

April 11, 1988
NASA/88-039
No response required

Mr. Michael Green
NASA Headquarters
300 7th Street, SW
Washington, D.C. 20546

SUBJECT: NASA CONTRACT NO. NASW-4301
PRELIMINARY ASSESSMENT/SITE INSPECTION
JET PROPULSION LABORATORY

Dear Mr. Green:

We have enclosed the Preliminary Assessment/Site Inspection report prepared for the Jet Propulsion Laboratory (JPL). The report incorporates the comments of both NASA Headquarters and JPL staff.

As indicated by the HRS score (38.3), this facility should have a high priority for additional contamination assessment work. Specifically, we would recommend prompt investigations of the six seepage pits where chemical wastes were disposed of in the 1940's and 1950's, and which may have caused contamination of the municipal water supply wells. We would also recommend investigations of the alleged chemical spills near Building 187 and continued study of the contaminated municipal wells. These studies should be coordinated with the on-going Corps of Engineers (Former Sites Program) study.

Specifically, we would recommend the following hydrogeologic studies:

- o Soil borings and groundwater monitoring wells should be implemented near each of the six alleged disposal pits and at Building 187 (former spill location). In order to determine more precise locations of the pits, further interviews with JPL employees should also be conducted.
- o Deeper definition of the contamination near the city water supply wells. Because the volatile organic constituents of concern are more dense than water, they tend to accumulate in the lowest part of the aquifer. Samples taken to date have been collected from a depth of 366 feet (cased depth of well), whereas the aquifer probably extends to 600 feet.
- o The seepage pits and the municipal wells should be sampled for all EPA priority pollutants because of the disposal of unknown chemicals in the seepage pits.

Mr. M. Green
Page 2
April 11, 1988

We wish to extend our thanks to Ms. Mary Drazek and the other JPL staff, who were very helpful in identifying past and present waste disposal practices. If you have any specific questions or concerns, please contact Mr. Gary Cronk at (714) 662-4050 or Mr. Stephen Turner at (703) 558-7512.

Sincerely,

Thomas H. Magness III
Manager of Environmental Projects

THM/ST/wpc
Attachments

cc: M. Drazek, JPL

3214E

SUMMARY

1. Introduction

Ebasco Services, Inc. representatives visited the NASA-Jet Propulsion Laboratory (JPL) in Pasadena, CA on February 22-24, 1988. The purpose of this visit was to perform a Preliminary Assessment and Site Inspection (PA/SI) as mandated by the EPA. Ebasco was represented by Mr. Gary Cronk and Ms. Michelle Leonard. The NASA-JPL representative was Ms. Mary Drazek. This summary report presents the findings of the Preliminary Assessment.

The NASA-JPL facility is located northeast of the 210 Foothill Freeway in Pasadena, California. The site is comprised of 176 acres, and is situated on the south-facing slope of a foothill ridge of the San Gabriel Mountains adjacent to the Arroyo Seco wash. The site is situated on an alluvial fan and is characterized by highly permeable soils.

The site was developed by the Army between 1945 and 1957, and remained under Army control until it was taken over by NASA in 1958. The California Institute of Technology (Cal Tech) operates the lab for NASA. The lab functions as NASA's primary center for unmanned interplanetary exploration in conjunction with the NASA mission of space exploration and aeronautical research and development. Over 100 different types of chemicals are used at the facility in conducting research in spacecraft propulsion and design, and in alternative energy sources and pollution control.

2. Concerns

Several areas of environmental concern were identified by Mary Drazek and other JPL staff. The following is a brief discussion of these areas:

- a. Seepage Pit #1 near Building #103 (see Map Location #1). The site was located outside of the JPL fence in the Arroyo Seco dry wash, at the southeast corner of the lab. This site was approximately 15

feet wide by 15 feet deep, and was used primarily for disposal of municipal solid wastes. However, according to JPL personnel, chemical wastes were also disposed, including solvents, freon, mercury, solid rocket fuel propellants, cooling tower chemicals, and sulfuric acid. None of the wastes were disposed in containers except for the mercury which was in small flasks. No sampling near this pit has been conducted to verify contamination.

- b. Seepage Pit #2 near Arroyo Parking Lot (see Map Location #2). This site was located below the Southern California Edison substation, approximately 50 yards from the end of the main storm drain that empties into the Arroyo Seco wash. This pit was approximately 30 feet wide and 15 feet deep. The pit is believed to be under the existing parking lot. Wastes disposed at this pit were similar to those at Pit #1. The site was also used for burning debris, and for disposal of fluorescent lights and waste magnesium. No sampling of this pit has been conducted.
- c. Seepage Pit #3 near Building #117 (see Map Location #3). This disposal pit was located just northwest of two current day bunkers #140 and #141, used for storing propellants. The pit was approximately 30 feet deep, and was used primarily for the disposal of propellants and mixed solvents. No sampling of this pit has been conducted. Seepage pits #1, #2, and #3 received chemical wastes over the period 1954-1958 according to JPL personnel.
- d. Seepage Pit #4 near Building 303 and former building 59 (see Map). This pit was used exclusively for disposal of chemistry lab wastes. This pit location was investigated down to a depth of 11 feet in 1984 by R.C. Slade.⁽¹⁾ Lead concentrations (200 ppm) were found above normal levels. No other contaminants were found.
- e. Seepage Pit #5 near Building 302 and former building 65 (see Map). This pit was also used exclusively for disposal of chemistry lab wastes. R.C. Slade also investigated this pit and didn't find any contaminants above normal levels down to 11 feet.

- f. Seepage Pit #6 near Building 97 (see Map). This was the former site of a chemistry lab that used this pit for disposal of lab wastes. R.C. Slade investigated this pit to 11 feet and no contaminants above normal levels were found. Disposal in Pits #4, #5, and #6 occurred during the approximate period of 1941-1960.
- g. Past Spills Near Chemical Storage Building (Building 187). According to JPL personnel, waste solvents were historically dumped onto the soils near this storage building. No sampling has ever been conducted to confirm any contamination.
- h. Municipal Water Wells. Testing in 1980 of three City of Pasadena wells, 1,000 feet downgradient of the JPL site, indicated concentrations of TCE, PCE, and CCl_4 above drinking water standards. The wells, which provide drinking water to San Gabriel Valley residents, were removed from service. A hydrogeologic study was conducted by R.C. Slade,⁽¹⁾ who drilled a monitoring well about half the distance (500 ft.) from JPL. This well showed contaminant levels of 7.5 ug/l for TCE and 2.4 ug/l for CCl_4 . He concluded that past JPL (and U.S. Army) activities probably contributed to the groundwater contamination. In another study conducted for the City by James M. Montgomery, several treatment alternatives were evaluated which led to the installation of a pilot treatment plant at one of the contaminated wells.⁽²⁾ However, the studies conducted to date have not determined the full extent or degree of contamination, nor do they identify the specific source areas of contamination.

The U.S. Army Corps of Engineers (Los Angeles District) is currently conducting a remedial investigation of the site, including the placement of monitoring wells in Arroyo Seco and west of the JPL facility.

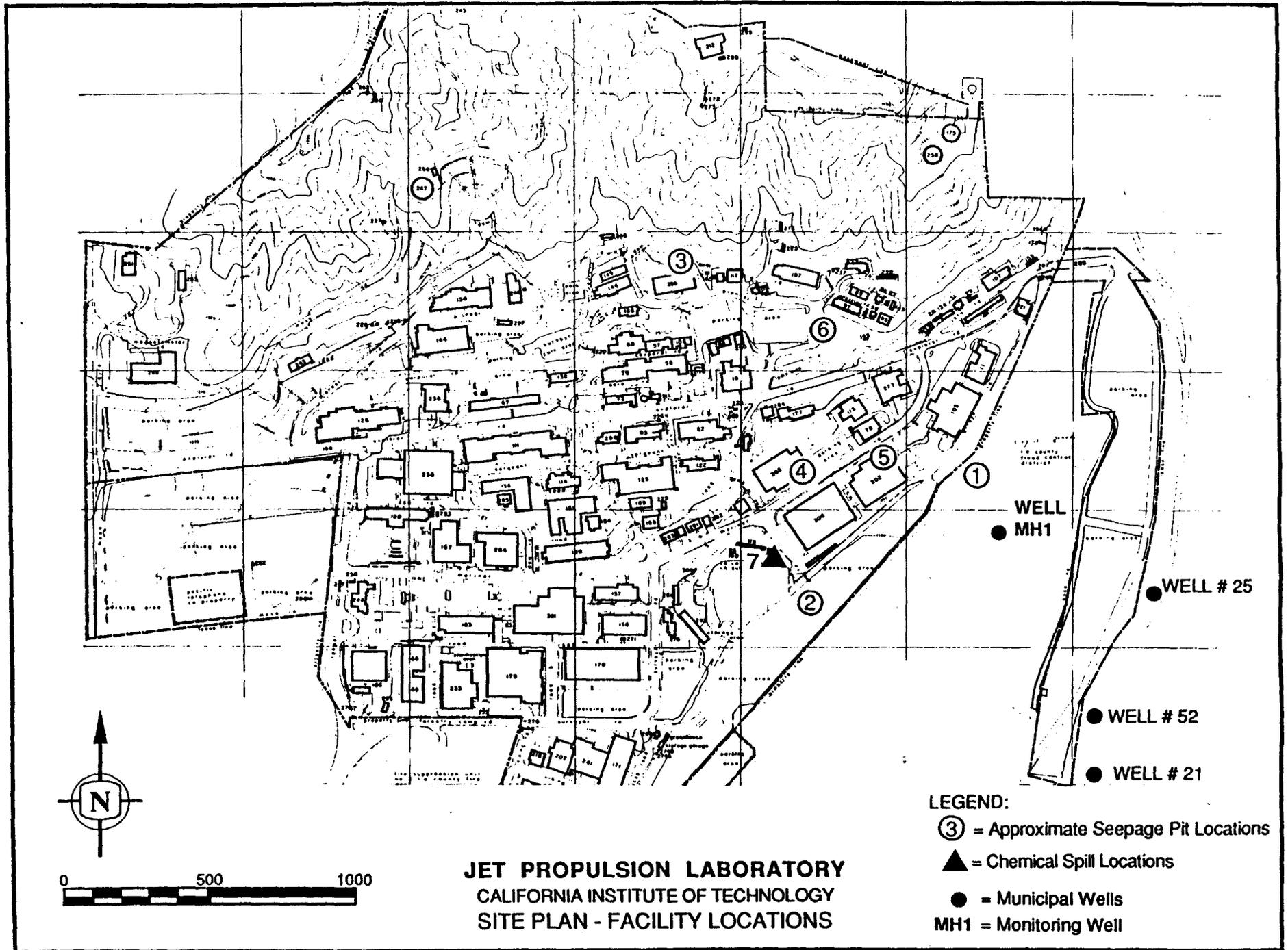
3. Recommendations

Due to the nature of past JPL waste disposal activities and the current contamination of downgradient municipal water supply wells, a Site Inspection of JPL should be conducted.



JET PROPULSION LABORATORY

SCALE 1" = 2,000 FEET



Reference Documents

1. Preliminary Hydrogeologic Assessment of Soils and Groundwater Monitoring at JPL; Richard C. Slade, September 1984. (Attachment).
2. Treatability/Feasibility Study for Groundwater Contaminated with Volatile Organic Chemicals in the Monk Hill Subarea of the Raymond Basin; James M. Montgomery, Consulting Engineers, Inc., November 1986. (Attachment).
3. Environmental Resources Document, JPL, December, 1980.
4. AB 1803 Water Analysis Plan for the Raymond Basin; Raymond Basin Management Board, May 1985.
5. Watermaster Service in Raymond Basin, July 1, 1984-June 30, 1985; California Department of Water Resources, Southern District, September 1985.
6. Memorandum from Mary Wang, JPL Environmental Coordinator, to William Rains, regarding review of Treatability feasibility Study, December 1986.
7. Letter from Karl A. Johnson, General Manager, City of Pasadena, to Lt. General Charles H. Terhune, Deputy Director, JPL, suggesting JPL and City work cooperatively on program to investigate presence of chemicals in City's wells.
8. Report on TCE Investigation, April 1980 (w/Addendums) - Los Angeles RWQCB.
9. Jet Propulsion Laboratory Asbestos Survey. Final Report: Building Plan Booklet, Associated Safety Consultants, January 1985.
10. Hazardous Materials Inventory. JPL, Occupational Safety and Environmental Health Office.

11. California Division of Mines and Geology, Open File Report 86-4 LA - Geology of North Half of Pasadena quad.
 - a. Geology of the North Half of the Pasadena Quad., L.A. County.
 - b. Geologic sections of the North Half of the Pasadena Quad.
 - c. Structural Contour Map of the Top of Crystalline Basement Rocks, North Half of Pasadena Quad.

Personnel Interviewed

1. Mary Drazek, JPL Environmental Coordinator (1½ years service with JPL), Meetings 2/21 - 2/23 -- Discussed overall program, concerns, approach to PA/SI, contacts.
2. Bruce Fisher, JPL Energy Resources Coordinator, Interview 2/22 -- Discussed underground tank program, asbestos removal, AQMD permits, and county sanitation sewer analyses.
3. Bill Fehlings, JPL Facilities Maintenance and Operation Section (JPL Employee since 1954). Interview 2/21 -- Discussed past waste disposal practices.
4. Roscoe Edwards, JPL Facilities Maintenance and Operation Section, Interview 2/23 -- Discussed waste disposal practices, aerial photograph (circa 1951).
5. Al Klascius, JPL Safety Office (JPL Employee since 1958). Interview 2/22 -- Discussed beryllium shop and subcommittee, sewer installation.
6. Richard MacGillivray, JPL Facilities Maintenance and Operation Section (JPL Employee since 1959). Interview 2/23 -- Discussed waste disposal practices.
7. Lane Prior, Former (Retired) JPL Safety Officer. Interview with M. Drazek, JPL Environmental Contact, information transferred to Ebasco Services. Discussed past disposal practices.

8. Tom Underbrink, Civil Engineer, City of Pasadena Water and Power Department. Discussed population served by groundwater; referred to Health Department for past response activities at JPL.
9. Tom Reardon, City of Pasadena Environmental Health Department. Discussed agency responsibilities for response activities.
10. Laura Dahl, Planner, City of Pasadena. Discussed land use and population densities in vicinity of JPL.
11. Bill Campbell, Director, City of La Canada, Flintridge Community Development Department. Discussed land use, and population densities in vicinity of JPL.



POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 1 - SITE INFORMATION AND ASSESSMENT

I. IDENTIFICATION
01 STATE | 02 SITE NUMBER
CA | 9800013030

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site)
NASA - Jet Propulsion Laboratory

02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER
4800 Oak Grove Dr.

03 CITY
Pasadena

04 STATE | 05 ZIP CODE | 06 COUNTY | 07 COUNTY CODE | 08 CONG DIST
CA | 91109 | Los Angeles | 037 | 25

09 COORDINATES LATITUDE | LONGITUDE
34°12' 00. N | 118°10' 30. W

10 DIRECTIONS TO SITE (Starting from nearest public road)
Off Highway 210 take Berkshire Exit East, then Northwest on Oak Grove approximately 1 mile

III. RESPONSIBLE PARTIES

01 OWNER (if known)
NASA

02 STREET (Business, mailing, residential)
4800 Oak Grove Drive

03 CITY
Pasadena

04 STATE | 05 ZIP CODE | 06 TELEPHONE NUMBER
CA | 91109 | (818) 354-4710

07 OPERATOR (if known and different from owner)
JPL/California Institute of Technology

08 STREET (Business, mailing, residential)
4800 Oak Grove Drive

09 CITY
Pasadena

10 STATE | 11 ZIP CODE | 12 TELEPHONE NUMBER
CA | 91109 | (818) 354-4710

13 TYPE OF OWNERSHIP (Check one)
 A. PRIVATE B. FEDERAL: NASA (Agency name) C. STATE D. COUNTY E. MUNICIPAL
 F. OTHER: (Specify) G. UNKNOWN

14 OWNER/OPERATOR NOTIFICATION ON FILE (Check all that apply)
 A. RCRA 3001 DATE RECEIVED: Fall / 80 (MONTH DAY YEAR) B. UNCONTROLLED WASTE SITE (RCRA 103 c) DATE RECEIVED: / / (MONTH DAY YEAR) C. NONE

IV. CHARACTERIZATION OF POTENTIAL HAZARD

01 ON SITE INSPECTION BY (Check all that apply)
 YES DATE / / (MONTH DAY YEAR) A. EPA B. EPA CONTRACTOR C. STATE D. OTHER CONTRACTOR
 NO E. LOCAL HEALTH OFFICIAL F. OTHER: (Specify)
CONTRACTOR NAME(S):

02 SITE STATUS (Check one)
 A. ACTIVE B. INACTIVE C. UNKNOWN

03 YEARS OF OPERATION
1941 | Present (BEGINNING YEAR | ENDING YEAR)
Army 1941-58
NASA 1958-Present

04 DESCRIPTION OF SUBSTANCES POSSIBLY PRESENT, KNOWN, OR ALLEGED
Three seepage Pits formerly used (1954-1958) for disposal of solvents, freon, mercury, solid rocket propellants, sulfuric acid, cooling tower chemicals. Three Seepage Pits formerly used (1941-1960) for disposal of chemistry lab wastes.

05 DESCRIPTION OF POTENTIAL HAZARD TO ENVIRONMENT AND/OR POPULATION
Former Seepage Pits are located in wash, creating a potential for surface and groundwater contamination. On-site pits present potential for soil and groundwater contamination. Downgradient drinking water supply has elevated levels of TCE, PCE, and CCl4

V. PRIORITY ASSESSMENT

01 PRIORITY FOR INSPECTION (Check one. If high or medium is checked, complete Part 2 - Waste Information and Part 3 - Description of Hazardous Conditions and Incidents)
 A. HIGH (Inspection required promptly) B. MEDIUM (Inspection required) C. LOW (Inspect on time available basis) D. NONE (No further action needed, complete current disposition form)

VI. INFORMATION AVAILABLE FROM

01 CONTACT
Mary Drazek

02 OF (Agency Organization)
NASA - JPL

03 TELEPHONE NUMBER
(818) 354-4710

04 PERSON RESPONSIBLE FOR ASSESSMENT
M. Leonard/G. Cronk

05 AGENCY
Ebasco

06 ORGANIZATION
Ebasco

07 TELEPHONE NUMBER
(714) 662-4050

08 DATE
2 / 22 / 88 (MONTH DAY YEAR)



POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 2 - WASTE INFORMATION

I. IDENTIFICATION
01 STATE 02 SITE NUMBER
CA 9800013030

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply) <input checked="" type="radio"/> SOLID <input type="radio"/> POWDER FINES <input type="radio"/> SLUDGE <input type="radio"/> OTHER _____ (Specify) _____ <input type="radio"/> SLURRY <input checked="" type="radio"/> LIQUID <input type="radio"/> GAS	02 WASTE QUANTITY AT SITE Measures of waste quantities must be independent! TONS _____ CUBIC YARDS _____ NO OF DRUMS <u>15-20/3 months</u>	03 WASTE CHARACTERISTICS (Check all that apply) <input checked="" type="radio"/> TOXIC <input type="radio"/> CORROSIVE <input type="radio"/> RADIOACTIVE <input type="radio"/> PERSISTENT <input type="radio"/> SOLUBLE <input type="radio"/> INFECTIOUS <input checked="" type="radio"/> FLAMMABLE <input type="radio"/> IRRITANT <input type="radio"/> HIGHLY VOLATILE <input type="radio"/> EXPLOSIVE <input type="radio"/> REACTIVE <input type="radio"/> INCOMPATIBLE <input type="radio"/> NOT APPLICABLE
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III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE	unknown	Drums	Paints
OLW	OILY WASTE	3,000	Gal	Waste Oil/4-5 months
SOL	SOLVENTS	10-15	Drums	Mixed Solvents/3 months
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS	Unknown	Drums	PCBs
IOC	INORGANIC CHEMICALS			
ACD	ACIDS	Unknown		Sulfuric, acetic, hydrochloric
BAS	BASES	Unknown		Sodium Hydroxide, Lead
MES	HEAVY METALS	1.2	Tons	Mercury, batteries (recycled)

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
MES	Beryllium	7440-41-7	Drums/contract Haul		
MES	Mercury	7439-97-6	Drums/contract Haul		
IOC	Asbestos	1332-21-4	Drums/contract Haul		
SOL	Benzene	71-43-2	Lab Packs/contract Haul		
SOL	Toluene	108-88-3	Lab Packs/contract Haul		
OCC	PCB oils	1336-36-3	Drums/contract Haul		
OCC	Freon	999	Drums/contract Haul		
SOL	Methylene Chloride	999	Drums/contract Haul		
MES	Lead	301-04-2	Recycle batteries	200 (soil)	PPM
SOL	Trichloroethane	25323-89-1	Drums/contract Haul		
SOL	Trichlorotrifluoroethane	999	Drums/contract Haul		
ACD	Sulfuric Acid	7664-93-9	Drums/contract Haul		
ACD	Acetic Acid	64-19-7	Drums/contract Haul		
BAS	Sodium Hydroxide	1310-73-2	Drums/contract Haul		
ACD	Hydrochloric Acid	7647-01-0	Drums/contract Haul		
	* See note below				

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS	Mercury	7439-97-6	FDS	Acetone	67-64-1
FDS	Toluene	108-88-3	FDS	Acetic Acid	64-19-7
FDS	Sulfuric Acid	7664-93-9	FDS	Hydrochloric Acid	7647-01-0
FDS	Sodium Hydroxide	1310-73-2	FDS		

VI. SOURCES OF INFORMATION (Cite specific references e.g. state files, sample analysis reports)

- Hazardous Waste Manifests
- Mary Drazek, JPL Environmental contact

Note: Over 100 hazardous substances stored at a time, in quantities of less than than a gallon of liquid or a kilogram of solids



POTENTIAL HAZARDOUS WASTE SITE
PRELIMINARY ASSESSMENT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE CA	02 SITE NUMBER 9800013030

II. HAZARDOUS CONDITIONS AND INCIDENTS

01 A GROUNDWATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED _____

02 OBSERVED (DATE since 1980) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

VOC contamination of three (3) Municipal wells 1000 ft. downgradient from JPL. Sampling at monitoring well between JPL and municipal wells showed concentration of VOCs at 7.5 ug/l for TCE and 2.4 ug/l for CCl₄.

01 B SURFACE WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED _____

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

Seepage pit located in Arroyo (1954-58) probably contaminated surface water.
Periodic chemical spills drain directly to Arroyo Seco

01 C CONTAMINATION OF AIR
03 POPULATION POTENTIALLY AFFECTED _____

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

None Alleged or Observed

01 D FIRE/EXPLOSIVE CONDITIONS
03 POPULATION POTENTIALLY AFFECTED _____

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

None Alleged or Observed

01 E DIRECT CONTACT
03 POPULATION POTENTIALLY AFFECTED _____

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

None Alleged or Observed

01 F CONTAMINATION OF SOIL
03 AREA POTENTIALLY AFFECTED _____ (Acres)

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

Potential for soil contamination at six seepage pits from dumping of freon, mercury, solvents and other chemicals (See facility map).

01 G DRINKING WATER CONTAMINATION
03 POPULATION POTENTIALLY AFFECTED _____

02 OBSERVED (DATE 1980) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

Municipal wells downgradient of JPL have been detected with TCE, PCE, CCl₄ contamination. Specific source has not been determined. Wells have been shut down periodically between 1983 and 1986.

01 H WORKER EXPOSURE/INJURY
03 WORKERS POTENTIALLY AFFECTED: _____

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

None Alleged or Observed

01 I POPULATION EXPOSURE/INJURY
03 POPULATION POTENTIALLY AFFECTED _____

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

04 NARRATIVE DESCRIPTION

None Alleged or Observed

SITE INSPECTION REPORT
FOR
NASA-JET PROPULSION LABORATORY
4800 Oak Grove Drive
Pasadena, CA 91109
Site Number CA9800013030

SUMMARY

1. Introduction

Ebasco Services, Inc. representatives visited the NASA-Jet Propulsion Laboratory (JPL) in Pasadena, CA on February 22-24, 1988. The purpose of this visit was to perform a Preliminary Assessment and Site Inspection (PA/SI) as mandated by the EPA. Ebasco was represented by Mr. Gary Cronk and Ms. Michelle Leonard. The NASA-JPL representative was Ms. Mary Drazek. This summary report presents the findings of the Site Inspection and the Hazard Ranking System (HRS) scoring.

2. Concerns

Potential areas of concern were evaluated through interviews with former and present JPL employees, a literature review, and investigations of seepage pit locations. The following sites were evaluated in the SI and the HRS scoring:

- a. Seepage Pit #1 near Building #103 (see Map Location #1). The site was located outside of the JPL fence in the Arroyo Seco dry wash, at the southeast corner of the lab. This site was approximately 15 feet wide by 15 feet deep, and was used primarily for disposal of municipal solid wastes. However, according to JPL personnel, chemical wastes were also disposed, including solvents, freon, mercury, solid rocket fuel propellants, cooling tower chemicals, and sulfuric acid. None of the wastes were disposed in containers except for the mercury which was in small flasks. No sampling near this pit has been conducted to verify contamination.
- b. Seepage Pit #2 near Arroyo Parking Lot (see Map Location #2). This site was located below the Southern California Edison substation, approximately 50 yards from the end of the main storm drain that empties into the Arroyo Seco wash. This pit was approximately 30 feet wide and 15 feet deep. The pit is believed to be under the

existing parking lot. Wastes disposed at this pit were similar to those at Pit #1. The site was also used for burning debris, and for disposal of fluorescent lights and waste magnesium. No sampling of this pit has been conducted.

- c. Seepage Pit #3 near Building #117 (see Map Location #3). This disposal pit was located just northwest of two current day bunkers #140 and #141, used for storing propellants. The pit was approximately 30 feet deep, and was used primarily for the disposal of propellants and mixed solvents. No sampling of this pit has been conducted. Seepage pits #1, #2, and #3 received chemical wastes over the period 1954-1958 according to JPL personnel.
- d. Seepage Pit #4 near Building 303 and former building 59 (see Map). This pit was used exclusively for disposal of chemistry lab wastes. This pit location was investigated down to a depth of 11 feet in 1984 by R.C. Slade.⁽¹⁾ Lead concentrations (200 ppm) were found above normal levels. No other contaminants were found.
- e. Seepage Pit #5 near Building 302 and former building 65 (see Map). This pit was also used exclusively for disposal of chemistry lab wastes. R.C. Slade also investigated this pit and didn't find any contaminants down to the 11 foot level.
- f. Seepage Pit #6 near Building 97 (see Map). This was the former site of a chemistry lab that used this pit for disposal of lab wastes. R.C. Slade investigated this pit to 11 feet and no contaminants above normal levels were found. Disposal in Pits #4, #5, and #6 occurred during the approximate period of 1941-1960.
- g. Past Spills Near Chemical Storage Building (Building 187). According to JPL personnel, waste solvents were historically dumped onto the soils near this storage building. No sampling has ever been conducted to confirm any contamination.

h. Municipal Water Wells. Testing in 1980 of three City of Pasadena wells, only 1,000 feet downgradient of the JPL site, indicated concentrations of TCE, PCE, and CCl_4 above drinking water standards. The wells, which provide drinking water to San Gabriel Valley residents, were removed from service. A hydrogeologic study was conducted by R.C. Slade, who drilled a monitoring well about half the distance (500 ft.) from JPL. This well showed contaminant levels of 7.5 ug/l for TCE and 2.4 ug/l for CCl_4 . He concluded that past JPL (and U.S. Army) activities probably contributed to the groundwater contamination.⁽¹⁾ In another study conducted for the City by James M. Montgomery, several treatment alternatives were evaluated which led to the installation of a pilot treatment plant at one of the contaminated wells.⁽²⁾ However, the studies conducted to date have not determined the full extent or degree of contamination, nor do they identify the specific source areas of contamination.

The U.S. Army Corps of Engineers (Los Angeles District) is currently conducting a remedial investigation of the site, including the placement of monitoring wells in Arroyo Seco and to the west of the JPL facility.

3. Data Gaps

The following information was not available or was estimated during completion of the SI form:

- o Hazardous substances, Part 2, IV (incomplete list)
- o Description of wells, Part 5, III-09 (not readily available)
- o Permeability of unsaturated zone, Part 5, VI-01 (estimated)
- o Permeability of bedrock, Part 5, VI-02 (estimated)
- o Depth of contaminated soil zone, Part 5, VI-04 (unknown)
- o Site slope and terrain average slope, Part 5, VI-08 (unknown)
- o Distance to agricultural land, Part 5, VI-13 (unknown)

4. Hazard Ranking System Score

Following completion of the SI investigation a Hazard Ranking System (HRS) score was computed for JPL. The overall migration route score (S_m) and the individual migration scores are summarized below:

S_m (weighted-overall score)	= 38.3
S_{gw} (groundwater migration route)	= 65.9
S_{sw} (surface water migration route)	= 7.4
S_a (air migration route)	= 0

The overall score of 38.3 is well above the 28.5 level to be considered for the National Priorities List (NPL). Thus, the relative environmental and public health hazard at JPL must be considered high. JPL was ranked very high for the groundwater migration route ($S_{gw} = 65.9$), since a municipal water supply has already been affected. It should be noted that this score assumed a conservative value for hazardous waste quantity disposed, using a range 41-250 drums (2,000-12,500 gallons). It is unknown how much hazardous waste may have actually been dumped into the seepage pits.

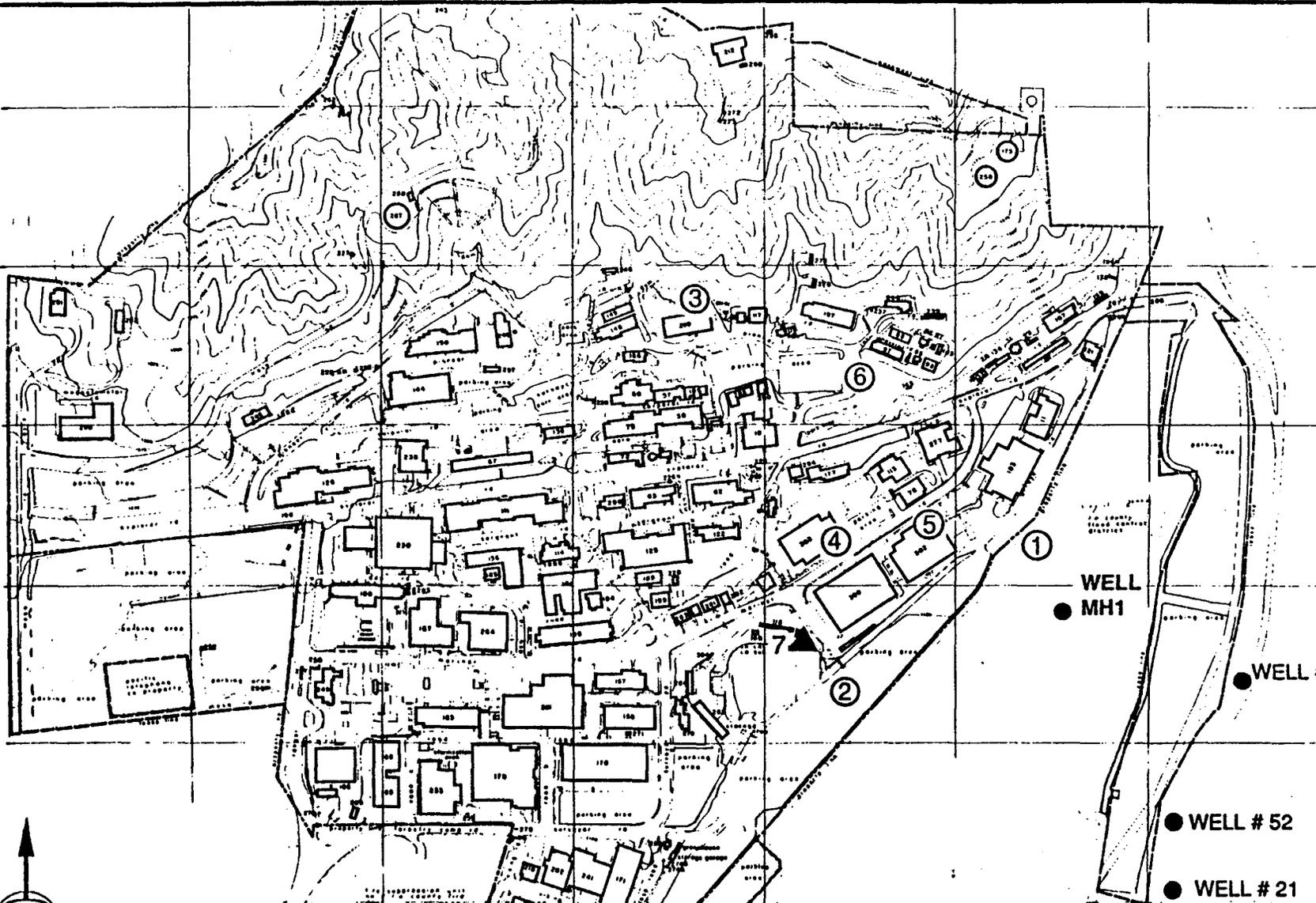
5. Recommendations

JPL should receive a high priority for further hydrogeologic studies due to the severity of the on-site contamination sources. The high HRS score of 38.3 is reflective of the high public health risk due to the contamination of the City of Pasadena's water wells. Additional studies should focus on the 6 seepage pits, the chemical spill site near Building 187, and continued monitoring of the municipal wells. The Army Corps of Engineers is currently conducting a remedial investigation surrounding the JPL Site, and efforts should be made to coordinate future work with the Corps of Engineers.

JET PROPULSION LABORATORY



SCALE 1" = 2,000 FEET



JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY
SITE PLAN - FACILITY LOCATIONS

- LEGEND:**
- ③ = Approximate Seepage Pit Locations
 - ▲ = Chemical Spill Locations
 - = Municipal Wells
 - MH1 = Monitoring Well

Reference Documents

1. Preliminary Hydrogeologic Assessment of Soils and Groundwater Monitoring at JPL; Richard C. Slade, September 1984. (Attachment).
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10. Hazardous Materials Inventory. JPL, Occupational Safety and Environmental Health Office.

11. California Division of Mines and Geology, Open File Report 86-4 LA - Geology of North Half of Pasadena Quad.
 - a. Geology of the North Half of the Pasadena Quad., L.A. County.
 - b. Geologic sections of the North Half of the Pasadena Quad.
 - c. Structural Contour Map of the Top of Crystalline Basement Rocks, North Half of Pasadena Quad.

Personnel Interviewed

1. Mary Drazek, JPL Environmental Coordinator (1½ years service with JPL), Meetings 2/21 - 2/23 -- Discussed overall program, concerns, approach to PA/SI, contacts.
2. Bruce Fisher, JPL Energy Resources Coordinator, Interview 2/22 -- Discussed underground tank program, asbestos removal, AQMD permits, and county sanitation sewer analyses.
3. Bill Fehlings, JPL Facilities Maintenance and Operation Section, (JPL Employee since 1954). Interview 2/21 -- Discussed past waste disposal practices.
4. Roscoe Edwards, JPL Facilities Maintenance and Operation Section, Interview 2/23 -- Discussed waste disposal practices, aerial photograph (circa 1951).
5. Al Klascius, JPL Safety Office (JPL Employee since 1958). Interview 2/22 -- Discussed beryllium shop and subcommittee, sewer installation.
6. Richard MacGillivray, JPL Facilities Maintenance and Operation Section (JPL Employee since 1959). Interview 2/23 -- Discussed waste disposal practices.
7. Lane Prior, Former (Retired) JPL Safety Officer. Interview with M. Drazek, JPL Environmental Contact, information transferred to Ebasco Services. Discussed past disposal practices.

8. Tom Underbrink, Civil Engineer, City of Pasadena Water and Power Department. Discussed population served by groundwater; referred to Health Department for past response activities at JPL.
9. Tom Reardon, City of Pasadena Environmental Health Department. Discussed agency responsibilities for response activities.
10. Laura Dahl, Planner, City of Pasadena. Discussed land use and population densities in vicinity of JPL.
11. Bill Campbell, Director, City of La Canada, Flintridge Community Development Department. Discussed land use, and population densities in vicinity of JPL.



**POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 1 - SITE LOCATION AND INSPECTION INFORMATION**

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
CA	9800013030

II. SITE NAME AND LOCATION

01 SITE NAME (Legal, common, or descriptive name of site) NASA - Jet Propulsion Laboratory		02 STREET, ROUTE NO., OR SPECIFIC LOCATION IDENTIFIER 4800 Oak Grove Drive			
03 CITY Pasadena		04 STATE CA	05 ZIP CODE 91109	06 COUNTY Los Angeles	
09 COORDINATES LATITUDE 34° 12' 00" N LONGITUDE 118° 10' 30" W		10 TYPE OF OWNERSHIP (Check one) <input type="checkbox"/> A. PRIVATE <input checked="" type="checkbox"/> B. FEDERAL NASA <input type="checkbox"/> C. STATE <input type="checkbox"/> D. COUNTY <input type="checkbox"/> E. MUNICIPAL <input type="checkbox"/> F. OTHER <input type="checkbox"/> G. UNKNOWN			

III. INSPECTION INFORMATION

01 DATE OF INSPECTION 2 / 22 / 88 <small>MONTH DAY YEAR</small>	02 SITE STATUS <input checked="" type="checkbox"/> ACTIVE <input type="checkbox"/> INACTIVE	03 YEARS OF OPERATION Approx. 1941 Present UNKNOWN <small>BEGINNING YEAR ENDING YEAR</small>	
04 AGENCY PERFORMING INSPECTION (Check all that apply)			
<input type="checkbox"/> A. EPA <input type="checkbox"/> B. EPA CONTRACTOR _____ (Name of firm) <input type="checkbox"/> C. MUNICIPAL <input type="checkbox"/> D. MUNICIPAL CONTRACTOR _____ (Name of firm) <input type="checkbox"/> E. STATE <input type="checkbox"/> F. STATE CONTRACTOR _____ (Name of firm) <input checked="" type="checkbox"/> G. OTHER Ebasco Services _____ (Specify)			

05 CHIEF INSPECTOR Mr. Gary Cronk	06 TITLE Hydrologist	07 ORGANIZATION Ebasco	08 TELEPHONE NO. (714) 662-4050
09 OTHER INSPECTORS Ms. Michelle Leonard	10 TITLE Environmental Scientist	11 ORGANIZATION Ebasco	12 TELEPHONE NO. (714) 662-4050
			()
			()
			()
			()

13 SITE REPRESENTATIVES INTERVIEWED Mary Drazek	14 TITLE Environmental Coordinator	15 ADDRESS JPL-Safety & Environmental Health 4800 Oak Grove Dr., Pasadena	16 TELEPHONE NO. (818) 354-4710
Bruce Fischer	Energy Resources Administrator	JPL-Facilities Maintenance and operation Section 4800 Oak Grove Dr., Pasadena	(818) 354-2539
William Fehlings	Supervisor, Plumbers	JPL-Facilities Section 4800 Oak Grove Dr., Pasadena	(818) 354-3522
Richard MacGillivray	Permit and Maintenance Records	JPL-Facilities Maintenance and Operations Section	(818) 354-3522
Alfonse Klascius	Industrial Hygienist	JPL - Safety Office	(818) 354-4710
			()

17 ACCESS GAINED BY (Check one) <input checked="" type="checkbox"/> PERMISSION <input type="checkbox"/> WARRANT	18 TIME OF INSPECTION 0800-1600 Hrs. Feb. 22-24, 1988	19 WEATHER CONDITIONS Clear, Warm
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IV. INFORMATION AVAILABLE FROM

01 CONTACT Mary Drazek	02 OF (Agency/Organization) NASA - JPL, Environmental Coordinator		03 TELEPHONE NO. (818) 354-4710
04 PERSON RESPONSIBLE FOR SITE INSPECTION FORM G. Cronk/M.P. Leonard	05 AGENCY	06 ORGANIZATION Ebasco Services	07 TELEPHONE NO. 714/ 662-4050
			08 DATE 03 / 17 / 88 <small>MONTH DAY YEAR</small>



**POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 2 - WASTE INFORMATION**

I. IDENTIFICATION	
01 STATE CA	02 SITE NUMBER 9800013030

II. WASTE STATES, QUANTITIES, AND CHARACTERISTICS

01 PHYSICAL STATES (Check all that apply) <input checked="" type="checkbox"/> A SOLID <input type="checkbox"/> B POWDER, FINES <input checked="" type="checkbox"/> C SLUDGE <input type="checkbox"/> D OTHER _____ <small>(Specify)</small>	02 WASTE QUANTITY AT SITE <small>(Measures of waste quantities must be independent.)</small> TONS _____ CUBIC YARDS _____ NO OF DRUMS <u>15-20/3 months</u>	03 WASTE CHARACTERISTICS (Check all that apply) <input checked="" type="checkbox"/> TOXIC <input checked="" type="checkbox"/> CORROSIVE <input checked="" type="checkbox"/> RADIOACTIVE <input checked="" type="checkbox"/> PERSISTENT <input checked="" type="checkbox"/> SOLUBLE <input type="checkbox"/> INFECTIOUS <input checked="" type="checkbox"/> FLAMMABLE <input checked="" type="checkbox"/> IRRITANT <input checked="" type="checkbox"/> HIGHLY VOLATILE <input checked="" type="checkbox"/> EXPLOSIVE <input checked="" type="checkbox"/> REACTIVE <input checked="" type="checkbox"/> INCOMPATIBLE <input type="checkbox"/> M NOT APPLICABLE
---	--	---

III. WASTE TYPE

CATEGORY	SUBSTANCE NAME	01 GROSS AMOUNT	02 UNIT OF MEASURE	03 COMMENTS
SLU	SLUDGE	Unknown		Paint sludge
OLW	OILY WASTE	3,000	Gallons	Waste oil/4-5 Months
SOL	SOLVENTS	10-15	Drums	Mixed solvents/3 months
PSD	PESTICIDES			
OCC	OTHER ORGANIC CHEMICALS	Unknown	Drums	PCBs
IOC	INORGANIC CHEMICALS			
ACD	ACIDS	Unknown		Sulfuric, acetic, hydrochloric
BAS	BASES	Unknown		Sodium hydroxide, lead
MES	HEAVY METALS	1.2	Tons	Mercury; Batteries (Recycled)

IV. HAZARDOUS SUBSTANCES (See Appendix for most frequently cited CAS Numbers)

01 CATEGORY	02 SUBSTANCE NAME	03 CAS NUMBER	04 STORAGE/DISPOSAL METHOD	05 CONCENTRATION	06 MEASURE OF CONCENTRATION
MES	Beryllium	7440-41-7	Drum/contract Haul		
MES	Mercury	7439-97-6	Drum/Contract Haul		
IOC	Asbestos	1332-21-4	Drum/Contract Haul		
SOL	Methylene chloride	999	Drum/Contract Haul		
SOL	Benzene	71-43-2	Drum/Contract Haul		
SOL	Toluene	108-88-3	Drum/Contract Haul		
OCC	PCB Oils	1336-36-3	Drum/Contract Haul		
MES	Lead	301-04-2	Recycle Batteries	200 (Soil)	PPM
SOL	Trichloroethane	25323-89-1	Drum/Contract Haul		
SOL	Trichlorotrifluoroethane	999	Drum/Contract Haul		
ACD	Sulfuric Acid	7664-93-9	Drum/Contract Haul		
ACD	Acetic Acid	64-19-7	Drum/Contract Haul		
BAS	Sodium Hydroxide	1310-73-2	Drum/Contract Haul		
ACD	Hydrochloric Acid	7647-01-0	Drum/Contract Haul		
	* See Note Below				

V. FEEDSTOCKS (See Appendix for CAS Numbers)

CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER	CATEGORY	01 FEEDSTOCK NAME	02 CAS NUMBER
FDS	Mercury	7439-97-6	FDS	Acetone	67-64-1
FDS	Toluene	108-88-3	FDS	Acetic Acid	64-19-7
FDS	Sulfuric Acid	7664-93-9	FDS	Hydrochloric Acid	7647-01-0
FDS	Sodium Hydroxide	1310-73-2	FDS		

VI. SOURCES OF INFORMATION (Cite specific references e.g. site files, sample analysis reports)

- . Mary Drazek, JPL Environmental Contact
- . Current JPL Disposal Practices List
- . JPL Waste Data Sheet, Manifests
- . R. C. Slade Report
- . Note: Over 100 hazardous substances stored at a time, in quantities of less than



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 3 - DESCRIPTION OF HAZARDOUS CONDITIONS AND INCIDENTS

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
CA	9800013030

II. HAZARDOUS CONDITIONS AND INCIDENTS *Continued*

01 J. DAMAGE TO FLORA
04 NARRATIVE DESCRIPTION

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

None alleged or observed

01 K. DAMAGE TO FAUNA
04 NARRATIVE DESCRIPTION *(include name of species)*

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

None alleged or observed

01 L. CONTAMINATION OF FOOD CHAIN
04 NARRATIVE DESCRIPTION

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

None alleged or observed

01 M. UNSTABLE CONTAINMENT OF WASTES
(Spills, Runoff, Standing liquids, Leaking drums)
03 POPULATION POTENTIALLY AFFECTED: _____ 04 NARRATIVE DESCRIPTION

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

No spill containment provisions at hazardous waste storage area.

01 N. DAMAGE TO OFFSITE PROPERTY
04 NARRATIVE DESCRIPTION

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

JPL may have contributed to contamination of Municipal Water Supply Wells.

01 O. CONTAMINATION OF SEWERS, STORM DRAINS, WWTPs
04 NARRATIVE DESCRIPTION

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

. Alleged dumping of chemicals into storm drains and sewers.

01 P. ILLEGAL/UNAUTHORIZED DUMPING
04 NARRATIVE DESCRIPTION

02 OBSERVED (DATE _____) POTENTIAL ALLEGED

None alleged or observed

05 DESCRIPTION OF ANY OTHER KNOWN, POTENTIAL, OR ALLEGED HAZARDS

III. TOTAL POPULATION POTENTIALLY AFFECTED: _____

IV. COMMENTS

Soil samples are from 2 of 6 former seepage/disposal pits on site. Further sampling from other pits is necessary.
No monitoring of groundwater has been conducted on site.

V. SOURCES OF INFORMATION *(Cite specific references e.g. state files, sample analysis reports)*

1. R.C. Slade: Preliminary Hydrogeologic Assessment of Soils and Groundwater Monitoring at JPL.; 1984.
2. J.M. Montgomery: Appdx E, Hydrogeologic Investigation Report, 1986.
3. Interviews with JPL Staff



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION
PART 4 - PERMIT AND DESCRIPTIVE INFORMATION

I. IDENTIFICATION
01 STATE CA 02 SITE NUMBER 9800013030

II. PERMIT INFORMATION

01 TYPE OF PERMIT ISSUED <small>(Check all that apply)</small>	02 PERMIT NUMBER	03 DATE ISSUED	04 EXPIRATION DATE	05 COMMENTS
<input type="checkbox"/> A. NPDES				
<input type="checkbox"/> B. UIC				
<input checked="" type="checkbox"/> C. AIR	SCAQMD 11887-AE			Emissions and several other permits
<input type="checkbox"/> D. RCRA				
<input type="checkbox"/> E. RCRA INTERIM STATUS				
<input type="checkbox"/> F. SPCC PLAN				
<input type="checkbox"/> G. STATE <small>Specify:</small>				
<input checked="" type="checkbox"/> H. LOCAL <small>Specify:</small> LA County Public Works		Unknown		Underground tanks/Interim Stat
<input checked="" type="checkbox"/> I. OTHER <small>Specify:</small> LA County Sanitation Dist.		Unknown		Wastewater permit
<input type="checkbox"/> J. NONE	1710061			

III. SITE DESCRIPTION

01 STORAGE/DISPOSAL <small>(Check all that apply)</small>	02 AMOUNT	03 UNIT OF MEASURE	04 TREATMENT <small>(Check all that apply)</small>	05 OTHER
<input type="checkbox"/> A. SURFACE IMPOUNDMENT			<input checked="" type="checkbox"/> A. INCENERATION (Past Years)	<input checked="" type="checkbox"/> A. BUILDINGS ON SITE
<input type="checkbox"/> B. PILES			<input type="checkbox"/> B. UNDERGROUND INJECTION	
<input checked="" type="checkbox"/> C. DRUMS, ABOVE GROUND	15-20	Drums	<input type="checkbox"/> C. CHEMICAL/PHYSICAL	
<input type="checkbox"/> D. TANK, ABOVE GROUND			<input type="checkbox"/> D. BIOLOGICAL	
<input type="checkbox"/> E. TANK, BELOW GROUND			<input type="checkbox"/> E. WASTE OIL PROCESSING	
<input type="checkbox"/> F. LANDFILL			<input type="checkbox"/> F. SOLVENT RECOVERY	
<input type="checkbox"/> G. LANDFARM			<input type="checkbox"/> G. OTHER RECYCLING/RECOVERY	
<input checked="" type="checkbox"/> H. OPEN DUMP	Unknown		<input type="checkbox"/> H. OTHER <small>(Specify)</small>	06 AREA OF SITE 176 (Acres)
<input type="checkbox"/> I. OTHER <small>(Specify)</small>				

07 COMMENTS
Open disposal pits were used between 1941 and 1960 for dumping of municipal solid wastes and solid and liquid hazardous wastes. Pits were located both on JPL property, and off property in Arroyo Seco Wash. Pits were approximately 15 feet wide by 15 feet deep, largest pit was 30 feet across by 15 feet deep. Two of the seepage pits were allegedly "Lined" with brick.

IV. CONTAINMENT

01 CONTAINMENT OF WASTES (Check one)
 A. ADEQUATE, SECURE B. MODERATE C. INADEQUATE, POOR D. INSECURE, UNSOUND, DANGEROUS

02 DESCRIPTION OF DRUMS, DIKING, LINERS, BARRIERS, ETC.
The historic dumping practices (until early 1960's) were insecure due to the hazardous nature of the substances disposed, proximity to sources of drinking water, and absence of protective measures to contain or prevent migration of substances. Present day storage of chemical drums and drummed wastes are not in bermed or protected areas.

V. ACCESSIBILITY

01 WASTE EASILY ACCESSIBLE YES NO
 02 COMMENTS
 Historic sites are beneath existing parking lots, paved areas, or in the Arroyo Seco Wash. Present day drums are sealed to prevent access.

VI. SOURCES OF INFORMATION (Check specific references & give date last sample analysis received)

- . JPL Environmental Resources Document; 1980.
- . JPL Staff Interviews.



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 5 - WATER, DEMOGRAPHIC, AND ENVIRONMENTAL DATA

I. IDENTIFICATION	
01 STATE	02 SITE NUMBER
CA	9800013030

VI. ENVIRONMENTAL INFORMATION

01 PERMEABILITY OF UNSATURATED ZONE (Check one)

A. $10^{-6} - 10^{-8}$ cm/sec B. $10^{-4} - 10^{-6}$ cm/sec C. $10^{-4} - 10^{-3}$ cm/sec D. GREATER THAN 10^{-3} cm/sec
estimated
silty-sand-gravel

02 PERMEABILITY OF BEDROCK (Check one)

A. IMPERMEABLE (Less than 10^{-6} cm/sec) B. RELATIVELY IMPERMEABLE ($10^{-4} - 10^{-6}$ cm/sec) C. RELATIVELY PERMEABLE ($10^{-2} - 10^{-4}$ cm/sec) D. VERY PERMEABLE (Greater than 10^{-2} cm/sec)
estimated

03 DEPTH TO BEDROCK

600+ (ft)

04 DEPTH OF CONTAMINATED SOIL ZONE

Unknown (ft)

05 SOIL pH

7.8

06 NET PRECIPITATION

20 (in)

07 ONE YEAR 24 HOUR RAINFALL

2 (in)

08 SLOPE
SITE SLOPE
Unknown %

DIRECTION OF SITE SLOPE
SSE

TERRAIN AVERAGE SLOPE
Unknown %

09 FLOOD POTENTIAL

SITE IS IN 500+ YEAR FLOODPLAIN

10

SITE IS ON BARRIER ISLAND, COASTAL HIGH HAZARD AREA, RIVERINE FLOODWAY

11 DISTANCE TO WETLANDS (5 acre minimum)

ESTUARINE OTHER
A. 22 (mi) B. N/A (mi)

12 DISTANCE TO CRITICAL HABITAT (of endangered species)

Possible existence 0.2 (mi)
in Arroyo Seco
ENDANGERED SPECIES: Nevin's Barberrry (Plant)

13 LAND USE IN VICINITY

DISTANCE TO:

COMMERCIAL/INDUSTRIAL

RESIDENTIAL AREAS, NATIONAL/STATE PARKS,
FORESTS, OR WILDLIFE RESERVES

AGRICULTURAL LANDS
PRIME AG LAND AG LAND

A. 0.04 (mi) B. 0.04 (mi) C. 0.04 (mi) D. Unknown (mi)

14 DESCRIPTION OF SITE IN RELATION TO SURROUNDING TOPOGRAPHY

The site is situated on a hillside at the base of the San Gabriel Mountains. The site is situated between the Angeles National Forest on the North and the Devil's Gate Dam/Reservoir on the South. To the East lies the Arroyo Seco Canyon, an intermittent stream, and to the Southwest are the San Rafael Hills. The rugged topography of the site and its surroundings separates the lab from the adjoining residential neighborhoods and other land uses in the vicinity.

VII. SOURCES OF INFORMATION (Cite specific references e.g. state files, sample analysis reports)

- USGS topographic Quad. Pasadena, CA
- City of Pasadena Planning Dept. census tract information - L. Dahl, Planner
- City of La Canada-Flintridge, community development - B. Campbell, Director
- JPL Environmental Resources Document
- Montgomery - Appndx. E Hydrogeologic Investigation Report, 1986.

EPA FORM 2070-13 (7-81)

- Slade - Preliminary Hydrogeologic Assessment, 1984.



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 6 - SAMPLE AND FIELD INFORMATION

I. IDENTIFICATION
01 STATE 02 SITE NUMBER
CA 9800013030

II. SAMPLES TAKEN

SAMPLE TYPE	01 NUMBER OF SAMPLES TAKEN	02 SAMPLES SENT TO	03 ESTIMATED DATE RESULTS AVAILABLE
GROUNDWATER	9	Montgomery Laboratories, Pasadena	1984
SURFACE WATER			
WASTE			
AIR			
RUNOFF			
SPILL			
SOIL	8	Montgomery Laboratories, Pasadena	1984
VEGETATION			
OTHER			

III. FIELD MEASUREMENTS TAKEN

01 TYPE	02 COMMENTS
Soils - Fluoride, pH, Chromium, Metals	All testing was done at off-site lab. One test pit sampled natural, uncontaminated, in-place soils, remaining test pits (7) sampled soils in areas of suspected seepage pits. (1)
Soils - Volatile Organics	Carbon tet, trichloroethane, tetra chloroethane, 1-1-1 trichloroethane (1)
Soils - Emission Spectroscopy	- On two tests with positive results for metals (1)
Water-Heavy metals Fluoride & Cyanide	All testing was done at off-site lab, for silver, arsenic, beryllium, cadmium, chromium, copper, mercury, nickel, lead, and antimony, selenium, thallium, zinc (1)
Water-Volatile organics	Carbon tet, tetra chloroethane, 1-1-1 trichloroethane, Hexane, trichloroethane (1)

IV. PHOTOGRAPHS AND MAPS

01 TYPE <input type="checkbox"/> GROUND <input checked="" type="checkbox"/> AERIAL	02 IN CUSTODY OF <u>Army Corps of Engineers-LA District</u> <small>(Name of organization or individual)</small>
03 MAPS <input checked="" type="checkbox"/> YES <input type="checkbox"/> NO	04 LOCATION OF MAPS <u>JPL; Ebasco Services, Santa Ana</u>

V. OTHER FIELD DATA COLLECTED (Provide narrative description)

Dispersion coefficient of 10 ft. ²/day and velocities between 0.07 and 0.14 ft/day were determined. (2)

VI. SOURCES OF INFORMATION (Cite specific references, e.g., state logs, sample analysis reports)

- R. C. Slade, Preliminary hydrogeologic Assessment of Soils and groundwater monitoring at JPL, 1984.
- J. M. Montgomery, Appndx. E, Hydrogeologic Investigation Report, 1986.



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 7 - OWNER INFORMATION

I. IDENTIFICATION

01 STATE CA 02 SITE NUMBER 9800013030

II. CURRENT OWNER(S)

PARENT COMPANY # 800-CAD99

01 NAME National Aeronautics and Space Administration			02 D+B NUMBER			08 NAME N/A			09 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.) 4800 Oak Grove						04 SIC CODE			10 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY Pasadena			06 STATE CA	07 ZIP CODE 91109		12 CITY			13 STATE	14 ZIP CODE				
01 NAME			02 D+B NUMBER			08 NAME			09 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.)						04 SIC CODE			10 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY			06 STATE	07 ZIP CODE		12 CITY			13 STATE	14 ZIP CODE				
01 NAME			02 D+B NUMBER			08 NAME			09 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.)						04 SIC CODE			10 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY			06 STATE	07 ZIP CODE		12 CITY			13 STATE	14 ZIP CODE				
01 NAME			02 D+B NUMBER			08 NAME			09 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.)						04 SIC CODE			10 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY			06 STATE	07 ZIP CODE		12 CITY			13 STATE	14 ZIP CODE				
01 NAME			02 D+B NUMBER			08 NAME			09 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.)						04 SIC CODE			10 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY			06 STATE	07 ZIP CODE		12 CITY			13 STATE	14 ZIP CODE				

III. PREVIOUS OWNER(S) (List most recent first)

IV. REALTY OWNER(S) (if applicable, list most recent first)

01 NAME U.S. Department of the Army			02 D+B NUMBER			01 NAME			02 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.)						04 SIC CODE			03 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY Washington, D.C.			06 STATE	07 ZIP CODE		05 CITY			06 STATE	07 ZIP CODE				
01 NAME			02 D+B NUMBER			01 NAME			02 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.)						04 SIC CODE			03 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY			06 STATE	07 ZIP CODE		05 CITY			06 STATE	07 ZIP CODE				
01 NAME			02 D+B NUMBER			01 NAME			02 D+B NUMBER					
03 STREET ADDRESS (P.O. Box, RFD #, etc.)						04 SIC CODE			03 STREET ADDRESS (P.O. Box, RFD #, etc.)					
05 CITY			06 STATE	07 ZIP CODE		05 CITY			06 STATE	07 ZIP CODE				

V. SOURCES OF INFORMATION (Cite specific references, e.g., state files, sample analysis reports)

JPL Staff



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 8 - OPERATOR INFORMATION

I. IDENTIFICATION
01 STATE 02 SITE NUMBER
CA 9800013030

II. CURRENT OPERATOR <i>(Provide if different from owner)</i>				OPERATOR'S PARENT COMPANY <i>(if applicable)</i>			
01 NAME Jet Propulsion Lab/ California Institute of Technology		02 D+B NUMBER		10 NAME		11 D+B NUMBER	
03 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i> 4800 Oak Grove			04 SIC CODE	12 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i>			13 SIC CODE
05 CITY Pasadena		06 STATE CA	07 ZIP CODE 91109	14 CITY		15 STATE	16 ZIP CODE
08 YEARS OF OPERATION 1941-Present	09 NAME OF OWNER NASA						

III. PREVIOUS OPERATOR(S) <i>(List most recent first; provide only if different from owner)</i>				PREVIOUS OPERATORS' PARENT COMPANIES <i>(if applicable)</i>			
01 NAME N/A		02 D+B NUMBER		10 NAME		11 D+B NUMBER	
03 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i>			04 SIC CODE	12 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i>			13 SIC CODE
05 CITY		06 STATE	07 ZIP CODE	14 CITY		15 STATE	16 ZIP CODE
08 YEARS OF OPERATION	09 NAME OF OWNER DURING THIS PERIOD						

01 NAME		02 D+B NUMBER		10 NAME		11 D+B NUMBER	
03 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i>			04 SIC CODE	12 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i>			13 SIC CODE
05 CITY		06 STATE	07 ZIP CODE	14 CITY		15 STATE	16 ZIP CODE
08 YEARS OF OPERATION	09 NAME OF OWNER DURING THIS PERIOD						

01 NAME		02 D+B NUMBER		10 NAME		11 D+B NUMBER	
03 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i>			04 SIC CODE	12 STREET ADDRESS <i>(P.O. Box, RFD #, etc.)</i>			13 SIC CODE
05 CITY		06 STATE	07 ZIP CODE	14 CITY		15 STATE	16 ZIP CODE
08 YEARS OF OPERATION	09 NAME OF OWNER DURING THIS PERIOD						

IV. SOURCES OF INFORMATION <i>(Cite specific references, e.g., state files, sample analysis reports)</i>							
JPL Staff Interviews							



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 9 - GENERATOR/TRANSPORTER INFORMATION

I. IDENTIFICATION

01 STATE 02 SITE NUMBER
CA 9800013030

II. ON-SITE GENERATOR

01 NAME NASA - JPL		02 D+B NUMBER	
03 STREET ADDRESS (P.O. Box, RFD #, etc.) 4800 Oak Grove		04 SIC CODE	
05 CITY Pasadena	06 STATE CA	07 ZIP CODE 91109	

III. OFF-SITE GENERATOR(S)

01 NAME None		02 D+B NUMBER		01 NAME		02 D+B NUMBER	
03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE		03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE	
05 CITY	06 STATE	07 ZIP CODE		05 CITY	06 STATE	07 ZIP CODE	
01 NAME		02 D+B NUMBER		01 NAME		02 D+B NUMBER	
03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE		03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE	
05 CITY	06 STATE	07 ZIP CODE		05 CITY	06 STATE	07 ZIP CODE	

IV. TRANSPORTER(S)

01 NAME None		02 D+B NUMBER		01 NAME		02 D+B NUMBER	
03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE		03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE	
05 CITY	06 STATE	07 ZIP CODE		05 CITY	06 STATE	07 ZIP CODE	
01 NAME		02 D+B NUMBER		01 NAME		02 D+B NUMBER	
03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE		03 STREET ADDRESS (P.O. Box, RFD #, etc.)		04 SIC CODE	
05 CITY	06 STATE	07 ZIP CODE		05 CITY	06 STATE	07 ZIP CODE	

V. SOURCES OF INFORMATION (Give specific references e.g. state files, laboratory reports)

• JPL Staff Interviews



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 10 - PAST RESPONSE ACTIVITIES

I. IDENTIFICATION
01 STATE | 02 SITE NUMBER
CA | 9800013030

II. PAST RESPONSE ACTIVITIES

01 <input type="checkbox"/> A. WATER SUPPLY CLOSED 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> B. TEMPORARY WATER SUPPLY PROVIDED 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> C. PERMANENT WATER SUPPLY PROVIDED 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> D. SPILLED MATERIAL REMOVED 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> E. CONTAMINATED SOIL REMOVED 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> F. WASTE REPACKAGED 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> G. WASTE DISPOSED ELSEWHERE 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> H. ON SITE BURIAL 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> I. IN SITU CHEMICAL TREATMENT 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> J. IN SITU BIOLOGICAL TREATMENT 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> K. IN SITU PHYSICAL TREATMENT 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> L. ENCAPSULATION 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> M. EMERGENCY WASTE TREATMENT 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> N. CUTOFF WALLS 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> O. EMERGENCY DIKING/SURFACE WATER DIVERSION 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> P. CUTOFF TRENCHES/SUMP 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____
01 <input type="checkbox"/> Q. SUBSURFACE CUTOFF WALL 04 DESCRIPTION N/A	02 DATE _____	03 AGENCY _____



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 10 - PAST RESPONSE ACTIVITIES

I. IDENTIFICATION
01 STATE | 02 SITE NUMBER
CA | 9800013030

II PAST RESPONSE ACTIVITIES (Continued)

01 R. BARRIER WALLS CONSTRUCTED
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 S. CAPPING/COVERING
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 T. BULK TANKAGE REPAIRED
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 U. GROUT CURTAIN CONSTRUCTED
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 V. BOTTOM SEALED
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 W. GAS CONTROL
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 X. FIRE CONTROL
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 Y. LEACHATE TREATMENT
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 Z. AREA EVACUATED
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 1. ACCESS TO SITE RESTRICTED
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 2. POPULATION RELOCATED
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

N/A

01 3. OTHER REMEDIAL ACTIVITIES
04 DESCRIPTION

02 DATE _____

03 AGENCY _____

III. SOURCES OF INFORMATION (Use specific references e.g., State/MSL Sample Analysis Reports)

JPL Staff Interviews



POTENTIAL HAZARDOUS WASTE SITE
SITE INSPECTION REPORT
PART 11 - ENFORCEMENT INFORMATION

I. IDENTIFICATION

01 STATE	02 SITE NUMBER
CA	9800013030

II. ENFORCEMENT INFORMATION

01 PAST REGULATORY/ENFORCEMENT ACTION YES NO

02 DESCRIPTION OF FEDERAL, STATE, LOCAL REGULATORY/ENFORCEMENT ACTION

III. SOURCES OF INFORMATION *(Cite specific references e.g., state files, sample analysis reports)*

Facility name: NASA - Jet Propulsion Laboratory

Location: Pasadena, CA

EPA Region: IX

Person(s) in charge of the facility: Mary Drazek, Environmental Engineer

Name of Reviewer: Gary Cronk Date: 3/17/88

General description of the facility:
 (For example: landfill, surface impoundment, pile, container; types of hazardous substances; location of the facility; contamination route of major concern; types of information needed for rating; agency action, etc.)

Six seepage pits were used in the past for disposal of chemical
wastes, such as solvents, mercury, sulfuric acids, and cooling
tower blowdown. Municipal water supply wells, 1,000 ft. downgrad-
iant, have recently been shown to have elevated levels of TCE,
PCE, and CCL₄.

Scores: $S_M = 38.3$ ($S_{GW} = 65.9$ $S_{SW} = 7.4$ $S_a = 0$)
 $S_{FE} = 15.2$
 $S_{DC} = 16.6$

FIGURE 1
HRS COVER SHEET

Ground Water Route Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)	
1 Observed Release	0 45	1	45	45	3.1	
If observed release is given a score of 45, proceed to line 4 . If observed release is given a score of 0, proceed to line 2 .						
2 Route Characteristics					3.2	
Depth to Aquifer of Concern	0 1 2 3	2		6		
Net Precipitation	0 1 2 3	1		3		
Permeability of the Unsaturated Zone	0 1 2 3	1		3		
Physical State	0 1 2 3	1		3		
Total Route Characteristics Score				15		
3 Containment	0 1 2 3	1		3	3.3	
4 Waste Characteristics					3.4	
Toxicity/Persistence	0 3 6 9 12 15 18	1	18	18		
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1	2	8		
Total Waste Characteristics Score			20	28		
5 Targets					3.5	
Ground Water Use	0 1 2 3	3	2	9		
Distance to Nearest Well/Population Served	0 4 6 8 10 12 16 18 20 24 30 32 35 40	1	40	40		
Total Targets Score			42	49		
6 If line 1 is 45, multiply 1 x 4 x 5 $45 \times 20 \times 42$			37,800			
If line 1 is 0, multiply 2 x 3 x 4 x 5				57,330		
7 Divide line 6 by 57,330 and multiply by 100			$S_{gw} = 65.9$			

**FIGURE 2
GROUND WATER ROUTE WORK SHEET**

Surface Water Route Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Weighted Score	
1 Observed Release	(0) 45	1	0	45	4.1	
If observed release is given a value of 45, proceed to line 4 . If observed release is given a value of 0, proceed to line 2 .						
2 Route Characteristics					4.2	
Facility Slope and Intervening Terrain	0 1 2 (3)		3	3		
1-yr. 24-hr. Rainfall	0 1 (2) 3	1	2	3		
Distance to Nearest Surface Water	0 1 2 (3)	2	6	6		
Physical State	0 1 2 (3)	1	3	3		
Total Route Characteristics Score			14	15		
3 Containment	0 1 2 (3)	1	3	3	4.3	
4 Waste Characteristics					4.4	
Toxicity/Persistence	0 3 6 9 12 15 (18)	1	18	18		
Hazardous Waste Quantity	0 (1) 2 3 4 5 6 7 8	1	1	8		
Total Waste Characteristics Score			19	28		
5 Targets					4.5	
Surface Water Use	0 1 (2) 3	3	6	9		
Distance to a Sensitive Environment	(0) 1 2 3	2	0	6		
Population Served/Distance to Water Intake Downstream	(0) 4 6 8 10 12 18 18 20 24 30 32 35 40	1	0	40		
Total Targets Score			6	55		
6 If line 1 is 45, multiply 1 x 4 x 5						
If line 1 is 0, multiply 2 x 3 x 4 x 5			4,782	64,350		
7 Divide line 6 by 64,350 and multiply by 100			S _{sw} = 7.4			

**FIGURE 7
SURFACE WATER ROUTE WORK SHEET**

Air Route Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multiplier	Score	Max. Score	Ref. (Section)	
1 Observed Release	(0) 45	1	0	45	5.1	
Date and Location:						
Sampling Protocol:						
If line 1 is 0, the $S_a = 0$. Enter on line 5 .						
If line 1 is 4, then proceed to line 2 .						
2 Waste Characteristics					5.2	
Reactivity and Incompatibility	0 1 2 3	1		3		
Toxicity	0 1 2 3	3		9		
Hazardous Waste Quantity	0 1 2 3 4 5 6 7 8	1		8		
Total Waste Characteristics Score				20		
3 Targets					5.3	
Population Within 4-Mile Radius	0 9 12 15 18 21 24 27 30	1		30		
Distance to Sensitive Environment	0 1 2 3	2		6		
Land Use	0 1 2 3	1		3		
Total Targets Score				39		
4 Multiply 1 x 2 x 3				35.100		
5 Divide line 4 by 35.100 and multiply by 100					$S_a = 0$	

**FIGURE 9
AIR ROUTE WORK SHEET**

	s	s ²
Groundwater Route Score (S _{gw})	65.9	4,342.8
Surface Water Route Score (S _{sw})	7.4	54.8
Air Route Score (S _a)	0	0
$S_{gw}^2 + S_{sw}^2 + S_a^2$		4,397.6
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2}$		66.3
$\sqrt{S_{gw}^2 + S_{sw}^2 + S_a^2} / 1.73 = S_M =$		38.3

**FIGURE 10
WORKSHEET FOR COMPUTING S_M**

Fire and Explosion Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)	
1 Containment	(1) 3	1	1	3	7.1	
2 Waste Characteristics					7.2	
Direct Evidence	(0) 3	1		3		
Ignitability	0 1 2 (3)	1		3		
Reactivity	0 1 2 (3)	1		3		
Incompatibility	0 1 (2) 3	1		3		
Hazardous Waste Quantity	0 1 (2) 3 4 5 6 7 8	1		8		
Total Waste Characteristics Score			10	20		
3 Targets					7.3	
Distance to Nearest Population	0 1 2 3 4 (5)	1		5		
Distance to Nearest Building	0 1 2 (3)	1		3		
Distance to Sensitive Environment	0 1 2 (3)	1		3		
Land Use	0 1 2 (3)	1		3		
Population Within 2-Mile Radius	0 1 2 3 4 (5)	1		5		
Buldings Within 2-Mile Radius	0 1 2 (3) 4 5	1		5		
Total Targets Score			22	24		
4 Multiply 1 x 2 x 3			220	1,440		
5 Divide line 4 by 1,440 and multiply by 100			SFE = 15.2			

**FIGURE 11
FIRE AND EXPLOSION WORK SHEET**

Direct Contact Work Sheet						
Rating Factor	Assigned Value (Circle One)	Multi-plier	Score	Max. Score	Ref. (Section)	
1 Observed Incident	0 45	1	0	45	8.1	
If line 1 is 45, proceed to line 4 If line 1 is 0, proceed to line 2						
2 Accessibility	0 1 2 3	1	0	3	8.2	
3 Containment	0 15	1	15	15	8.3	
4 Waste Characteristics Toxicity	0 1 2 3	5	15	15	8.4	
5 Targets					8.5	
Population Within a 1-Mile Radius	0 1 2 3 4 5	4	16	20		
Distance to a Critical Habitat	0 1 2 3	4		12		
Total Targets Score			16	32		
6 If line 1 is 45, multiply 1 x 4 x 5 If line 1 is 0, multiply 2 x 3 x 4 x 5			3,600	21,600		
7 Divide line 6 by 21,600 and multiply by 100			SOC = 16.6			

**FIGURE 12
DIRECT CONTACT WORK SHEET**