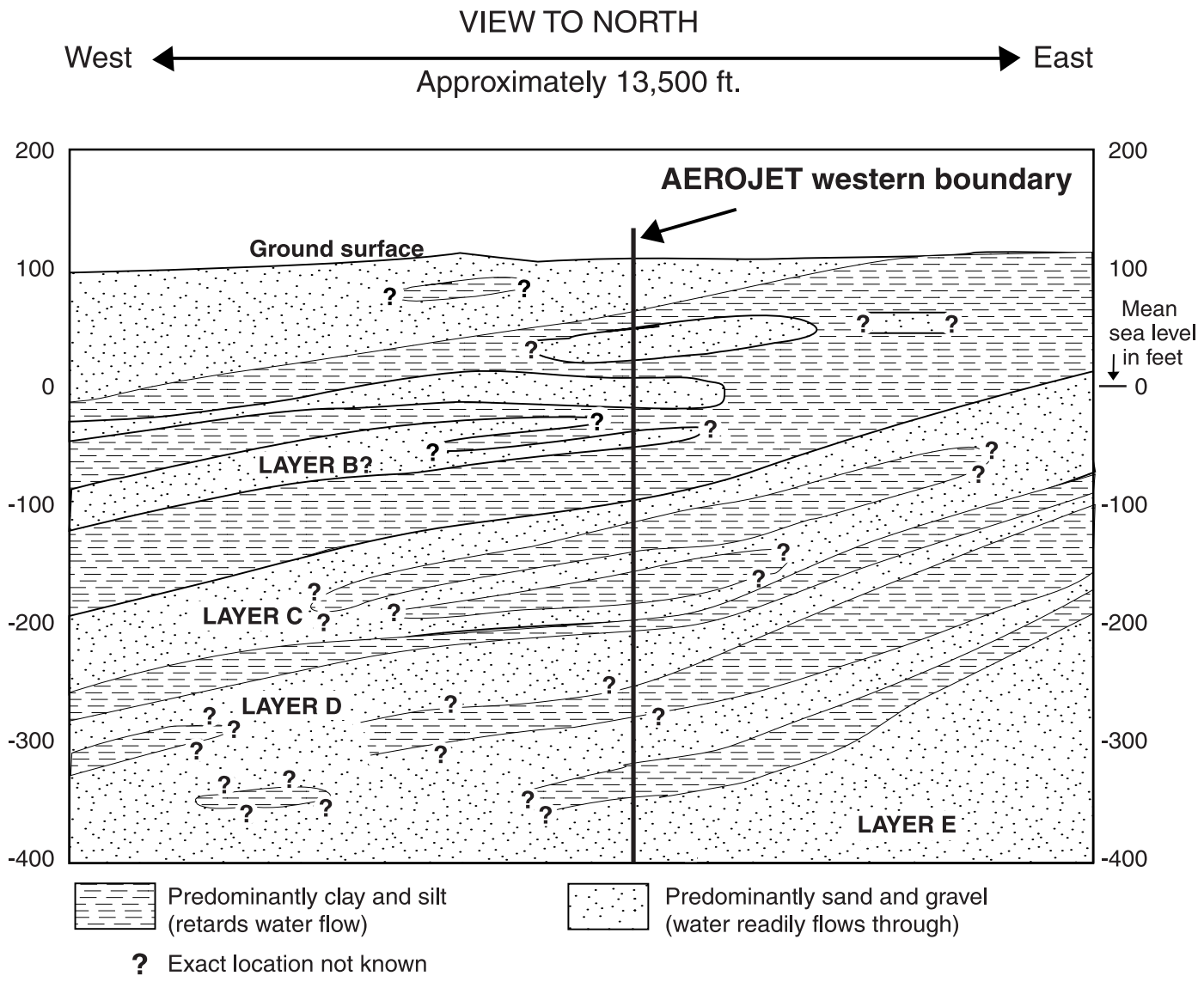

Figure 3: Site hydrogeology approximately parallel to Union Pacific Railroad (Simplified, not to scale).

Hydrogeology

On the western portion of the Aerojet Site, groundwater flows generally to the west-southwest through a complex, mixed aquifer. The aquifer has been subdivided into five layers (A through E) based on similarity of composition and water flow properties (see Figure 3 on page 4). The aquifer under OU-3 is used for drinking water and Layers C, D, and E are adversely impacted by the present groundwater contamination. The source of the contamination, which is not located in or part of OU-3, will be addressed later, after the risk to local drinking water supplies is mitigated.

Overall, the most contaminated layer of the aquifer is C. Layer C contamination is approximately nine square miles in area and contains approximately 61 percent of the total contamination. Perchlorate is the main contaminant, with the widest distribution, extending to Zinfandel Avenue, and the highest off-property concentration, 8,000 parts per billion (ppb). TCE is the second most prevalent contaminant. It projects off-property in a long narrow plume along Highway 50 and Folsom Boulevard to just beyond Zinfandel Avenue, with a maximum detected off-property concentration of 97 ppb. NDMA is the third most prevalent chemical in Layer C. A small plume extends to the northwest extending beyond Sunrise Boulevard, with a maximum detected concentration off-property of 0.39 ppb. Table 1 on page 7 shows additional contaminants found on-property at levels above EPA or State action levels.

Layer D contamination is approximately 4.6 square miles in area and contains approximately 31 percent of the total contamination. The main contaminant is perchlorate, extending in a narrow plume to halfway between Sunrise Boulevard and Zinfandel Avenue, with a maximum detected concentration off-property of 420 ppb. In layer D, both TCE and NDMA extend off-property slightly to the northeast with maximum detected concentrations of 8.5 ppb and 0.49 ppb respectively.

Layer E contamination is approximately one square mile in area and contains approximately 9 percent of the total contamination. In layer E, only a small portion of perchlorate, TCE, and NDMA contamination extends off-property. NDMA extends the furthest in a narrow plume which does not reach Sunrise Boulevard. The maximum detected off-property concentrations are: perchlorate at 410 ppb, TCE at 220 ppb, and NDMA at 0.18 ppb.

Direct vs. indirect reuse of treated water

Some of the alternatives presented in this proposed plan would allow for either direct or indirect reuse of the treated water. Direct reuse means that the treated water is piped straight to a water company for delivery to its customers. Such water must meet drinking water standards. No site treatment permit for all the contaminants of concern at Aerojet has been issued that would allow direct reuse of the water. However, the drinking water program of the California Department of Health Services is currently evaluating permitting an application in southern California of a new technology that might also work at Aerojet.

Under the indirect reuse option, treated water would be discharged under permit to Buffalo Creek, which flows to the American River. The treated water would meet state and federal drinking water standards. In addition, the surface water discharge would be diluted by river water, and the water would be treated again before any downstream systems distributed it to consumers. Water distributors affected by the Aerojet groundwater contamination could receive replacement water via the Folsom South Canal diversion from the American River. The cost estimate for this option includes new piping from the Folsom South Canal to a new surface water treatment plant that would supply the water purveyors' systems, replacing lost water supplies.

The advantage of direct reuse is the lower cost of constructing the system, since no surface water treatment plant is required, but over the duration of the remedy it is more expensive.

SCOPE AND ROLE OF THE WESTERN GROUNDWATER OPERABLE UNIT

The Western Groundwater Operable Unit (OU-3) is the first of several operable units EPA is addressing at the Aerojet site. The first remedy will contain and remediate groundwater at the western perimeter of the site, in the Western Groundwater OU. The OU-3 remedy takes priority because contamination of groundwater in OU-3 has already resulted in the shut-down of seven public water supply wells (PWSWs) and one private well and could cause the shut-down of 13 more PWSWs in the next 25 years, unless the contaminated groundwater is first contained. The OU-3 remedy will (1) prevent the off-property groundwater contamination plume from migrating further west and (2) restore contaminated groundwater between the on- and off-property extraction wells to drinking-water quality.

A second groundwater OU, tentatively called the Perimeter Groundwater OU, includes the perimeter of the site on the three remaining sides. The remedy chosen for this OU will address contamination on the remaining perimeter, where public water supplies are not as immediately threatened. Four or more later operable units will address on-property soil and groundwater contamination east of OU-3. One or more of these OUs will address the sources of the contamination of groundwater at the site, which may include "principle threat wastes".

The EPA's operable units will augment State orders issued for groundwater and soil actions at the Inactive Rancho Cordova Test Site adjacent to the Aerojet site, southwest of OU-3. The two perimeter groundwater OUs will incorporate orders issued by the RWQCB for plumes emanating from the Aerojet site.

EPA'S REMEDY SELECTION CRITERIA

To select a remedy, the EPA uses nine criteria to evaluate the different remediation alternatives individually and against each other. The nine criteria fall into three groups:

Threshold criteria, that each alternative must meet, to be eligible for selection:

- overall protection of human health and the environment; and
- compliance with applicable or reasonable and appropriate requirements (ARARs) pertaining to the chemicals of concern, the location, the proposed action, or other elements

Primary balancing criteria, used to weigh major trade-offs among alternatives:

- long-term effectiveness, including risk remaining after remedy is implemented, and reliability of long-term controls;
- reduction in toxicity, mobility or volume through treatment;
- short-term effectiveness, including safety of workers and the community during remedy implementation, and time until remedy objectives are met;
- implementability, including ability to obtain technology, ease of constructing the remedy, reliability of remedy operations, and ability to monitor effectiveness; and
- costs, including capital (construction) costs, costs to operate and maintain the remedy, and the 30-year present worth cost.

Modifying criteria, which EPA considers after State and other agencies and the public respond to the proposed plan during the comment period, and incorporates into the final remedy selection process documented in the ROD:

- state and support agency acceptance; and
- community acceptance.

RISKS FROM OU-3

To help determine whether to take action to protect human health at a site, EPA considers the health risks to people who might be exposed to the chemicals at the site. In October 2000, Aerojet, under EPA oversight, completed a risk assessment for the Western Groundwater OU that estimated these risks. Table 1, below, shows the chemicals of concern in groundwater that the risk assessment evaluated. The risk assessment was based on current and expected residential land use and on the current use of off-property groundwater for drinking and other household uses. On-property groundwater use is restricted and the City of Folsom supplies non-contaminated potable and non-potable water to Aerojet. The risk assessment evaluated exposure to children and adults through drinking the water; through breathing contaminants that are released from the water during activities such as showering, toilet flushing, and clothes washing; and through absorbing contaminants through the skin while bathing. The EPA uses protective assumptions and safety factors in risk evaluation.

In its risk assessments, EPA considers two types of risks: cancer risk and non-cancer risk. Cancer risk is the excess lifetime chance of getting cancer due to a chemical exposure. For example, a one-in-a-million risk is the equivalent of one cancer more than would normally occur in a hypothetical population of a million people. The EPA manages risk at a site so that the risk falls within a "risk management range" of one in ten thousand to one in a million. Risk greater than one in ten thousand generally requires action at a site to reduce the risk. At OU-3, groundwater layer C exhibits the highest cancer risk at four in ten thousand off of the Aerojet property and 100 in ten thousand on-property. Both the on- and off-property cancer risk values are above the threshold of one in ten thousand.

Table 1: Chemicals of Concern in Groundwater

Chemical	Abbreviation	Category	Source	Remedial action objective
Perchlorate		Inorganic anion	Component of oxidizer in solid rocket propellant	4 ppb [1]
N-Nitroso-dimethylamine	NDMA	Semi-volatile organic compound (SVOC)	Impurity in and combustion product of liquid rocket fuel	1.3 ppt [2]
Trichloroethene	TCE	Volatile organic compound (VOC)	Solvent for cleaning and degreasing	0.8 - 5 ppb
Tetrachloroethene	PCE	VOC	Solvent	0.7 - 5 ppb*
1,1-Dichloroethene	1,1-DCE	VOC	Solvent	0.06 - 6 ppb*
1,2-Dichloroethene	1,2-DCE	VOC	Solvent	1.0 - 6 ppb*
1,1-Dichloroethane	1,1-DCA	VOC	Solvent	0.5 - 5 ppb*
1,2-Dichloroethane	1,2-DCA	VOC	Solvent	0.4 - 0.5 ppb*
Carbon Tetrachloride	CCl_4	VOC	Solvent, refrigerant, propellant	0.1 - 0.5 ppb*
Chloroform	$CHCl_3$	VOC	Solvent	0.43 - 100 ppb*
1,1,2 Trichloroethane	1,1,2-TCA	VOC	Solvent	0.49 - 5 ppb*
Vinyl chloride	VC	VOC	VOC degradation product	0.05 - 5 ppb*
Freon 113	--	VOC	refrigerant	1,200 ppb
Nitrate	NO_3		inorganic	10,000 ppb
Nitrite	NO_2		inorganic	1,000 ppb

[1] Parts per billion
[2] Parts per trillion

* Range of RAO no higher than MCLs. The lower number is expected to be achieved through remediation of remedy-driving COCs, Perchlorate and NDMA. The ROD will select a fixed number.

The non-cancer risk is measured by what is called a hazard index. A hazard index below one (1) means that it is extremely unlikely for any non-cancer health effect to occur. A hazard index above one means that adverse effects could potentially occur, with adverse effects more likely the higher the number. The hazard index for layer C is 670 off-property and 2,200 on-property, both of which are well above the threshold of one.

These risk values were estimated for the highest exposures that could reasonably be expected to occur if no action were taken. One of EPA's goals is to insure that actual exposure to contaminated groundwater at unsafe levels does not occur, now or in the future. The elevated current and potential future risks and exceedances of drinking water standards in the Western Groundwater OU support EPA's decision to take action. EPA believes that the preferred alternative in this proposed plan, or one of the other active measures, is necessary to protect public health.

REMEDIAL ACTION OBJECTIVES

EPA's objectives for the actions considered in this proposed plan for OU-3 are to:

(1) protect human health and the environment from exposure to contaminated groundwater;

(2) achieve containment of the groundwater contamination to minimize future migration of contaminants until cleanup is accomplished;

(3) protect public drinking water wells through short-term and long-term contingency plans for alternative water supplies; and

(4) restore both on-property and off-property western groundwater to beneficial uses.

These objectives are based on present use of groundwater as a public water supply to approximately 40,000 people served by the closest water purveyor; current and expected loss of public water supply wells and private wells; and expanding population and limited water supply.

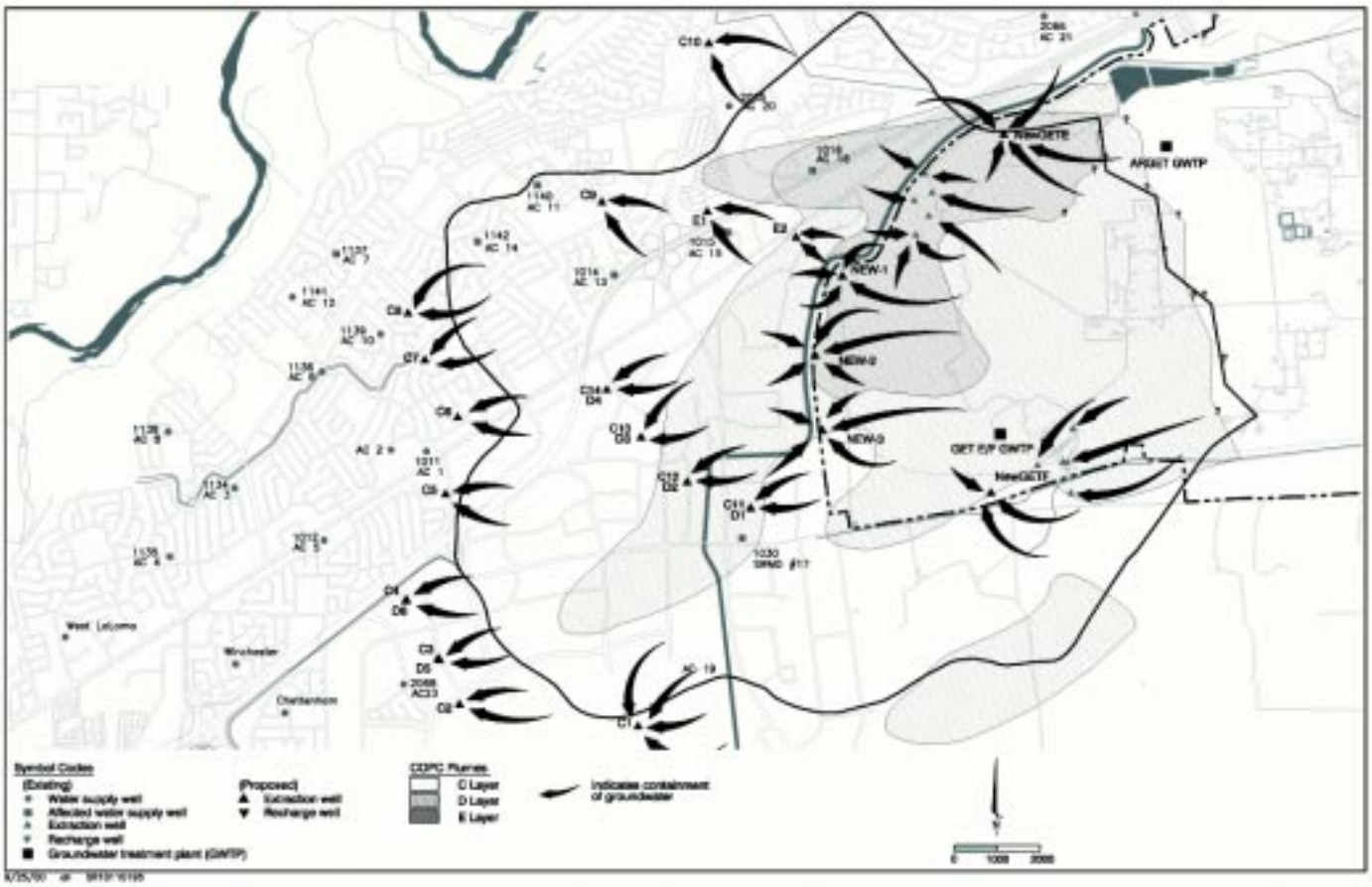

Figure 4: Preferred alternative well locations.

Table 2: Cost Comparison

	Reuse Option	3A	3B	4A	4B	4C (preferred)	5A	5B
30-year capital cost ($M)		64.0	78.0	52.6	46.5	52.7	52.4	53.2
Annual O&M cost range ($M) [1]	direct indirect	1.7-5.4 N/A	1.7-6.0 N/A	1.6-3.9 1.6-3.8	1.8-4.2 1.7-4.1	2.0-4.3 1.9-4.2	1.8-4.3 1.7-4.2	1.9-4.4 1.8-4.3
Present worth value ($M) [2]	direct indirect	97.3 N/A	119.8 N/A	93.9 95.8	92.9 94.8	107.8 109.7	99.6 101.5	105.6 107.5
Total cost ($M) [3]	direct indirect	2,178.0 N/A	2,995.0 N/A	1,524.0 1,521.0	1,813.0 1,809.0	1,191.7 1,188.2	1,889.0 1,887.0	1,941.0 1,937.0
Duration (years)		330	480	234	348	240	258	348

[1] O&M costs are not a fixed annual cost because not all the remedy components are installed in the same year and vary from alternative to alternative

[2] Capital costs and operations and maintenance for 30 years at 7% discount rate

[3] Total non-discount cost estimate is the total of the estimates to fund the remedy for each year of the entire duration until remedy completion

Table 1 on page 7 shows the proposed cleanup levels for all fifteen chemicals of concern in groundwater in order to comply with all applicable or reasonable and appropriate requirements. We anticipate that achieving the cleanup standard for perchlorate and to some extent NDMA will also result in achieving the lower range of the remedial action objectives for VOCs. The ROD will select a fixed number.

SUMMARY OF REMEDIAL ALTERNATIVES

This proposed plan evaluates variations of five basic cleanup alternatives. All the alternatives would rely on institutional controls to prevent the installation of drinking water wells in contaminated groundwater and would monitor the plume until remedial action objectives were met. All except the no-action alternative include the continued operation of the existing extraction and treatment plant in OU-3 (which fails to prevent contamination from moving off-property, necessitating further remediation).

Preferred Alternative

New off-property extraction wells with treatment of contaminants and disposal to surface waterways. EPA's preferred alternative optimizes placement of extraction wells. It requires pumping of contaminated groundwater to contain the plume and treatment of the contaminants of concern between the on- and off-property extraction wells to cleanup standards. It provides for discharge of approximately 7000 gallons per minute of treated groundwater to Buffalo Creek and, finally, requires deed restrictions on groundwater use on Aerojet property within OU-3.

Non-Qualifying Alternatives

Alternative 1: no action. This alternative requires monitoring of the extent of the contamination but no remediation. EPA always compares a no-action alternative to any active cleanup technology under consideration.

Alternative 2 variations: Replacement water supply. As down-gradient public water supply wells become contaminated, alternative 2 would simply replace the water from another source. Alternatives 1 and 2 fail to meet EPA's threshold criteria for remedy selection and are not evaluated further.

Evaluated Alternatives

To develop the remaining alternatives, many clean-up technologies were first screened for suitability to this site and then combinations of the suitable technologies were assembled into alternatives for further evaluation.

Alternatives 3, 4, and 5 include **A- and B-variations**. The A-variations would continue to reinject treated water through the GET E and F on-property reinjection wells. The B-variations would replace the on-property reinjection wells with new extraction wells. Both alternative 5 variations also add off-property reinjection wells. (See the sidebar "To Reinject or Not to Reinject" on page 3 for a discussion of the trade-offs involved.)

The variations of alternatives 3, 4, and 5 all include an upgraded on-property extraction well system at GET E/F. This system consists of all the on-property extraction wells shown in Figure 3 on page 4 (NEW-1, NEW-2, NEW-3, New GET F, New GET E, and the 10 existing extraction wells shown for GET E/F). All variations of alternatives 4 and 5 also include new off-property extraction wells. Figure 3 shows these wells in the preferred configuration (C1 through 10, D1 through 6, and E 1 and 2). All variations of alternatives 4 and 5 allow for either direct or indirect reuse of treated water. Cost estimates for both are included in Table 2, Alternative Costs, on page 9. (See the sidebar "Direct vs. Indirect Reuse of Treated Water" on page 5 for a discussion of the trade-offs involved.)

Alternative 3 variations: wellhead treatment for public water supply wells. Pumping from existing drinking water wells would impede if not contain the spread of contaminated groundwater. An ion-exchange wellhead treatment technology, recently approved by the California Department of Health Services' drinking water program, would remove perchlorate. However, this technology has not yet been permitted for a specific application. Ultraviolet light would destroy NDMA and air stripping would remove the remaining VOCs. If wellhead treatment at existing wells were sufficient to contain the plume, it would continue until remedial action objectives are achieved. More likely, further work would be necessary to meet RAOs.

Alternative 4 variations: new off-site extraction wells, containment of the plume, and restoration of contaminated groundwater. Alternative 4 variations would collect contaminated groundwater and bring it back on-property for treatment of perchlorate by biological treatment, NDMA by ultra-violet light, and remaining VOCs by air stripping. Besides the standard A- and B-variations, alternative 4 includes a variation 4C. This alternative includes the 4B wells plus one more extraction well in Layer E, and moves four Layer D and one of the Layer E wells closer to the present extent of contamination in Layers D and E to expedite cleanup of these layers (Figure 3 on page 4). 4C is EPA's preferred alternative.

Alternative 5 variations: new off-site extraction and reinjection wells, treatment of contaminated groundwater, and containment of the plume. Alternative 5 variations are similar to alternative 4 variations except that they provide for seven new off-property injection wells to help the off-property extraction wells control the plume hydraulically. (See the sidebar "To Reinject or Not to Reinject" on page 3 for a discussion of the trade-offs involved.)

Contingency technologies: *in-situ* bioremediation and ligand treatment. Pilot studies of *in-situ* biological remediation and improved wellhead treatment using ligands (binding molecules) are ongoing. These technologies are being evaluated and could augment the proposed remedy if the studies show that they can help clean up the contamination faster and cheaper, and if EPA approves them. Until the studies are completed, many unknowns prevent meaningful estimates of the cost of implementing these new technologies.

EVALUATION OF ALTERNATIVES

To select the preferred alternative, EPA evaluated the possible clean-up alternatives against a standard set of nine criteria designed to measure the effectiveness and acceptability of each alternative (see "EPA's remedy selection criteria" on page 6 for definitions of the criteria). The alternatives and variations considered are:

1. **No action** except groundwater monitoring

2A. Off-property alternate water supply with GET E/F **extraction** and **reinjection wells**

2B. Off-property alternate water supply with GET E/F **extraction wells only**

3A. Off-property wellhead treatment at water supply wells with GET E/F **extraction** and **reinjection wells**

3B. Off-property wellhead treatment at water supply wells with GET E/F **extraction wells only**

4A. New off-property **extraction wells** with GET E/F **extraction** and **reinjection wells**

4B. New off-property **extraction wells** with GET E/F **extraction wells only**

4C. New off-property **extraction wells** with optimal well placement and with GET E/F **extraction wells only**

5A. New off-property **extraction** and **reinjection wells** with GET E/F **extraction** and **reinjection wells**

5B. New off-property **extraction** and **reinjection wells** with GET E/F **extraction wells only**

Table 3, below, summarizes EPA's evaluation of the alternatives against eight of the nine criteria. As the result of this evaluation, EPA currently prefers alternative 4C.

Threshold criteria: overall protection of human health and the environment and compliance with ARARs

Alternatives 1, 2A, and 2B fail to meet these threshold criteria because none of them contain or clean up the contaminated groundwater. These alternatives are not evaluated further. The seven variations of alternatives 3, 4, and 5 meet the threshold criteria.

Long-Term Effectiveness and Permanence

All the retained alternatives would permanently remove known chemicals of concern from the groundwater, although is possible that residual amounts of the chemicals of concern could remain in portions of the groundwater aquifer after remedial action objectives for these chemicals have been achieved. However, some alternatives do have the potential to provide better long-term effectiveness. Where reinjection is used, it is possible that incomplete treatment could return contamination to the aquifer. Consequently alternatives 4B and 4C should be more effective than alternatives 3A, 4A, 5A, and 5B, which include reinjection in the remedy. The indirect reuse of

Table 3: Comparison of Alternatives

Criteria	3A	3B	4A	4B	4C (preferred)	5A	5B
Protectiveness	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Compliance with ARARs	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Long-term effectiveness	Yes	Yes	Yes	Potentially better	Potentially better	Yes	Yes
Reduction in toxicity, mobility, or volume	Rejection control difficult	Non-optimal well locations	Rejection control difficult	2nd best	Best	Rejection control difficult	Rejection control difficult
Short-term effectiveness	Rejection control difficult	Non-optimal well locations	Reinjection control difficult	2nd best	Best	Rejection control difficult	Rejection control difficult
Implementability	Direct reuse not yet permitted	Direct reuse not yet permitted	Allows for indirect reuse	Allows for indirect reuse & most implementable	Allows for indirect reuse	Allows for indirect reuse	Allows for indirect reuse
Cost [1]	Next highest	Highest	Next lowest	Mid-range	Lowest	Mid-range	Mid-range
State acceptance	No	No	Mixed	Yes	Yes	No	No
Public acceptance	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown

[1] Based on total cost over entire duration of remediation (see Table 2 for specific cost estimates)

treated water under alternatives 4B and 4C also has the potential for lower residual risk, due to dilution and additional treatment before reuse. (See box ADirect vs. indirect reuse of treated water on page 5 for more on this point.) Alternatives 4B and 4C, therefore, would have the least long-term risk.

All the evaluated alternatives depend equally on legal or "institutional" controls to protect the public. These controls could include on-property deed restrictions and existing Department of Health Services regulations on the operations of potable water suppliers (i.e., monitoring, sampling, shut-down of wells as necessary, and approval of new well locations). The County will have approval authority over new use permits for wells and Aerojet will also monitor proposed new well drilling in OU-3.

Reduction of Toxicity, Mobility, or Volume through Treatment

All the retained alternatives equally reduce the toxicity of the chemicals of concern in the treated groundwater. However, alternative 3 variations allow for only direct reuse of the treated water as drinking water, while alternative 4 and 5 variations allow for the indirect reuse of the treated water. Indirect reuse adds additional protection through dilution and additional treatment before use of the water for drinking. Alternatives 4B and 4C would most effectively reduce mobility of groundwater contaminants, because they use only extraction and selective placement of extraction wells for hydraulic control. Of these, alternative 4C would install all remedy components the earliest and remediate layers D and E the fastest. 4C would reduce the volume of contaminated groundwater faster than 4B by an estimated 108 years or 31 percent.

Short-Term Effectiveness

Potential danger to workers and to the environment during the implementation of alternative 4 and 5 variations would be higher than for alternative 3 variations because of the need to install approximately 20 additional extraction wells, piping central treatment, and, in the case of indirect reuse, a surface water treatment plant with piping to Folsom South Canal. However, the alternative 3 variations would require maintenance for a significantly longer period. Also, alternative 3 variations might require construction of additional extraction wells to contain the contamination, since existing drinking water well locations are not optimal for plume control. In this case, short-term effectiveness of alternative 3 variations would be little better than that of alternative 4 and 5.

None of the alternatives considered are truly short-term remedies. Alternative 4A is estimated to achieve remedial action objectives (RAOs) in the shortest period of time, 234 years. However, 4A as well as 3A have disadvantages under the reduction of mobility criterion, due to the continued reinjection of treated water on-site. The variations of alternative 5 have the same drawback, due to off-site reinjection. Of the alternatives that do not include reinjection (3B, 4B, and 4C), alternative 3B would not control the contaminant plumes as well as alternatives 4B and 4C because the water supply wells that would remove the contamination are not in the best locations for this purpose. Of the two remaining non-reinjection alternatives, alternative 4B is less hydraulically complicated to maintain than 4C, as 4C must be implemented in a manner that avoids additional effects on layer D. However, alternative 4C more effectively prevents the spread to the west of contamination in layers D and E and reduces clean-up time. 4C achieves RAOs in 240 years or only 3 percent longer than 4A, but faster than 4B by an estimated 108 years or 31 percent.

Implementability

Alternatives 3A and 3B would require no additional wells to be installed, making them potentially easier to implement. However, although the California Department of Health Services' drinking water program recently approved an ion-exchange wellhead treatment technology, DHS has not yet permitted a direct reuse system for perchlorate-contaminated drinking water at a specific site. For the present, this curtails the implementability of alternatives 3A and 3B. A permit for a southern California application using ion exchange treatment, with requirements similar to the Aerojet site's, is pending and a biological treatability study is also in progress, so implementability of alternatives 3A and 3B , as well as the direct-reuse of treated water from alternative 4 and 5 variations, could increase at a later date.

But, at the current time, variations of alternatives 4 and 5, which allow for indirect reuse of the treated water, are more easily implemented. Of these, 4A and 5A and 5B do not rate well under the long-term effectiveness and reduction in mobility and volume criteria, due to the continued reinjection of treated water. Of the remaining alternatives, 4C is more complicated hydraulically and must be implemented more carefully to address the risk of contaminating layer D from layer C, so 4B is the most easily implemented, followed by 4C .

Cost

Table 2, Alternative Costs, on page 9 provides specific cost estimates for each alternative. Costs for the variations of alternatives 4 and 5 depend partly on whether treated water is reused directly or indirectly. Using a 30-year net-present-worth method, alternative 4B ($92.9-94.8M) is the least expensive alternative, $14.9M or 13.8 percent cheaper than alternative 4C. However, not all the remedy is installed in the first 30 years. Under the total non-discount cost method, which totals the annual costs of the remedy for the entire duration until the RAOs are met, alternative 4C is the least expensive remedy at $1,182.2 to $1,191.7M, which is $681.3M or 34.3 percent cheaper than alternative 4B.

State Acceptance

The State of California's Department of Toxic Substances Control and the Regional Water Quality Control Board support both alternative 4B and 4C, with a more detailed analysis of how 4C can be implemented to prevent potential migration of Layer C contamination down to Layer D. The State agencies do not accept alternatives 3A and 3B because they cost more than 4B and do not provide for optimal extraction well placement, which could require additional wells to achieve containment and meet remedial action objectives. The State prefers alternatives 4B and 4C to the remedies with reinjection (3A, 4A, 5A, and 5B) because of the complexity of the site hydrogeology and the potential for residual contamination.

EPA'S PREFERRED ALTERNATIVE

Based on current information, EPA prefers alternative 4C, which requires new off-property extraction wells with optimal well placement and includes the GET E/F extraction wells but not the reinjection wells. This alternative:

- includes the installation of six extraction wells closer to the Aerojet site and the present toe of contamination in Layers D and E,
- remediates the contained contaminants between on-property and off-property extraction wells,
- provides for the discharge of approximately 7000 gallons per minute of treated water to Buffalo Creek and then into the American River, and
- provides deed restrictions for groundwater use on Aerojet property within OU-3.

This alternative provides the earliest containment of the contaminated groundwater in Layers D and E and the earliest implementation of all components of the remedy to provide treatment of contaminated groundwater. It would restore layers D and E 31 percent faster than the next preferred alternative, 4B. Alternative 4C would also cost least over the life of the project and has the support of the State agencies.

EPA believes alternative 4C meets the threshold criteria and provides the best balance of tradeoffs among the alternatives. The EPA expects the preferred alternative to satisfy the following statutory requirements of CERCLA Section121(b):

(1) to be protective of human health and the environment;
(2) to comply with ARARs;
(3) to be cost effective;
(4) to utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
(5) to satisfy the preference for treatment as a principal element.

The preferred alternative can change in response to public comment and new information.

INFORMATION REPOSITORIES

THE PUBLIC INFORMATION REPOSITORIES FOR THE AEROJET SUPERFUND SITE PROPOSED PLAN MAY BE FOUND AT:

California State University Sacramento Library • 2000 State University Drive East • Sacramento, CA 95899-6039
Contact: Ben Amata, Government Documents • Tel: (916) 278-5672
For Library hours and information, please call (916) 278-6926

THE MOST COMPLETE COLLECTION OF DOCUMENTS RELATING TO THE AEROJET SUPERFUND SITE MAY BE FOUND AT:

EPA Superfund Records Center • SFD-7C • 95 Hawthorne Street • Suite 403S • San Francisco, CA 94105
(415) 536-2000

FOR MORE INFORMATION

If you have questions or concerns regarding the Aerojet Superfund site or would like to be added to the site mailing list, please contact:

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