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**FINAL**

# Remedial Design/Remedial Action (RD/RA) Work Plan For the Monk Hill Treatment System (MHTS)

**This document also serves as the Technical Report for the Department of Public Health (DPH) and as Pasadena Sampling Plan (PSP) No. 2008-1**

**National Aeronautics and Space Administration (NASA)**
**Jet Propulsion Laboratory (JPL)**
**Pasadena, California**

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*NASA has approved funding the construction and operation of a treatment plant and the City of Pasadena has initiated the permit approval process regarding siting, construction, and operation of the plant at the proposed Windsor Reservoir site. All discussion in and about the contents of this document regarding the proposed treatment facility recognizes that commencement of construction of the treatment plant is contingent upon receiving all necessary approvals for siting, construction, and operation.*

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## ABBREVIATIONS

| | |
|---|---|
| ANSI | American National Standards Institute |
| AWWA | American Water Works Association |
| | |
| bgs | below ground surface |
| | |
| CalARP | California Accidental Release Prevention |
| Caltech | California Institute of Technology |
| CCC | Calgon Carbon Corporation |
| $CCl_4$ | carbon tetrachloride |
| CCR | California Code of Regulations |
| CEQA | California Environmental Quality Act |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| CPI | Certified Pump Installer |
| CUP | Conditional Use Permit |
| CWC | California Water Code |
| CWD | Certified Well Driller |
| | |
| DCA | dichloroethane |
| DO | dissolved oxygen |
| DPH | California Department of Public Health |
| DTW | depth to water |
| | |
| FWEC | Foster Wheeler Environmental Corporation |
| | |
| GAC | granular activated carbon |
| gpm | gallon per minute |
| | |
| HASP | Health and Safety Plan |
| hp | horsepower |
| | |
| JPL | Jet Propulsion Laboratory |
| | |
| LAWC | Lincoln Avenue Water Company |
| | |
| mA | mili-Amp |
| MCL | maximum contaminant level |
| MHTS | Monk Hill Treatment System |
| | |
| NA | not applicable |
| NASA | National Aeronautics and Space Administration |
| NGWA | National Ground Water Association |
| NL | Notification Level |
| NPDES | National Pollutant Discharge Elimination System |
| NPL | National Priorities List |
| NSF | NSF International |
| NTU | nephelometric turbidity unit |

| | |
|---|---|
| O&M | operation and maintenance |
| ORP | oxidation-reduction potential |
| OU | Operable Unit |
| | |
| P&ID | piping and instrumentation diagram |
| PCE | tetrachloroethene |
| PFD | process flow diagram |
| PHG | public health goal |
| psi | pounds per square inch |
| PVC | polyvinyl chloride |
| PWP | Pasadena Water and Power |
| | |
| RAO | Remedial Action Operation |
| RD/RA | Remedial Design and Remedial Action |
| RMP | Risk Management Plan |
| ROD | Record of Decision |
| RTU | remote terminal unit |
| RWQCB | Regional Water Quality Control Board |
| | |
| SAP | Sampling and Analysis Plan |
| SCADA | supervisory control and data acquisition |
| | |
| TCE | trichloroethylene |
| TDS | total dissolved solids |
| | |
| UBC | Uniform Building Code |
| USA | Underground Service Alert |
| U.S. EPA | United States Environmental Protection Agency |
| | |
| VDC | volt direct current |
| VOC | volatile organic compound |
| | |
| WDR | waste discharge requirement |

# 1 INTRODUCTION

## 1.1 Project Background

The Jet Propulsion Laboratory (JPL) is a Federally Funded Research and Development Center in Pasadena, California, currently operated under contract by the California Institute of Technology (Caltech) for the National Aeronautics and Space Administration (NASA). NASA has been investigating and taking actions to clean up the groundwater associated with historic practices since the mid-1980s. In 1992, JPL was placed on the National Priorities List (NPL) of sites governed by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). The JPL facility has been divided into three Operable Units (OUs). OU-1 is on-facility groundwater at JPL; OU-2 is on-facility vadose zone soil at JPL; and OU-3 is off-facility groundwater adjacent to the JPL property.

Located in Los Angeles County, JPL adjoins the incorporated cities of La Cañada-Flintridge and Pasadena, and is bordered on the east by the unincorporated community of Altadena. A NASA-owned facility, JPL encompasses approximately 176 acres of land and more than 150 buildings and other structures. Of the JPL facility's 176 acres, approximately 156 acres are federally owned. The remaining land is leased for parking from the City of Pasadena and the Flintridge Riding Club. Development at JPL is primarily located on the southern half, in two regions: an early-developed northeastern area and a later-developed southwestern area. Figure 1-1 shows the location and boundaries of the JPL facility. The facility is bordered by the San Gabriel Mountains to the north, an equestrian club and Fire Station to the southwest, residential neighborhoods to the west, and the Arroyo Seco wash to the east and southeast. JPL is located in the Monk Hill Subarea of the Raymond Basin, which serves as a source of drinking water for several communities in the area. Using data from the United States Census 2000, it is estimated that approximately 44,000 people reside within 3 miles of JPL.

To address chemicals in off-facility groundwater, NASA will fund removal of target chemicals (perchlorate and volatile organic compounds [VOCs]) from the aquifer at four City of Pasadena, Water and Power Department (PWP) drinking water wells by adding a treatment facility to treat pumped groundwater. Additional information regarding the site characteristics (i.e., site setting, nature and extent of chemicals, fate and transport, and exposure pathways) can be found in the Record of Decision (ROD) for OU-3 (NASA, 2007).

The proposed treatment facility will be known as the Monk Hill Treatment System (MHTS). In this remedy, NASA will directly administer the work associated with designing, permitting, and constructing the MHTS. PWP will be funded by NASA to lease treatment equipment and operate the system. Groundwater from four PWP drinking water wells (i.e., Arroyo Well, Well 52, Windsor Well, and Ventura Well) will be cleaned in this new treatment facility using a liquid-phase granular activated carbon (GAC) 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 1-2).

The MHTS is part of the OU-3 response action and NASA's multi-phased approach to develop a comprehensive remedy that will successfully remediate chemicals in groundwater. This includes on-facility treatment of source area groundwater and off-facility treatment of groundwater extracted from drinking water wells owned by Lincoln Avenue Water Company (LAWC) and the City of Pasadena (NASA, 2006; NASA, 2007).

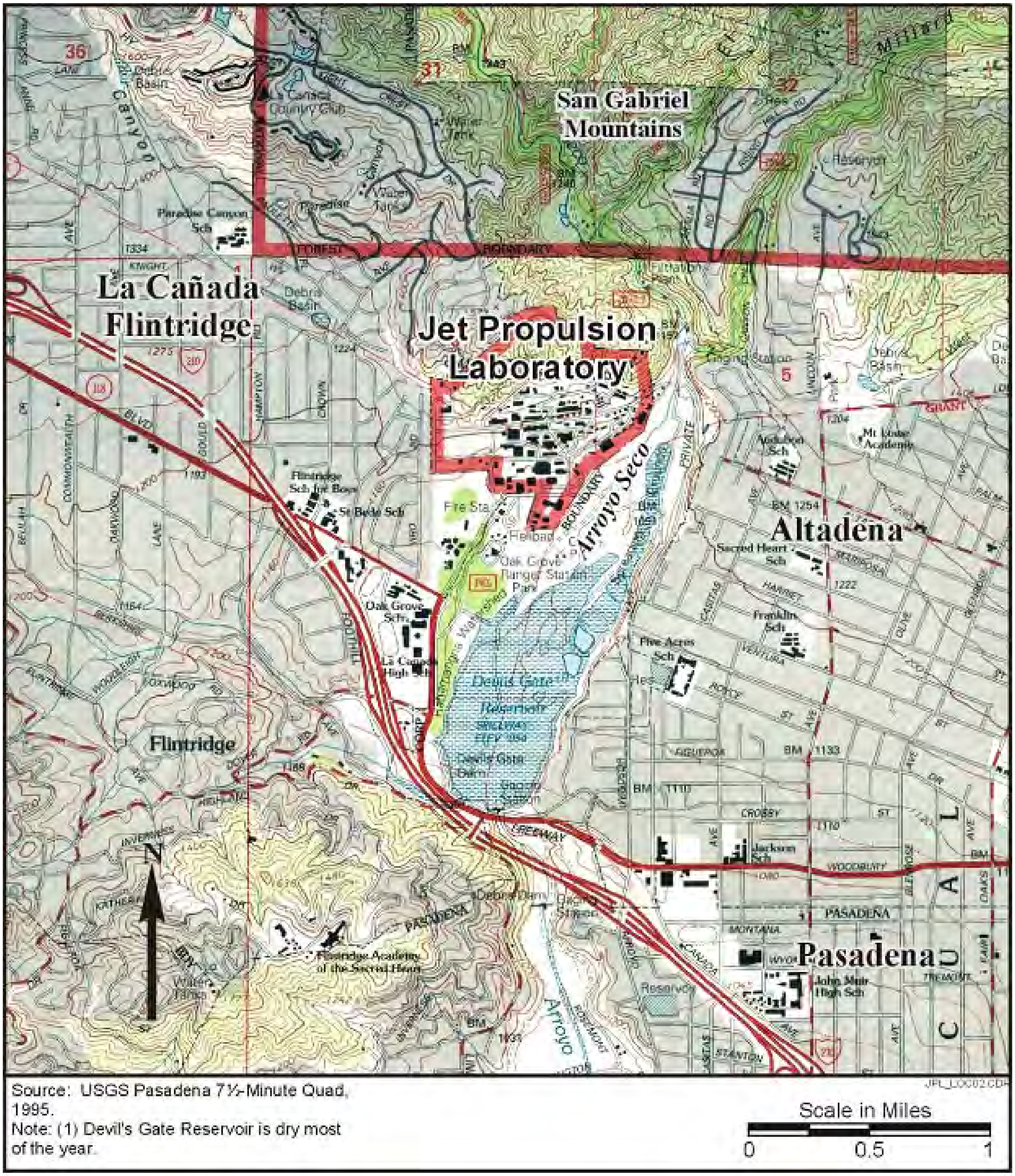


**Figure 1-1. Site Location Map**


**Figure 1-2. Aerial Photograph of the Proposed Monk Hill Treatment System**

## 1.2 Objectives and Scope

The purpose of this Remedial Design and Remedial Action (RD/RA) work plan is to present details of the engineering design, construction and operation for the proposed MHTS.

The objectives of the proposed response action are as follows (NASA, 2007):

- Remove target chemicals from the aquifer by treating water pumped from specified drinking water wells in the Monk Hill Subarea of the Raymond Basin;
- 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; and
- Ultimately restore aquifer water quality so that the City of Pasadena can reliably utilize its water rights to supply potable water.

## 2 SYSTEM DESIGN

This section provides an overview of the system design. Detailed design drawings are provided in Appendix P of this report.

### 2.1 Technology Overview

The MHTS will treat groundwater in the Monk Hill Subarea from four PWP production wells (Arroyo Well, Well 52, Ventura Well, and Windsor Well) with a maximum total capacity of 7,000 gallons per minute (gpm). The proposed treatment train includes two stages of chemical removal: perchlorate removal using ion exchange and VOC removal using GAC. The treatment system design influent and effluent criteria are shown in Table 2-1.

**Table 2-1. Water Quality Design Criteria**

| Constituent | Estimated Influent Concentration | Maximum Effluent Concentration | Units |
|---|---|---|---|
| Nitrate | 24 | 36 | mg/L |
| Sulfate | 55 | 60 | mg/L |
| Chloride | 53 | 60 | mg/L |
| Bicarbonate | 230 | NA | mg/L |
| Perchlorate | 45 | <4 | µg/L |
| Trichloroethene | 3.2 | <0.5 | µg/L |
| Tetrachloroethene | 0.59 | <0.5 | µg/L |
| 1,2-Dichloroethane | 0.46 | <0.5 | µg/L |
| Carbon Tetrachloride | 2.7 | <0.5 | µg/L |
| 1,2,3-Trichloropropane | 0.02 | <0.005 | µg/L |

NA = not applicable

Water pumped from the four production wells will be passed through two parallel 10-micron cartridge filters to remove sediment and particulates which may be discharged from the well pumps to prevent fouling and excessive pressure drop across the treatment system. The filtered water will then be directed and distributed between four fixed bed ion exchange systems. Each ion exchange system will include two Calgon Carbon Corporation (CCC) Model 12 vessels operating in a lead/lag configuration.

The effluent water from the perchlorate removal system will be distributed between five fixed bed GAC adsorber systems. Each GAC adsorber system will consist of two vessels operating in a lead/lag configuration. In order for the treated water from the MHTS to be supplied as drinking water for the City of Pasadena, PWP will disinfect the water using chloramine and send the disinfected water to the Windsor Reservoir.

### 2.2 Extraction Wells

The municipal production wells (Arroyo, Well 52, Windsor, and Ventura) are owned by the City of Pasadena. These wells are adjacent to JPL and have not been operational since being shut down when perchlorate concentrations in groundwater exceeded the California Department of Public Health (DPH) action level in 1997 (for Arroyo Well) and 2002 (for Well 52, Windsor, and Ventura wells). The four production wells will be evaluated and rehabilitated as part of the MHTS construction activities. Figure 2-1 shows the relative locations of the four production wells to each other and the JPL facility. Well characteristics are summarized in Table 2-2 and discussed in detail in the following subsections.

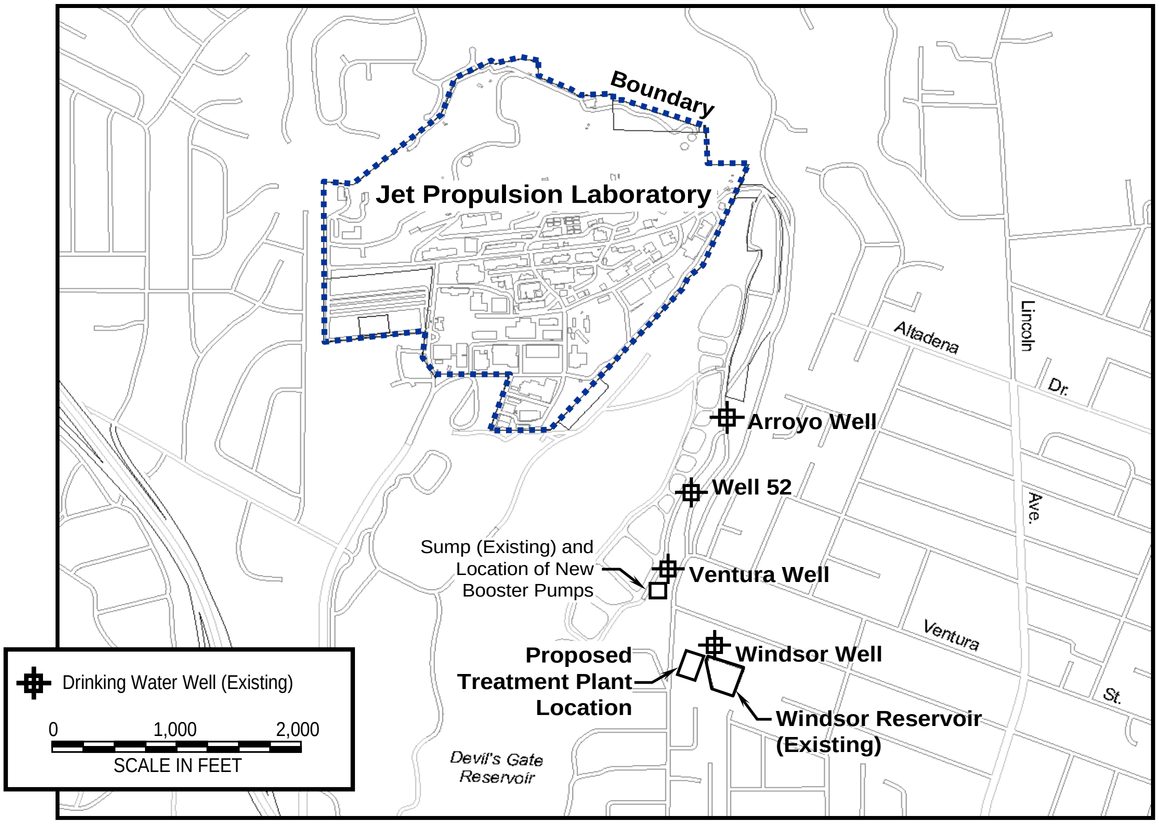


**Figure 2-1. Location of Production Wells, Sump, and Treatment Plant**

**Table 2-2. Summary of Production Well Characteristics**

| Well | Completion Date | Depth (ft bgs) | Diameter (inches) | Screened Intervals (ft bgs) | Well Casing | Production Rate Goal (gpm) |
|---|---|---|---|---|---|---|
| Arroyo | 1930 | 668 | 20[(a)] | 127-299 306-331 367-372 398-401 457-485 488-503 508-521 538-554 568-594 598-624 | #8 steel gauge | 2,200 |
| 52 | 1977 | 647 | 20 | 250-360 360-367 372-556 556-630 | #8 steel gauge | 1,800 |
| Windsor | 1969 | 600 | 20 | 320-344 374-384 426-450 474-485 497-585 | #8 steel gauge | 1,400 |
| Ventura | 1924 | 473 | 26 | 102-141 164-218 241-311 410-468 | #8 steel gauge | 1,600 |

(a) Well originally constructed with a 26-in diameter – modified in 1975 with a 20-in diameter liner.
bgs = below ground surface

### *2.2.1 Arroyo Well (No. 25)*

The Arroyo well is located on the eastern side of the JPL east parking lot access road (see Figure 2-1). The well is located 126 feet south of the JPL east parking lot fence, and approximately 1,350 feet north of the intersection of Windsor Avenue and Ventura Street. The property consists of a small well house (approximate dimensions: 18 ft × 23 ft) that houses the well and associated ancillary piping and electrical equipment, and is surrounded by a chain-link fence (61 ft × 32 ft) (see Figures 2-2 and 2-3). There are two access gates located on the eastern and southern perimeter.

The Arroyo well was constructed in October 1930 and consists of 26-inch diameter No. 8 gauge steel casing. The casing was extended by approximately 5 feet and the shaft was filled with gravel in 1967. The well was re-lined in October 1975 with 324 feet of 20-inch steel liner with the bottom 100 feet perforated (i.e., 0 to 224 feet blank casing and 224 to 324 feet perforated casing). The total depth of the well is 668 feet bgs; the well was sounded November 30, 1971 and recorded a total depth of only 643 feet bgs due to a buildup of fines in the base of the borehole. Characteristics of the Arroyo well are summarized in Table 2-2 and a boring log is presented in Appendix A.

**Figure 2-2. Arroyo Well (East View)**

**Figure 2-3. Arroyo Well (North View)**

Operation of the Arroyo Well ceased in 1997. In the two years prior to system shutdown, the median monthly groundwater production rate from the Arroyo Well was 2,400 gpm, with an associated depth to water of approximately 145 ft bgs. The pump and associated equipment was removed from the well in September 2003 by General Pump Company, and video and geophysical logging of the well was completed by Pacific Surveys.

The production rate goal for this well is 2,200 gpm.

### *2.2.2 Well 52*

Well 52 is located on the east side of Karl Johnson Parkway (the City of Pasadena maintenance access road located east of the spreading grounds which extends from the JPL east parking lot access road [to the north] all the way to the Devil's Gate dam). The well is located 462 ft due south of the intersection of Karl Johnson Parkway and the east parking lot. The well site consists of two attached buildings constructed of brick and cinder blocks (see Figure 2-4). The actual wellhead is located outside, and the associated electrical equipment and panels are located inside the northern building. The well site is surrounded by a chain-link fence (north side: 71-ft; south side: 51-ft; east side: 106-ft; west side: 113-ft; height: 8-ft) with three gates located on the north, west, and south sides.

Well 52 was constructed in 1977 and consists of 20-inch diameter double No. 8 gauge steel casing. The conductor casing consists of three-ply No. 8 gauge steel and extends from the ground surface to 24 feet bgs. Characteristics of Well 52 are summarized in Table 2-2 and a boring log is presented in Appendix A.

Operation of Well 52 ceased in January 2002. In the two years prior to system shutdown, the median monthly groundwater production rate from Well 52 was 1,600 gpm, with an associated depth to water of approximately 170 ft bgs. The pump and associated equipment were removed from the well in September 2003 by General Pump Company, and video and geophysical logging of the well was completed by Pacific Surveys.

The production rate goal for this well is 1,800 gpm.

**Figure 2-4. Northwest Aerial View of Well 52**

### *2.2.3 Ventura Well*

The Ventura well is located on the east side of Karl Johnson Parkway, and is located approximately 1,350 ft due south of the intersection of Karl Johnson Parkway and the JPL east parking lot access road. The well site consists of two attached buildings constructed of brick and cinder blocks with a removable roof (see Figure 2-5). The wellhead is housed in the northernmost building (see Figure 2-6). The entrance to the buildings is encompassed in a fenced lot that is roughly 172-ft × 40-ft in size. The fenced lot currently houses two concrete-lined sumps that are located immediately north of the well buildings and have a combined volume of 38,000 gallons. The remainder of the fenced lot is currently empty.

The Ventura well was constructed in 1924 and consists of 26-inch diameter double No. 8 gauge steel casing. The conductor casing consists of double ¼-inch gauge steel and extends from the ground surface to 30 feet bgs. Characteristics of the Ventura well are summarized in Table 2-2 and a boring log is presented in Appendix A. Operation was ceased in January 2002. The production rate goal for this well is 1,600 gpm.

Figure 2-5. Ventura Well Building

Figure 2-6. Ventura Well

### *2.2.4 Windsor Well (No. 48)*

The Windsor well (No. 48) is located in the northeast corner of the Windsor Avenue reservoir yard. The well is located approximately 325-ft due east of the Windsor Avenue north gate. The well is not enclosed in a well house (see Figure 2-7).

The Windsor well was constructed in 1969, and consists of 20-inch diameter double No. 8 gauge steel casing. The conductor casing consists of ¼-inch gauge steel and extends from the ground surface to 50 feet bgs. Characteristics of the Windsor well are summarized in Table 2-2 and a boring log is presented in Appendix A. Operation was ceased in January 2002. The production rate goal for this well is 1,400 gpm.

## 2.3 Treatment System Piping

The MHTS layout along with the location of influent and effluent piping at the Windsor Site is shown on Design Drawing C-102 in Appendix P. Extracted groundwater from the Arroyo Well, Well 52 and Ventura Well will be pumped to the two existing equalization sumps (the former air stripper discharge sumps) via existing pipelines. The two equalization sumps have a combined volume of 38,000 gallons and will be used to remove sand and air from the extracted groundwater. Water from the equalization sumps will be pumped to the proposed treatment system at the Windsor Reservoir site via an existing 16-inch steel transfer pipeline. The water from Windsor Well will be transferred directly to the new treatment system through an existing 12-inch steel line. A desanding unit may be installed at Windsor Well to remove sand and air from the extracted groundwater depending on the results of well rehabilitation efforts. A new section of 24-inch ductile iron pipe will be installed to connect the existing 16-inch steel influent pipeline from the equalization sumps and the existing 12-inch steel influent pipeline from Windsor Well to the MHTS.

**Figure 2-7. Windsor Well**

All existing pipelines were inspected by Closed Circuit Television in order to assess the condition of the pipelines and determine if they will be suitable for continued use. The inspected pipelines include a 12-inch transite, 12-inch ductile iron, 12-inch steel, 16-inch steel, 24-inch cast iron, and 30-inch hume. Overall, the pipes were found to be in good condition; however, additional pressure testing was recommended on two of the pipes to further evaluate their condition. The pressure testing was performed on 1,100 feet of the 16-inch steel pipeline (from Ventura Well to the proposed connection point) and 255 feet of the 12-inch ductile iron pipeline (from Windsor Well to a location just east of the north driveway at the Windsor Site). Both pipelines passed the pressure tests. A short section of existing pipeline, approximately 20 feet in length, and meter from Arroyo Well could not be video logged due to obstructions in the pipeline (meter and tee). This section of pipeline and meter may require replacement and will be determined during the construction. A summary of the Close Circuit Television video investigation, as well as results of the pipeline pressure testing, are included as Appendix B.

The existing 30-inch pipeline along Windsor Avenue will be used to transfer treated water to the Arroyo Seco spreading basins. Discharge of treated water to the spreading basins will be necessary during periods of startup and testing, when the water cannot be sent to the Windsor Reservoir (see Section 4.1.3). The existing 30-inch pipeline which runs from the Windsor Reservoir site to the Arroyo Well and beyond will be connected to an existing concrete outfall located along the Windsor Avenue extension to allow discharge to Basin No. 5. A section of pipe, approximately 50 feet long, will be installed from the existing 30-inch pipe near the Arroyo Well, under the Windsor Avenue extension, and to the existing concrete outfall location on the other side of the road.

## 2.4 Treatment Equipment

A process flow diagram (PFD) of the proposed treatment system is shown in Design Drawing G-103. Influent and effluent design flow rates and water quality are also shown in Design Drawing G-103. The treatment equipment vessel layout is shown on Design Drawing TPM-101, and cross sections of the vessel layout are shown on Design Drawings TPM-102 through TPM-105. All exposed tanks, piping, equipment, and new facilities shall be a neutral (or earth-toned) color to help the MHTS blend with the existing area views. Design information for the proposed treatment equipment is provided in the following subsections. All Design Drawings are provided in Appendix P.

### *2.4.1 Feed Pumps*

Three feed (sump) pumps will be installed to transfer water to the treatment plant, across the treatment vessels and associated piping, valves, and fittings, and into Windsor Reservoir. Two pumps will be operational with the third one in standby mode serving as a backup. The total pressure drop through the MHTS is expected to be in the range of 70 to 90 pounds per square inch (psi) (clean versus dirty filters). Design Drawing G-103 provides details on pressure drops through each stage of the MHTS (see Appendix P). A sound enclosure will be installed around the feed pumps to ensure that the noise generated by the pumps is reduced to comply with Pasadena Municipal Code Section 9.36.100. In addition, potential vibrations associated with the pumps will be attenuated with shock absorbers and proper alignment to the satisfaction of the City of Pasadena Director of Planning and Community Development.

By modifying the existing pipelines to allow Windsor Well to by-pass the equalization sumps and pump directly to the treatment plant (Section 2.3), the maximum flow rate requirement of the feed (sump) pumps is reduced from 7,000 gpm to 5,600 gpm, and 250 horsepower pumps can be used instead of 300 horsepower pumps. A technical memorandum evaluating the energy and cost savings associated with pumping the Windsor Well directly to the MHTS is included as Appendix C.

### *2.4.2 Inlet Water Filter*

The inlet water filter system will be a triplex (three vessel) filter. Each filter will be designed with a 3,500 gpm capacity, and two filters will operate in parallel under normal flow conditions. Each filter will contain 155 polypropylene pleated filter cartridges rated at 10 micron to prevent particles from building up in the media treatment vessels downstream. Each vessel will be 42 inches in diameter and 100 inches tall. They will be constructed of carbon steel with an NSF International (NSF)-certified, two part epoxy internal coating and rated at 150 psi at 300 $^{o}$F. The filter vessels will have a full diameter top access port secured by 23 heavy duty closure bolts. The top access will have a bearing assisted davit cover lift for access to the filter elements. The filter system will be equipped with a filter vessel operation platform approximately 6 feet high and 10 feet by 25 feet 3 inches long, which will be accessible by stairs. The platform grating will be fiberglass and the support structure will be steel with polyurethane finish paint. The expected pressure drop is 5 psi through the clean filter and 25 psi through the dirty filter.

### *2.4.3 Ion Exchange System Header Piping*

Following the filtration stage, the water will be directed and distributed between four fixed bed ion exchange vessel pairs. The ion exchange system header piping will be a 24-inch carbon steel pipe with a NSF-certified epoxy based interior lining. All flowrates to individual vessels will be adjusted manually.

### *2.4.4 Ion Exchange Vessels*

The ion exchange system will consist of eight High Flow Modular Model 12 water treatment system vessels. The system will be arranged with four parallel pairs of vessels, each operated in a lead/lag configuration. Each vessel will be 12-foot in diameter with an overall height of approximately 16 feet and 4 inches, and will be constructed of carbon steel. The interior surfaces of each vessel will be lined to meet requirements for certification for use in potable water systems per NSF/American National Standards Institute (ANSI) Standard 61. The structural aspects of the vessels will be sufficient to meet the Uniform Building Code (UBC) requirements for Seismic Zone 4.

Each vessel will be designed with the necessary piping connections for operation of the vessels in a lead/lag configuration, as well as for backwashing of the vessels. Conical strainers will be installed on the effluent end of each vessel to provide protection of downstream equipment in the case of an unexpected release of media. Each vessel will also be provided with one 20-inch manway and three 2-

inch sample nozzles for use with in-bed water sample probes at 25%, 50%, and 75% of the media bed depth.

Each pair of ion exchange vessels will be designed with a maximum treatment capacity of 1,750 gpm. The pressure drop across each pair of ion exchange vessels will be approximately 22.2 psi at 1,750 gpm. Each individual ion exchange vessel will contain approximately 353 cubic feet of CalRes 2109 Anion Exchange Resin, a single-use ion exchange resin for perchlorate removal. CalRes 2109 has been certified for potable water use by the Water Quality Association according to "Drinking Water System Components – Health Effects," NSF/ANSI-61 for drinking water system components. Perchlorate breakthrough curves are provided in Appendix D. Specifications and drawings for the ion exchange vessels and ion exchange resin are presented in Appendix E.

#### *2.4.5 GAC System Header Piping*

Following ion exchange treatment, the water will be directed and distributed between five fixed bed GAC systems. The GAC system header piping will be a 24-inch carbon steel pipe with a NSF/ANSI-certified epoxy based interior lining. All flowrates to individual vessels will be adjusted manually.

#### *2.4.6 GAC System*

The GAC system will consist of 10 Extended Capacity Modular Model 12 Carbon Adsorption system vessels. The system will be arranged with five parallel pairs of vessels, each operated in a lead/lag configuration. Each vessel will be 12-foot in diameter with an overall height of approximately 22 feet, 7 inches, and will be constructed of carbon steel. The interior surfaces of each vessel will be lined to meet requirements for certification for use in potable water systems per NSF/ANSI Standard 61. The structural aspects of the vessels will be sufficient to meet the UBC requirements for Seismic Zone 4.

Each vessel will be designed with the necessary piping connections for operation of the vessels in a lead/lag configuration, as well as for backwashing of the vessels. Conical strainers will be installed on the effluent end of each vessel to provide protection of downstream equipment in the case of an unexpected release of GAC media. Each vessel will also be provided with one 20-inch manway and three 2-inch sample nozzles for use with in-bed water sample probes at 25%, 50%, and 75% of the carbon bed depth.

Each GAC vessel pair will be designed with a maximum treatment capacity of 1,400 gpm and an empty bed contact time of 7.5 min/bed. The pressure drop across each pair of GAC vessels at 1,400 gpm will be approximately 13.4 psi. Each individual GAC vessel will contain 40,000 pounds of Filtrasorb 300 GAC. Filtrasorb 300 GAC has been certified for potable water use by the Water Quality Association according to "Drinking Water System Components – Health Effects," NSF/ANSI-61 for drinking water system components. GAC specifications are provided in Appendix F. Specifications and drawings for the GAC vessels are provided as Appendix G.

#### *2.4.7 Chloramination System*

A disinfection system will be included as the last stage of treatment. The chloramination system is required to disinfect the treated water prior to entering the City of Pasadena distribution system. As such, PWP is responsible for funding all aspects of design, construction, permitting, and operation associated with the chloramination system.

The proposed disinfection system will consist of gas chlorine cylinders and ammonium hydroxide stored in a single cylindrical vessel. Both the gas chlorine and ammonia hydroxide will be stored in a secured building enclosure with measurements of approximately 30 feet wide by 45 feet long and 18 feet high. The gas chlorine will be stored in pressurized steel cylinders weighing 200 to 300 pounds per cylinder

(cylinder and contents). The ammonium hydroxide tank will have a 2,000 gallon capacity and will be approximately 8 to 10 feet in diameter. The gas chlorine will be injected into the discharge of the treated effluent water leaving the GAC system, and ammonium hydroxide will be injected downstream following chlorine injection. A chemical metering pump will be installed for adjusting the dosage of injected ammonium hydroxide.

The chlorine system, including the building, will be designed in accordance with the Chlorine Institute and the American Water Works Association (AWWA) recommended best practices. This will include adequate ventilation, state-of-the-art leak detection devices, and advanced warning systems. PWP will pre-coordinate emergency response activities with local emergency responders, and will comply with all of the California Accidental Release Prevention (CalARP) Program requirements (see Section 4.1.2).

### *2.4.8 SCADA Interface*

A Supervisory Control and Data Acquisition (SCADA) junction box will be installed to receive all of the signals from the monitoring instrumentation and will include a 24 volt direct current (VDC) power supply for the system instrumentation (see Section 2.5). The City will provide power to, and pick up all signals from this junction box. The existing remote terminal units (RTU) will be used to connect this SCADA to the existing City's SCADA.

## 2.5 Instrumentation and Controls

Piping and instrumentation diagrams (P&ID) are provided in design drawings PID-101 through PID-108 (Appendix P). These P&IDs show the piping, valves and instrumentation for the proposed system. Monitoring instrumentation on the treatment system will be interfaced with the existing SCADA system and electrical service. Instrumentation on the treatment system will monitor only; no devices will require return control signals. Table 2-3 lists all instrumentation provided throughout the system, including that for the production wells, feed pumps, equalization sump, and treatment equipment.

Instrumentation associated with the MHTS equipment primarily includes flow meters, differential pressure gauges, and rupture disk alarms. Magnetic flow meters will be installed on each of the treatment vessels (ion exchange and GAC) to monitor and totalize flow. Flow will be measured on the vessel influent/backwash discharge line to detect flow both entering and exiting (under backwash conditions) the vessel. The magnetic flow meters will be powered by 24 VDC from the SCADA junction box. The flow meters will each source a 4 to 20 mili-Amp (mA) DC signal for input to the SCADA interface. All flow control through the system will be manually adjusted using the appropriate flow control valves.

There will be one differential pressure transmitter on each of the treatment vessels (ion exchange and GAC) to monitor pressure drop across each pair of vessels. The differential pressure transmitter will provide a 4-20 mA signal for input to the SCADA interface. The differential pressure transmitters will be powered by 24 VDC from the SCADA junction box. In addition, the process piping will be equipped with pressure gauges to indicate the water pressure entering each pair of treatment vessels (ion exchange and GAC). The pressure gauges will have a range of 1 to 200 psi. Rupture disks will also be provided with each vessel, and will incorporate burst indicators to allow remote indication of rupture disk status.

Differential pressure transmitters will also be provided for the inlet filter system. One differential pressure transmitter will be provided to measure the pressure drop across the filter vessels. The combined effluent line from the GAC units will also be equipped with a magnetic flow meter to monitor and totalize flow. The flow meter will be powered by 24 VDC from the SCADA junction box, and will source a 4-20 mA DC signal for input to the SCADA interface.

**Table 2-3. Summary of Equipment Instrumentation and Alarms**

| LOCATION | INST # | SERVICE | LOCAL PANEL/READOUT | HMI | HMI/LOCATION | SCADA/REMOTE |
|---|---|---|---|---|---|---|
| PRODUCTION WELLS | FIT-10X | WELL DISCHARGE FLOWTRANSMITTER | | X | ARROYO BLDG | X |
| | LIT-10X | WELL LEVEL TRANSMITTER | | X | ARROYO BLDG | X |
| | PI-10X | WELL DISCHARGE PRESSURE INDICATOR/MANUAL | X | | | |
| | PIT-10X | WELL DISCHARGE PRESSURE INDICATOR/TRENDING | | X | ARROYO BLDG | X |
| | PS-10X/TD3 | PUMP FAILURE ALARM | X | X | ARROYO BLDG | X |
| | HPS-10X | HIGH PRESSURE ALARM | | X | ARROYO BLDG | X |
| | TD5 | MOTOR OVERHEAT | X | X | ARROYO BLDG | X |
| | CR8 | POWER FAILURE | X | X | ARROYO BLDG | X |
| | CR6 | PUMP LIGHT LOAD ALARM | X | X | ARROYO BLDG | X |
| | OL | PUMP OVER LOAD ALARM | X | | | |
| | CR7 | PUMPING WATER STATUS | | X | ARROYO BLDG | X |
| | CR4 | WELL MOTOR RUN STATUS | X | X | ARROYO BLDG | X |
| | CR5 | PUMP CALL | X | X | ARROYO BLDG | X |
| | HOA | HAND OFF AUTO STATUS | X | X | ARROYO BLDG | X |
| VENTURA BOOSTER STATION | FS-100 | SUMP OVERFLOW SENSOR TO SPREADING GROUNDS | | | | |
| | FA-100 | SUMP OVERFLOW INDICATION ALARM | | X | VENTURA ELEC BLDG | X |
| | FIT-100 | PUMP DISCHARGE FLOW TRANSMITTER | | X | VENTURA ELEC BLDG | X |
| | XA | PUMP FAULT INDICATION ALARM (P-101 ; P-102; P-103) | X | | | |
| | LIT-100 | SUMP LEVEL TRANSMITTER | X | | | |
| | LIT-101 | SUMP LEVEL TRANSMITTER | X | | | |
| | LAL-101 | SUMP LEVEL LOW ALARM | X | | | |
| | LAH-101 | SUMP LEVEL HIGH ALARM | X | | | |
| | LS-101 | SUMP LEVEL FLOAT | X | | | |
| | LAL-101 | SUMP LEVEL LOW LOW ALARM | X | | | |

**Table 2-3. Summary of Equipment Instrumentation and Alarms (continued)**

| LOCATION | INST # | SERVICE | LOCAL PANEL/READOUT | HMI | HMI/LOCATION | SCADA/REMOTE |
|---|---|---|---|---|---|---|
| | PIT-100 | PUMP DISCHARGE PRESURE TRANSMITTER | X | | | |
| | PI-100 | PUMP DISCHARGE INDICATOR | X | | | |
| | PAL-100 | PUMP DISCHARGE LOW PRESSURE ALARM | X | | | |
| | PAH-100 | PUMP DISCHARGE HIGH PRESSURE ALARM | X | | | |
| | LS-102 | SUMP LEVEL FLOAT | X | | | |
| | LAH-102 | SUMP LEVEL HIGH HIGH ALARM | X | | | |
| | ZA-104 | RELIEF VALVE OPEN INDICATION ALARM | X | | | |
| | YLA | PUMP FAILURE ALARM (P-101 ; P-102; P-103) | X | | | |
| | TAH | PUMP HIGH TEMPERATURE ALARM (P-101 ; P-102; P-103) | X | | | |
| INFLUENT FILTERS | PIT-200 | PRESSURE TRANSMITTER/RECORDING | X | X | WINDSOR ELEC BLDG | X |
| | PAL-200B | LOW PRESSURE ALARM | | X | WINDSOR ELEC BLDG | X |
| | PAH-200A | HIGH PRESSURE ALARM | | X | WINDSOR ELEC BLDG | X |
| | PDIT-201 | DIFFERENTIAL PRESSURE INDICATOR | X | X | WINDSOR ELEC BLDG | X |
| | PDAH-201A | DIFFERENTIAL PRESSURE HIGH ALARM | | X | WINDSOR ELEC BLDG | X |
| | PDIR-201B | DIFFERENTIAL PRESSURE RECORDER | | X | WINDSOR ELEC BLDG | X |
| FILTERED EFFLUENT | PI-202 | PRESSURE TRANSMITTER | X | | | |
| INFLUENT TO IX VESSELS | PDIT-30XA | DIFFERENTIAL PRESSURE INDICATOR | X | X | WINDSOR ELEC BLDG | X |
| | PDAH-30XA1 | DIFFERENTIAL PRESSURE HIGH ALARM | | X | WINDSOR ELEC BLDG | X |
| | PDIR-30XA2 | DIFFERENTIAL PRESSURE | | X | WINDSOR ELEC | X |

**Table 2-3. Summary of Equipment Instrumentation and Alarms (continued)**

| LOCATION | INST # | SERVICE | LOCAL PANEL/READOUT | HMI | HMI/LOCATION | SCADA/REMOTE |
|---|---|---|---|---|---|---|
| | | RECORDER | | | BLDG | |
| | PI-30XA | PRESSURE INDICATOR | X | | | |
| | PI-30XAA | PRESSURE INDICATOR | X | | | |
| | PDIT-30XB | DIFFERENTIAL PRESSURE INDICATOR | X | X | WINDSOR ELEC BLDG | X |
| | PDAH-30XB1 | DIFFERENTIAL PRESSURE HIGH ALARM | | X | WINDSOR ELEC BLDG | X |
| | PDIR-30XB2 | DIFFERENTIAL PRESSURE RECORDER | | X | WINDSOR ELEC BLDG | X |
| | PI-30XB | PRESSURE INDICATOR | X | | | |
| | FIE-30XA | RUPTURE DISK SENSOR | | | | |
| | FIA-30XA | DISK RUPTURE ALARM | | X | WINDSOR ELEC BLDG | X |
| | FIE-30XB | RUPTURE DISK SENSOR | | | | |
| | FIA-30XB | DISK RUPTURE ALARM | | X | WINDSOR ELEC BLDG | X |
| IX VESSEL EFFLUENT | FIT-30XA | FLOW TRANSMITTER | | X | WINDSOR ELEC BLDG | X |
| | FIR-30XA | FLOW RECORDER | | X | WINDSOR ELEC BLDG | X |
| | FIT-30XB | FLOW TRANSMITTER | | X | WINDSOR ELEC BLDG | X |
| | FIR-30XB | FLOW RECORDER | | X | WINDSOR ELEC BLDG | X |
| INFLUENT TO LGAC VESSELS | PDIT-40XA | DIFFERENTIAL PRESSURE INDICATOR | X | X | WINDSOR ELEC BLDG | X |
| | PDAH-40XA1 | DIFFERENTIAL PRESSURE HIGH ALARM | | X | WINDSOR ELEC BLDG | X |
| | PDIR-40XA2 | DIFFERENTIAL PRESSURE RECORDER | | X | WINDSOR ELEC BLDG | X |
| | PI-401XA | PRESSURE INDICATOR | X | | | |
| | PI-401XAA | PRESSURE INDICATOR | X | | | |
| | PDIT-40XB | DIFFERENTIAL PRESSURE INDICATOR | X | X | WINDSOR ELEC BLDG | X |
| | PDAH-40XB1 | DIFFERENTIAL PRESSURE HIGH | | X | WINDSOR ELEC | X |

**Table 2-3. Summary of Equipment Instrumentation and Alarms (continued)**

| LOCATION | INST # | SERVICE | LOCAL PANEL/READOUT | HMI | HMI/LOCATION | SCADA/REMOTE |
|---|---|---|---|---|---|---|
| | | ALARM | | | BLDG | |
| | PDIR-40XB2 | DIFFERENITIAL PRESSURE RECORDER | | X | WINDSOR ELEC BLDG | X |
| | PI-40XB | PRESSURE INDICATOR | X | | | X |
| | FIE-40XA | RUPTURE DISK SENSOR | | | | |
| | FIA-40XA | DISK RUPTURE ALARM | | X | WINDSOR ELEC BLDG | X |
| | FIE-40XB | RUPTURE DISK SENSOR | | | | |
| | FIA-40XB | DISK RUPTURE ALARM | | X | WINDSOR ELEC BLDG | X |
| LGAC VESSEL EFFLUENT | FIT-40XA | FLOW TRANSMITTER | | X | WINDSOR ELEC BLDG | X |
| | FIR-40XA | FLOW RECORDER | | X | WINDSOR ELEC BLDG | X |
| | FIT-40XB | FLOW TRANSMITTER | | X | WINDSOR ELEC BLDG | X |
| | FIR-40XB | FLOW RECORDER | | X | WINDSOR ELEC BLDG | X |
| CLEAN WATER TO WINDSOR RES | FIT-500 | FLOW TRANSMITTER/TRENDING | | X | WINDSOR ELEC BLDG | X |
| | FIR-500 | FLOW RECORDER | | X | WINDSOR ELEC BLDG | X |
| DISCHARGE WATER TO SAND BOX | FIT-502 | FLOW TRANSMITTER/TRENDING | | X | WINDSOR ELEC BLDG | X |
| | FIR-502 | FLOW RECORDER | | X | WINDSOR ELEC BLDG | X |
| BACKWASH DISCHARGE | FIT-501 | FLOW TRANSMITTER/TRENDING | | X | WINDSOR ELEC BLDG | X |
| | FIR-501 | FLOW RECORDER | | X | WINDSOR ELEC BLDG | X |

## 2.6 Treatment Equipment Pad and Access Driveways

The MHTS equipment will be placed on a new concrete pad with maximum dimensions of 100-feet by 150-feet, as shown on Design Drawing TPS-101 (Appendix P). The concrete pad will be located in the south central portion of the Windsor Reservoir site. The location of the plant is being proposed based on its proximity to the Monk Hill Wells and Windsor Reservoir, the accessibility of the location for routine maintenance needs, as well as the results of topographical and geophysical surveys, and a geotechnical study that was conducted at the site.

Design of the pad will take into account equipment loading as well as the seismic conditions of the area. The concrete pad thickness will vary depending on the loading. In addition to the equipment, (one set of three influent filters, four pairs of ion exchange vessels, and five pairs of GAC vessels) the pad must also support maintenance vehicles. There will be access for vehicles in the center of the pad. Details on the pad thickness and reinforcement are shown on Design Drawings TPS-102 (Appendix P). Design and construction of the concrete pad will also take into consideration the completed geotechnical investigation which recommends that soil preparation for the pad include 2 ft of over excavation and compaction of native material at 95% relative density below the foundation and extending at least 2 ft horizontally beyond the foundation perimeter.

Paved driveways will be built to provide truck access to the treatment pad. The main access road running between the north and south entrance gates and along the west side of the treatment pad will be 20-feet wide. The center of the pad will be accessible to vehicles from this main access road. A secondary 15-foot wide access road will also be built around the north, south, and east sides of the treatment pad. A portion of Windsor Avenue, located just below the south gate, will be widened to provide easy access for delivery trucks. Design Drawing C-110 shows the layout of the treatment pad and access driveways, as well as the rough grading plan for the site (see Appendix P).

## 2.7 Environmental Impact Concerns

In accordance with the Environmental Policy Guidelines of the City of Pasadena, an Initial Study was prepared to determine whether this proposed project may have a significant effect on the environment. Several Mitigation Measures are included as part of the project design and noted the Initial Study to minimize potential significant effects on the environment. The proposed Mitigation Measures and required Mitigation Monitoring are summarized in Attachment B of the Conditional Use Permit Staff Report (Appendix I). All Mitigation Measures have been incorporated into the MHTS design, construction, and operational requirements.

Therefore, the Initial Study determined that the proposed project will have less than significant environmental impacts with the incorporation of the proposed Mitigation Measures.

# 3 PRODUCTION WELL EVALUATION AND REHABILITATION

The following subsections outline the procedures involved with the evaluation, repair, and rehabilitation of the four municipal production wells. All work associated with the well rehabilitation, as well as all treatment system construction activities (see Section 4), will be conducted in accordance with the project Health and Safety Plan (HASP) provided in Appendix J of this document.

## 3.1 Pump Removal, Storage, and Disposal

This task includes removal of the existing pump, shaft, pump bowl, and motor at each well. The pump and equipment were removed from Well 52 and the Arroyo Well in September 2003, so this task will only be performed for the Ventura and Windsor wells. Power to the pumps will be secured using lock-out and tag-out procedures to prevent shock or electrocution during removal. The electrical wires connecting the pump will be disconnected, and the well head equipment will be disconnected from the well casing. Once the electric has been disconnected, the well house roof access hatch will be removed for an enclosed well, and the equipment will be hoisted from the well using the development rig. The removed equipment will initially be staged in the well yard on plastic sheeting during initial inspection. If deemed unusable during the initial inspection, the equipment will be permanently removed and disposed of at an offsite location. During the equipment removal process, care will be taken to minimize the nuisance to the surrounding area (i.e., noise and odor).

## 3.2 Initial Well and Pump Inspection

Once the existing equipment has been removed from each well, the pump and the well will be evaluated by National Ground Water Association (NGWA) Certified Well Driller (CWD) and/or a Certified Pump Installer (CPI) and PWP personnel to determine its condition and potential for reuse. The pump bowl and motor will be subsequently dismantled and similarly evaluated. Each well will be sounded to determine the depth to water and borehole depth, and debris that has settled in the well will be removed using a suction bailer. The debris will be temporarily stored on site in a Baker tank or similar storage unit pending offsite disposal. It is assumed that approximately 250 gallons of water and debris will be removed from each well using the suction bailer. A sieve analysis will be performed in the laboratory on the debris removed from the well by the suction bailer, and the results will be graphed and later used to assist in determining appropriate screen size and gravel pack composition for the stainless steel well liner (if necessary). A 40-ft mandrel will be run down the well to determine whether a liner will fit into the well casing and the casing will be examined for variations (i.e., alignment). A deviation plot will also be performed to note the levels of deviation in the casing and hole. An initial down-hole video log of the well casing will be taken to inspect for any damage and to determine the extent of biofouling, sedimentation, and encrustation within the well.

## 3.3 Well Rehabilitation and Development

Based on the results of the initial well inspection, each well will be repaired, as appropriate, to meet the design criteria. Although the exact procedure for well rehabilitation will not be known until after the initial inspection, it is anticipated that it will require a combination of an initial well cleaning, development pumping, and well relining. These techniques are discussed in the following subsections.

Schematic diagrams showing the proposed equipment layout at each well during rehabilitation activities are presented in Figures 3-1 through 3-4. To maintain pedestrian, equestrian, and bicycle access along Karl Johnson Parkway (access road along the east side of the spreading basins) during work at the Ventura Well and Well 52 sites, equipment will be staged such that at least four horizontal feet of pavement remains unobstructed. This can likely be accomplished by staging all equipment inside the site’s fence or, if space inside the fence is inadequate, as close to the fence as possible (as shown in

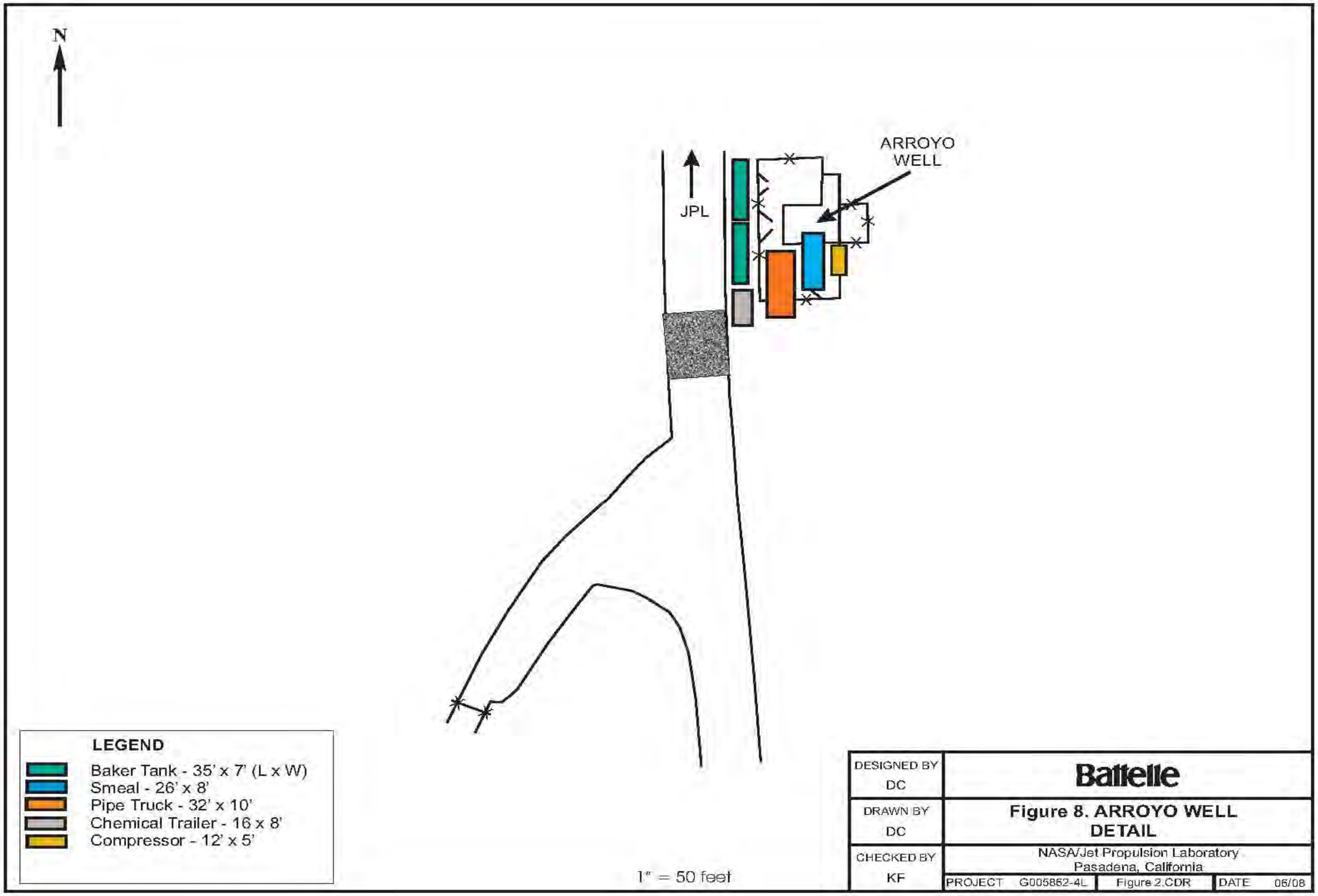


**Figure 3-1. Arroyo Well Detail**

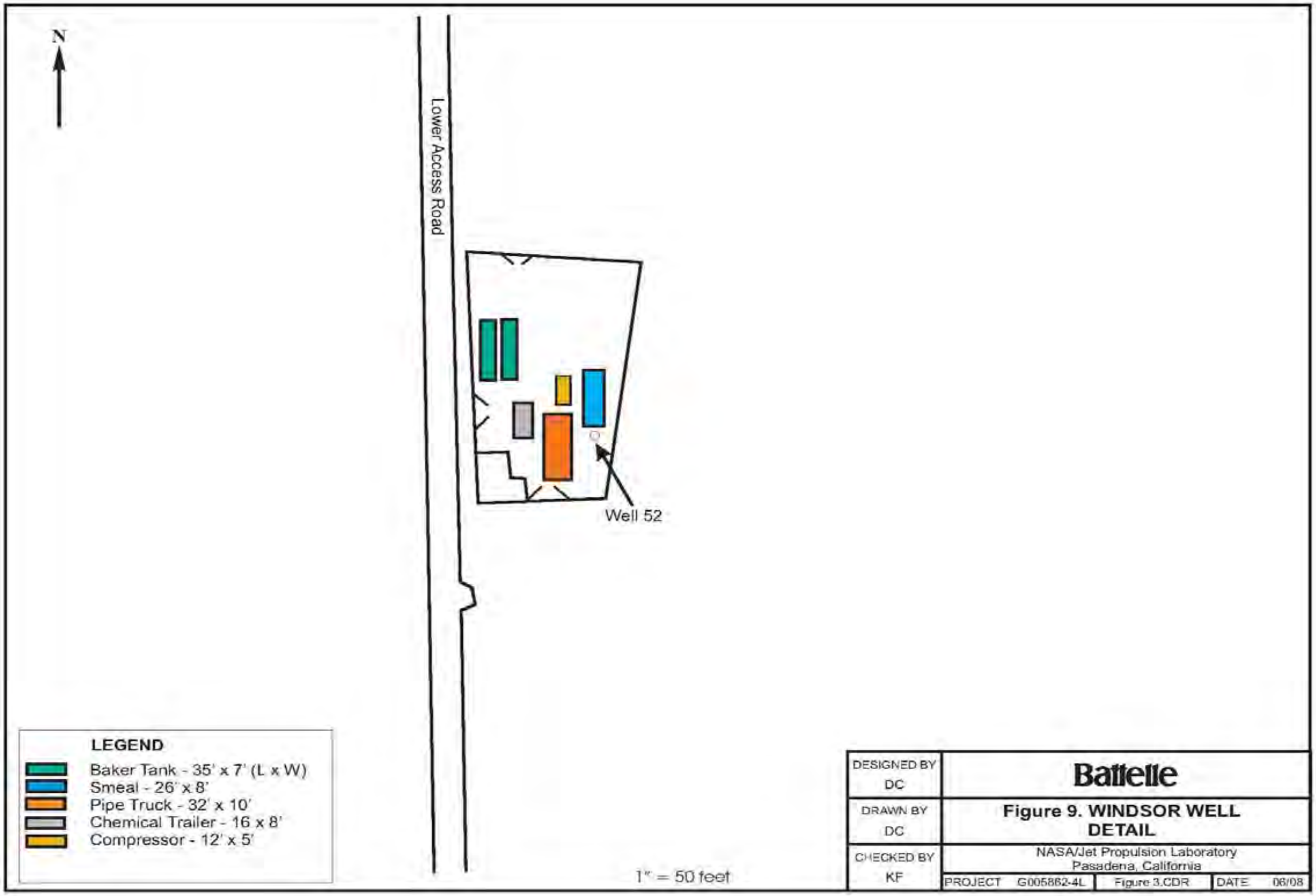


**Figure 3-2. Well 52 Detail**

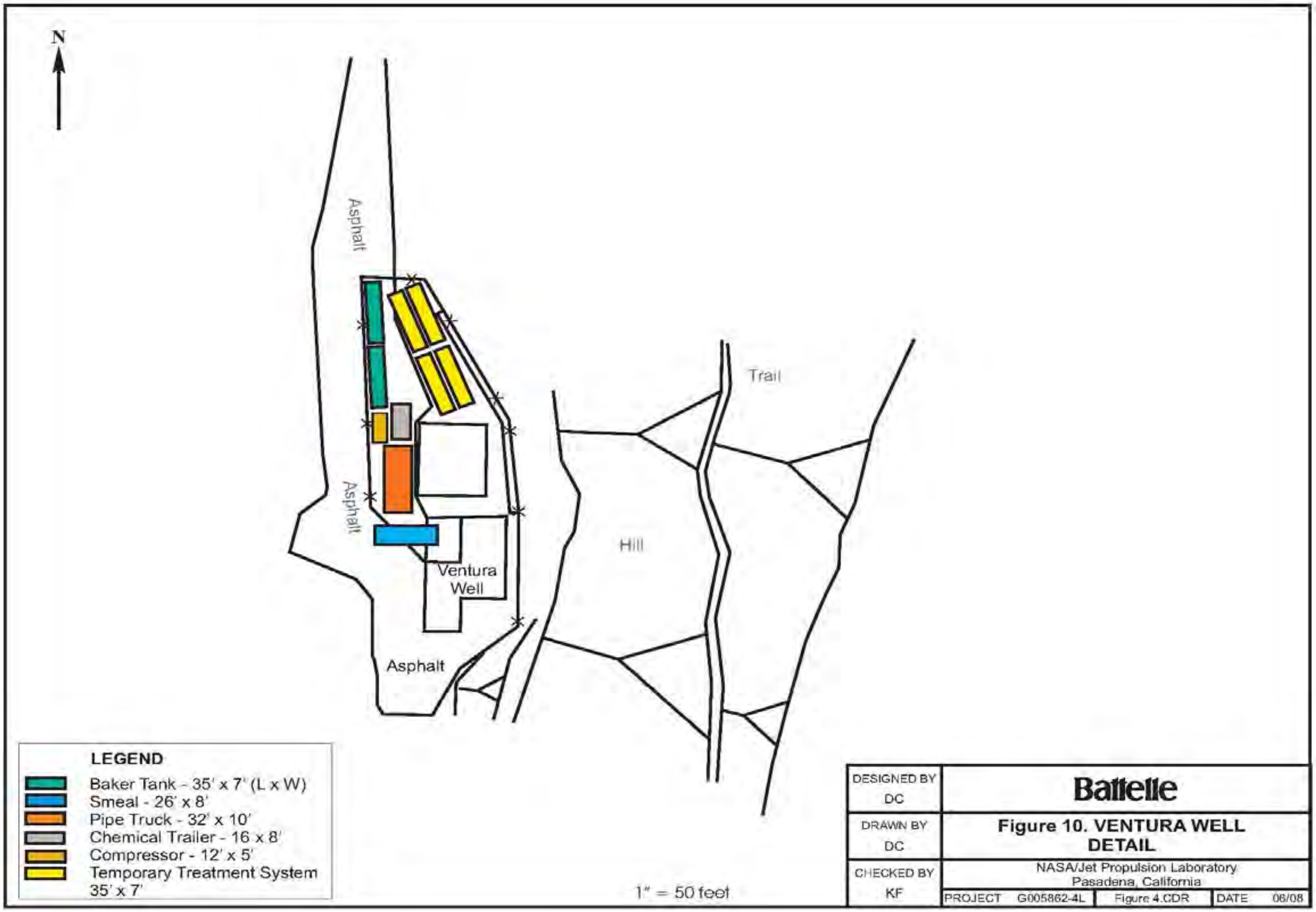


**Figure 3-3. Ventura Well Detail**

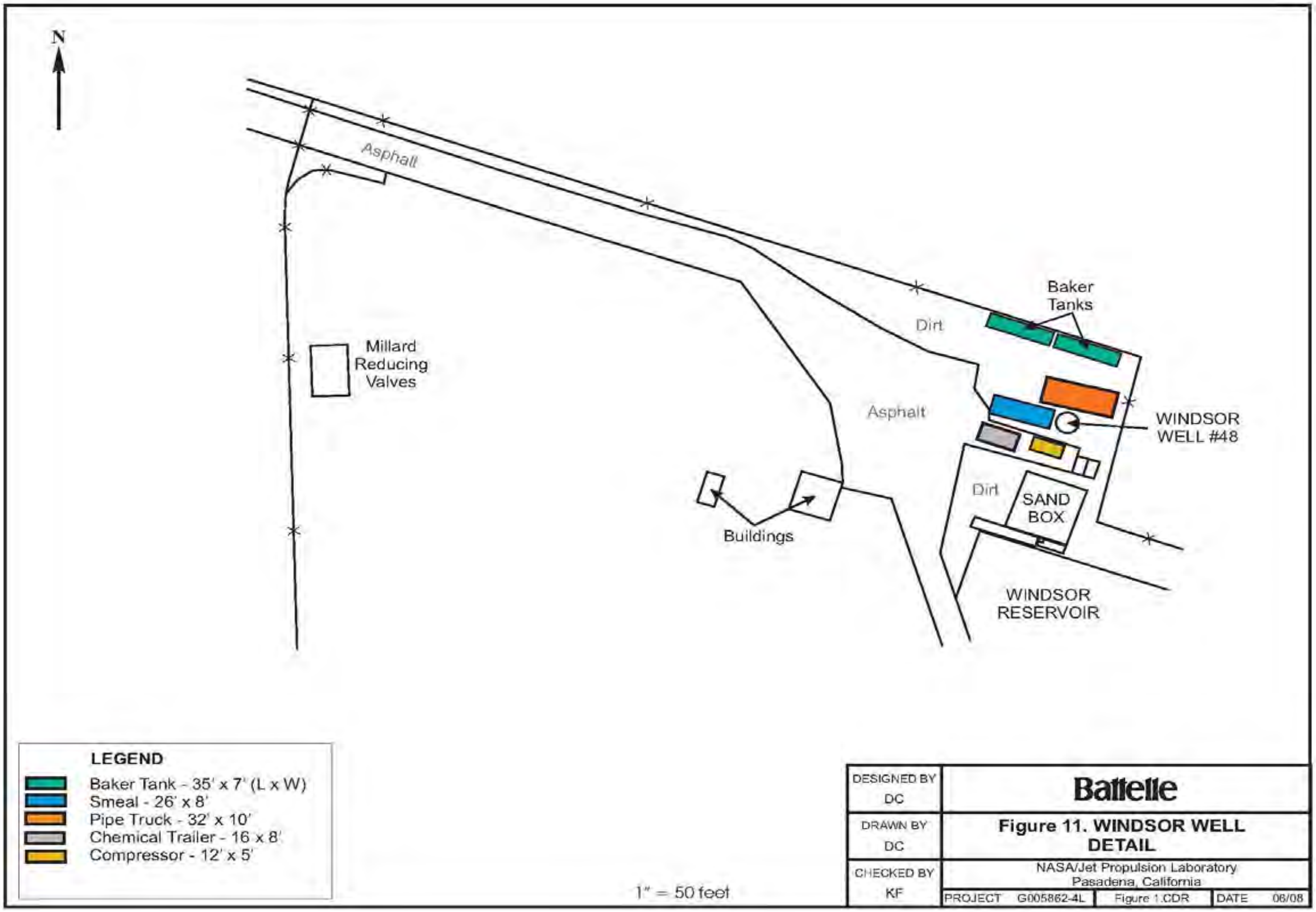


**Figure 3-4. Windsor Well Detail**

Figures 3-3 and 3-4). If maintaining four horizontal feet of pavement is not possible, pedestrian, equestrian, and bicycle traffic will be redirected to the service road on the west side of the spreading basins. A Construction Staging and Traffic Management Plan will be prepared for implementation of this work, and the plan will be reviewed and approved by the City of Pasadena Public Works Department.

#### *3.3.1 Initial Well Cleaning*

After the equipment has been removed from the well and inspected, an initial well cleaning will be performed to remove debris that may have accumulated on the well casing over time. During the initial well cleaning, it is anticipated that one or more of the procedures discussed in the following subsections may be utilized.

*3.3.1.1 Brushing.* This method is utilized as a preparative step before other rehabilitation techniques are utilized in the well, and will likely be performed in each well. The inside of the existing well casing will be brushed with a wire or nylon brush to remove debris and incrustations. The brush diameter will be at least the size of the inside of the well casing and will be moved up and down using a spudder arm attached to the development rig. The brush will be moved at a rate of approximately 45 feet per hour through the screened area. Following the brushing activities, material that has accumulated in the well will be removed using a suction bailer and temporarily stored on site in a Baker tank or similar storage unit pending offsite disposal.

*3.3.1.2 Dual-Swab Airlifting.* The dual-swab airlifting method is designed to dislodge debris from the casing and remove it from the well. The tool consists of a vertical discharge pipe (eductor) with a smaller airline suspended down the middle of the pipe. A perforated section of pipe with two rubber swab flanges (i.e., rubber disks approximately the same size as the inside diameter of the well) is connected and located at the bottom of the eductor pipe. The swabs are primarily designed for cleaning (i.e., when raised and lowered during pumping) and stabilization of the assembly in the well. The airline discharge is installed above the surge blocks inside the pipe. Compressed air is pumped through the airline from the surface with an air compressor and is released into the eductor pipe causing a mixture of air bubbles and water. Continued injection of compressed air causes the mixture to flow up and out of the eductor pipe. The general pumping principal is based on the difference in hydrostatic pressure inside and outside of the pipe resulting from the lower specific gravity of the mixed column of water and air bubbles. It is anticipated that the dual-swab tool will be moved up and down within the well over an approximately 10-15 foot interval while simultaneously pumping the well. The actual field-applied method depends upon a number of factors, including air volume, submergence (i.e., the depth below the static water level at which the air is introduced), total lift, and the cross-sectional area of the discharge or eductor pipe (i.e., diameter of discharge pipe). Generally, the larger the diameter of the eductor pipe, greater tool submergence, and higher volumes of compressed air will increase the extraction rates.

Dual-swab airlifting will likely be implemented in each well following the initial brushing (see Section 3.3.1.1). This technique will be performed over a 24-hour period at a maximum flowrate of 300 gpm, and will result in approximately 300,000 gallons of water and debris being removed from each well. During this initial rehabilitation stage, all water removed from the wells will be routed through a temporary treatment system for discharge to the spreading grounds. A complete description of the temporary treatment system is provided in Section 3.7.

*3.3.1.3 Chemical Treatment.* Chemical treatment may be performed on the well casing using acids, dispersants, or disinfectants. The chemicals will be mixed above-ground and injected into the well via a tremie pipe between dual/swabs with rubbers set 10 feet apart. The injected chemicals will have a sufficient quantity to displace at least one complete borehole volume. The injected chemical solution will remain in the well for a period of time (chemical-specific) that is sufficient for the chemicals to react with and dislodge or dissolve the debris that has accumulated on the well casing. Once the chemical treatment has reacted with the debris, the solution will be removed from the well and treated at the temporary treatment system.

*3.3.1.4 Air Bursting.* Air bursting may be performed in the well to further clean the casing. This method is performed using an air gun device (BoreBlast) that is lowered into the well on a high pressure hose. The gun is pressurized with an inert gas (e.g., nitrogen) when it reaches the perforations in the well casing. As the pressure is released, the pressure wave dislodges mineral scale from the casing and scours the casing surface as the inert gas rushes to the surface.

*3.3.1.5 AquaFreed®.* AquaFreed® is a method that involves the controlled injection of liquid and vapor-phase carbon dioxide into a well. The well is sealed after three injection lines have been strategically placed throughout the perforated zones of the well. The carbon dioxide expands up to 500 times when the liquid converts to a gas. This rapid expansion allows for excellent penetration of the gravel pack and formation; penetration of the gas phase into the aquifer can be substantial (60 feet or more). The groundwater in the well will become saturated with carbon dioxide forming a mild carbonic acid that will assist in the breakup the matrix of the mineral deposits within the well. The resulting physical agitation scours the casing and gravel pack. Injection of the carbon dioxide creates a pressurized environment inside the sealed well casing and depresses the column of water in the casing down to the top of the perforations where it begins to constantly surge the well in response to the injection process.

### *3.3.2 Disposal of Extracted Water from Initial Well Cleaning*

During the initial well cleaning, the anticipated water quality (elevated turbidity, sand content, and chemical concentrations), coupled with a discontinuous water supply, will not allow use of the MHTS for treatment of extracted water. A technical evaluation of the potential disposal options for the initial development water recommended that on-site treatment and disposal is the most cost effective disposal option (see Appendix L). The proposed treatment process associated with this disposal option is discussed in the following paragraphs.

To implement temporary on-site treatment and disposal of extracted development water, a temporary treatment system capable of handling 300 gpm will be utilized. The temporary system will be trailer-mounted and housed initially at the Windsor Reservoir property to handle development water from the Windsor Well, and subsequently at the Ventura Well in the adjacent fenced yard (see Figure 3-3) to handle development water from the Arroyo well, Well 52, and the Ventura Well.

Development water from each of the wells will be pumped directly to a roll-off bin where the majority of solids will settle out, and then through a series of two (or more) holding (Baker) tanks designed for additional settling capacity. The final tank in series will have a riser where decanted water will be drawn off with a booster pump and routed to the temporary system for treatment. Treated water leaving the temporary treatment system will be routed through a series of holding (Baker) tanks, from which composite samples will be periodically collected for expedited water quality analysis. The development water will have to be treated to meet the Regional Water Quality Control Board (RWQCB) General Waste Discharge Requirements (WDRs) prior to disposal. These WDRs are presented in Section5. To meet these discharge requirements, the temporary treatment system will be engineered to consist of a three-step process that includes a filtration step, an adsorption step, and an ion exchange step. The initial filtration step will consist of a sand filter that is designed to remove particulate and coagulated particles, resulting in effluent water having turbidity less than 0.5 nephelometric turbidity units (NTU). The second (adsorption) step will consist of VOC adsorption by GAC, and the third step ion exchange will consist of a perchlorate-sensitive ion exchange resin that will be utilized to remove perchlorate (and to a lesser degree sulfate and nitrate) from the water.

Results from the treated water analyses will be evaluated and distributed to PWP. Once it is determined that the WDRs have been met, the treated water will be discharged. Treated water from the Windsor Well will be transferred via 4-inch polyvinyl chloride (PVC) or low carbon steel piping to the existing 30-inch hume drain, which gravity drains to Spreading Basin 5 located west of the Arroyo Well. Treated water from the Arroyo Well, Well 52, and the Ventura Well will be transferred via temporary 4-inch PVC or low carbon steel piping to the existing sump adjacent to the Ventura well. A temporary sump pump will be connected to the 12-inch overflow line, allowing the water to drain from the sump to Spreading Basin 10, which is located to the west of the Ventura Well.

The temporary PVC piping will cover a maximum distance of 2,500 ft. It is anticipated that the discharge piping will temporarily cross the access road at one location adjacent to the Arroyo Well during rehabilitation of the Arroyo well; the piping will not cross Karl Johnson Parkway. A traffic ramp will be used to allow for vehicle access over the piping. After the initial well cleaning is complete at a well, all residual solids contained in the initial settling tanks will be profiled and transported offsite for appropriate disposal before moving the roll-off bin and holding tanks to the next well in succession. Any water generated from backwashing the sand filter will also be characterized and disposed offsite at an approved facility.

Because the initial well cleaning will substantially increase the quality of extracted water, it is anticipated that water generated during the latter stages of the rehabilitation effort (well development and performance testing, discussed below) can be routed through the MHTS for treatment and subsequent disposal.

### *3.3.3 Initial Development Pumping*

After the initial well cleaning, well development pumping is performed to flush impacted fines from the surrounding gravel pack and borehole face and to consolidate the gravel pack. Development pumping consists of lowering an electric submersible pump into the well screened interval at a depth below the anticipated permanent production pump setting. Four separate 10-hour constant rate pumping tests will then be performed in each well on consecutive days. Table 3-1 summarizes the duration, extraction rate, and extraction volume for the development pumping tests that are to be performed for each well. The extraction rate for each test will vary, and increase each day from a low percentage of the expected capacity on the first day to at least 125% of the anticipated permanent discharge rate on the final day. This incremental pumping method is utilized to flush impacted fines from the gravel pack and borehole face and to consolidate the gravel pack. During each development test, the sand content and turbidity will be monitored to evaluate the condition of the discharge water. To avoid interferences between wells, one well will be developed at a time.

**Table 3-1. Estimated Extraction Schedule for Well Rehabilitation Effort**

| Task | | Duration (hr) | Arroyo Well | | Well 52 | | Ventura Well | | Windsor Well | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Rate (gpm) | Volume (gal) | Rate (gpm) | Volume (gal) | Rate (gpm) | Volume (gal) | Rate (gpm) | Volume (gal) |
| Development Pumping | Day 1 | 10 | 800 | 480,000 | 500 | 300,000 | 600 | 360,000 | 400 | 240,000 |
| | Day 2 | 10 | 1,500 | 900,000 | 1,100 | 660,000 | 900 | 540,000 | 700 | 420,000 |
| | Day 3 | 10 | 2,200 | 1,320,000 | 1,800 | 1,080,000 | 1,600 | 960,000 | 1,400 | 840,000 |
| | Day 4 | 10 | 2,800 | 1,680,000 | 2,100 | 1,260,000 | 1,900 | 1,140,000 | 1,700 | 1,020,000 |
| Step Test (avg. rate) | | 8 | 1,800 | 864,000 | 1,400 | 672,000 | 1,200 | 576,000 | 1,000 | 480,000 |
| Continuous Rate Test | | 24 | 2,200 | 3,168,000 | 1,800 | 2,592,000 | 1,600 | 2,304,000 | 1,400 | 2,016,000 |
| Performance Testing | | NA | NA | 500,000 | NA | 400,000 | NA | 400,000 | NA | 300,000 |

Due to the significant extraction rate and overall volume of water removed from each well during development pumping, the extracted water will be routed to the MHTS for treatment and discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir. Sacrificial IX and GAC media will be used to treat water produced during the initial development pumping. The sacrificial media will be removed following completion of all well rehabilitation activities, and each vessel will be inspected, disinfected, and tested prior to virgin media being loaded for startup of the treatment system.

### *3.3.4 Well Relining*

After the existing well casing has been rehabilitated to the extent possible, a second down-hole video log of the well casing will be performed. Results from this second video log will be compared to those of the initial video-log to evaluate the effectiveness of the initial well cleaning and development pumping. Relining of the casing and/or screen zones of the production wells with a stainless-steel liner and associated filter pack will be necessary if casing/screen damage is observed in the video-log. The composition of the filter pack and the screen slot size will be determined based on the sieve analysis of the debris (sand) bailed from the well during the initial inspection of the well (see Section 3.2) and on results of the initial development pumping (see Section 3.3.2). Any significant proposed changes to the well configuration that may result from installation of a liner will be cleared through PWP prior to implementation.

If a liner is required to effectively rehabilitate the well, the damaged (i.e., peeled or collapsed casing, holes, etc.) areas are first repaired by swaging the casing or screen as close to the original inside diameter as possible. The drive swages are operated by cable tool, hydraulically, or through the use of electrically operated swages. Generally, collapsed sections can be restored as long as there is sufficient space to permit the guiding of the swage into the well. Collapsed sections that have been swaged can be reinforced by placing a liner (i.e., casing) across and bridging the damaged area. The liners can be cemented or expanded in place either hydraulically or electronically. The cementing procedure consists of lowering the liners equipped with a cement basket near the bottom. The liners are of sufficient length to cover the repair plus an additional four to six feet of overlap at each end. During installation, the liner and cementing apparatus is suspended at the desired depth. The cementing apparatus consists of a bell shaped device which directs the cement towards holes cut in the sides of the liners. Once the liner is set into place, a string of tubing (or threaded pipe) is lowered into the well and centered on the bell shaped device. The bottom of the tubing or pipe is equipped with an entering socket that seals into the bell with an o-ring. Once the tubing or pipe is in place, water and sand is flushed through the pipe or tubing to seal the cement basket and a calculated volume (i.e., enough cement to fill the annular space between liner and original casing) is pumped in. Following the pumping a wiper or plug is sent down the pipe/tubing to flush the cement out of the tubing. After the cement has set, the pipe or tubing is removed, and the feed through apparatus brought back to the surface. If complete relining is necessary (i.e. screen and casing) then the same process is used for the casing, and a properly sized filter pack will be filled between the annular space between the old and new section of screen.

### *3.3.5 Well Development Pumping*

Once the liner is installed, or after it is not deemed necessary to install a liner, well development pumping is performed. Two separate well development pumping tests will be performed in each well using a submersible electric test pump: a variable rate pumping test followed by a constant rate pumping test.

A variable-rate (i.e., step-drawdown) pumping test will first be performed for approximately 8 hours. This test will be conducted to estimate the maximum extraction capacity of the well and the response of the aquifer system to the stresses during extraction. The extraction rate will be incrementally increased during the test once the groundwater level in the well has stabilized; reaching a maximum pumping rate that is slightly above the design flow rate. The proposed well-specific extraction rates and production volumes for the variable-rate test are summarized in Table 3-1. Data collected during this test will be used to measure the hydraulic response to extraction cycles. During the pumping test, flow rates will be recorded every ten minutes using an in-line flow totalizer. Continuous groundwater-level measurements will be recorded throughout the test using a pressure transducer, and periodic measurements of sand content, and air/gas production also will be collected and recorded. Continuous groundwater-level measurements also will be recorded in two to four nearby production and/or monitoring wells and used in conjunction with production rate data to estimate aquifer parameters. Groundwater-levels will continue to be recorded in the production well and in the adjacent monitoring wells after extraction during the recovery period, and the data will be used to further assist in estimating aquifer parameters.

After the completion of the step-drawdown test, and once aquifer levels have returned to static conditions, a continuous-rate pumping test will be performed on the well at its design pumping rate (see Table 3-1) for 24 hours. Similar to the step-drawdown test, continuous groundwater-level measurements will be recorded in the well throughout the test using a pressure transducer, and periodic measurements of sand content, and air/gas production also will be collected and recorded. Continuous groundwater-level measurements also will be recorded in two to four nearby production and/or monitoring wells and used in conjunction with production rate data to estimate aquifer parameters.

During and after the continuous-rate pumping test, a spinner probe will be used to measure well hydraulics (i.e., water flow patterns) in the well. A static spinner log is conducted with the well pump equipment turned off while the groundwater is under static conditions. Conversely, a dynamic spinner log is completed while the well pump is operating under normal conditions. The flow log reveals zones where water enters and exits the well screen and allows for flow contributions from individual zones to be measured and documented. Spinner log data will be correlated with geophysical and lithologic logs to evaluate flow conditions within the well during static and dynamic conditions. This information will then used to identify and map specific zones within a well that have higher flow potential.

After well development, the test pump will be removed and the groundwater level will be allowed to re-equilibrate to static conditions. A second down-hole video log of the well casing will then be taken to inspect the condition of the well casing (liner).

Due to the significant extraction rate and overall volume of water removed from each well during development pumping, the extracted water will be routed to the MHTS for treatment and discharged to the Arroyo Seco Spreading Grounds. Sacrificial IX and GAC media will be used to treat water produced during the well development pumping. The sacrificial media will be removed following completion of all well rehabilitation activities, and each vessel will be inspected, disinfected, and tested prior to virgin media being loaded for startup of the treatment system.

### *3.3.6 Electrical Updates*

Concurrent with the rehabilitation procedures discussed in Sections 3.3.1 through 3.3.4, the electrical systems at each wellhead will be updated as necessary to meet the requirements of the proposed equipment. The electrical systems for each well are housed in an adjacent wellhouse. SCADA components will be installed during the update so that monitoring of well performance can be performed.

## 3.4 Discrete-Depth Groundwater Sampling

Based on the results of the spinner log analyses and review of the boring logs, depth discrete groundwater samples will be collected from high flow zones (if present) within each well to create a baseline vertical contaminant profile. All groundwater samples will be collected in accordance with the project Sampling and Analysis Plan (SAP) provided in Appendix K. Groundwater samples will be collected and analyzed for the following target analytes: perchlorate, VOCs, and geochemical parameters (cations, anions, and total dissolved solids [TDS]). Specifically, VOC testing will include a full CG/MS scan, including lab reporting of TICs and unknown peaks as well as all target analytes. In addition, other sample analysis required by DPH to support the permitting process will be conducted at this time. Groundwater chemical analyses will be performed by a California DPH-certified laboratory. Depth to water (DTW) measurements will be taken using an interface probe.

The low-flow purging (micropurge) technique will be utilized to collect groundwater samples from each well. The micropurge technique was evaluated during groundwater sampling activities conducted during an initial evaluation of City of Pasadena Wells Arroyo, 52, Atlanta, and Casitas (PSP 2003-1). Due to the poor condition of the Pasadena wells (limited to no flow) at the time of initial sampling, groundwater sample data did not appear to be representative of the groundwater conditions present in the aquifer surrounding these wells. However, the evaluation indicated that groundwater samples collected using the micropurge technique may be more representative of aquifer conditions if groundwater samples were collected after well rehabilitation is performed.

During purging, the groundwater level in each well will be measured and in-line water quality parameters will be monitored continuously using QED's MicroPurge® MP20 flow-through cell and meter. Groundwater level monitoring and water quality parameter measurements will be taken each time that the flow cell is completely filled and discharged. Stabilization is considered to be achieved after three consecutive readings within:

- ± 0.2 units for pH
- ± 20 millivolts for oxidation-reduction potential (ORP)
- ± 0.2 mg/L for dissolved oxygen (DO)
- ± 3% of reading (± 0.2°C) for temperature
- ± 3-5% of reading for conductivity

Upon parameter stabilization, sampling will be initiated. To collect a representative groundwater sample the in-line water quality parameter-monitoring device will be disconnected and the sample will be collected directly from the water discharge tubing. During sample collection, the sample flow rate will be adjusted to minimize aeration, bubble formation, turbulent filling of sample bottles, or loss of volatiles due to extended residence time in tubing. Samples will be collected in approved sample containers for the appropriate type of analysis to be performed which were provided by the analytical laboratory specifically for this project. After the sample container is filled with groundwater, a Teflon™ lined cap will be screwed on tightly to prevent the container from leaking. Groundwater samples will then be shipped under chain-of-custody procedures to the designated analytical laboratory for analysis.

### 3.5 Pump Rehabilitation/Installation

The pump bowl and motor for each well will be dismantled and evaluated during the initial inspection. Preliminary evaluations indicate that the pump bowls and heads can be refurbished and used, although the initial inspection may reveal the need for replacement of one or both in each well. The level of the pump bowls will be set based on estimated future groundwater levels and conditions observed during and immediately after the well rehabilitation effort. PWP will be notified of the proposed depths for concurrence prior to implementation.

Based on results of the development pumping, historical extraction information, well evaluation data, and expected future performance, an appropriate permanent pump will be chosen for each well. The proposed pump size and production rate goal for each well is summarized in Table 3-2. It should be noted, however, that the pump size may vary based on the results of development pumping. Each pump will be complete with a new premium efficiency motor. Soft start equipment will be furnished and installed when updating the existing electrical circuitry. The pump motor and shaft will be set into the well using the development rig. Once the equipment is lowered into place, the well head flange plates will be bolted, and associated piping reconnected to the discharge line. Power to the pumps will be reconnected using lock-out and tag-out procedure, and the electrical wires connecting the transducer and pump will be connected.

**Table 3-2. Proposed Production Well Specifications**

| Well | Pump Size (hp) | Production Rate Goal (gpm) |
|---|---|---|
| Arroyo | 200 | 2,200 |
| 52 | 250 | 1,800 |
| Windsor | 125 | 1,400 |
| Ventura | 250 | 1,600 |

### 3.6 Well Performance Testing

Performance testing will be conducted to check each of the rehabilitated wells for leaks, vibration, flow, efficiency, loading, impeller setting, sand content, and pressure. After initial performance testing, a brief pumping test will be performed to develop an operation baseline for future performance tracking and maintenance. Table 3-1 summarizes the proposed volume of water that will be removed from each well during well performance testing. Due to the significant extraction rate and overall volume of water removed from each well during performance testing, the extracted water will be routed to the MHTS for treatment and discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

# 4 SYSTEM CONSTRUCTION

Construction of the MHTS will be conducted in accordance with all applicable laws and regulations. This section provides a summary of permitting, coordination, and scheduling associated with construction of the MHTS.

## 4.1 Permitting Plan

CERCLA section 121(e)(1) provides that no Federal, State, or local permit shall be required for the portion of any response action conducted entirely on-site. On-site is defined as the "areal extent (including surface area, air, soil, and groundwater) of contamination and all suitable areas in very close proximity to the contamination necessary for implementation of the response action (United States Environmental Protection Agency [U.S. EPA], 1992). As such, the Arroyo Seco spreading basins and the Devil's Gate Reservoir are "on-site." Therefore, discharges to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir will not require obtaining a National Pollutant Discharge Elimination System (NPDES) permit from the Regional Water Quality Control Board (RWQCB); however, the substantive NPDES requirements will be met. Substantive requirements for the NPDES permit are discussed in Section 4.1.3.

Various other permits will need to be obtained during design and construction of the MHTS. These include a drinking water permit amendment from the DPH and several permits and approvals from departments within the City of Pasadena and/or the county. PWP will be the applicant and permit holder for each of these permits. A sanitary sewer connection is not part of the design, so a sewer discharge permit will not be required.

### *4.1.1 DPH Permit Amendment*

The DPH regulates all public drinking water systems. The groundwater within the area defined as OU-3 is considered by the DPH to be an extremely impaired drinking water source. Therefore, an evaluation under Policy Memo 97-005 is being prepared to ensure that a safe drinking water supply can be obtained from this area (California Department of Public Health [formerly the California Department of Health Services], 1997). Upon approval of this evaluation, DPH will issue a permit for the use of this drinking water source. The operating permit will include all necessary treatment, compliance monitoring, operational, and reporting requirements for the MHTS.

Upon initial startup of the MHTS, treated water will be sampled per the DPH requirements to demonstrate that all permit requirements are met. The DPH will then review the results and issue a permit for distribution of the treated drinking water.

### *4.1.2 City of Pasadena Permitting*

Permitting with the City of Pasadena for construction and operation of the MHTS included a Conditional Use Permit (CUP), Design Review approval, a Building Permit, and complying with the CalARP requirements.

- **CUP:** The purpose of the CUP is to obtain approval from the City to construct and operate the MHTS at the proposed location. The CUP application was approved with conditions on July 10, 2008 and became effective after a 10 day appeals period on July 22, 2008. The Mitigated Negative Declaration (MND) associated with the California Environmental Quality Act (CEQA) initial study was also approved on July 10, 2008. The MND became final on August 15, 2008 following the absence of any filed appeals during the prior 30 day statute of limitations. The CEQA initial study provides an assessment of whether the project may have a significant effect on the environment (see Section 2.7).

- **Design Review Approval:** PWP submitted an application for Design Review to the Pasadena Planning and Development Department whose staff had determined the proposed plans regarding landscaping, fencing, finish materials, colors and other aspects of appearances met the City's design review procedures and requirements. A conceptual landscaping plan was developed and reviewed as part of the Design Review process (see Figure 4-1). The Design Review was approved and became effective on September 13, 2008.
- **Building Permit:** The Building Permit is required to confirm that construction of the MHTS will meet all applicable building codes. The building permit will also include approval of a number of other elements of the proposed project, including traffic management, construction staging, grading and storm water approvals. PWP submitted for a building permit on November 12, 2008, and is awaiting approval from the City's Planning and Development Department.
- **CalARP:** The proposed water disinfection process would use chlorine and liquid ammonia hydroxide. Use of these substances requires that a Risk Management Plan (RMP) be prepared to evaluate and minimize the potential for any accidental releases. Under CalARP, the City's Fire Department reviews the RMP and makes inspections to ensure the planned engineering and administrative controls are adequate. The RMP must be approved by the Fire Department prior to deliveries of the disinfection chemicals to the site.

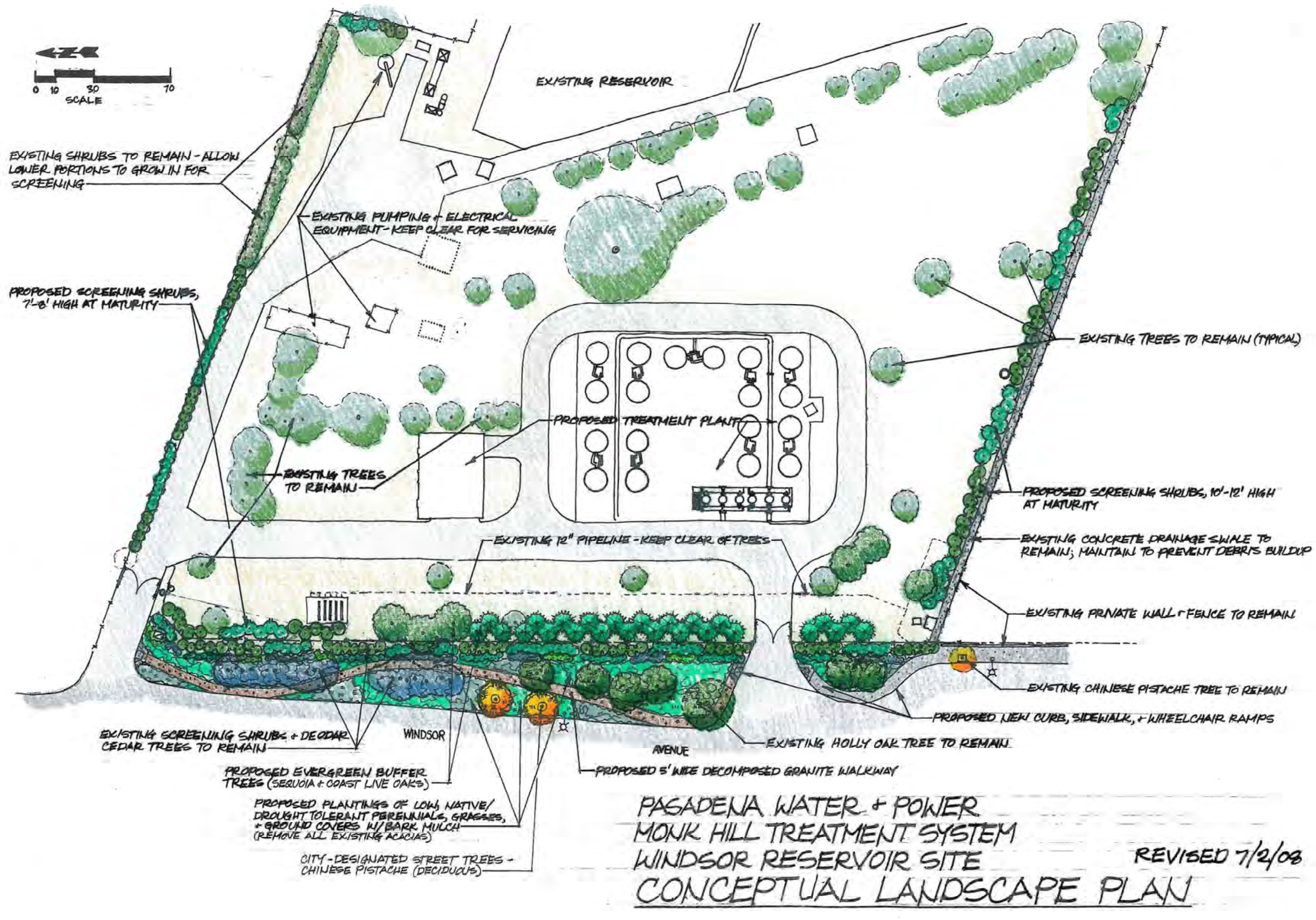


**Figure 4-1. MHTS Conceptual Landscape Plan**

#### *4.1.3 Surface Water Discharge Permitting*

During initial startup of the MHTS, system maintenance activities, and startup after extended periods of downtime, it will be necessary to discharge treated water from the system. It is anticipated that startup and testing of the production wells and treatment system will last for several days and produce large volumes of water that will not be able to be discharged to the Windsor Reservoir until final approval has been obtained from the DPH. Similarly, large volumes of purge water will be produced during annual well startup and testing. During these periods, the treated water from the MHTS will be discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir. It is estimated that approximately 62 acre-feet of water (assuming each well is purged for 2 days at full capacity) will be generated each year during well startup activities.

General WDRs associated with discharge of treated groundwater to surface water during remedial activities are provided by the California RWQCB Los Angeles Region in Order No. R4-2007-0022, *Waste Discharge Requirements for Discharges of Treated Groundwater from Investigation and/or Cleanup of Volatile Organic Compound Contaminated Sites to Surface Waters in Coastal Watersheds of Los Angeles and Ventura Counties* (RWQCB, 2007). These general WDRs are applicable to the discharges of utility water during startup and operation of the MHTS. The requirements contained in Order No. R4-2007-0022 are consistent with all water quality control policies, plans, and regulations in the California Water Code (CWC) and the revised *Water Quality Control Plan (Basin Plan) for the Los Angeles Region* (RWQCB, 1994). Therefore, NASA will comply with the substantive requirements contained in Order No. R4-2007-0022 when discharging utility water to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

### 4.2 Coordination and Site Logistics

#### *4.2.1 Project Coordination*

All site work for this project will be conducted in accordance with the *Use Agreement and Right-of-Entry for Environmental Actions* between the City of Pasadena and NASA (2003). NASA will directly administer some of the work associated with siting and design of the MHTS. The City of Pasadena is required by its own ordinances to go through several permitting processes (see Section 4.1.2), and NASA will provide technical support to the City for this permitting. NASA will provide funds to the City of Pasadena to lease treatment equipment and operate the system, with the exception of the chloramination system.

The chloramination system is necessary for PWP to distribute the treated water as drinking water. As such, PWP is responsible for funding all aspects of design, construction, permitting, and operation associated with the chloramination system.

#### *4.2.2 Surveying*

A topographic site survey was completed by a California-licensed surveyor in June 2005, and was used in preparing the MHTS site plan. A second survey will be completed by a California-licensed surveyor following construction of the MHTS in order to prepare as-built drawings for the project. The location of the concrete pad, as well as any new underground pipelines and utilities will be documented during the survey. As-builts generated during the construction will also be documented in the final surveyor plans. As part of pipeline inspection activities, a survey for the existing pipeline for the MHTS was completed. Survey records were provided to PWP.

#### *4.2.3 Utility Clearance*

A subsurface geophysical survey was completed in conjunction with the topographic survey in June 2005. Specifically, the subsurface geophysical survey included locating utilities and underground structures within the proposed footprint of the treatment plant, delineating underground utilities at various locations along the northern portion of the site, and performing two seismic P-wave refraction lines and two ReMi lines in the area of the proposed treatment plant. The purpose of the surveys was to provide information regarding underground structures in the area of planned improvements, and to obtain seismic data to be used in the design of the treatment plant facility. Additional geophysical surveys were also conducted in 2008 in conjunction with the pipeline video logging, and in 2009 prior to completion of landscaping activities at the Windsor Site. Information obtained from these surveys was used in developing the MHTS design.

As required by California State law, any areas requiring digging during construction will be clearly marked, and a utility clearance will be requested by contacting Underground Service Alert (USA) at (800)-422-4133 at least 2 days prior to starting construction activities at the site.

#### *4.2.4 Waste Management*

The primary wastes generated from construction and operation of the MHTS will include the following:

- Sediment from production well repairs,
- Water from purging the production wells,
- Excavated soil from construction of the concrete treatment pad,
- Spent ion exchange resin and GAC media, and
- Treated waste water from startup, and periodic maintenance (i.e., backwashing vessels).

The amount of waste generated will vary based on actual field operations. Waste water will be sampled and discharged in accordance with all permit requirements. Solid wastes will be characterized and classified as hazardous or non-hazardous waste based on the laboratory results in accordance with the Code of Federal Regulations (40 CFR 261.31 to 261.33 and 261.21 to 261.24) and the California Code of Regulations (22 CCR). An appropriate U.S. EPA-certified waste disposal facility and licensed transporter will be selected for off-site waste transportation and disposal. All waste transported off-site will be accompanied by the appropriate hazardous or non-hazardous waste manifests. The disposal of waste will be in accordance with Federal, state, and local laws, regulations, and instructions.

### 4.3 Project Schedule

MHTS design and construction permitting is expected to be completed by February 2009. All permits from the City of Pasadena should be secured by that time. In order to minimize traffic impacts in the area, mobilization to the Windsor Reservoir site for the MHTS construction project will not occur while roofing materials are being delivered for the Windsor Reservoir Seismic Retrofit project. Treatment system construction is scheduled to begin in March 2009 and may take six to eight months for completion. DPH permitting and water delivery is expected to occur in late 2010. A current project schedule is included in Appendix N.

# 5 SYSTEM OPERATION

## 5.1 System Operation Roles and Responsibilities

NASA will provide funding to the City of Pasadena for PWP to lease the treatment equipment and operate the system with the exception of the chloramination system. PWP will be responsible for operation of the MHTS.

## 5.2 Treatment System Startup

Prior to operating the ion exchange and GAC equipment, all piping connections will be checked for proper installation and tightness, and all gauges and instruments will be tested to ensure that they are functional and installed correctly. Gauges and instrumentation will be re-calibrated if necessary. All treatment system vessels and piping will be cleaned and disinfected prior to filling the system with resin and GAC.

After the system has been checked and disinfected, the vessels will be ready to be filled with ion exchange resin and GAC. The ion exchange resin and GAC media will be delivered to the site and installed by the treatment system vendor. The resin will be transferred to the vessels via either a vacuum or slurry; the GAC will be transferred to the vessels as a water slurry. If an air compressor is used onsite during delivery of the treatment media, it will be equipped with properly operated mufflers that meet the manufacturer's specifications to minimize excess noise associated with system construction. Prior to operating the GAC beds, the carbon media will be deaerated (wetted). This step is necessary to remove air from within the pore volume of the carbon media. If this is not done, air within these pores will displace into the void spaces between the carbon particles during operation and cause high pressure drop and channeling in the adsorbers. A period of up to 72 hours may be required for complete wetting. After wetting, the vessels will be backwashed with potable water to remove any remaining air or carbon fines, and to segregate the carbon by size. Backwashing will be completed per the manufacturers instructions provided in the final Operation and Maintenance (O&M) manual (Appendix O).

Unlike activated carbon, ion exchange resin is supplied in the hydrated form and therefore does not require a wetting step. However, it is recommended that prior to transfer of the resin into the exchanger, the ion exchanger be filled approximately one-third full of water. This will allow proper settling of the resin as it is transferred into the exchanger. Virgin resin beds will be backwashed with potable water prior to being brought on-line for the first time. The reasons for backwashing before placing fresh resin on-line are to: (1) size segregate the resin so subsequent backwashing will return the resin beads to the same relative position in the bed, (2) remove any remaining air from the bed, and (3) remove fines which can, in some cases, lead to excessive pressure drop and flow restriction. If the resin is not pre-rinsed at the CCC Santa Fe Springs facility, then it will be forward rinsed with approximately 25 bed volumes of well water after backwashing is complete. Samples will be collected upon completion of the forward rinse to confirm that nitrosamine levels are below 10 μg/L before the resin is brought on-line.

The ion exchange and GAC vessel pairs will be operated in series. Valve settings will be configured according to the final O&M manual (Appendix O) to establish downflow through both vessels in series. The treatment system flow rate will be set at the desired value after flow is established to the vessels.

Prior to allowing water to be discharged to the drinking water reservoir, treated water samples will be collected and analyzed to verify that the treatment system is operating effectively. A monitoring program including the constituents to be monitored, analytical methods, reporting limits, maximum contaminant levels (MCLs), notification levels (NLs), public health goals (PHGs), and monitoring frequency, will be developed and approved by DPH following completion of the final design and operating permit amendment application. During the startup and testing phase, treated water will be discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir in accordance with RWQCB Order No. R4-2007-0022 (see Section 4.1.3).

## 5.3 System Operation and Maintenance

A final O&M manual will be developed for the MHTS by CCC as part of the final treatment system design (Appendix O). General O&M guidelines are provided below as part of this 90% design document.

### *5.3.1 Ion Exchange System Operation*

The ion exchange system is operated in a downflow mode with each pair of parallel ion exchange resin beds in a series configuration. During normal operation, no special controls are required to operate at flowrates ranging from 6,300 to 7,000 gpm, as the flow will be evenly distributed among the four ion exchange vessel pairs. The vessels and distribution system are designed to operate effectively and efficiently within this flow range.

Each vessel will contain single-use, ion exchange resin for perchlorate removal. As the resin becomes saturated with perchlorate over time, the lead resin bed will be replaced with fresh resin. DPH will require lead-lag operation at all times; therefore an entire vessel pair will be taken off-line during a resin changeout of the lead bed. After the first ion exchanger is emptied, filled with fresh resin, backwashed, and rinsed, it can be placed on-line in the lag position. At this point, the second ion exchanger becomes the lead bed. The saturated resin will be disposed at a CERCLA-permitted facility.

The resin transfer can be accomplished in two ways, using either supersacks or by bulk transfer. If an air compressor is used onsite during resin transfer, it will be equipped with properly operated mufflers that meet the manufacturer's specifications to minimize excess noise associated with system construction. After new resin is transferred, the vessel will be backwashed with a minimum five bed volumes of potable water (at 150 gpm) before being brought on-line. If the resin is not pre-rinsed at the CCC Santa Fe Springs facility, then it will be forward-rinsed with approximately 25 bed volumes after backwashing is completed to reduce nitrosamine concentrations leaving the resin bed to below 10 μg/L, as confirmed by lab test results. Well water will be used for this purpose. The rinse water will be sent through the GAC vessels for further treatment and then discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

The need to backflush during normal system operation is indicated by an increased pressure drop across the bed. Backflushing during normal system operation can reduce the pressure drop across the bed by removing: (1) sediment from the bed, (2) fines that may be plugging the underdrain nozzles, and (3) air that is trapped in the bed. However, use of the equalization sumps and influent filters should eliminate much of the sediment and fines that are produced from the wells, significantly reducing the frequency of backflushing. The backflush water enters the vessel through the flush connection and flows up through the underdrain and the resin bed. The backflush water discharge from the resin fill line should be observed for clarity to determine the duration of backflushing. The backflush water will be treated using either one pair of GAC vessels in the MHTS or a portable sacrificial GAC unit brought to the site for this purpose, and then discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

In order to obtain full utilization of the resin and prevent air entrapment and channeling in the bed, the water level must remain above the resin bed. To prevent the bed from draining due to gravity or loss of influent supply, each vessel will be equipped with high point air releases on the vessel heads.

### *5.3.2 GAC System Operation*

The GAC system is operated in a downflow mode with each pair of parallel GAC beds in a series configuration. During normal operation, no special controls are required to operate at flowrates ranging from 6,300 to 7,000 gpm, as the flow will be evenly distributed among the five GAC vessel pairs. The vessels and distribution system are designed to operate effectively and efficiently within this flow range.

Each vessel will contain virgin Filtrasorb 300 GAC for VOC removal. Initially, the VOCs are adsorbed onto the carbon in the upper portion of the lead bed. As this top portion becomes saturated, adsorption takes place lower in the bed. Eventually, all of the carbon in the lead adsorber becomes saturated, and the lead carbon adsorber will be replaced with fresh GAC. DPH will require lead-lag operation at al times; therefore an entire vessel pair will be taken off-line during a GAC changeout of the lead bed. After the first vessel is emptied; filled with fresh GAC, wetted, and backwashed, it can be placed on-line in the lag position. At this point, the second carbon adsorber becomes the lead bed. Upon receipt of waste characterization sampling, the spent GAC will be either thermally reactivated or disposed at a CERCLA-permitted facility.

The spent carbon is transferred from the adsorber to the bulk trailer by first filling the adsorber with water. The adsorber is then pressurized using compressed air to transfer the carbon to the trailer. A charge of fresh carbon is transferred back into the vessel by filling the bulk trailer with water and placing a water cushion in the adsorber. The bulk trailer is then pressurized with compressed air to facilitate the carbon transfer into the adsorber. The air compressor used onsite during transfer of the GAC media will be equipped with properly operated mufflers that meet the manufacturer's specifications to minimize excess noise associated with the system maintenance.

Prior to bringing the new GAC bed on-line, the carbon media will be wetted for up to 72 hours to remove air from within the pore volume of the media. After wetting, the new GAC bed will be backwashed with potable water to remove any air or carbon fines, and to segregate the carbon by size. Backwashing will be completed per the manufacturer's instructions provided in the final O&M plan. For this treatment plant, the estimated backwash rate for each GAC vessel is 1,100 gpm for 30 minutes. The backwash water will be filtered through a bag filter and treated using either one pair of GAC vessels in the MHTS or a portable sacrificial GAC unit brought to the site for this purpose, prior to being discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

Backflushing may be required during normal system operation when the pressure drop across an adsorber increases by 5 to 10 psi. Backflushing can reduce the pressure drop across an adsorber by removing: (1) sediment from the bed, (2) carbon fines that may be plugging the underdrain nozzles, and (3) air that is trapped in the bed. However, use of the equalization sumps and influent filters should eliminate much of the sediment and fines that are produced from the wells, significantly reducing the frequency of backflushing. The backflush flow rate depends upon the carbon particle mesh size and the water temperature. Backflushing will be completed per the manufacturer's instructions provided in the final O&M manual. The backflush water will be filtered through a bag filter and treated using either one pair of GAC vessels in the MHTS or a portable sacrificial GAC unit brought to the site for this purpose, prior to being discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

In order to obtain full utilization of the carbon and prevent air entrapment and channeling in the bed, the water level must remain above the carbon bed. To prevent the bed from draining due to gravity or loss of influent supply, each vessel will be equipped with high point air releases on the vessel heads.

### *5.3.3 Valve Operation*

All valves will be manually operated and should be operated in a slow and even motion. Abrupt opening and closing of the valves can shock the system. Valves should be opened/closed such that the flow is increased/decreased 100 gpm per minute. Since complete shut-off of flow while a pump is operating could cause damage to the pump, the valves should be operated in the proper sequence in order to always maintain flow through the system. The final O&M plan will identify proper valve positioning during operation of the ion exchange and GAC vessels.

### *5.3.4 Utility Water Treatment*

Utility water will be generated during operation of the treatment system, and will require treatment prior to discharge. After initial startup and testing of the system, the types of utility waters expected to be generated include:

- Water from production well start-up each season, and
- Water from periodic maintenance activities, including equipment vessel backwashing.

The approximate volume of utility water expected during each of these events is summarized in Table 5-1. Due to the large volume of water generated, off-site disposal or discharge to the sanitary sewer system is not feasible. Therefore, the utility water will be treated and discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir, as discussed in Section 4.1.3. Utility water sampling will be conducted daily during discharge events for chemicals that have been detected at levels above the effluent limitations during historical groundwater monitoring at JPL. The results will be documented as part of annual progress reporting.

**Table 5-1. Estimated Utility Water Volumes**

| Utility Water | Volume (gallons) |
|---|---|
| **Well Start-up(1)** | |
| Arroyo Well | 6,336,000 |
| Well 52 | 5,184,000 |
| Ventura Well | 4,608,000 |
| Windsor Well | 4,032,000 |
| **Treatment Vessel Backwashing & Forward Rinse** | |
| GAC | 33,000 (per vessel) |
| Ion Exchange | 79,200 (per vessel) |

(1) Utility water volume produced during well start-up assumes 2 days of purging.

***<u>Annual Well Startup/Purge Water</u>***

Water produced during the well startup activities could potentially transfer bacterial contamination to the GAC and ion exchange treatment media if precautions are not in place. To limit the potential for bacterial growth in the wells, the water column will be disinfected per Section 5.2 of AWWA C654 at select intervals during the pump downtimes. Intervals can be set once per month during well downtime or at more appropriate times as deemed necessary during operation.

In addition, the production wells will be super chlorinated (i.e., 12% sodium hypochlorite added to generate 250 mg/L chlorine residual) immediately prior to annual well startup and purging. To ensure that the treatment system does not become contaminated by bacterial growth, chlorine will be metered into the well discharge at a location subsequent to the bacterial testing point while the production wells are being purged and results of bacterial testing are pending. A PPG PowerPro 3150 Accu-Tab chlorination system will be utilized to meter adequate chlorine to produce a residual of 2.5 mg/L. The purge water will be treated at the MHTS, and the chlorine residual will be removed in the GAC vessels prior to discharge to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir. Table 5-2 summarizes the WDRs in accordance with the California RWQCB Los Angeles Region in Order No. R4-2007-0022 (RWQCB, 2007). Once the bacterial testing is reported to be negative, chlorine metering will be discontinued and treated water may be sent to the Windsor Reservoir.

The PPG PowerPro 3150 Accu-Tab chlorination system is a calcium hypochlorite tablet system that dispenses 0.05% chlorine solution. The system is built on a skid and can easily be transferred to any of the wells. The controls require a 110 V connection while the metering pump will require either a 120 or 240 Volt connection for a 3 hp (horsepower) pump operating at 18 gpm.

***Periodic System Maintenance Activities***

Utility water will also be produced when vessels are backwashed, forward rinsed, or backflushed. Use of the equalization sumps and inlet water filters should limit the need for backflushing. However, if backflushing is required, flow to the MHTS will be reduced, allowing a single vessel pair to be taken off-line and flushed to waste. Treated water from the system will continue to be produced for the Windsor Reservoir through the remaining vessels in service. Similarly, when media changeout of a lead vessel is required, flow to the MHTS will be reduced so the vessel pair can be taken off-line for changeout. Backwash water will be directed to the sandbox and then Arroyo Seco spreading basins and/or the Devil's Gate Reservoir, while treated water from the remaining vessels is sent to the Windsor Reservoir.

If resin is not pre-rinsed at the CCC Santa Fe Springs facility, then new resin must be forward rinsed after being backwashed to ensure that nitrosamine concentrations in water leaving the resin is below 10 μg/L. Forward rinsing the resin at the MHTS will require that the vessel pair be on-line and all water from the system will be sent to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir until sampling results indicate that nitrosamine concentrations are acceptable.

### *5.3.5 Short Term Shutdown*

For short duration shutdowns lasting less than one week, little needs to be done. All valves should be closed in the exchanger piping system and the vent line valves open on each vessel. The feed pumps should be shut down and the valves closed in the lines to and from the pumps. Any drain valves in the pump casing should be opened for the duration of the shutdown. Freeze protection measures such as draining lines at the low points should be taken when there is a chance of freezing.

**Table 5-2. Effluent Limitations for Surface Water Discharge**

| Parameters | Units | Effluent Limitations | |
|---|---|---|---|
| | | Average Monthly | Maximum Daily |
| pH | S.U. | | 6.5 – 8.5 |
| Temperature | F | | 100 |
| Total Dissolved Solids | mg/L | | 1,550 |
| Total Suspended Solids | mg/L | 50 | 150 |
| Turbidity | NTU | 50 | 150 |
| BODs 20°C | mg/L | 20 | 30 |
| Oil and Grease | mg/L | 10 | 15 |

**Table 5-2. Effluent Limitations for Surface Water Discharge (continued)**

| Parameters | Units | Effluent Limitations | |
|---|---|---|---|
| | | Average Monthly | Maximum Daily |
| Settleable Solids | ml/L | 0.1 | 0.3 |
| Sulfides | mg/L | | 1.0 |
| Phenols | mg/L | | 1.0 |
| Residual Chlorine | mg/L | | 0.1 |
| Sulfate | mg/L | | 350 |
| Chloride | mg/L | | 150 |
| Nitrogen | mg/L | | 15* |
| Acetone | μg/L | | 700 |
| Acrolein | μg/L | | 100 |
| Acrylonitrile | μg/L | | 0.059 |
| Benzene | μg/L | | 1.0 |
| Bromoform | μg/L | | 4.3 |
| Carbon tetrachloride | μg/L | | 0.25** |
| Chlorobenzene | μg/L | | 30 |
| Chlorodibromomethane | μg/L | | 0.401** |
| Chloroethane | μg/L | | 100 |
| Chloroform | μg/L | | 100 |
| Dichlorobromomethane | μg/L | | 0.56 |
| 1,1-Dichloroethane | μg/L | | 5 |
| 1,2-Dichloroethane | μg/L | | 0.38** |
| 1,1-Dichloroethylene | μg/L | | 0.057** |
| 1,2-Dichloropropane | μg/L | | 0.52 |
| 1,3-Dichloropropylene | μg/L | | 0.5 |
| Di-isopropyl ether (DIPE) | μg/L | | 0.8 |
| 1,4-Dioxane | μg/L | | 3 |
| Ethylbenzene | μg/L | | 700 |
| Ethylene dibromide | μg/L | | 0.05** |
| Lead, Total Recoverable | μg/L | 2.6 | 5.2 |
| Chromium III, Total Recoverable | μg/L | 50 | 50 |
| Chromium VI, Total Recoverable | μg/L | 8 | 16 |
| Methyl bromide | μg/L | | 10 |
| Methyl chloride | μg/L | | 3 |
| Methylene chloride | μg/L | | 4.7 |
| Methyl ethyl ketone (MEK) | μg/L | | 700 |
| Methyl tertiary butyl ether (MTBE) | μg/L | | 5 |
| Naphthalene | μg/L | | 21 |
| N-Nitrosodimethyl amine (NDMA) | μg/L | | 0.00069** |
| Perchlorate | μg/L | | 4 |
| Tertiary butyl alcohol (TBA) | μg/L | | 12 |
| 1,1,2,2- Tetrachloroethane | μg/L | | 0.17** |
| Tetrachloroethylene | μg/L | | 0.8 |
| Toluene | μg/L | | 150 |
| Total petroleum hydrocarbons*** | μg/L | | 100 |

**Table 5-2. Effluent Limitations for Surface Water Discharge (continued)**

| Parameters | Units | Effluent Limitations | |
|---|---|---|---|
| | | Average Monthly | Maximum Daily |
| 1,2- Trans-trichloroethylene | μg/L | | 10 |
| 1,1,1- Trichloroethane | μg/L | | 200 |
| 1,1,2- Trichloroethane | μg/L | | 0.6 |
| Trichloroethylene | μg/L | | 2.7 |
| Vinyl chloride | μg/L | | 0.5 |
| Xylenes | μg/L | | 1750 |

Note:
*. Nitrogen effluent limitation consistent with the concentration in the Monk Hill Subarea groundwater.
**. If reported detection level is greater than effluent limit, then a non-detect result using 0.5 μg/L detection level is deemed to be in compliance. For NDMA, detection limits below 0.5 μg/L can be achieved.
***. Toxicity of this chemical increases with decreasing hardness concentrations. The figure in the table is determined based on effluent $CaCO_3$ concentration of 100 mg/L.
1. The acute toxicity of the effluent shall be such that the average survival in the undiluted effluent for any three (3) consecutive 96-hour static or continuous flow bioassay tests shall be at least 90%, with no single test less than 70% survival.

### *5.3.6 Extended System Shutdown*

Due to the change in the seasonal flowrates for the drinking water used by the City of Pasadena and the limited volume of water available for PWP to pump each year, the treatment system will experience downtime for approximately six months of the year. Ion exchange vessels that are not in service for periods longer than one week will be required to have five bed volumes of well water passed through each vessel once per week at a flow of approximately 100 gpm for approximately 15 minutes. Water used for this flushing process during system downtime will be discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

The carbon adsorbers out of service for longer than one week will be drained of all water and kept dry. Other options include transfer of the media to an off-site facility for storage or disposal.

Biological growth can occur inside the ion exchange and GAC vessels on the media during a lengthy system downtime. If bacterial contamination of the media occurs, rinsing of the vessels and the media using acidic/caustic solutions and disinfectants such as chlorine solution will be necessary. These chemicals will not be stored at the site. A mobile unit will be used to deliver the chemicals to the site, perform the rinsing, and haul away the used chemicals.

When the treatment system is re-started, treated water samples will be collected and analyzed to verify the treatment system is operating effectively prior to allowing water to be discharged to the Windsor Reservoir. A monitoring program including the constituents to be monitored, analytical methods, reporting limits, MCLs, NLs, PHGs, and monitoring frequency, will be developed and approved by DPH following completion of the final design and operating permit amendment application. During the startup and testing phase, treated water will be discharged to the Arroyo Seco spreading basins and/or the Devil's Gate Reservoir.

### *5.3.7 Preventative Maintenance*

As preventative maintenance, periodic inspection of the vessel internal parts should be made to ensure that the underdrain, vessel lining, and nozzles are in good condition. At a minimum, each exchanger should be inspected once per year. Systems with high backwash frequencies and rigorous backwash requirements should be inspected more frequently. The vessels must be fully emptied to allow inspection of the interior of the vessels. Vessel linings should be inspected carefully, including spark testing according to recommendations from the lining manufacturer. Any nozzles showing signs of fatigue or surface area restriction due to pluggage of the nozzle slots should be replaced. Nozzles should be physically checked to ensure that they are tightly secured.

Differential pressure transmitters with indicating gauges will be installed on each vessel to monitor the pressure drop across the vessel. The system should be operated to not exceed a differential pressure of 20 psi. If the differential pressure exceeds this value, then the vessel should be backwashed. If pressure differential becomes a frequent problem, the upstream filtration of water should be evaluated.

Other preventative maintenance should include testing and alignment of rotating equipment, and periodic calibration and maintenance of instrumentation such as pressure differential elements and flow meters, as recommended by the respective manufacturer.

### 5.4 System Monitoring

Once flow is established to both vessels and the flow rate is set, no further adjustments will be made during normal operation. A routine check of the exchangers and collection of operating data will be established as part of the final O&M plan. This routine may include a system monitoring checklist and schedule of monitoring activities. The data will be used to establish a maintenance schedule or to determine when fresh resin or carbon is needed.

At a minimum, operating data will be taken for (1) flow rates, (2) beds in service, (3) pressure drop across each unit, and (4) necessary analytical work for influent and effluent to each vessel. Pressure gauges will be provided to determine the pressure drop across each ion exchange and GAC vessel. Taking periodic pressure readings will provide the operator with historic data for troubleshooting purposes. In the event that operating conditions change, the operator will have the capability of taking corrective action.

Table 5-3 summarizes the proposed treatment system monitoring schedule. The final treatment system monitoring schedule will be reviewed and approved by the DPH during the permitting process.

A water quality surveillance plan is also proposed to provide early detection of potentially increasing chemical concentrations in the PWP wells. As system operation progresses, fate and transport analysis of data collected from upgradient monitoring wells will be evaluated to estimate concentrations in the water supply wells. This evaluation will be completed to verify that the treatment capacity of the plant is sufficient to address potentially increasing concentrations of chemicals. Based on modeling conducted for the 97-005 document, the following monitoring wells were selected to be included in the water quality surveillance plan because they are located within the capture zone of the PWP wells: MW-3, MW-4, MW-5, MW-10, MW-17, MW-18, and MW-19. Details of the water quality surveillance plan will be prepared as part of the 97-005 document. Samples will be collected as part of the on-going JPL groundwater monitoring program.

**Table 5-3. MHTS Sampling Locations and Monitoring Schedule**

| Analyte | Method | Ventura Well | Windsor Well | Arroyo Well | Well 52 | IX Influent | Each IX Effluent | LGAC Influent | Each LGAC- (75%) | Combined Effluent |
|---|---|---|---|---|---|---|---|---|---|---|
| VOCs[(a)] | EPA 524.2 | M | M | M | M | - | - | W | W | W |
| 1,2,3-Trichrolopropane[(b)] | EPA 504.1 | M | M | M | M | - | - | - | - | - |
| Perchlorate | EPA 314.0 | M | M | M | M | W | W | - | - | W |
| Total Coliform | EPA 1604 | M | M | M | M | - | - | M | M | W |
| Heterotrophic Plate Count | SM 9215B | M | M | M | M | - | - | M | M | W |
| Nitrate | EPA 300.0 | M | M | M | M | M | M | - | - | M |

(a) VOCs by GC/MS method 624.2, with reporting of all TICs and unknown peaks other than instrument artifacts.
(b) 1,2,3-trichloropropane shall be reported down to 5 ng/L using a method approved by the DPH. Samples for 1,2,3-trichloroprane will be collected monthly from all production wells. System sampling will include weekly plant effluent samples and lead GAC effluent samples on a schedule to be determined by the DPH, only if the chemical is first detected in the production wells.
M = Monthly
W = Weekly

## 5.5 Data Interpretation and Reporting

The data obtained from system monitoring and sampling will be tabulated, reviewed, and interpreted on a continuous basis. Annual progress reports will be prepared as part of the CERCLA program regarding the MHTS performance and the progress in meeting the treatment objectives and performance criteria.

In addition, monthly operation summary reports will be prepared by PWP and submitted to the DPH. The monthly reports will include the quantity of water extracted from each well and the total flowrate and operational parameters for the treatment system. A summary of analytical results, including monitoring well samples and process monitoring samples, will be included in the report. Any abnormal conditions or treatment system maintenance also will be included in the summary report.

## 5.6 System Optimization and Exit Strategy

The general steps for system optimization include the following (Naval Facilities Engineering Command, 2001):

- Review and evaluate remedial objectives
- Evaluate remediation effectiveness
- Evaluate the cost effectiveness
- Consider remediation alternatives
- Develop and prioritize optimization strategies.

The above steps will be used on a continuing basis to seek to improve the O&M of the MHTS. The results of this OU-3 response action will be evaluated along with the results of the OU-1 response action (NASA, 2006) to assess possible final cleanup remedies for groundwater at JPL.

It is anticipated that the response action will treat a great proportion of the water extracted from the production wells for drinking water use, restore the use of the municipal drinking water wells, reduce concentrations of perchlorate and VOCs from groundwater, and prevent further migration of chemicals in the groundwater from the JPL facility. Performance objectives have been established for the OU-3 response action to achieve the remedial action objectives. The system will be optimized until performance objectives have been achieved. The performance of the system will be evaluated on a continuing basis and the information regarding the amount of VOCs and perchlorate removed will be reported to the regulatory agencies during quarterly status meetings and in annual progress reports to effectively evaluate system performance objectives. PWP will report system performance data to DPH on a monthly basis.

The performance objectives include the following:

- Reduce $CCl_4$, TCE, PCE, and perchlorate concentrations in the extracted groundwater so that the treatment system will safely and reliably produce drinking water for the residents and customers of the City of Pasadena. See Table 5-4 for the applicable drinking water standards for these chemicals.
- Achieve a high on-line percentage for operation of the treatment system.
- Operate the MHTS treatment system until $CCl_4$, TCE, PCE, and perchlorate concentrations in the extracted water are consistently reduced to levels that no longer exceed applicable drinking water standards.

After the performance objectives have been achieved, NASA will no longer fund the OU-3 treatment systems although groundwater monitoring will continue. If rebound of chemical concentrations occurs in the production wells above drinking water standards, NASA would reinitiate funding. When performance objectives have been achieved and it is determined that no rebound of chemical concentrations occurred, NASA would remove the treatment equipment, restore the site, and end the funding agreement with the City of Pasadena. The City of Pasadena may decide to continue treatment; however, it would be an action taken outside the CERCLA process.

**Table 5-4. Summary of Applicable Drinking Water Standards for Target Chemicals**

| Analyte | Federal MCL (40 CFR § 141.61) | California MCL (CCR Title 22, § 64444) |
|---|---|---|
| $CCl_4$ | 5 | 0.5 |
| TCE | 5 | 5 |
| PCE | 5 | 5 |
| 1,2-DCA | ? | 0.5 |
| Perchlorate | NA | 6 |

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