Technical Memorandum

Pasadena Water & Power Monk Hill Treatment System
National Aeronautics and Space Administration
Jet Propulsion Laboratory, Pasadena, California

Final April 2014

This technical memorandum documents the performance of the Monk Hill Treatment System (MHTS) operations through December 2013. The treatment system was implemented under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Program at the National Aeronautics and Space Administration (NASA) Jet Propulsion Laboratory (JPL). Operation of the treatment system is a part of the remedial action for Operable Unit 3 (OU-3), documented in the Final Interim Record of Decision (ROD) 2007.[1] Table 1 provides an overview of the system operations to date. Startup testing was conducted in early 2011 and Pasadena Water and Power (PWP) began drinking water production operations in July 2011.

Table 1. MHTS System Operational Summary (January 2011 through December 2013)

Parameter	Units	Windsor	Arroyo	Well 52	Ventura	Total
Total Volume of Groundwater Extracted	acre-ft	88	6,052	2,221	1,643	10,004
Mass of Perchlorate Removed	lb	1	715	46	23	785
Mass of Carbon Tetrachloride (CCl_4) Removed	lb	0	43	0	0	43
Mass of Trichloroethene (TCE) Removed	lb	0.50	11	9	11	31.5

BACKGROUND

Liquid wastes (such as cleaning solvents, solid and liquid rocket propellants, cooling tower chemicals, and analytical laboratory chemicals) generated at JPL in the 1940s and 1950s were disposed of in seepage pits, a common and acceptable practice at the time. Some of these wastes contained chemicals (e.g., perchlorate and chlorinated solvents containing volatile organic compounds [VOCs]) that have been found in groundwater beneath and adjacent to JPL, including groundwater extracted from four drinking water wells operated by PWP (Windsor, Arroyo, Well 52, and Ventura). Figure 1 presents the location and boundaries of the JPL facility, PWP production wells, and MHTS.

VOCs were first detected in the PWP production wells in 1980. By 1989, VOC concentrations were increasing and all four wells were shut down. With NASA funding, PWP installed a VOC treatment facility for the wells in 1990; NASA also funded the ongoing operations of the plant. The VOC treatment facility consisted of an air stripping tower and vapor-phase granular activated carbon (VGAC). The treatment facility was operated in accordance with requirements of the California Department of Public Health (CDPH).

[1] NASA. 2007. *Final Interim Record of Decision for Operable Unit, Off-Facility Groundwater*, National Aeronautics and Space Administration Jet Propulsion Laboratory, Pasadena, California. April.

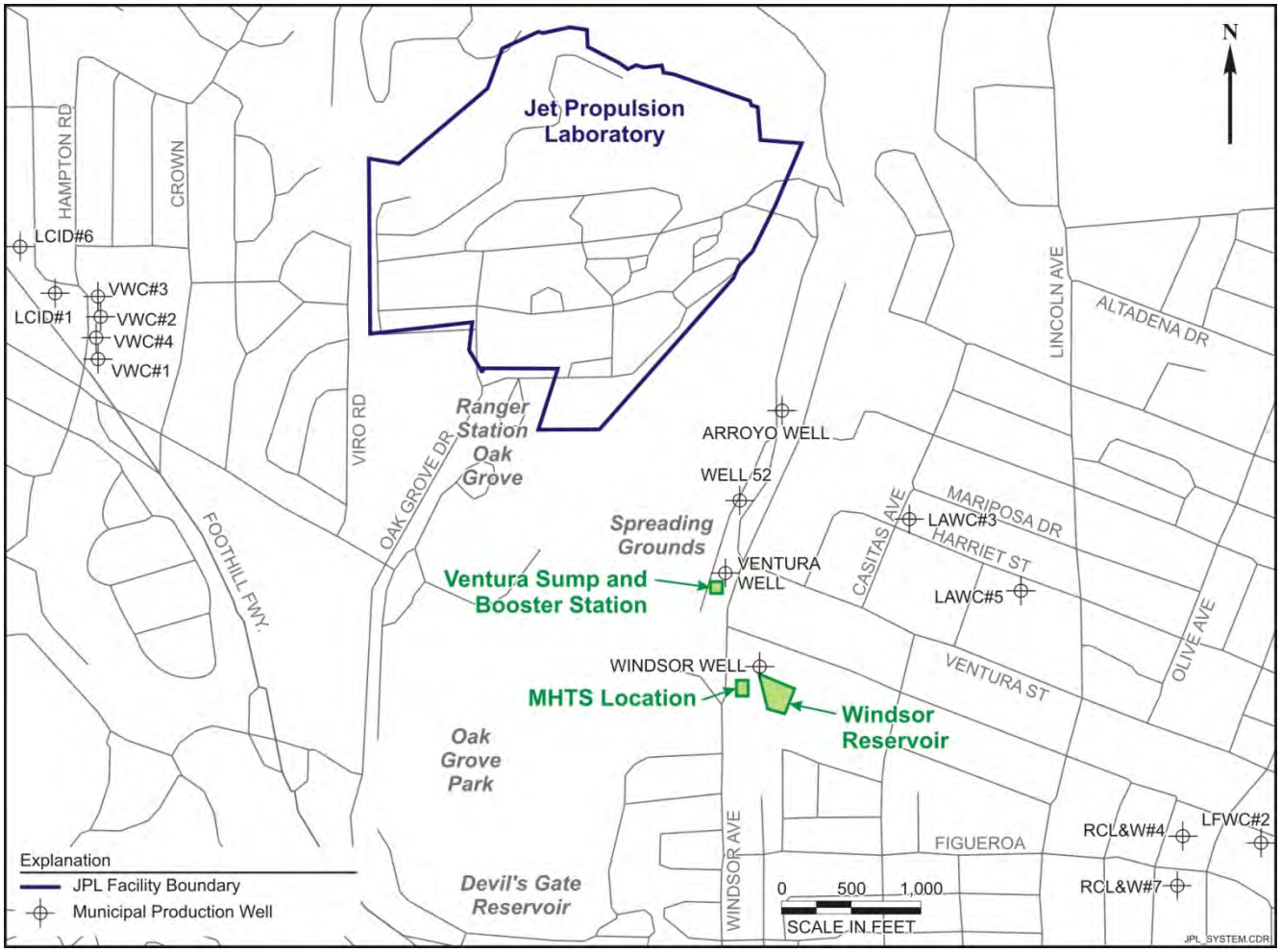

Figure 1. Location Map

Elevated perchlorate concentrations were detected in samples collected from the Arroyo Well in 1997, when an improved analytical method using ion chromatography was developed to detect low levels of perchlorate. The elevated perchlorate level caused an immediate shutdown in operation of the Arroyo Well; five years later, in 2002, the remaining PWP wells were shut down due to elevated perchlorate levels.

In 2009, construction was initiated for the MHTS. Construction and start-up testing were completed in March 2011 and a CDPH permit was issued. The MHTS consists of eight ion exchange (IX) treatment vessels and 10 liquid-phase granular activated carbon (LGAC) treatment vessels (Figure 2). The IX system is divided into four pairs of Calgon Carbon Corporation (CCC) Model 12 vessels operating in a lead/lag configuration. The LGAC system is divided into five pairs of 20,000 lb CCC vessels. CDPH issued a permit amendment on March 17, 2011 for the MHTS system. A copy of the permit is provided as Attachment A. NASA completed a MHTS Installation Report[2] in August 2011 as a record of the installation and construction activities. NASA completed a MHTS Installation Report Addendum[3] in

[2] NASA. 2011. *OU-3 Monk Hill Treatment System Installation Report.* National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California. August.

[3] NASA. 2012. *OU-3 Monk Hill Treatment System Installation Report Addendum, Liner Removal, Evaluation and Repair of Windsor Well (No. 48) and Well 52.* National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California. August.

December 2012 as a record of the liner removal, evaluation, and repair activities conducted at Windsor Well and Well 52.

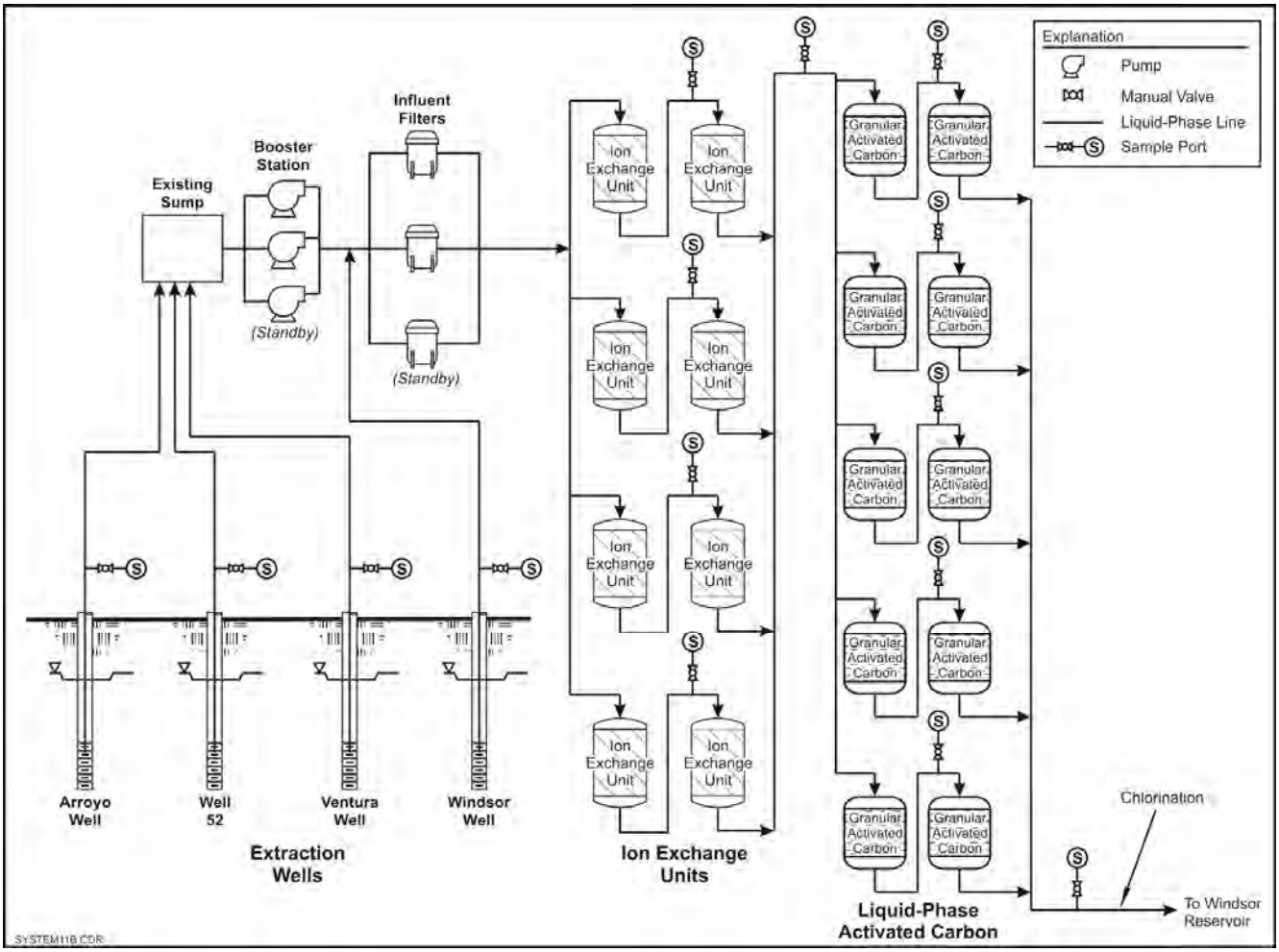

Figure 2. Process Flow Diagram

PWP PRODUCTION WELLS (WINDSOR, ARROYO, WELL 52 AND VENTURA)

Table 2 summarizes the maximum and average perchlorate, CCl_4, and TCE concentrations detected in the PWP production wells. Currently, Arroyo, Well 52 and Ventura are in operation; Windsor is offline due to nitrate concentrations (not associated with the JPL CERCLA Site), which prevent it from being operated with the other wells. Perchlorate concentrations in Arroyo ranged from 24 to 45 µg/L, with an average of 32 µg/L. Concentrations of CCl_4 and TCE in Arroyo were stable throughout the reporting period, averaging 2.2 µg/L and 0.6 µg/L, respectively. Perchlorate concentrations in Well 52 ranged from 5.7 to 10.1 µg/L, with an average of 8.1 µg/L. Concentrations of CCl_4 were < 0.5 µg/L and TCE ranged from 1.3 µg/L to 2.3 µg/L, with an average of 1.7 µg/L. Perchlorate concentrations in Ventura ranged from 4.1 to 6.8 µg/L, with an average of 5.6 µg/L. Concentrations of CCl_4 and TCE in Ventura Well were stable throughout the reporting period, averaging < 0.5 µg/L and 3.8 µg/L, respectively. Figures 3, 4 and 5 are graphs of the concentrations in extracted groundwater samples collected at Arroyo, Well 52, and Ventura, respectively.

Table 2. Summary of Chemical Concentrations in the MHTS Wells, Since Startup

Analyte	Units	WINDSOR		ARROYO		WELL 52		VENTURA		MCL
		Avg.	Max	Avg.	Max	Avg.	Max	Avg.	Max	
CCl_4	µg/L	<0.5	<0.5	2.5	3.8	<0.5	<0.5	<0.5	<0.5	0.5
TCE	µg/L	2.1	2.1	0.6	0.9	1.4	2.3	3.0	4.6	5
Perchlorate	µg/L	5.3	5.3	43.2	85.6	8.1	10.1	5.5	6.8	6

MCL = maximum contaminant level
Bold indicates concentration greater than MCL.

As part of the CDPH permit requirements for the MHTS, samples were collected quarterly from Arroyo, Well 52, and Ventura and analyzed for low-level 1,2,3-trichloropropane (TCP) and 1,4-dioxane. Results for all samples were non-detect.

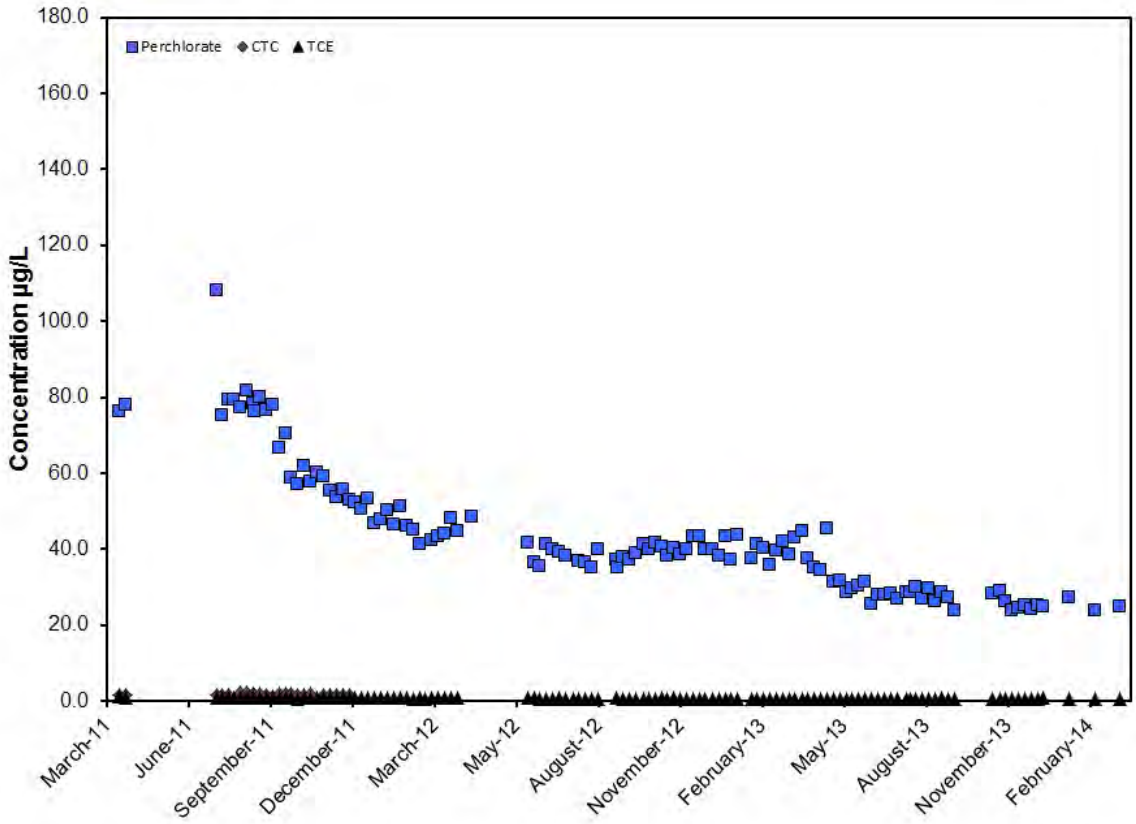

Figure 3. Concentrations of Perchlorate, CCl_4 and TCE in Arroyo Well

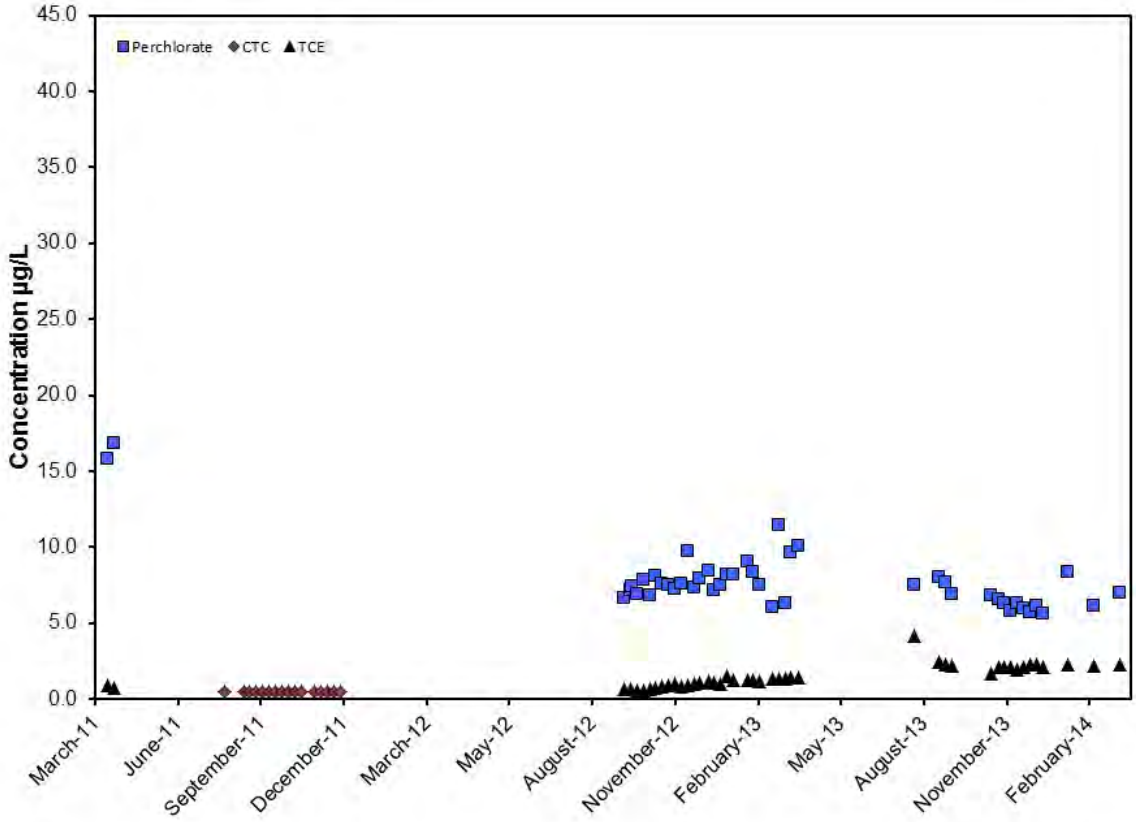

Figure 4. Concentrations of Perchlorate, CCl_4 and TCE in Well 52

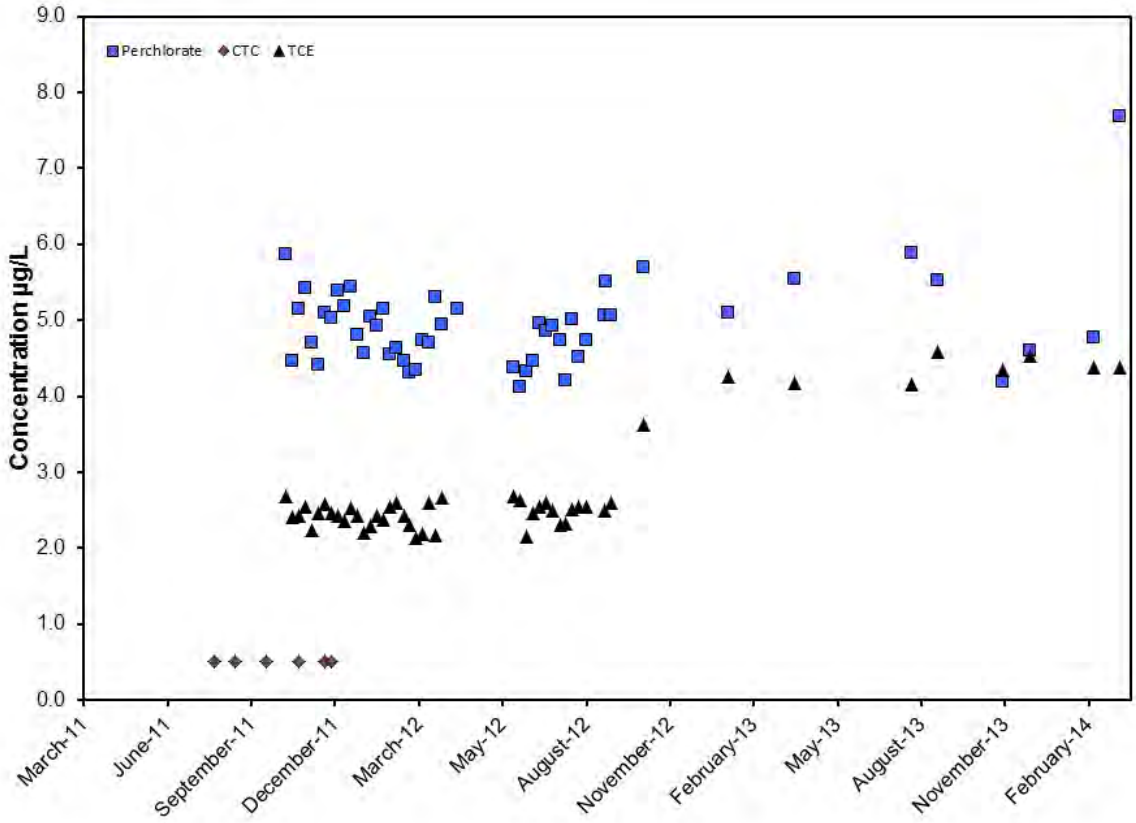

Figure 5. Concentrations of Perchlorate, CCl_4 and TCE in Ventura Well

UPGRADIENT SURVEILLANCE MONITORING WELLS

NASA JPL has multiple monitoring wells located within the vicinity of the MHTS production wells (see Figure 6). The CDPH permit provision #39 (Attachment A) identified MW-3 (Screen 2), MW-4 (Screen 2), MW-5, MW-10, MW-17 (Screen 3), MW-18 (Screen 4) and MW-19 (Screen 2) as part of the MHTS upgradient surveillance monitoring program. These wells are sampled quarterly as part of NASA's long-term groundwater monitoring program at JPL.

The upgradient surveillance monitoring wells serve as the best available indicator of near-future concentrations that may be observed in PWP production wells. Table 3 provides concentrations of CCl_4, TCE, and perchlorate for the year prior to MHTS startup (2010) and the current reporting period through the end of 2013. The sample results in Table 3 represent the maximum and average concentrations recorded at the sampling locations. All historical groundwater results for the NASA JPL monitoring wells can be found in the most recent quarterly groundwater monitoring report.[4] Concentrations of VOCs and perchlorate at the upgradient surveillance monitoring wells have decreased or remained relatively stable since MHTS operations began, with the exception of perchlorate in MW-4 (Screen 2). Even so, the observed concentrations do not indicate a need to modify treatment operations at the MHTS. The effect of sustained pumping on the chemical concentrations in monitoring wells near JPL will be closely monitored over the next several years of MHTS operations.

Low-level 1,2,3-TCP is monitored on an annual basis from the MHTS upgradient surveillance monitoring wells. During the 2013 annual sampling event (second quarter 2013), 1,2,3-TCP was detected at MW-18 (Screen 4) at a concentration of 0.035 µg/L which exceeds the state notification level of 0.005 µg/L. 1,2,3-TCP was not detected at the other six sampling locations. During the two previous annual events, 1,2,3-TCP was detected in MW-18 (Screen 4) with concentrations of 0.028 µg/L and 0.036 µg/L which are above the state notification level (0.005 µg/L. 1,2,3-TCP was not detected at the other six sampling locations during the 2011 and 2012 annual sampling events.

N-Nitrosodimethylamine (NDMA) is also monitored on an annual basis from the MHTS upgradient surveillance monitoring wells. During the 2013 annual sampling event (second quarter 2013), all seven sample results were non-detect. During the previous two annual sampling events, NDMA was detected once at MW-17 (Screen 3) with a concentration of 2.2 ng/L which is below the state notification level. All other concentrations were non-detect. These results are consistent with sampling results from 2011 and 2012.

1,4-dioxane is also monitored on an annual basis from the MHTS upgradient surveillance monitoring wells. During the 2013 annual sampling event (second quarter 2013), 1,4-dioxane was detected at MW-4 (Screen 2) at a concentration of 1.7 µg/L which exceeds the state notification level of 1.0 µg/L. All other concentrations were non-detect. During the annual 2011 and 2012 sampling events, 1,4-dioxane was detected in MW-18 (Screen 4) at a concentration of 1.1 and 1.5 µg/L, respectively, which both exceed the state notification level of 1 µg/L. All other concentrations were non-detect.

[4] NASA. 2014. *Technical Memorandum First Quarter 2014 Monitoring Summary*. National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California. April.

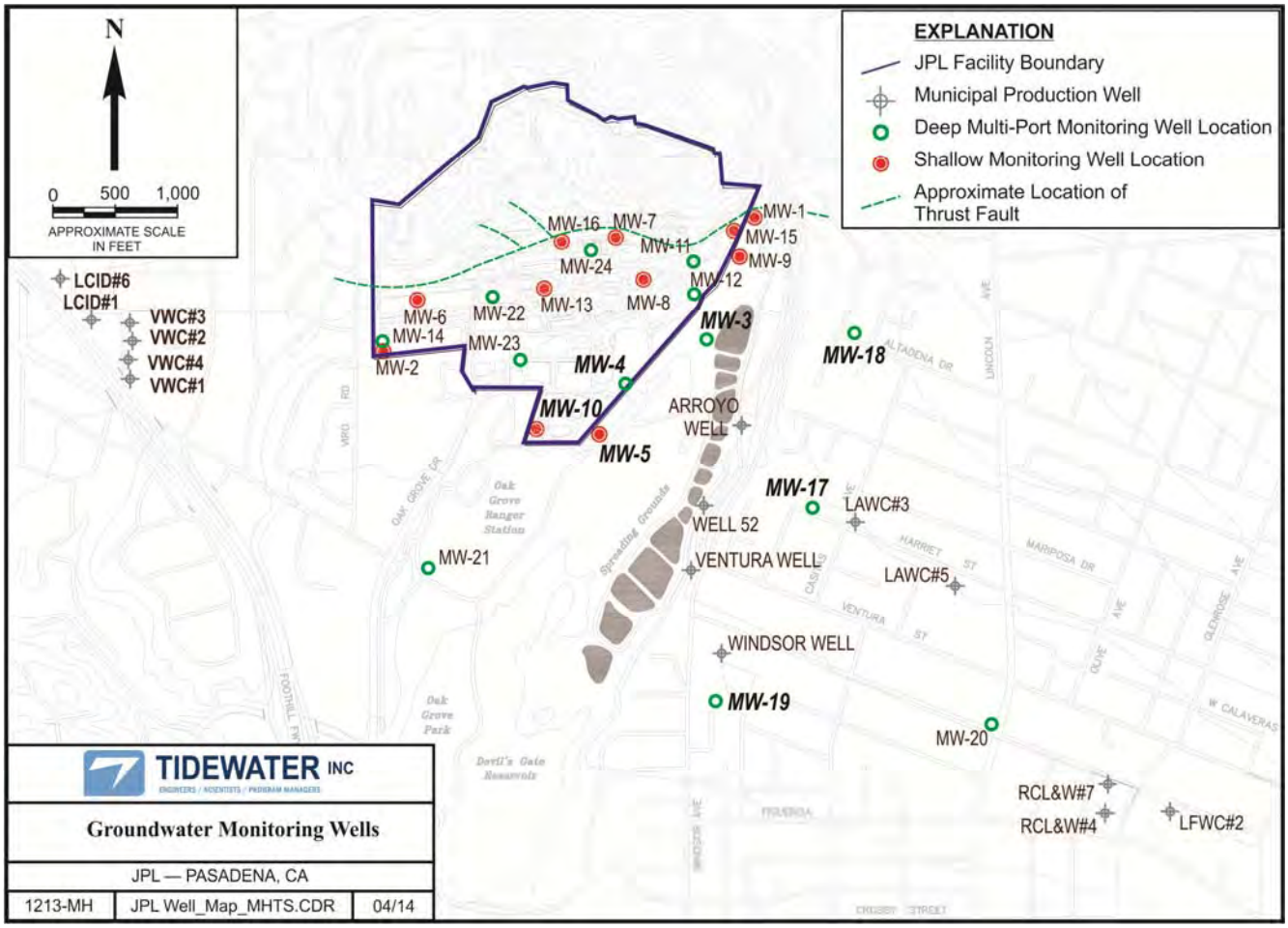

Figure 6. Monitoring Well Locations

Table 3. Analytical Results Summary from Upgradient Surveillance Monitoring Wells

		Perchlorate		CCl_4		TCE	
		2010	2013	2010	2013	2010	2013
		MCL= 6.0		MCL= 0.50		MCL= 0.50	
		µg/L		µg/L		µg/L	
MW-3 (Screen 2)	Max	**184.0**	<4.0	<0.5	<0.5	<0.5	<0.5
	Avg.	**175.2**	<4.0	<0.5	<0.5	<0.5	<0.5
MW-4 (Screen 2)	Max	3.8	**250.0**	<0.5	0.2J	**0.9**	**1.1**
	Avg.	3.1	**225.0**	<0.5	<0.5	**0.7**	**0.5**
MW-5	Max	<1.0	1.5J	<0.5	<0.5	<0.5	0.2J
	Avg.	<1.0	<4.0	<0.5	<0.5	<0.5	<0.5
MW-10	Max	**75.9**	**9.6**	<0.5	<0.5	**5.1**	**9.8**
	Avg.	**43.8**	**7.9**	<0.5	<0.5	**3.7**	**8.0**
MW-17 (Screen 3)	Max	**10.7**	**6.6**	**0.5**	0.3J	<0.5	0.2J
	Avg.	**9.9**	**7.6**	**0.5**	<0.5	<0.5	<0.5
MW-18 (Screen 4)	Max	**67.2**	**15.0**	**10.0**	**2.1**	**1.2**	**0.7**
	Avg.	**54.1**	**13.0**	**7.2**	**1.6**	**1.1**	**0.9**
MW-19 (Screen 2)	Max	**6.8**	**6.1**	<0.5	<0.5	**1.9**	**1.2**
	Avg.	**6.0**	5.7	<0.5	<0.5	**1.4**	**0.8**

Bold indicates concentration greater than MCL.

ROUTINE MONITORING AND DISCHARGES

Table 4 summarizes the routine monitoring schedule for the MHTS and the associated production wells. PWP provides monthly reports to CDPH summarizing analytical and performance data from the system.

Figure 7 shows perchlorate analytical results associated with the IX system. The system was online for all of 2013 and treated approximately 337 acre-ft of water per month. The system operated effectively, removing perchlorate to below detectable levels at the effluent sample location. Perchlorate breakthrough in the lead IX vessels occurred six times during this reporting period, triggering IX resin change-out events. A total of 4,043 acre-ft of water was treated and distributed to customers during this reporting period.

The LGAC system operated effectively, removing VOCs to below detectable levels at the effluent sample location. Concentrations of CCl_4 and TCE at the MHTS prior to LGAC treatment averaged 1.4 and 1.1 µg/L, respectively, in 2013. VOC breakthrough in the lead LGAC vessels occurred 11 times during this reporting period, triggering carbon change-out events. LGAC and IX change-out frequencies have averaged 282 and 314 days, respectively, since system startup. LGAC and IX change-out frequencies will continue to be monitored closely to identify any operational issues.

Table 4. Sampling Locations and Monitoring Schedule

Analyte	Method	Windsor Well*	Arroyo Well*	Well 52*	Ventura Well*	IX Influent	IX Effluent	LGAC-Effluent	Windsor Reservoir
CCl_4	EPA 524.2	W	W	W	W	-	W	W	W
TCE	EPA 524.2	W	W	W	W	-	W	W	W
PCE	EPA 524.2	W	W	W	W	-	W	W	W
Perchlorate	EPA 314.0	W	W	W	W	W	W	W	W
Nitrate	EPA 300.0	W	W	W	W	W	W	W	W
Total Coliform	EPA 1604	M	W	W	W	W	W	W	W
Heterotrophic Plate Count	9215B	W	W	W	W	W	W	W	W

* Sampled when in operation only
M = Monthly; W = Weekly; EPA = Environmental Protection Agency

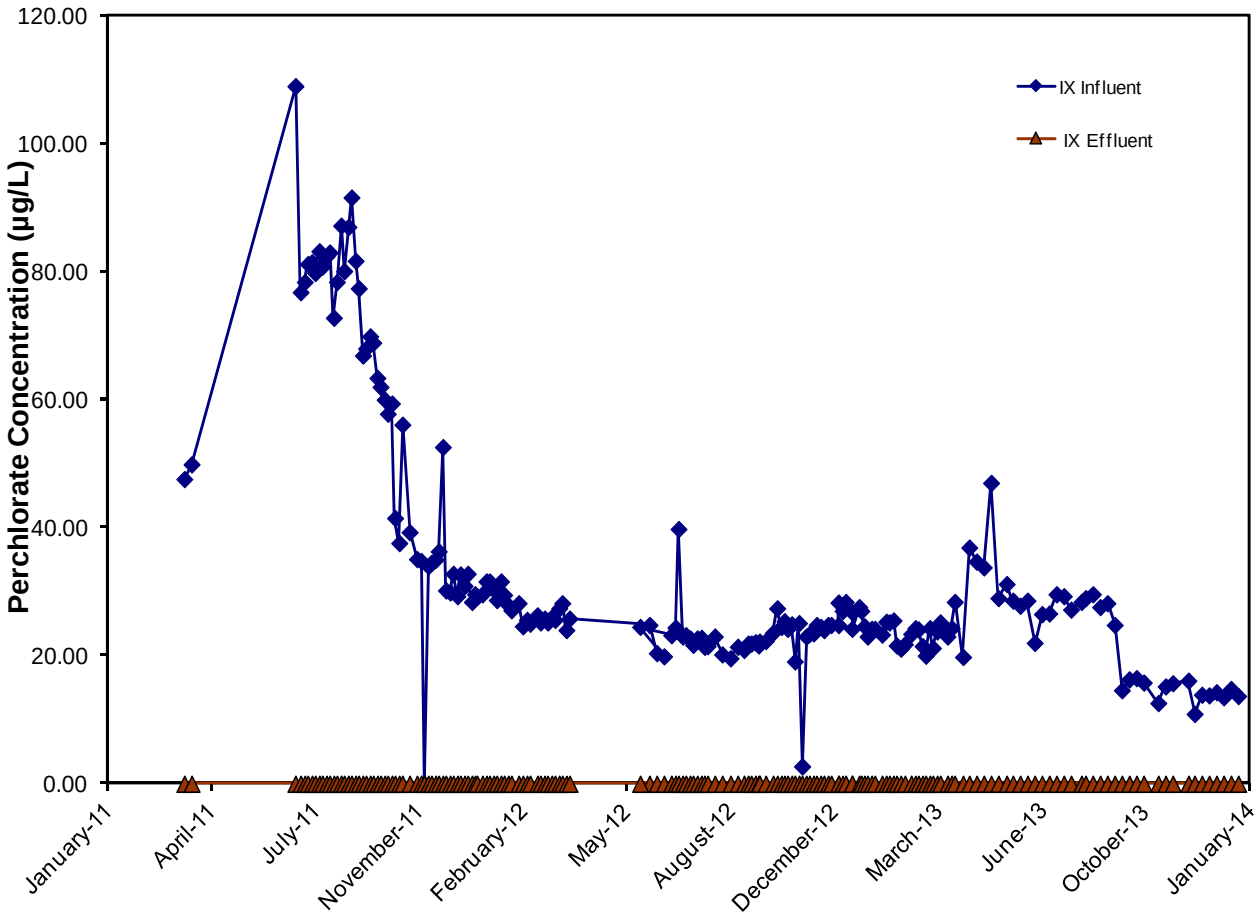

Figure 7. Ion Exchange System Performance

The combined effluent sampling locations have not contained detectable CCl_4, TCE, PCE, or perchlorate concentrations at any time since startup in July 2011. This demonstrates that the plant is operating effectively. Also, samples are collected at influent and effluent locations of the plant on a weekly basis to analyze for nitrate concentrations. During this reporting period, effluent concentrations of nitrate (NO_3) were stable, ranging from 13 to 35 mg/L. Lastly, total coliform and heterotrophic plate count sampling is conducted weekly to evaluate biological activity in the system. Results indicated that biological activity was effectively controlled.

LGAC and IX change-outs require utility water to backwash each vessel prior to being utilized for treatment. These discharges have followed the substantive requirements of General National Pollutant Discharge Elimination System (NPDES) Permit No. CAG914001 in accordance with CERCLA Section 121(e) (1) and the approved Discharge Protocol (NASA, 2010).[5] On March 7, 2013 the NPDES Permit No. CAG914001 was amended and as a result new discharge parameters were established and followed. All water discharged was stored in City of Pasadena spreading basins and allowed to percolate back into the aquifer from which it originated and was not allowed to flow into receiving waterways.

[5] NASA. 2010. *Discharge Protocol Monk Hill Treatment System Protocol for Discharge to Arroyo Seco.* National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California. April.

A total of approximately 42.1 acre-ft was discharged to Spreading Basin #5 during the course of this reporting period. Discharge samples were collected during each of the 12 discharge events that occurred in 2013. Nitrogen (NO_3 as N) was detected in the October 24, 2013 discharge sampling event at a concentration of 8.2 mg/L, which exceeds the effluent limitation of 8.0 mg/L. All other nitrogen results were < 8 mg/L. Nitrogen will continue to be closely monitored as part of the annual discharge sampling events; if elevated nitrogen concentrations are detected during future sampling events, it will be investigated in more detail. Residual chlorine was detected in the December 9, 2013 discharge sampling event at a concentration of 0.12 µg/L, which exceeds the effluent limitation of 0.10 µg/L. All other residual chlorine results were <0.10 µg/L or non-detect. Data tabulation for all 2013 discharge sample results is included as Attachment B.

The future surface discharges will remain consistent with the regulations and operations outlined within the Discharge Protocol.[5] The discharge operations will continue to be reviewed and optimized during the next annual reporting period.

FIVE-YEAR REVIEW

In February 2012, NASA completed its first Five-Year Review of the JPL CERCLA program.[6] The review concluded that the interim remedy at MHTS was protective of human health and the environment in the short term. Potential exposure pathways that could result in unacceptable risk (i.e., ingestion and contact with chemicals in groundwater) are being controlled through groundwater extraction and treatment by the MHTS. Treated water from the MHTS is in compliance with all water quality requirements specified by Federal and state regulations, with concentrations below Federal and California maximum contaminant levels (MCLs).

One recommendation was made in the Five-Year Review Report related to the MHTS. The recommendation was to minimize nitrosamine leaching from virgin resin at the MHTS by minimizing the use of chlorinated water to flush the resin; pre-rinse newly installed resin prior to placing the vessel into service; perform subsequent monitoring for nitrosamines; develop best practices with the vendor for on-site maintenance activities to minimize the formation of nitrosamines; and require that the vendor pre-rinse resin at an off-site location prior to placing it in the MHTS vessels. The nitrosamines have been minimized as follows:

- PWP currently flushes and rinses virgin resin using treated system water that is non-chlorinated. The vessel containing virgin resin is rotated to the lag position and the pair in lead-lag configuration is forward rinsed and operated in normal treatment mode.
- All resin deliveries are pre-rinsed prior to installation at MHTS.
- CCC recently installed a rinsing station for all resin deliveries. All resin will be rinsed (20-25 bed volumes) by CCC prior to delivery at MHTS. Resin was previously being rinsed in trailers by CCC prior to delivery.
- Samples for nitrosamines are in compliance with levels set by the CDPH.

[6] NASA. 2012. *Final First Five-Year Review Report,* National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California. February.

SYSTEM OPTIMIZATION

NASA submitted a revised draft Optimization Work Plan[7] in April 2014. This plan proposed two potential voluntary optimization projects for MHTS: 1) a new production well located north of the Arroyo Well and within the Arroyo Seco for enhanced chemical removal, and 2) incorporation of PWP's existing Behner Plant into the MHTS for enhanced wastewater management. Both projects are in the conceptual design phase. In 2014, NASA will continue to work with PWP and the regulators on these potential optimization projects.

COST SUMMARY

Table 5 summarizes the operational costs incurred between December 2012 and November 2013. These costs equate to $833.00 per acre-ft of treated water.

Table 5. Operational Costs: December 2012 through November 2013

Description	Subtotal
Engineering Labor	$ 199,027.44
Field Labor	$ 148,119.42
Laboratory Fees	$ 6,857.00
Carbon Treatment Costs	$866,758.54
IX Treatment Costs	$1,618,825.83
Pre-Filters	$31,039.50
Disposal	$ -
Misc. Equipment	$ 32,721.75
Misc. Services	$8,972.83
Excess Energy Costs (Ventura Booster)	$147,742.52
DPH Billing	$ 9,471.37
Treated Water ($80/Acre-Ft)	$300,236.90
GRAND TOTAL	**$3,369,773.10**

[7] NASA, 2014. Draft Final Optimization Work Plan, National Aeronautics and Space Administration, Jet Propulsion Laboratory, Pasadena, California. April.

Attachment A
CDPH Drinking Water Permit

California Department of Public Health
Drinking Water Field Operations Branch

PERMIT AMENDMENT 1910124PA-003

CITY OF PASADENA WATER & POWER

Los Angeles County

System No. 1910124

March 17, 2011

STATE OF CALIFORNIA

AMENDMENT TO THE

DOMESTIC WATER SUPPLY PERMIT ISSUED TO

City of Pasadena Water and Power

Public Water System Number – 1910124

ORIGINAL PERMIT: ***04-15-99P-010***	DATE OF ISSUE: ***11/9/1999***
PERMIT AMENDMENT: ***1910124PA-001***	EFFECTIVE DATE: ***8/12/2002***
PERMIT AMENDMENT: ***1910124PA-002***	EFFECTIVE DATE: ***1/15/2003***
PERMIT AMENDMENT: ***1910124PA-003***	EFFECTIVE DATE: ***3/17/2011***

WHEREAS:

I. The ***City of Pasadena Water and Power (hereinafter, PWP)*** submitted an application to the California Department of Public Health on ***February 9, 2010*** for an amendment to the Domestic Water Supply Permit issued to the ***PWP*** on ***November 9, 1999***.

II. The purpose of the amendment, as stated in the application, is to allow the ***PWP*** to make the following modification to the public water system:

Include treatment of contaminated groundwater from Arroyo Well, Well 52, Ventura Well, and Windsor Well at the Monk Hill Treatment System (MHTS); and distribution of the treated water for potable use.

III. The ***PWP*** has submitted all of the supporting information required to evaluate the application.

IV. The California Department of Public Health has evaluated the application and the supporting material and has determined that the proposed modifications comply with all applicable State drinking water requirements.

THEREFORE:

I. The California Department of Public Health hereby approves the application submitted by the ***PWP*** for a permit amendment. The Domestic Water Supply Permit issued to the ***PWP*** on ***November 9, 1999*** is hereby amended as follows:

The PWP may treat Arroyo Well, Well 52, Ventura Well, and Windsor Well at the Monk Hill Treatment System, which consists of ion exchange treatment for perchlorate removal and liquid phase granular activated carbon treatment for volatile organic chemicals removal. The treated water will receive disinfection and nitrate blending at the Windsor Reservoir prior to distribution to the customers.

II. This permit amendment is subject to the following conditions:

GENERAL

1. This document amends and adds to the domestic water supply permit issued to Pasadena Water and Power (PWP) for the City of Pasadena's public water system on November 9, 1999 by the Department, and the subsequent amendments on August 12, 2002, and January 15, 2003. If any condition of this amendment conflicts with the permit and its subsequent amendments, the conditions of this amendment shall be followed.

2. PWP shall comply with all the requirements set forth in the California Safe Drinking Water Act, California Health and Safety Code and any regulations, standards or orders adopted thereunder. All water supplied by PWP for domestic purposes shall meet all Maximum Contaminant Levels (MCLs) established by the State Department of Public Health.

3. If the water quality does not comply with the California Drinking Water Standards, treatment shall be provided to meet standards. The plans and specifications for the proposed treatment facilities shall be submitted to the Department for review and approval prior to construction.

4. The only sources approved for potable water supply are those listed in Tables 1 and 2.

Table 1. Groundwater Sources

Source	Primary Station Code	Status	Treatment
Arroyo	1910124-001	Active	Ion exchange for perchlorate removal and activated carbon adsorption for organics removal and chloramination at MHTS
Bangham Well	1910124-028	Active	Blending VOCs, perchlorate, and nitrate at Sunset Reservoir
Chapman Well	1910124-005	Active	Chlorination
Copelin Well	1910124-006	Active	Blending VOCs, perchlorate, and nitrate at Sunset Reservoir
Craig Well	1910124-007	Active	Chlorination
Eaton Canyon Well	1910124-009	Other	Pending return to Standby Status. See Provision No. 7 of 1999 permit.
Garfield Well	1910124-010	Active	Blending VOCs, perchlorate, and nitrate at Sunset Reservoir
Monte Vista Well	1910124-014	Active	Chlorination
Sunset Well	1910124-018	Active	Blending VOCs, perchlorate, and nitrate at Sunset Reservoir
Ventura Well	1910124-019	Active	Ion exchange for perchlorate removal and activated carbon adsorption for organics removal and chloramination at MHTS
Villa Well	1910124-020	Active	Blending VOCs, perchlorate, and nitrate at Sunset Reservoir
Well No. 52	1910124-021	Active	Ion exchange for perchlorate removal and activated carbon adsorption for organics removal and chloramination at MHTS
Windsor Well	1910124-022	Active	Ion exchange for perchlorate removal and activated carbon adsorption for organics removal and chloramination at MHTS
Woodbury Well	1910124-023	Active	Chlorination
Well 58	1910124-045	Active	Chlorination
Well 59	1910124-047	Active	Chlorination
Metropolitan Water District (MWD)-P1 Connection	1910124-033	Active	N/A
MWD-P2 Connection	1910124-034	Active	N/A
MWD-P3 Connection	1910124-035	Active	N/A
MWD-P4 Connection	1910124-036	Active	N/A
MWD-P5 Connection	1910124-037	Active	N/A

The following are the only approved interconnections for receiving water from other water systems:

Table 2. Interconnections with Other Systems

Water System	Location	Nominal Capacity (gpm)
Lincoln Avenue Water Company	Canyon Crest Road	500
Kinneloa Irrigation District	Kinneloa Canyon Road	1200
California American Water Company	Lamanda Park Reservoir	2500
Valley Water Company	St. Katherine Place	1500
Valley Water Company	Normandy Drive	1200
Foothill Municipal Water District	CalTrans Yard	4000
City of Sierra Madre	Michillinda Avenue	300

5. The only approved treatment facilities are those listed in Table 3. The treatment facility and distribution system shall be operated by personnel who have been certified in accordance with Chapter 13, Title 22, California Code of Regulations (CCR) - Operator Certification. The minimum certification requirements for the chief and shift operator(s) for each PWP treatment facility are listed in Table 3. For MHTS, PWP will meet T4 chief operator certification requirement within two years of receiving this permit amendment.

Table 3. Approved Treatment Facilities and Minimum Operator Certification Requirements

Treatment Facility	PS Code	Treatment Facility Classification	Min. Treatment Grade Required	
			Chief Operator	Shift Operator
Sunset Reservoir - Nitrate, perchlorate and VOCs blending for Bangham, Copelin, Garfield, Sunset, and Villa Wells	1910124-030 (Sunset Reservoir 1 effluent) 1910124-031 (Sunset Reservoir 2 effluent)	T3	T3	T2
Chapman Well – Chlorination	1910124-038	T1	T1	T1
Craig Well - Chlorination	1910124-039	T1	T1	T1
Monte Vista Well - Chlorination	1910124-042	T1	T1	T1
Woodbury Well - Chlorination	1910124-044	T1	T1	T1
Well 58 - Chlorination	1910124-046	T1	T1	T1

Treatment Facility	PS Code	Treatment Facility Classification	Min. Treatment Grade Required	
			Chief Operator	Shift Operator
Well 59 - Chlorination	1910124-048	T1	T1	T1
Monk Hill Treatment Facility (MHTS) – Arroyo, Ventura, Windsor Wells and Well 52 • Ion exchange (IX) for perchlorate removal • Liquid phase granular activated carbon adsorption (LGAC) for organics removal • Chloramination • Nitrate blending at Windsor Reservoir	1910124-051 (IX combined effluent) 1910124-050 (LGAC combined effluent) 1910124-025 (Windsor Reservoir Compliance Point for nitrate, perchlorate and VOCs)	T4	T4	T3

6. No changes, additions, or modifications shall be made to the sources or treatment mentioned in Conditions 4 and 5 unless an amended water supply permit has first been obtained from the Department.

7. PWP shall comply with Title 17, CCR, to prevent the water system and treatment facilities from being contaminated by possible cross-connections. PWP shall maintain a program for the protection of the domestic water system against backflow from premises having dual or unsafe water systems in accordance with Title 17. All backflow prevention devices shall be tested annually.

8. PWP shall monitor all active groundwater sources in accordance with the current Vulnerability Assessment and Monitoring Guidelines issued by the Department or as specified in this permit amendment.

9. Pursuant to Sections 64590 and 64591, Title 22 of the California Code of Regulations, no chemical or product shall be added to drinking water as a part of the treatment process unless it has been certified as meeting the specifications of American National Standard Institute/National Sanitation Foundation (ANSI/NSF) Standard 60, and no indirect additive shall be used unless it has been certified as meeting the specifications of ANSI/NSF Standard 61. PWP may use an uncertified chemical, material, or product if the requirements specified in Section 64593 are met.

MONK HILL TREATMENT SYSTEM (MHTS)

10. Water leaving the MHTS shall not exceed any MCLs or Notification Levels (NLs) established by the Department. In addition, the MHTS should be operated to achieve a treatment goal of non-detect for perchlorate and VOCs.

11. Arroyo Well, Well 52, Ventura Well and the Windsor Well shall be the only sources for the MHTS. The entire flow from the wells shall be treated by all unit processes (ion exchange and granular activated carbon adsorption) of the MHTS prior to distribution as a domestic water supply. No treatment process shall be bypassed at any time.

12. The overall plant flow rate shall not exceed 7,000 gpm without written permission from the Department.

13. Except as specified in this permit amendment, the MHTS shall be operated in accordance with an Operations. Monitoring, and Maintenance Plan (OMMP) approved by this Department. All additions, deletions, or amendments to the OMMP shall be approved by the Department prior to implementation. PWP is responsible for ensuring that the OMMP is, at all times, representative of the operations, maintenance, and monitoring of the facility and appropriate changes to the OMMP are submitted to the Department for approval in a timely manner.

14. The MHTS shall be removed from service if concentrations of chemicals of concern in the plant influent significantly exceed the design concentration. PWP shall conduct an evaluation and make necessary operational adjustment, and/or plant modification, and obtain an approval from the Department before placing the treatment facility back into service. Permit amendment might be required depending on the extent of the required modification.

ION EXCHANGE SYSTEM

15. PWP shall operate and maintain the inlet filters of the ion exchange system in a manner to minimize the build-up of solids within the media beds.

16. Each pair of ion exchange vessels shall be operated at not less than 350 gpm (1 gpm/ft^3 of media) and not more than 2,000 gpm, with a planned design capacity of 1,750 gpm when the plant is operating at 7,000 gpm. The vessels shall be operated in a down-flow mode, with two vessels operated in series (lead-lag).

17. At least 353 ft^3 of virgin CalRes 2109 resin that meets the specifications identified in the approved OMMP shall be used in each ion exchange vessel. Any change in resin employed shall be approved in writing by the Department. Only resin certified as meeting NSF Standard 61 may be used.

18. After virgin resin is installed, PWP shall flush the resin and conduct nitrosamine monitoring, using EPA method 521, to characterize the duration and extent of nitrosamine formation. Based on the monitoring results, PWP may modify the resin installation and flushing procedures to minimize the risk of producing water with nitrosamines and revise the OMMP accordingly.

19. Compliance with the perchlorate MCL shall be based on the results of the weekly samples collected at Windsor Reservoir (PS Code: 1910124-025). PWP shall be deemed in violation of the perchlorate MCL if a weekly sample, consisting of one result or the average of an initial result and a confirmation result, exceeds 6 µg/L. Department notification and Tier 1 public notification are required within 24 hours of a confirmed perchlorate MCL exceedance.

20. PWP shall ensure that the laboratory notifies PWP operators and management within 48 hours whenever the level of perchlorate in a single sample exceeds the MCL, and shall ensure that a contact person is available to receive such analytical results 24 hours a day. PWP shall also require the laboratory to immediately notify the Department of any perchlorate MCL exceedance if the laboratory cannot make direct contact with the designated contact person within 48 hours.

LIQUID-PHASE GRANULAR ACTIVATED CARBON (LGAC) TREATMENT

21. When delivering treated water to Windsor Reservoir and the distribution system, each train of LGAC vessels shall not be operated above its maximum design capacity of 1,400 gpm. In addition, they shall not be operated below 200 gpm. The empty bed contact time for each LGAC vessel shall be at least 7.1 minutes at all times. The vessels should be operated in a down-flow mode, with two vessels operated in series in each train.

22. The granular activated carbon utilized in the LGAC vessels shall be 40,000 pounds of virgin Filtrasorb 300 per vessel. Both the initial and replacement carbons shall meet the manufacturer's specifications. Any change of carbon specifications shall be approved in writing by the Department.

23. The replacement carbon shall be virgin or reactivated carbon that is NSF Standard 61 certified for use as drinking water system component.

24. PWP shall minimize system downtime by scheduling carbon changeouts in a timely manner. After changeout, PWP shall monitor for total coliform and HPCs.

25. The LGAC adsorption system shall be maintained according to the manufacturer's recommendations.

NITRATE BLENDING

26. If any of the Monk Hill Wells exceeds 40 mg/L nitrate, PWP shall implement nitrate blending treatment in accordance with the approved OMMP.

27. PWP's blending plan shall include performing a daily blending projection, using the most recent wellhead water quality analysis results to determine the proper flowrate that shall be produced from each well, then control the pumping from each well so that the blended effluent is reliably below 80% of the nitrate MCL.

28. Compliance with the nitrate MCL shall be based on the results of the weekly samples collected at Windsor Reservoir (PS Code: 1910124-025). PWP shall be deemed in violation of the nitrate MCL if a sample, consisting of one result or the average of an initial result and a confirmation result, exceeds 45 mg/L. Department notification and Tier 1 public notification are required within 24 hours of a confirmed nitrate MCL exceedance.

29. PWP shall ensure that the laboratory notifies PWP operators and management within 24 hours whenever the level of nitrate in a single sample exceeds the MCL, and shall ensure that a contact person is available to receive such analytical results 24 hours a day. PWP shall also require the laboratory to immediately notify the Department of any nitrate MCL exceedance if the laboratory cannot make direct contact with the designated contact person within 24 hours.

MONITORING

General

30. All water samples for compliance purposes shall be analyzed by a laboratory certified by the Department's Environmental Laboratory Accreditation Program (ELAP) for each analytical technique. If no certification is available for a particular compound, the method and detection limit shall be submitted for approval by the Department on a case-by-case basis.

31. Except for bacteriological analyses and constituents without chemical storet numbers, all water quality monitoring results obtained from a certified laboratory shall be submitted to the Department by Electronic Data Transfer (EDT) using the PS Codes listed in Table 4.

Table 4. MHTS Sampling Points

Location	Description	PS Code
Arroyo Well	Arroyo Well Discharge	1910124-001
Well 52	Well 52 Discharge	1910124-021
Ventura Well	Ventura Well Discharge	1910124-019
Windsor Well	Windsor Well Discharge	1910124-022
IX Combined Effluent	Combined Ion Exchange Plant Effluent	1910124-051
LGAC Combined Effluent	Combined Plant Effluent after LGAC and before Disinfection	1910124-050
Windsor Reservoir	Compliance Point for Nitrate, Perchlorate, and VOCs	1910124-025

32. Monitoring requirements for the Monk Hill production wells, MHTS, and Windsor Reservoir are provided in Table 5 and also described in Provisions 40 through 56.

Table 5. Monitoring Requirements

Monitoring Location	P.S. Code	Constituent	Frequency
Monk Hill Production Wells			
Arroyo Well Well 52 Ventura Well Windsor Well	1910124-001 1910124-021 1910124-019 1910124-022	VOCs, nitrate, perchlorate, total coliform, HPC	Monthly
		Chlorate, 1,4-dioxane, and low level 1,2,3-TCP	Quarterly
		Atrazine, simazine	Initially within 120 days of well activation and triennial thereafter
		Inorganic per Table 64431-A; general mineral per Section 64449 (b)(2); and secondary standard chemicals per Tables 64449A&B	Per recent vulnerability assessment and monitoring frequency guidelines
		Radionuclides including gross alpha, uranium, radium 226 and 228	Four consecutive quarterly samples; subsequent monitoring requirements TBD
Ion Exchange (IX)			
Combined influent to IX vessels (after influent cartridge filters)	N/A	Perchlorate	Weekly
		Nitrate	Weekly when nitrate blending plan is implemented
Each lead vessel effluent	N/A	Perchlorate	Weekly
IX combined effluent	1910124-051	Perchlorate	Twice weekly or weekly if combined influent perchlorate is consistently below 18 ug/L
		Total coliform, HPC	Weekly and following any changeout or prolonged shutdown
Each lag vessel effluent	N/A	Perchlorate	Sample if detected at combined effluent (1910124-051)
Each lead and lag vessel effluent	N/A	Total coliform, HPC	Sample if combined effluent (1910124-051) is detected with total coliform

Monitoring Location	P.S. Code	Constituent	Frequency
Liquid Phase Granular Activated Carbon (LGAC)			
Combined influent to LGAC vessels	19101240-051	VOCs	Weekly
LGAC combined effluent (prior to chloramination)	1910124-050	VOCs	Weekly
		Total coliform, HPC	Weekly and following any changeout or prolonged shutdown
		Nitrate	Weekly when nitrate blending plan is implemented
Each lag vessel effluent	N/A	VOCs	Sample if detected at combined effluent (1910124-050)
Each lead vessel 25% port			Monthly until detected
Associated lead vessel 50% port with VOC detection in its 25% port			Monitor 50% port immediately following detection at 25% Port; Continue weekly until detected
Associated lead vessel 75% port with VOC detection in its 50% port			Monitor 75% port immediately following detection at 50% port; Continue weekly until detected
Associated lead vessel effluent with VOC detection in its 75% port			Monitor lead vessel effluent immediately following detection at 75% port; Continue weekly until detected
Each lead and lag vessel effluent	N/A	Total coliform, HPC	Sample if combined effluent (1910124-050) is detected with total coliform

Monitoring Location	P.S. Code	Constituent	Frequency
Compliance Monitoring Location for Monk Hill Treatment System			
Windsor Reservoir	1910124-025	VOCs, nitrate, perchlorate, total coliform, HPC	Weekly
		Chlorate	Monthly

33. The laboratory performing the analyses shall be instructed to report all calibrated peaks on gas chromatographic/mass spectroscopic (GC/MS) analyses. Uncalibrated peaks on chromatographic analyses shall be reported according to CDPH guidance documents Analysis and Reporting of Volatile Non-Target Organic Compounds in Extremely Impaired Water Sources and Recycled Water by Methods 524.2, and Analysis and Reporting of Non-Target Semi-Volatile Organic Compounds in Extremely Impaired Water Sources and Recycled Water Using Methods 3510C/8270 C.

    http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Drinkingwaterlabs/nt-vocs.pdf and

    http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Drinkingwaterlabs/nt-svocs.pdf

    If the TIC or unknown compound is repeatedly detected and not a one-time event, the Department may require and allow time for additional work to positively identify the compound(s) and/or additional testing of the MHTS plant effluent to verify removal of the compound(s).

    Records of the mass spectra, sample date and sample location for all TICs and unknown chemical species described above shall be maintained by PWP.

34. PWP shall comply with any additional monitoring and treatment requirements the Department deems necessary based on any newly identified constituents. If necessary, the Department may modify the monitoring provisions specified herein based on additional information. PWP may request a modification of any monitoring provision based upon substantiating data at any time.

35. Where specified, low level analysis for 1,2,3-trichloropropane (1,2,3-TCP) shall be performed by an ELAP certified laboratory with the lowest achievable reporting limit.

36. When analysis for metals is required, PWP shall follow The Protocol for Characterizing Severely Impaired Water Sources Through Elemental Analysis located on the Department's website:

http://www.cdph.ca.gov/certlic/drinkingwater/Documents/Drinkingwaterlabs/ProceduresforElementalAnalysis.pdf

All detected metals shall be reported.

37. Prior to proceeding with the requirements for further monitoring following a detection of a VOC, PWP may first confirm the analytical result, as follows: Within seven (7) days (24 hours for LGAC ports, LGAC effluent and Windsor Reservoir effluent) from the notification of an initial detection from a laboratory reporting the presence of one or more VOCs in a water sample, PWP may collect and analyze one or two additional samples to confirm the initial finding. Confirmation of the initial finding shall be shown by the presence of the VOC in either the first or second additional sample, and the detected level of the VOC for compliance purposes, if applicable, shall be the average of the initial and the confirmation sample(s). The initial finding shall be disregarded if two additional samples do not show the presence of the VOC.

38. PWP shall be responsible for, and require, the timely notification from the laboratory by telephone or fax of analytical results, particularly those which trigger additional sampling within time limits.

Upgradient Surveillance Wells Monitoring

39. Monitoring wells MW-5, MW-10, MW-3 (screen 2), MW-4 (screen 2), MW-17 (screen 3), MW-18 (screen 4), and MW-19 (screen 2), shall be monitored annually for explosives (TNT, HMX, and RDX), nitrosamines, fluoride, 1,4-dioxane, MTBE and related oxygenates (ETBE, TBA, and TAME), low level 1,2,3-TCP, total and hexavalent chromium, and triennially for semi-volatile organics (including PAHs, phthalates, PCBs, and phenol), total petroleum hydrocarbons, and 2,3,7,8-TCDD.

    Sampling should be coordinated with the long-term quarterly groundwater monitoring program implemented by NASA, which includes quarterly monitoring of perchlorate, VOC, and other contaminants of concern. Initial sampling shall be done within 120 days of issuance of this permit amendment.

Monk Hill Production Wells Monitoring

40. Each of the four Monk Hill production wells shall be sampled in accordance with the current Vulnerability Assessment table issued to PWP by the Department.

41. Each of the four Monk Hill production wells shall also be sampled in accordance with the raw water monitoring scheduled outlined in the approved OMMP, which includes monthly monitoring of VOCs, nitrate, perchlorate, coliform bacteria and heterotrophic plate count (HPC); and quarterly for chlorate, 1,4-dioxane, and low level 1,2,3-TCP.

The four Monk Hill production wells shall also be tested for atrazine and simazine within 120 days of activation of the wells and once every three years thereafter.

42. PWP shall begin initial radionuclide monitoring at each of the Monk Hill production wells within one quarter of initiating water service from the MHTS to the public.

43. PWP shall revise its raw water monitoring plan 1) if additional chemicals are detected in any upgradient surveillance well which might threaten the quality of the water produced by the Monk Hill production wells, 2) if new chemicals are detected in the production wells, or 3) if the monitoring data indicates a rapid change in a contaminant's concentration which warrants more frequent monitoring.

44. If any additional contaminant is consistently found in one or more of the surveillance wells, it should be tested for in the closest production wells. If the additional contaminant is detected in any of the production wells, it should be verified by sampling that it is removed by the treatment equipment.

Ion Exchange Treatment Monitoring

45. The perchlorate concentration of the IX combined effluent shall be operated to achieve a treatment goal of below California's Detection Limit for Reporting (DLR).

46. In order to verify the removal efficiency of the IX System, weekly perchlorate samples shall be collected at the combined influent to the IX vessels (the plant influent after the influent cartridge filters) and twice weekly at the IX combined effluent (PS Code: 1910124-051). If the influent concentration is reliably and consistently below 18µg/L, the IX combined effluent may be tested weekly.

47. Weekly perchlorate samples shall be collected at each lead vessel effluent, which is the cross-over point between the lead and lag vessels. The resin in the lead vessel will be changed out when the lead vessel effluent perchlorate concentration reaches the perchlorate MCL of 6 µg/L.

48. If perchlorate is detected above DLR at the IX combined effluent (PS Code: 1910124-051), sample each lag vessel effluent. Any vessel pair found to be discharging greater than DLR from the lag vessel shall be taken out of service and the lag vessel switched to the lead position, and fresh resin placed in the former lead vessel.

49. HPC and coliform samples shall be collected weekly and following any changeout or prolonged shutdown at the IX combined effluent to ensure no bacteriological contamination is occurring in the IX process. The IX combined effluent shall be free of total coliforms. If coliforms are detected, PWP shall inform the Department within 24 hours and begin weekly total coliform and HPC monitoring at the individual IX lead and lag vessels. The Department may require additional investigation. If monitoring results indicate a sudden or significant increase in coliform bacteria or HPC, the Department may require PWP to shut down the treatment facility and disinfect the resin and vessel.

LGAC Treatment Monitoring

50. Concentrations of all VOCs in the LGAC combined effluent (PS Code: 1910124-050) shall be operated to achieve a treatment goal of below their respective Detection Limits for Reporting (DLR).

51. In order to verify the removal efficiency of the LGAC System, weekly VOCs samples shall be collected at the combined influent to the LGAC vessels (PS Code: 1910124-051) and the LGAC combined effluent prior to chloramination (PS Code: 1910124-050).

52. If any VOCs are detected in the LGAC combined effluent above their respective DLRs, each lag vessel effluent must be tested and if breakthrough from one or more of the lag vessels has occurred, the LGAC in the associated lead vessel shall be replaced and that vessel then placed in the lag position.

53. In order to ensure that VOCs are not detected in the LGAC combined effluent, monthly samples should be collected at the 25 percent bed depth port of each lead vessel. Once any VOC is detected at a 25 percent port, the 50 percent sampling port should be immediately sampled and analyzed; sampling of the 50 percent port should continue weekly until any VOC is detected. Upon detection of the 50 percent port, the 75 percent port should immediately be tested; sampling of the 75 percent port should continue weekly until any VOC is detected. Upon VOC detection at the 75 percent port, the lead vessel effluent must be sampled immediately for VOCs and weekly thereafter. Detection of any VOC at the 75 percent sampling port shall trigger PWP to arrange for the replacement of the lead vessel bed, which will then become the lag bed.

    As PWP gains experience with the LGAC behavior and the actual levels of VOC, PWP may request a modification of the frequency of operational monitoring.

54. HPC and coliform samples shall be collected weekly and following any changeout or prolonged shutdown at the LGAC combined effluent to ensure no bacteriological contamination is occurring in the LGAC process. The LGAC combined effluent shall be free of total coliforms. If coliforms are detected, PWP shall inform the Department within 24 hours and begin weekly total coliform and HPC monitoring at the individual LGAC lead and lag vessels. The Department may require additional investigation. If monitoring results indicate a sudden or significant increase in coliform bacteria or HPC, the Department may require PWP to shut down the treatment facility and disinfect the media and vessel.

Nitrate Blending Monitoring

55. Nitrate blend shall be operated to achieve a treatment goal of 36 mg/L and less than the nitrate MCL of 45 mg/L at the Windsor Reservoir effluent (PS Code: 1910124-25) at all times. Nitrate blending monitoring shall be implemented in accordance with the approved OMMP.

Windsor Reservoir Compliance Monitoring

56. Windsor Reservoir (PS Code: 1910124-025) shall be the compliance monitoring location for MHTS. Weekly samples of nitrate, perchlorate, VOCs, total coliform, and HPC, and a monthly sample of chlorate shall be collected at Windsor Reservoir. These results shall be used to determine compliance with nitrate, perchlorate, and VOCs MCLs.

OPERATION AND MAINTENANCE

57. The status of the Monk Hill production wells shall be recorded daily, and the treatment facilities shall be inspected daily, when in use, for any abnormal occurrences including, but not limited to, leaks, unusual noises, vibrations, pressure and flow readings. A checklist of items to be examined shall be filled out daily and maintained for a minimum of five years.

58. All instruments, including but not limited to chemical analyzers and flow meters, shall be calibrated at the frequencies and by the methods recommended by their respective manufacturers. Records for all instrument calibrations shall be maintained by PWP for at least five years and made available to the Department when requested.

59. Sampling ports for the Monk Hill production wells, LGAC vessels, ion exchange vessels, and Windsor Reservoir's inlets/outlets shall be maintained in good operating condition.

60. PWP shall update the OMMP to reflect the monitoring parameters, frequencies, and compliance locations as specified in this permit.

61. At the conclusion of the first year of operation, PWP shall prepare and submit to the Department an evaluation of the performance of the MHTS and any proposed revisions to the OMMP for review.

RECORDS AND REPORTING

62. A monthly report of the MHTS shall be submitted to the Department by the 20th day of the following month. As a minimum, the report shall include:

    a) A summary of analytical results received by PWP in the reporting calendar month, including any results from the upgradient monitoring wells enumerated in this permit amendment.

    b) A summary of the bacteriological quality of water leaving the Monk Hill production wells, ion exchange combined effluent, LGAC combined effluent, and Windsor Reservoir.

63. PWP shall keep the following operational records for the MHTS:

    a) The daily operation and production of the Monk Hill production wells;

    b) Daily flowrate of the LGAC and ion exchange vessels;

    c) Daily disinfectant residual of the effluent leaving Windsor reservoir

64. The records shall also document any emergency and/or scheduled or unscheduled interruptions, including:

    a) Location of interruption,

    b) Cause of interruption,

    c) Date, approximate time, and duration of interruption,

    d) Precautions taken to minimize contamination of the supply and notification of the affected users, and

    e) Solution/resolution of the interruption and steps taken to prevent a reoccurrence.

65. Copies of reports, inspections and all records shall be kept for at least five years. Water quality records shall be kept for ten years.

66. Within 24 hours of receiving notification from the laboratory, PWP shall notify the Department of any exceedance of an MCL or NL in the finished water leaving the MHTS.

67. PWP shall prepare annual report to the Department, which shall include compliance with the permit provisions, the treatment plant's status, condition, and performance and any problems or difficulties and any proposed revisions to the OMMP for review. This report shall be due by March 30th of the following year.

    The annual report shall also provide an evaluation and technical review of the water quality data gathered from the upgradient surveillance monitoring wells listed in Condition 39, the Monk Hill production wells, the removal efficiency and reliability of the MHTS, and an evaluation of any changes in the characteristics of the contaminant concentrations and the possible impacts on the MHTS.

This amendment shall be appended to and shall be considered to be an integral part of the Domestic Water Supply Permit issued to the ***City of Pasadena Water and Power*** on ***November 9, 1999.***

FOR THE CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

March 17, 2011
Date

Jeff O'Keefe, P.E., District Engineer
Metropolitan District
Los Angeles Region

Attachment B
2013 Discharge Sample Tabulation

General NPDES Permit No. CAG914001 Januray 1, 2013 through April 7, 2013

Parameters	Units	Effluent Limitations		M001	M001	M001	M001-CBW	M001	M001
		Average Monthly	Maximum Daily	1/2/2013	1/17/2013	2/13/2013	2/14/2013	2/19/2013	3/14/2013
Total Flow	Gal/day	--	continuously						
pH	S.U.	--	6.5 – 8.5	7.4	7.4	7.5	7.5	7.4	7.6
Temperature	F	--	100	66	66	68	68	66	70
Total Dissolved Solids	mg/L	--	1,550	340	340	350	350	360	360
Total Suspended Solids	mg/L	50	150	<2.5	<2.5	<2.5	<2.5	<2.5	3.2
Turbidity	NTU	50	150	0.13	0.17	2.6	2.6	<0.041	2.3
BODs 20°C	mg/L	20	30	<4	<4	<4	<4	<2	<4
Oil and Grease	mg/L	10	15	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Settleable Solids	ml/L	0.1	0.3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sulfides	mg/L	--	1	-	-	<0.10	<0.10	-	-
Phenols	mg/L	--	1	-	-	<0.01	<0.01	-	-
Residual Chlorine	mg/L	--	0.1	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Sulfate	mg/L	--	350	55	51	52	52	47	52
Chloride	mg/L	--	150	40	39	42	42	45	40
NO3 as Nitrogen	mg/L	--	15(1)	5.3	5.3	4.4	4.4	5	4
Acetone	µg/L	--	700	< 10	< 10	< 10	< 10	< 10	< 10
Acrolein	µg/L	--	100	< 100	< 100	< 100	< 100	< 100	< 100
Acrylonitrile	µg/L	--	0.059	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	µg/L	--	1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Bromoform	µg/L	--	4.3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Cadmium	µg/L	1.6	3.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Carbon tetrachloride	µg/L	--	0.25(2)	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Chlorobenzene	µg/L	--	30	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chlorodibromomethane	µg/L	--	0.401(2)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroethane	µg/L	--	100	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Chloroform	µg/L	--	100	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	µg/L	11	22	<20	<20	<20	<20	<20	<20
Dichlorobromomethane	µg/L	--	0.56	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethane	µg/L	--	5	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	µg/L	--	0.38(2)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1-Dichloroethylene	µg/L	--	0.057(2)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloropropane	µg/L	--	0.52	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichloropropylene	µg/L	--	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-isopropyl ether (DIPE)	µg/L	--	0.8	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,4-Dioxane	µg/L	--	3	-	-	<3.0	<3.0	-	-
Ethylbenzene	µg/L	--	700	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Ethylene dibromide	µg/L	--	0.05(2)	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Lead, Total Recoverable	µg/L	2.6	5.2	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Chromium III, Total Recoverable	µg/L	50	50	-	-	<20	<20	-	-
Chromium VI, Total Recoverable	µg/L	8	16	-	-	<20	<20	-	-
Chromium	µg/L			<10	<10	<10	<10	<10	<10
Methyl bromide	µg/L	--	10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl chloride	µg/L	--	3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methylene chloride	µg/L	--	4.7	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methlyene Blue Active Substance (MBAS)	µg/L	--	0.5	-	-	<50	<50	-	-
Methyl ethyl ketone (MEK)	µg/L	--	700	< 10	< 10	< 10	< 10	< 10	< 10
Methyl tertiary butyl ether (MTBE)	µg/L	--	5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Naphthalene	µg/L	--	21	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
N-Nitrosodimethyl amine (NDMA)	µg/L	--	0.00069(2)	-	-	-	< 0.002	-	-
Perchlorate	µg/L	--	4	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Tertiary butyl alcohol (TBA)	µg/L	--	12	< 10	< 10	< 10	< 10	< 10	< 10
1,1,2,2- Tetrachloroethane	µg/L	--	0.17(2)	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Tetrachloroethylene (PCE)	µg/L	--	0.8	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Toluene	µg/L	--	150	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Total petroleum hydrocarbons(3)	µg/L	--	100	-	-	<50	<50	-	-
1,2- Trans-dichloroethylene	µg/L	--	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,1- Trichloroethane	µg/L	--	200	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,1,2- Trichloroethane	µg/L	--	0.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trichloroethylene (TCE)	µg/L	--	2.7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Vinyl chloride	µg/L	--	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Xylenes	µg/L	--	1750	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Zinc	µg/L	80	159	<100	<100	<100	<100	<100	<100
Acute Toxicity(4)	-	--	90%	-	-	100%	100%	-	-

Notes:

(1) Nitrogen effluent limit is consistent with the concentration in the Monk Hill Subarea groundwater.

(2) 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.

(3) 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.

(4) 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.

Sample Result Exceeds Limitation

General NPDES Permit No. CAG914001 April 7, 2013 through March 7, 2018

Parameters	Units	Effluent Limitations		M001-IX	M001	M001	M001	M001	M001	M001	M001
		Average Monthly	Maximum Daily	4/30/2013	6/13/2013	6/18/2013	8/5/2013	9/30/2013	10/3/2013	10/24/2013	12/9/2013
Total Flow	Gal/day	--	continuously								
pH	S.U.	--	6.5 – 8.5	7.6	7.5	7.6	7.6	7.5	7.5	7.7	7.7
Temperature	F	--	80	72	64	66	72	72	79	75	75
Total Dissolved Solids	mg/L	--	1,550	330	310	370	350	380	420	470	410
Total Suspended Solids	mg/L	50	75	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	<2.5	13
Turbidity	NTU	50	75	<0.10	0.14	0.36	1.4	0.9	0.59	0.48	8.6
BODs 20°C	mg/L	20	30	<4	<2	<2	2	<2	<2	-	<4
Oil and Grease	mg/L	10	15	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	<5.0	<5.0
Settleable Solids	ml/L	0.1	0.3	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Sulfides	mg/L	--	1	<0.10	<0.10	-	-	-	-	-	-
Phenols	mg/L	--	1	<0.01	<0.01	-	-	-	-	-	-
Residual Chlorine	mg/L	--	0.1	0.9	< 0.10	< 0.10	<0.10	<0.10	<0.10	<0.10	**0.12**
Sulfate	mg/L	--	350	44	53	60	50	66	66	87	62
Chloride	mg/L	--	150	33	39	45	38	50	55	63	47
NO_3 as Nitrogen plus NO_2 as Nitrogen	mg/L	--	8(1)	3.2	4.2	2.6	4.1	7.0	6.4	**8.2**	5.6
Acetone	µg/L	--	700	< 10	< 10	< 10	< 10	< 10	< 10	<10	<10
Acrolein	µg/L	--	100	< 100	< 100	< 100	< 100	< 100	< 100	<100	<100
Acrylonitrile	µg/L	--	0.059	< 10	< 10	< 10	< 10	< 10	< 10	<10	<10
Benzene	µg/L	--	1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
Bromoform	µg/L	--	4.3	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
Cadmium	µg/L	1.5	3.1	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Carbon tetrachloride	µg/L	--	0.25(2)	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
Chlorobenzene	µg/L	--	30	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
Chlorodibromomethane	µg/L	--	0.401(2)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
Chloroethane	µg/L	--	100	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
Chloroform	µg/L	--	100	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
Copper	µg/L	8.5	17	<20	<20	<20	<20	<20	<20	<20	<20
Dichlorobromomethane	µg/L	--	0.56	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
1,1-Dichloroethane	µg/L	--	5	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloroethane	µg/L	--	0.38(2)	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
1,1-Dichloroethylene	µg/L	--	0.057(2)	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0	<1.0	<1.0
1,2-Dichloropropane	µg/L	--	0.52	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
1,3-Dichloropropylene	µg/L	--	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Di-isopropyl ether (DIPE)	µg/L	--	0.8	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
1,4-Dioxane	µg/L	--	3	1.1	<1.0	-	-	-	-	-	-
Ethylbenzene	µg/L	--	700	< 0.5	< 0.5	< 0.5	< 0.5	< 0.50	< 0.50	<0.50	<0.50
Ethylene dibromide	µg/L	--	0.05(2)	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	<2.0	<2.0
Lead, Total Recoverable	µg/L	9	18	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	<5.0	<5.0
Chromium III, Total Recoverable	µg/L	50	50	<20	<20	-	-	-	-	-	-
Chromium VI, Total Recoverable	µg/L	8	16	<20	<20	-	-	-	-	-	-
Chromium	µg/L			<10	<10	<10	<10	<10	11	<10	<10
Methyl bromide	µg/L	--	10	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl chloride	µg/L	--	3	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methylene chloride	µg/L	--	4.7	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Methyl ethyl ketone (MEK)	µg/L	--	700	< 10	< 10	< 10	< 10	< 10	< 10	<10	<10
Methyl tertiary butyl ether (MTBE)	µg/L	--	5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
Naphthalene	µg/L	--	21	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	<2.0	<2.0
N-Nitrosodimethyl amine (NDMA)	µg/L	--	0.00069(2)	<0.002	-	-	-	-	-	-	-
Perchlorate	µg/L	--	6	<2.0	<2.0	<2.0	-	-	-	-	-
Tertiary butyl alcohol (TBA)	µg/L	--	12	< 10	< 10	< 10	< 10	< 10	< 10	<10	<10
1,1,2,2- Tetrachloroethane	µg/L	--	0.17(2)	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
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Toluene	µg/L	--	150	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
Total petroleum hydrocarbons(3)	µg/L	--	100	<50	<50	-	-	-	-	-	-
1,2- Trans-dichloroethylene	µg/L	--	10	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
1,1,1- Trichloroethane	µg/L	--	200	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
1,1,2- Trichloroethane	µg/L	--	0.6	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
Trichloroethylene (TCE)	µg/L	--	2.7	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	<1.0	<1.0
Vinyl chloride	µg/L	--	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
Xylenes	µg/L	--	1750	<0.50	<0.50	<0.50	< 0.50	< 0.50	< 0.50	<0.50	<0.50
Zinc	µg/L	79	160	<100	<100	<100	<100	< 100	< 100	<100	<100
Acute Toxicity(4)	-	--	90%	100%	100%	-	-	-	-	-	-
E.coli density	MPN/100m	126	235	-	-	-	-	-	-	-	-

Notes:

(1) Nitrogen effluent limit is consistent with the concentration in the Monk Hill Subarea groundwater.

(2) 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.

(3) 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.

(4) 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.

Sample Result Exceeds Limitation