April 19, 2006

Proposed Plan To Fund Construction and Operation of Treatment Systems for Groundwater from Drinking Water Wells Located near the National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California

The purpose of this Proposed Plan is to describe the actions proposed by NASA to clean up chemicals located in deep groundwater adjacent to the Jet Propulsion Laboratory (JPL).
NASA encourages the public to comment on this Proposed Plan.

ATTENTION!
Please note that the public comment period has been extended to Friday, July 7.

INTRODUCTION

NASA has been conducting environmental investigations and cleanup activities at the Jet Propulsion Laboratory (JPL) for more than a decade. These activities have been performed under the federal law requirements of the *Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)*[1]. NASA has already implemented several cleanup initiatives to accelerate remediation of *groundwater* and soils while considering options for the final remedy. For example, two groundwater treatment plants are already operating and cleaning up groundwater. One is off-facility (or outside the JPL fenceline) treating water from two Lincoln Avenue Water Company wells in Altadena, and one is on-facility (within the JPL fenceline) to clean water directly underneath JPL.

This *Proposed Plan* outlines NASA's *Preferred Alternative* to conduct a *remedial action* for cleaning up the off-facility groundwater, which is the deep groundwater outside the JPL fenceline. Under this alternative, NASA would take two separate actions:

1. Work closely with the City of Pasadena and fund the construction and operation of a treatment system for groundwater from the four City drinking water wells located just east of JPL near the Arroyo Seco. While NASA proposes to provide the funding, given the nature of how the system would operate and where it needs to be located, NASA would not be directly operating the treatment system proposed for this remedial action. Rather, the City of Pasadena would be funded by NASA to lease the treatment equipment and operate the system.
2. Continue to fund treatment of groundwater from two Lincoln Avenue Water Company drinking water wells at the existing treatment facility. The Lincoln Avenue Water Company system is currently funded by NASA as a CERCLA *removal action*. This Proposed Plan includes continued funding of this treatment system as part of the overall remedial action for off-facility groundwater.

Public Meeting and Comment Period Mark Your Calendar

Public Comment Period: APRIL 19 – MAY 19
Public Meeting: 7 P.M. MAY 3 at the ALTADENA COMMUNITY CENTER, ALTADENA

NASA invites public comment on the actions described in this Proposed Plan. Supporting technical documents are available by visiting any of the public information repositories listed on the last page of this document or at the NASA JPL Groundwater Cleanup website at http://jplwater.nasa.gov. The public also may call **(818) 393-0754** for more information.

Comments on NASA's Proposed Plan may be submitted electronically to mfellows@nasa.gov or by mail to the attention of **Merrilee Fellows, NASA Water Cleanup Outreach Manager, Jet Propulsion Laboratory, NASA Management Office, 180-801, 4800 Oak Grove Drive, Pasadena, CA 91109.**

No specific format for the comments is necessary. All comments must be submitted either electronically before midnight May 19 or, if comments are submitted by mail, must bear a postmark of no later than May 19. Oral and written comments will also be accepted at the May 3rd meeting and NASA will prepare a transcript of the meeting.

In addition to describing NASA's Preferred Alternative, this document also briefly describes the other cleanup alternatives that NASA evaluated for cleaning up the deep groundwater beyond and adjacent to the JPL facility. Finally, this document describes how members of the public can comment on the proposed action either through written comments or by participating in the public meeting.

NASA will make a final decision on the proposed cleanup remedy after reviewing and considering all information submitted during a 30-day public comment period (**APRIL 19 – MAY 19**). NASA may modify its Preferred

[1] Definitions of *italicized* words are in a glossary on page 12.

Alternative based on public comments, before issuing a *Record of Decision*.

NASA will conduct an integrated *Feasibility Study* in the future to evaluate the overall effectiveness of all the remedial actions for groundwater and to determine whether additional cleanup measures are required for on-facility and off-facility groundwater.

SUMMARY OF PREFERRED ALTERNATIVE

NASA proposes to remove target chemicals from the aquifer at four City of Pasadena drinking water wells by building a treatment facility to remove *perchlorate* and *volatile organic compounds (VOCs)* and also proposes to continue funding a treatment plant for two Lincoln Avenue Water Company wells (see Figure 1). This approach is referred to as centralized treatment because groundwater from the wells is treated after the water is pumped from the wells and prior to use by City of Pasadena and Lincoln Avenue Water Company customers.

In this approach, NASA would directly carry out the work connected with designing, permitting, and construction of the new City of Pasadena treatment system. The City of Pasadena would be funded by NASA to lease treatment equipment and operate the system. Groundwater from four City of Pasadena drinking water wells – Arroyo Well, Well 52, Windsor Well, and Ventura Well – would be cleaned in this new treatment facility using a *liquid-phase granular activated carbon (LGAC)* system to remove VOCs, and an *ion exchange* system to remove perchlorate. The system is proposed to be located adjacent to the Windsor Well and Windsor Reservoir (see Figure 1). Operation of this new treatment system likely would be initiated in 2007.

NASA would also continue to fund the existing treatment system that was constructed in 2004 at the Lincoln Avenue Water Company. This system also uses LGAC with ion exchange and has been operating very successfully since July 2004.

This combined alternative (i.e., the two centralized treatment systems) is preferred by NASA because it would support the final remedial outcome of removing the target chemicals from the groundwater in an aquifer being used by the local community (Lincoln Avenue Water Company and the City of Pasadena) for drinking water.

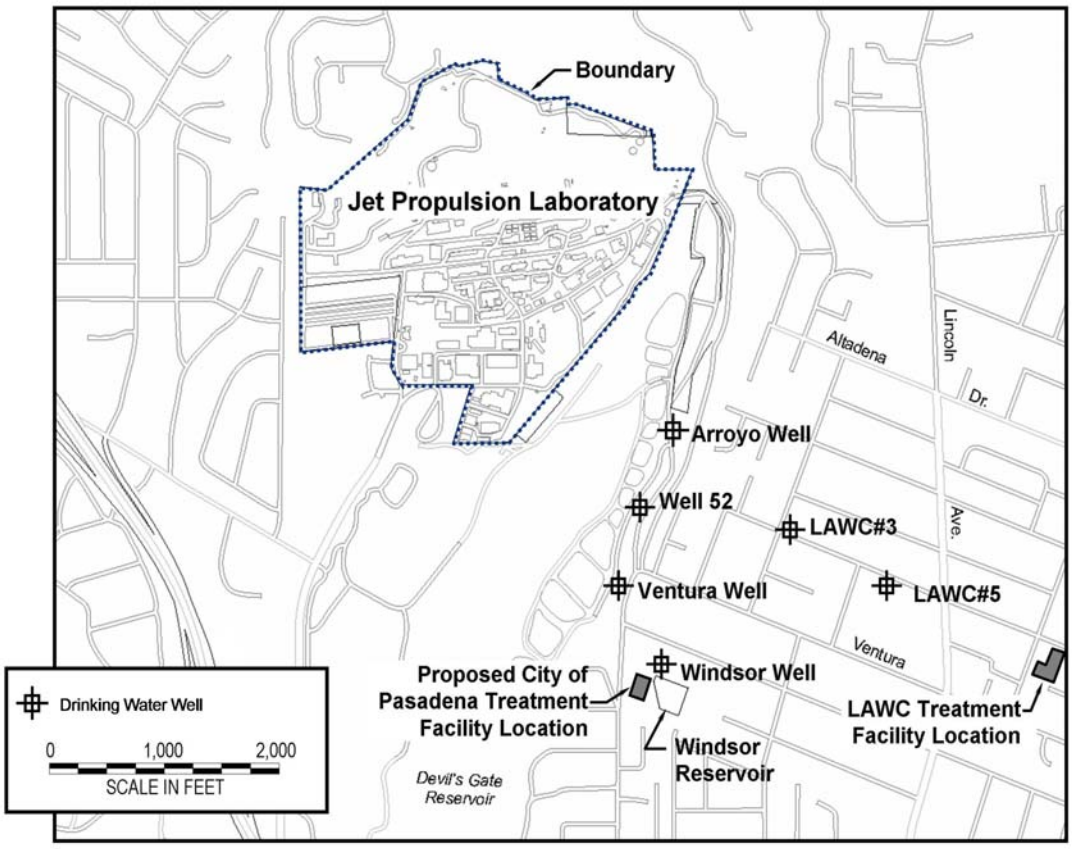

Figure 1. Location Map

SITE BACKGROUND

In the 1940s and 1950s, liquid wastes from materials used and produced at JPL (such as solvents, solid and liquid rocket propellants, cooling tower chemicals, and analytical laboratory chemicals) were disposed of into seepage pits, a practice considered common at that time. VOCs and perchlorate, have been found in groundwater beneath the north-central portion of JPL and in certain areas of deep groundwater adjacent to JPL. Specifically, groundwater extracted from two drinking water wells operated by the Lincoln Avenue Water Company, and four drinking water wells operated by the City of Pasadena (Arroyo Well, Well 52, Windsor Well, and Ventura Well) have been found to contain these chemicals.

NASA has been investigating and taking actions to clean up the groundwater associated with historic practices since the mid-1980s as described below. In October 1992 the site was placed on the U.S. Environmental Protection Agency (EPA) *National Priorities List* of sites governed by the federal CERCLA, as amended by the Superfund Amendments and Reauthorization Act. NASA entered into a *Federal Facility Agreement* with the EPA and appropriate state agencies, and NASA was designated the lead agency responsible for carrying out the CERCLA investigation and cleanup process at JPL. The government agencies included in the Federal Facility Agreement are NASA, the EPA, the California Department of Toxic Substances Control, and the California Regional Water Quality Control Board, Los Angeles Region.

PREVIOUS ACTIONS

CERCLA requires a thorough and often lengthy process to fully investigate and determine the best methods for cleanup. As the responsible agency, NASA has conducted a number of detailed investigations and studies on the site and adjacent areas since the early 1990s. All CERCLA documentation associated with the JPL site including the information that supports the Preferred Alternative in this Proposed Plan can be found at the *information repositories* listed on the last page of this document and in the *Administrative Record* found at http://jplwater.nasa.gov.

These studies have helped NASA identify and understand the type and extent of chemicals in soil and groundwater. As part of this effort, NASA divided the site into three separate areas referred to as *Operable Units (OUs)*. Designated by numbers, OU-1 consists of on-facility groundwater (the *source area*), OU-2 consists of on-facility soils, and OU-3 consists of off-facility groundwater adjacent to JPL. Ultimately, NASA will look at the entire site to ensure that the remedies, taken together, achieve cleanup of the entire area.

In September 2002, NASA signed the Record of Decision for OU-2. *Soil vapor extraction (SVE)* was identified as the Preferred Alternative for OU-2 to remove VOCs from the soil and prevent further migration of the chemicals to the groundwater. SVE has proven to be effective in removing the VOCs from on-facility soils, and the cleanup of soils is nearly complete.

As part of the site investigation activities for groundwater located on (OU-1) and off (OU-3) JPL, NASA:

- Conducted a *Remedial Investigation* from 1994 to 1998. The Remedial Investigation report, which characterized the nature and extent of the chemicals in the groundwater, was completed in the fall of 1999. The Remedial Investigation for OU-1 and OU-3 contained *human health* and *ecological risk assessments* which look at the possible effects to human health and the environment in the absence of any cleanup action (i.e., if no cleanup occurred).
- Initiated a groundwater monitoring program in August 1996 analyzing for VOCs and other chemicals, including perchlorate, metals, anions, cations, and other field parameters. Analytical results are summarized in quarterly reports and technical memoranda that are available in the Information Repositories and on the project Web site.
- Conducted modeling and aquifer testing at and adjacent to JPL to characterize the complex groundwater conditions and groundwater flow.
- Completed a draft Feasibility Study in January 2000 that identified and evaluated various groundwater cleanup alternatives for both the source area and areas adjacent to the JPL facility.

In addition to these studies, NASA funded treatment facilities for Lincoln Avenue Water Company in Altadena and for the City of Pasadena in the early 1990s to remove VOCs from drinking water wells that were affected by chemicals from JPL. In July 2004, NASA implemented a *Removal Action* directed at the off-facility groundwater to achieve quick, protective results. For that Removal Action NASA funded additional treatment facilities at Lincoln Avenue Water Company to remove perchlorate in addition to VOCs. The perchlorate removal system uses an ion-exchange technology that has worked well, successfully treating over one billion gallons of water since initiating operation. This removal action is one part of the current Preferred Alternative for OU-3.

NASA has also done a number of studies to determine the best technologies to use to treat groundwater. In the late

1990s and early 2000s, NASA conducted pilot testing of several technologies to address dissolved perchlorate in source area groundwater, including a study that evaluated the effectiveness of a biological treatment technology called a fluidized bed reactor (FBR). Based on these studies, NASA installed a demonstration treatment plant located on JPL in the source area in early 2005. This system, which consists of LGAC treatment to remove VOCs and a fluidized bed reactor to remove perchlorate, has been successful in the demonstration phase. A Proposed Plan regarding the on-facility groundwater treatment plant was presented to the public on November 16, 2005. NASA received a few comments on this plan and expects to present its responses to the public comments in a Record of Decision later in 2006.

Source area treatment consists of pumping water out of the ground, treating it, and then reinjecting the water back into the ground. Water treated at the source area treatment plant is not used for drinking water purposes.

SUMMARY OF SITE RISKS

The concentrations of chemicals in the groundwater plume exceed drinking water standards and/or public health goals. Thus, restoration of the aquifer is necessary. State and federal standards or a State Public Health Goal (PHG) for drinking water are set at levels to be protective of public health.

The chemicals are in groundwater located several hundred feet below the ground surface. The only way for the public to come in contact with the water would be through pumping the drinking water production wells. The closest water production wells are owned by the City of Pasadena and are located in, or near, the Arroyo Seco. Over time, some chemicals in groundwater have moved to these wells, which were subsequently shut down. These wells will remain closed until the water meets California and federal drinking water requirements. The next-closest wells are owned by Lincoln Avenue Water Company. The water from these wells is treated to meet state and federal standards prior to distribution to customers. Other wells in the Monk Hill Subarea have not been impacted by chemicals originating from JPL above state or federal requirements.

Although the chemicals do not present a human health risk at this time, the aquifer does not meet drinking water standards and/or public health goals, resulting in the inability to use this valuable resource. Also, if these wells do not pump, the chemicals will migrate further in the aquifer and affect other water supplies. Thus, restoration of the aquifer is necessary.

REMEDIAL ACTION OBJECTIVES

The remedial action objectives for NASA's Proposed Plan are as follows:

- Remove target chemicals from the aquifer to levels that meet drinking water requirements by treating water pumped from specified drinking water wells in the Monk Hill Subarea of the Raymond Basin. This is referred to as centralized treatment.
- Prevent further migration of the chemicals in groundwater.
- Provide additional data to assess possible long-term cleanup remedies for groundwater both on and off the JPL facility.

CLEANUP LEVELS

CERCLA requires that chemicals in groundwater be removed to levels that meet federal and state standards called maximum contaminant level (MCLs). The MCLs for VOCs detected in groundwater associated with JPL are listed in Table 1. The Preferred Alternative would clean up water to levels at or below the MCLs.

Table 1. Standards for Chemicals in Groundwater (units reported in parts per billion [ppb])

Chemical	Federal Standard	State Standard	State PHG	Highest Historical Level in OU-3 Production Wells
Carbon tetrachloride	5	0.5		15
Trichloroethylene (TCE)	5	5		57.4
Tetrachloroethylene (PCE)	5	5		3.8
Perchlorate			6	160

For perchlorate, no level has been established as a drinking water standard by either the federal government or the State of California. On January 26, 2006, the EPA issued guidance that the recommended preliminary remediation goal for perchlorate be 24.5 parts per billion (ppb). The preliminary remediation goal is not a drinking water standard, but it is a chemical-specific value to be considered by NASA. However, until a standard is established, the treatment plant would meet the State Public Health Goal (PHG), which is 6 ppb. Once the final drinking water standard is established, all treatment plants will meet that standard for perchlorate removal.

SUMMARY OF ALTERNATIVES EVALUATED

NASA identified and evaluated alternatives to achieve the remedial action objectives described above. The Preferred Alternative provides the best approach to meet the remedial action objectives.

As an alternative to the centralized treatment, NASA considered and evaluated the possibility of installing wells and a treatment system just inside the JPL fenceline and reinjecting the treated water. While either fenceline wells or centralized treatment would prevent further migration of the chemicals in groundwater and provide additional data to assess possible long-term cleanup remedies, only centralized treatment with restoration of drinking water meets the first Remedial Action Objective, and allows for large volume pumping. Treated water from fenceline wells would need to be re-injected into the aquifer, which would limit the volume of the system. Thus, centralized treatment is a more effective alternative to achieve all of the remedial action objectives.

NASA also evaluated the best treatment technologies for groundwater extracted from the production wells. In January 2000, NASA completed a draft Feasibility Study that identified and evaluated various groundwater cleanup alternatives for both OU-1 (groundwater directly beneath the JPL facility) and OU-3 (off-facility groundwater). As part of this effort, NASA also conducted a number of different tests to see which technologies might be the most promising for use at the JPL site. The technologies tested included reverse osmosis, fluidized bed reactor, packed-bed reactors, in situ bioremediation, and ion exchange.

The best perchlorate treatment is dependent on several factors, including existing perchlorate concentrations and specific site conditions. Two aboveground perchlorate treatment processes have been proven to be effective at full-scale at JPL and other sites: fluidized bed reactor and ion exchange. A fluidized bed reactor contains carbon particles covered with a coating of bacteria that destroy perchlorate. Fluidized bed reactor technology is cost-effective for relatively high concentrations of perchlorate (greater than 100-200 ppb) and at locations where continuous operation can be achieved, such as the source area beneath JPL. However, fluidized bed reactor technology is not cost-effective for perchlorate concentrations in the range detected in the City of Pasadena and Lincoln Avenue Water Company production wells. Also, microbial populations used in a fluidized bed reactor would be difficult to maintain for the water supply systems, as flexibility is necessary for flow rates to be varied significantly to meet seasonal water supply needs.

Ion exchange consists of small plastic beads, or resin, in a tank. As the water passes through the tank, perchlorate attaches to the resin. After enough perchlorate attaches to the resin, the resin is removed and sent to a licensed disposal facility, and new resin is placed in the tank. Ion exchange is the only perchlorate removal technology that has been approved for drinking water systems in California, and has performed well at the NASA-funded Lincoln Avenue Water Company system (see Figure 2). Ion exchange is more cost-effective at low perchlorate levels, such as those found in the City of Pasadena and Lincoln Avenue Water Company production wells, and it is more appropriate for the seasonal variability in water supply operations associated with these systems. In addition, ion exchange is simpler to operate than a fluidized bed reactor and does not require maintaining an active population of microorganisms. Therefore, NASA chose ion exchange as the preferred treatment technology for perchlorate removal.

The EPA has identified *air stripping* and LGAC as the best technologies to use for VOCs, referring to these as "presumptive technologies" for aboveground treatment of groundwater containing VOCs. EPA expects one of these technologies to be used for removal of VOCs at "all appropriate sites." LGAC treatment is currently in place and working effectively as part of the existing Lincoln Avenue Water Company treatment system. The City of Pasadena air stripping facility was effectively removing VOCs from groundwater, although the wells were later shut down by the City of Pasadena when the perchlorate levels exceeded the public health goal. As part of the proposed Preferred Alternative, NASA would fund the removal of the existing air stripping system and install a new LGAC system. While both technologies are effective, given the concentrations of VOCs in the groundwater, use of LGAC would be more cost-effective than continuing to use the air stripper. Also, air stripping alters the water chemistry in such a way that other treatment would need to be added prior to ion exchange to prevent scaling (i.e., residues, corrosion, or fouling), thus increasing complexity and cost. Construction of the new ion exchange treatment plant at the site of the existing air stripper was determined unfeasible due to lack of adequate space and lack of adequate piping if water ever needs to be returned to the spreading grounds. In Addition, the LGAC has the ability to treat a broader range of chemicals.

In summary, NASA's Preferred Alternative includes (a) centralized treatment of water extracted from four City of Pasadena wells in a new treatment plant proposed to be sited on a vacant portion of the property at the Windsor Reservoir and (b) continued centralized treatment for Lincoln Avenue Water Company wells. Both the City of Pasadena and the Lincoln Avenue Water Company treatment systems would use LGAC and ion exchange to remove VOCs and perchlorate. Also, both the City of

Pasadena and Lincoln Avenue Water Company will use the treated water for drinking water purposes. This Preferred Alternative is evaluated further in comparison with what is referred to as the *no-action alternative*.

EVALUATION OF THE PREFERRED ALTERNATIVE

Nine evaluation criteria were developed by the EPA under the *National Oil and Hazardous Substances Pollution Contingency Plan* for evaluation of remedial action alternatives. This Preferred Alternative is evaluated against these criteria. The nine criteria are categorized into three groups: threshold criteria, primary balancing criteria, and modifying criteria, as follows:

Threshold Criteria

- Overall Protection of Human Health and the Environment
- Compliance with *Applicable or Relevant and Appropriate Requirements (ARARs)*

Primary Balancing Criteria

- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, or Volume of Contaminants
- Short-Term Effectiveness
- Implementability
- Cost

Modifying Criteria

- State Acceptance
- Community Acceptance

The threshold criteria must be satisfied in order for an alternative to be eligible for selection. The primary balancing criteria are used among alternatives to weigh major tradeoffs, such as effectiveness and implementability. The modifying criteria are taken into account after the public comment period has ended and all comments have been reviewed and considered (in this case, by NASA) to determine if the Preferred Alternative remains the most appropriate remedial action or if modifications are needed.

For this remedial action, the Preferred Alternative of installing a new system for centralized treatment at four City of Pasadena wells and continued treatment at Lincoln Avenue Water Company is evaluated against the no-action alternative.

Figure 2. Ion Exchange Vessels Used to Remove Perchlorate at Lincoln Avenue Water Company

Threshold Criteria

Overall Protection of Human Health and the Environment. This criterion assesses whether an alternative provides adequate public health and environmental protection, and describes how health and environmental risks posed by the site will be eliminated, reduced, or controlled through treatment, engineering controls, or other means.

Under current conditions, the risks to local residents associated with VOCs and perchlorate in groundwater are negligible, assuming that the City of Pasadena wells remain closed and are not used to supply drinking water. In the Preferred Alternative, the groundwater pumped from the aquifer is treated to meet applicable, relevant, or appropriate state and federal water quality requirements prior to distribution to consumers. The Preferred Alternative is therefore protective of human health since the groundwater would be treated to meet all applicable or relevant and appropriate requirements. Also, removing chemicals restores the aquifer and prevents further migration of the chemicals in groundwater, thus protecting the environment. The no-action alternative does not prevent the spread of chemicals, and therefore does not protect the environment. In addition, the no-action alternative does not restore a groundwater aquifer being used by the local community (Lincoln Avenue Water Company and the City of Pasadena) for drinking water.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs). Compliance with ARARs addresses whether a remedial action alternative meets all pertinent federal and state environmental statutes and requirements. An alternative must comply with ARARs or be covered by a waiver to be acceptable.

No prehistoric sites, historic sites, historic buildings or landmarks were identified on the Windsor Reservoir property. No endangered or threatened species or critical habitats were present within the area identified for construction of the system nor is the property located in a floodplain or wetland.

Fugitive dust associated with Windsor Reservoir plant construction would be controlled to comply with South Coast Air Quality Management District Rules 401 and 403. No other air quality rules apply since, during plant operation, VOCs would be removed using the LGAC, which allows no emissions to escape.

Treated water would be required to comply with the most stringent of the federal and state MCLs, set forth in the Safe Drinking Water Act (40 CFR § 141.61(a) and (c)) and the CCR (Title 22, § 64444). A federal or state MCL for perchlorate has not been set. Until the perchlorate MCL is in place, the treatment plants would meet the state public health goal. Once an MCL is established, the system would meet that level.

JPL is located in the Monk Hill Subarea of the Raymond Basin. In 1944, the Superior Court of California approved the Raymond Basin Judgment, which adjudicated the rights to groundwater production to preserve the safe yield of the groundwater basin. Adjudication refers to the practice of landowners and other parties allowing the courts to settle disputes over how much groundwater can rightfully be extracted. In an adjudicated groundwater basin, the court appoints a Watermaster to administer the court judgment and determine an equitable distribution of water that will be available for extraction each year. The Raymond Basin Management Board, made up of representatives of the water purveyors, oversees the management and protection of the Raymond Basin. A total of six Raymond Basin water purveyors, including the City of Pasadena and Lincoln Avenue Water Company, operate wells in the Monk Hill Subarea. The City of Pasadena and Lincoln Avenue Water Company will continue to be subject to the extraction, reporting, and monitoring requirements associated with the Raymond Basin Judgment.

As is currently occurring at Lincoln Avenue Water Company, a relatively small volume of solid waste, consisting of spent ion exchange resin beads and wastes from the LGAC process, would be generated during operation of the new treatment system. Waste from the new treatment system would also be disposed at a properly licensed facility.

The Preferred Alternative would comply with all identified ARARs and would prevent further migration of VOCs and perchlorate in groundwater. The no-action alternative does not meet ARARs because chemicals are left in place, and untreated groundwater does not meet drinking water standards.

Because the plants constituting the Preferred Alternative would be leased and operated by the City of Pasadena and Lincoln Avenue Water Company, there may be a number of regulations that these entities would need to comply with in addition to NASA's requirements under CERCLA:

- The City of Pasadena and Lincoln Avenue Water Company would be required to comply with all applicable regulations associated with drinking water identified in the California Code of Regulations Titles 17 and 22. This includes obtaining certification of treatment plant operators and a permit to

operate the system from the Department of Health Services.

- The City of Pasadena and Lincoln Avenue Water Company would be required to comply with the requirements of the Department of Health Services Policy Memorandum 97-005 associated with purveying water from an aquifer located within a CERCLA operable unit
- As part of the new plant construction, the City of Pasadena would be required to comply with the California Environmental Quality Act (CEQA), a state environmental protection law that applies to projects undertaken or requiring approval by state or local government agencies. CEQA imposes requirements on those agencies that are similar to the requirements the National Environmental Protection Act (NEPA) imposes on federal agencies. In particular, CEQA requires California public agencies to identify the significant environmental effects of its actions to, where feasible, either avoid and/or mitigate any significant environmental effects. Lincoln Avenue Water Company prepared a CEQA initial study in 2004 associated with its treatment plant.
- Because the proposed location is within the City of Pasadena's city limits, as part of the new plant construction, the City of Pasadena would obtain local permits prior to constructing a new treatment facility, including a City Conditional Use Permit and a City Building Permit. Lincoln Avenue Water Company complied with the construction permitting requirements of the County of Los Angeles when it built its treatment plant in 2004.

Actions that meet CERCLA requirements are considered to be functionally equivalent to the National Environmental Policy Act. Therefore, a separate evaluation under NEPA is not needed. However, to ensure that all NEPA values are considered, NASA would document environmental impacts, if any, to support the recommended action as part of the Record of Decision.

Primary Balancing Criteria and Permanence

Long-Term Effectiveness and Permanence. Long-term effectiveness addresses the ability of an alternative to maintain reliable protection of human health and the environment over time, including the degree of certainty that the alternative will prove successful.

The location and the volume (at least 5,000 acre-feet/year) to be extracted from the City of Pasadena and Lincoln Avenue Water Company wells would effectively prevent further migration of the chemicals in groundwater. In addition, the technologies proposed (ion exchange and LGAC) have proven to be effective in treating groundwater to standards or goals required by the state and federal government. The Preferred Alternative is likely to operate for several decades and the technologies and equipment proposed have proven to be effective over such duration.

Operation of the two drinking water treatment systems will be effective for the long term. The systems would permanently remove chemicals from groundwater by extracting the groundwater and treating it to remove VOCs and perchlorate before the treated water is provided to customers. Results from daily monitoring of the treatment systems, as well as NASA's ongoing groundwater monitoring program, would be used to monitor the effectiveness of the Preferred Alternative.

The no-action alternative would not remove the chemicals; therefore, under that alternative long-term effectiveness would not be achieved.

Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment. The evaluation of this criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and significantly reduce toxicity, mobility, and volume of chemicals in groundwater.

The Preferred Alternative uses treatment that would permanently and irreversibly remove chemicals from the groundwater, thereby reducing the volume and mobility of chemicals in groundwater around JPL. The proposed technologies for removing VOCs and perchlorate transfer chemicals from the groundwater to the carbon and ion exchange media. The two media would be properly disposed in accordance with federal and state regulations as is currently the case for the Lincoln Avenue Water Company plant. The Preferred Alternative would reduce toxicity, mobility, and volume of affected groundwater. Because the chemicals are transferred to another material, the Preferred Alternative does not permanently destroy the chemicals; however, they would be contained and disposed of according to strict state and federal regulations.

The no-action alternative would leave chemicals in the groundwater to spread and further impact groundwater. Therefore, the no-action alternative does not permanently or significantly reduce toxicity, mobility, or volume of chemicals in groundwater.

Short-Term Effectiveness. The evaluation of short-term effectiveness addresses how well human health and the environment are protected from impacts during the construction and implementation of a remedial

alternative, and the length of time until protectiveness is achieved.

Construction of the new City of Pasadena treatment system would include conventional construction activities. These are expected to include such activities as well maintenance, plant concrete pad construction, and placement of vessels for the treatment system. Construction activities would result in a temporary increase in traffic and noise, expected to last less than six months. In addition, dust is often generated during construction activities. Care would be taken during construction, and work would be performed under strict health and safety requirements, including those required by the Occupational Safety and Health Administration (OSHA) for worker safety, to minimize human health and environmental impacts during construction. The City of Pasadena would follow appropriate processes for construction activities, including building permits, CEQA and requirements of the South Coast Air Quality Management District

Operation of the treatment systems would present minimal risks to workers, the public, and the environment. The systems are designed to shut down in case of malfunction and automatically alert operating staff if a shutdown occurs. The chemicals in the extracted water would be removed by the aboveground treatment system in accordance with state and federal regulations. While not part of the Proposed Plan, for purposes of drinking water disinfection, the City of Pasadena will use and store permitted disinfection chemicals and obtain all necessary permits to do so.

Ion exchange and LGAC are proven technologies with minimal startup issues and are able to supply clean water almost immediately upon installation as demonstrated by the Lincoln Avenue Water Company plant startup.

Experience with ion exchange and LGAC at the Lincoln Avenue Water Company plant has shown that some of the factors that could impact short-term effectiveness include solids in the extracted water and bacterial growth in the vessels during prolonged shutdown periods. These factors can be addressed by installing *bag filters* prior to ion exchange treatment to remove solids and by adhering to strict protocols for media handling and low-flow/no-flow operations.

No construction or implementation activities are associated with the no-action alternative. The no-action alternative does not generate any short-term negative impacts, but it also does not reduce existing impacts from the chemicals in the groundwater.

Implementability. Evaluation of implementability addresses the technical and administrative feasibility of implementing an alternative, including an evaluation of the availability of technologies, services, and materials required during implementation.

Implementation of a new treatment system would require relatively complex permitting efforts by the City of Pasadena. These efforts would include obtaining a Conditional Use Permit, conducting a CEQA evaluation, obtaining a Building Permit, and obtaining a permit to operate from the Department of Health Services, including compliance with Policy Memorandum 97-005. While these efforts increase the difficulty of implementing the Preferred Alternative, it still has a high level of implementability. The City of Pasadena strongly supports this approach and Pasadena Water and Power is the City Department that will coordinate the effort with the other technical and permitting departments within the city.

Construction of a new City of Pasadena system would require the use of commercially available equipment and services. Several vendors are capable of providing the ion exchange and LGAC equipment. Electrical work, pipeline installation, and concrete pad construction are common construction services with many potential providers in the Los Angeles area.

The no-action alternative has a high level of implementability because there are no technologies, services, or materials required for implementation.

Cost. Evaluation of cost addresses the total cost of the remedial action, including capital costs and *operation and maintenance costs*. Total costs are given in 2006 dollars.

Costs associated with construction of the City of Pasadena treatment system include installation of a 7,000-gallon per minute (gpm) ion exchange system, production well rehabilitation, electrical, pump and piping upgrades, system design, and associated permitting. The estimated construction cost for the treatment system is $3,400,000. The construction of the Lincoln Avenue Water Company plant in 2004 cost about $200,000.

Operation and maintenance (O&M) costs for both treatment systems include activated carbon change-outs, ion exchange resin change-outs, system maintenance, sample analysis, and regulatory fees. The estimated annual operating cost for the City of Pasadena system is $3,500,000. Based upon costs incurred since July 2004, the estimated annual operating cost for the Lincoln Avenue Water Company system is $1,000,000.

The no-action alternative would not result in any capital or O&M costs.

Modifying Criteria

State Acceptance. Evaluation of the criterion addresses any concerns regarding the preferred alternative and other alternatives raised by the State of California regulatory agencies and State comments on ARARs. The evaluation of State acceptance will be fully addressed during the public comment period and preparation of the Record of Decision.

Community Acceptance. Evaluation of this criterion addresses the apparent acceptability of the alternative to the community. The evaluation of community acceptance for this proposed plan will be fully addressed during the public comment period and preparation of the Record of Decision.

SUMMARY OF PREFERRED ALTERNATIVE

Based on the evaluation of the criteria described above, implementation of the Preferred Alternative – funding for the construction and operation of a system for treatment of water from four City of Pasadena wells and continued operation of a system for treatment of water from two Lincoln Avenue Water Company wells – is the most effective response action for meeting the remedial action objectives. The no-action alternative is not appropriate because there would be no removal of target chemicals from the aquifer, and further migration of chemicals in groundwater would not be controlled. Therefore, the remedial action objectives would not be met.

NASA's Preferred Alternative calls for the funding of a new treatment plant. NASA would directly administer the work connected with the designing, permitting, and construction of the City of Pasadena treatment system. The City of Pasadena and Lincoln Avenue Water Company would be funded by NASA to lease treatment equipment and operate the systems. The new City of Pasadena treatment system is proposed to be constructed in Pasadena on a vacant portion of the same property as the current Windsor Reservoir and Windsor Well.

NASA's Preferred Alternative would achieve the remedial action objectives: remove target chemicals from the aquifer used by the targeted drinking water wells and prevent further migration of the chemicals in groundwater. Results from periodic monitoring of the treatment systems, as well as NASA's ongoing groundwater monitoring program, would be used to monitor the effectiveness of the treatment system.

The Preferred Alternative satisfies the statutory requirements in CERCLA Section 121(b) that the selected alternative:

- Be protective of human health and the environment
- Comply with ARARs
- Be cost-effective
- Timely implement treatment solutions that are technically practicable
- Satisfy the regulatory preference for treatment solutions that reduce the volume or mass of target chemicals rather than solutions that only immobilize or contain the chemicals.

COMMUNITY PARTICIPATION

Over the past two years, NASA has engaged residents of the communities surrounding JPL, updating them about the status of the cleanup by holding several public meetings, sending out newsletters, maintaining a Web site (http://jplwater.nasa.gov), and meeting with community groups, individuals, health care and local government representatives and water purveyors.

In January 2004, public meetings were held to inform the public and JPL employees about the progress of cleanup activities that included describing several possible alternatives to treat perchlorate beneath the JPL facility. A newsletter on the project was mailed to residents of communities surrounding the JPL site.

In April 2004, another public meeting was held to discuss questions about potential public health effects associated with chemicals in the groundwater near JPL. Additional newsletters were distributed to more than 15,000 local residents in August 2004 and March 2005 that described cleanup actions funded by NASA at the two wells operated by the Lincoln Avenue Water Company. Progress of the Lincoln Avenue Water Company plant has continued to be communicated to the community via newsletters, tours, and community involvement meetings.

A community information session was held in late March 2005, providing an opportunity for attendees to speak one-on-one with, and ask questions of, NASA project staff and contractors involved in the groundwater cleanup, and to view a selection of displays about the overall cleanup effort. The off-facility systems (the existing treatment plant for Lincoln Avenue Water Company and the Preferred Alternative considered in this Proposed Plan) also were discussed at this session.

On November 16, 2005, a public meeting was held to provide information, and take public comments on a Proposed Plan for the on-site source area groundwater treatment system.

NASA is now asking for public comment on NASA's Preferred Alternative discussed in this Proposed Plan. A newsletter briefly describing NASA's Proposed Plan was mailed to area residents on April 14. The public meeting regarding this issue will be on May 3, and written comments will be accepted through May 19.

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
CEQA	California Environmental Quality Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
EPA	U.S. Environmental Protection Agency
FBR	Fluidized Bed Reactor
gpm	gallons per minute
JPL	Jet Propulsion Laboratory
LGAC	liquid-phase granular activated carbon
MCL	maximum contaminant level
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
O&M	Operation and Maintenance
OU	Operable Unit
PCE	tetrachloroethylene
PHG	public health goal
ppb	parts per billion
SVE	soil vapor extraction
TCE	trichloroethylene
VOC	volatile organic compound

GLOSSARY

Administrative Record: A collection of all documents used to select and justify remedial actions. These documents are available for public review.

Air Stripping: A treatment system that removes VOCs from contaminated groundwater or surface water by forcing an airstream through the water and causing the compounds to evaporate. The air can be further treated (for example, by using granular activated carbon) before it is released into the atmosphere.

Applicable or Relevant and Appropriate Requirement (ARAR): A federal or state law or regulation that must be followed during implementation of the remedy selected for site cleanup.

Bag Filter: A treatment process for removing suspended solids from water, whereby the water is passed through a unit containing the filter(s) that traps the solids but allows the water to pass through. The filter bags are replaced periodically, as needed.

Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA): Legislation from 1980 that authorizes federal action to respond to the release, or the threat of release, into the environment of hazardous substances, pollutants, or chemicals that may present an imminent or substantial danger to public health or welfare or to the environment. Commonly referred to as Superfund.

Ecological Risk Assessment: A quantitative process that estimates the risk to flora and fauna from exposure to chemicals at a site.

Feasibility Study: An engineering evaluation of technologies that may be used to remediate a site. An Feasibility Study evaluates site conditions, technical problems, costs, and human and ecological impacts to determine the effectiveness of potentially applicable technologies.

Federal Facility Agreement: A legal document that defines the roles and responsibilities of the government agencies associated with a federal facilities CERCLA site.

Groundwater: Water beneath the ground surface that fills spaces between soil particles.

Human Health Risk Assessment: A quantitative process that estimates the risk to human health from exposure to chemicals at a site.

Information Repository: The physical location where a collection of site information is maintained. Documents in an information repository are available for public review.

Ion Exchange: A method of treating water for the removal of perchlorate or other ions. Water is passed through a bed of resin and ions are exchanged between the water and the resin.

Liquid-Phase Granular Activated Carbon (LGAC): A form of carbon that is heated to promote "active" sites which can adsorb pollutants. LGAC has a strong potential to attract and adsorb VOCs from extracted groundwater and gases.

National Oil and Hazardous Substances Pollution Contingency Plan: A regulation issued by the EPA to implement the requirements of CERCLA.

National Priorities List: A list of uncontrolled hazardous-substance release sites in the United States that are priorities for long-term remedial evaluation and response. The National Priorities List is compiled by the EPA pursuant to Section 105 of CERCLA.

No-Action Alternative: A remedial action alternative that involves no additional site environmental activities beyond a Remedial Investigation.

Operation and Maintenance (O&M): Activities and their associated costs that are needed to operate and maintain a site remedial activity or technology.

Operable Unit (OU): An area designated under NASA's program to identify, investigate, assess, characterize, clean up, or control past releases of hazardous substances.

Perchlorate: A chemical compound that is a primary component of solid rocket propellant that dissolves readily in water.

Preferred Alternative: The preferred approach to site cleanup presented in the Proposed Plan and determined based on its ability to achieve the cleanup objectives. The Preferred Alternative can change as a result of public comment or new information.

Proposed Plan: A document that summarizes cleanup information and solicits public input. A proposed plan includes a summary of the environmental conditions at a site, as determined by the Remedial Investigation; describes remedial alternatives for the site; provides a summary of ARARs; and provides a brief analysis to support the Preferred Alternative.

Record of Decision: A document that summarizes how a site will be cleaned up and justifies the selection of the cleanup method chosen.

Remedial Investigation: A field study that includes collecting and analyzing field samples to evaluate the types and concentrations of chemicals present at a site.

Soil Vapor Extraction (SVE): A treatment technology in which VOCs are removed from soils by induced airflow.

Source Area: The area where the majority of chemicals remain in groundwater at elevated concentrations. The source area correlates with the suspected chemical release area.

Volatile Organic Compound (VOC): A chemical compound that contains the element carbon and that readily evaporates into air at room temperature.

INFORMATION REPOSITORIES

Pasadena Central Library
285 East Walnut Street
Pasadena, CA 91101
(626) 744-4052

Altadena Public Library
600 East Mariposa Avenue
Altadena, CA 91001
(626) 798-0833

La Cañada Flintridge Public Library
4545 Oakwood Avenue
La Cañada Flintridge, CA 91011
(818) 790-333-

JPL Library
(JPL On-Site Personnel)
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