



2014 Annual Water Quality Report



YOUR WATER. YOUR FUTURE.

2014 Annual Water Quality Report

Prepared by the Water Control Department

Contributing efforts by
Arizona State University

August 2015



YOUR WATER. YOUR FUTURE.

P.O. Box 43020 – Phoenix, AZ 85080-3020 • 23636 North 7th Street – Phoenix, AZ 85024 • 623-869-2333 • www.cap-az.com



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Introduction

The Central Arizona Project (CAP) delivers Colorado River water from Lake Havasu, located on Arizona's western border, to central and southern Arizona. The total CAP system is 336 miles long and consists of open canals, inverted siphon pipelines, tunnels, pumping plants, check structures, turnouts, and the Lake Pleasant storage reservoir. CAP is Arizona's largest supplier of renewable water.

CAP is a multi-purpose project with an annual Colorado River diversion of approximately 1.6 million acre-feet delivered to cities, industries, Indian communities, and agricultural customers as it crosses the arid desert. Colorado River water offsets groundwater mining, which benefits the state by conserving water, providing long-term storage for future use, supplementing surface water supplies, drought management, and complying with the Arizona Groundwater Management Act. CAP also provides flood control, power management, recreation, and wildlife benefits.

CAP does not provide potable water directly to the public, but supplies raw Colorado River water to municipal water treatment plants. These plants perform the necessary filtering, disinfection, and other treatment of the water to remove suspended particles and bacteria. The treated water is then delivered through the municipal distribution system for domestic use.

Water Quality Program

In a concerted effort to provide vital information and minimize water quality impacts to customers, CAP has developed a water quality monitoring program, which consists of three areas:

- 1) Ongoing monitoring of primary pollutants and general water chemistry
- 2) Ongoing corrosion and materials studies
- 3) Customers' parameters of interest

Water quality monitoring provides data and information to CAP staff and customers about patterns and trends in the canal and Lake Pleasant water quality. The data can also be used to identify potential water contaminant sources.

Water comes from two basic sources: (1) Colorado River, and (2) Lake Pleasant. As previously mentioned, the Colorado River is the main source of CAP water, but Agua Fria River inflow from rainfall/runoff on the Lake Pleasant watershed mixes with Colorado River water that is stored in the reservoir.

The CAP canal system has cross-drainage structures, which are designed to convey natural drainages over or under the CAP canal. However, there is some limited onsite drainage that is collected in the CAP system.

Historical Water Quality Information

Prior to 1996, the United States Bureau of Reclamation (USBR) and the Central Arizona Water Conservation District (CAWCD) cooperated with the United States Geological Survey (USGS) for a water quality sampling program. The USGS collected monthly and quarterly grab samples at three sites on the CAP canal system:

	Location	USGS Site Name	USGS Site Number
(1)	Planet Ranch Road bridge (Mile Post 8)	CAP CANAL AT MP 7.9 NR PARKER DAM, AZ	09426700
(2)	7th Street bridge (Mile Post 162)	CAP CANAL AT MP 162.3 AT 7TH ST AT PHOENIX, AZ	09427100
(3)	County Road bridge just upstream of the Santa Rosa Turnout (Mile Post 252)	CAP CANAL ABV BRADY PUMPPLANT NR COOLIDGE AZ	09427300

The water quality program tested and analyzed over 50 parameters. Historical CAP water quality data was published in the annual USGS Water Resources Data for Arizona reports. The data is also available online at <http://nwis.waterdata.usgs.gov/nwis/qwdata>. The period of record for the historical data is July 1985 through September 1995. The cooperative agreement with the USGS sampling program expired on September 30, 1995.

CAP began publishing an annual water quality report in 1996. Copies of the annual reports since 1996 can be obtained by contacting the CAP Water Control Department at (623) 869-2573.



Canal Water Quality Data



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CAP Canal Water Quality Data

CAP's water quality program consists of real-time water quality data from sensors installed at various locations along the canal system, and regularly scheduled grab samples, which are analyzed by a commercial laboratory. CAP also coordinates with its customers to provide additional sampling if needed.

Real-Time Water Quality Program

The transition to a single real-time water quality sensor, located in the canal adjacent to CAP Headquarters, was completed in January 2014. This multi-probe device is intended to replace the sensors at the Mark Wilmer Pump Plant, Hassayampa Pump Plant, and the Waddell Pump/Generator Plant, except for the Hach turbidity meter still in use at the Mark Wilmer Pump Plant. Parameters measured include: turbidity, temperature, conductivity, pH, and dissolved oxygen. Real-time data can be found on CAP's website at:

<http://www.cap-az.com/departments/water-operations/water-quality>

Grab Sample Program and Results

CAP contracts with a State of Arizona licensed and certified laboratory to perform the water quality analysis on grab samples. This program includes the following constituents and sampling sites:

-Water Quality Constituents-

General Parameters:	Temperature	(field measured)
	pH	(field measured)
	Dissolved Oxygen (DO)	(field measured)
	Conductivity	(field & lab measured)
	Alkalinity	
	Ammonia Nitrogen	
	Barium	
	Bromide	
	Calcium	
	Chloride	
	Copper	
	Dissolved Organic Carbon	
	Dissolved Iron	
	Iron (Total)	
	Magnesium	
	Manganese	
	Nitrate	
	Orthophosphate-P	
	Potassium (Total)	
	Silica	
	Sodium (Total)	

	Specific Conductance
	Strontium
	Sulfate
	Total Dissolved Solids (TDS)
	Total Phosphorus-P
	Total Suspended Solids (TSS)
	Turbidity
Taste and Odor:	MIB / Geosmin (as needed basis only)
Pathogens:	Giardia / Cryptosporidium
Priority Pollutants:	Heavy Metals (As,Cd,Cr,Pb,Hg,Se,Ag,U) Volatile Organic Compounds (VOC's) Volatile Organic Aromatics (VOA's) Organophosphorus Pesticides Carbamate Pesticides Chlorinated Herbicides

-Water Quality Sampling Sites-

CAP Canal at Milepost

Mark Wilmer Pump Plant	0
Little Harquahala Pump Plant	59.5
99th Avenue	148.9
McKellips Road	193.3
Brady Pump Plant	253.8
San Xavier Pump Plant	318.3

Figure 1 is a map that identifies the above mentioned grab sample locations. Table 1 shows the grab sample schedule for 2014. The water quality data collected during 2014 is presented in Table 2 - Table 7. The data shows the measured values for each month per site. Figure 2 - Figure 6 provide graphical representations of site versus time comparisons for dissolved oxygen (DO), water temperature, pH, turbidity, and total dissolved solids (TDS). The results for the grab sample program are also updated monthly on CAP's website:

<http://www.cap-az.com/departments/water-operations/water-quality>

Central Arizona Project Canal Sampling Program

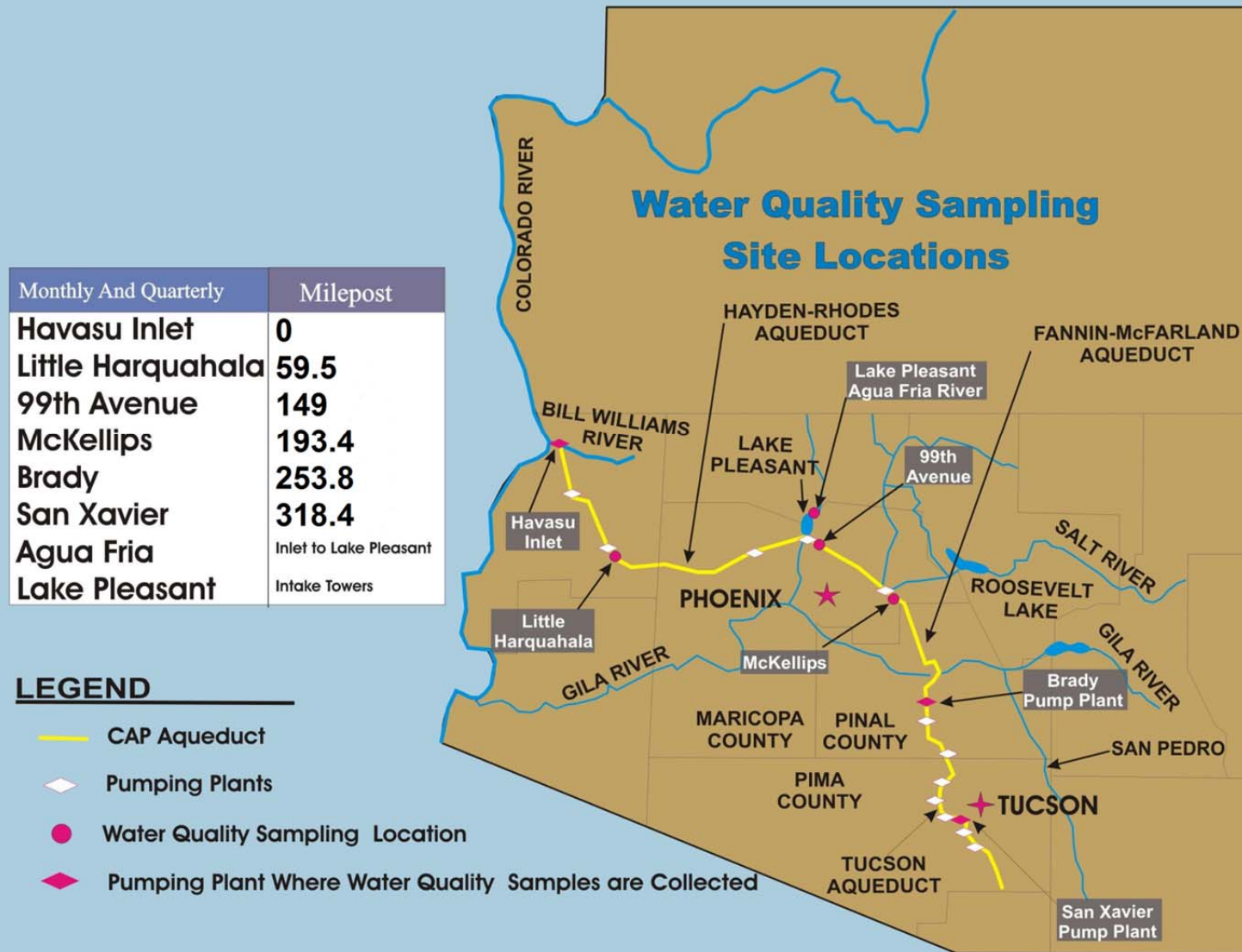


Figure 1 CAP Sampling Location Map

Table 1 Grab Sample Schedule – 2014

Month	Havasupai	Little Harquahala	Lake Pleasant	99th Ave.	McKellips	Brady	San Xavier
JAN	G, H	G, H	H	G, H	G, H	G, H	G, H
FEB	G, H, GC, PP (2/11)	G, H	G, H, GC, PP (2/10)	G, H, GC, PP (2/10)	G, H	G, H	G, H, GC, PP (2/13)
MAR	G, H	G, H	H	G, H	G, H	G, H	G, H
APR	G, H	G, H	H	G, H	G, H	G, H	G, H
MAY	G, H, GC, PP (5/5)	G, H	G, H, PP (5/6)	G, H, GC, PP (5/6)	G, H	G, H	G, H, GC, PP (5/8)
JUN	G, H	G, H	H	G, H	G, H	G, H	G, H
JUL	G, H	G, H	H	G, H	G, H	G, H	G, H
AUG	G, H, GC, PP (8/6)	G, H	G, H, GC, PP (8/5)	G, H, GC, PP (8/4)	G, H	G, H	G, H, PP (8/14)
SEP	G, H	G, H	H	G, H	G, H	G, H	G, H
OCT	G, H	G, H	H	G, H	G, H	G, H	G, H
NOV	G, H, GC, PP (11/13)	G, H	G, H, GC, PP (11/12)	G, H, GC, PP (11/12)	G, H	G, H	G, H, GC, PP (11/18)
DEC	G, H	G, H	H	G, H	G, H	G, H	G, H

G= General Chemistry: alkalinity, ammonia nitrogen, barium, bromide, calcium, chloride, copper, dissolved organic carbon*, dissolved iron, total iron, magnesium, manganese, nitrate, orthophosphate, potassium, silica, sodium, specific conductance, strontium, sulfate, total dissolved solids (TDS), total phosphorus, total suspended solids (TSS), and turbidity.

H= Hydrolab readings of temperature, dissolved oxygen, conductivity, and pH will be taken each month at Lake Pleasant.

GC= Giardia/Cryptosporidium

PP= Priority pollutants: metals (silver, arsenic, cadmium, chromium, mercury, lead, selenium), volatile organic compounds (VOCs) semi-volatile organic compounds (semi-VOCs), aldicarbs, herbicides, perchlorate (beginning August 2004), and uranium (beginning August 2013).

Table 2 Lake Havasu Grab Sample Results

Lake Havasu 2014 at Mark Wilmer Pumping Plant, Parker Arizona													
General Chemistry Analytes	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	°F	55.3	55.3	60.0	63.6	69.9	78.0	82.1	83.5	82.1	75.0	67.5	60.5
Dissolved Oxygen	mg/L	10.27	10.73	10.37	9.60	9.60	9.20	9.58	7.95	8.27	6.94	8.30	10.97
Specific Conductance	µS/cm	924	892	923	929	1201	926	912	918	913	926	925	912
pH		8.3	8.3	8.5	8.4	7.0	8.2	8.5	8.2	8.3	8.1	8.1	7.9
Alkalinity in CaCO3 units	mg/L	130	130	120	120	120	120	120	120	120	130	130	130
Ammonia Nitrogen	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium, Total, ICAP/MS	µg/L	100	150	100	120	110	120	120	110	120	120	130	130
Bromide	µg/L	75	72	72	76	71	75	72	72	73	77	75	75
Calcium, Total, ICAP	mg/L	72	85	72	80	72	73	66	70	73	69	76	76
Chloride	mg/L	79	78	79	78	77	80	76	77	76	78	77	80
Copper, Total, ICAP/MS	µg/L	ND	4.4	ND	ND	340	ND	ND	7.6	ND	ND	ND	ND
Dissolved Organic Carbon	mg/L	2.8	2.8	2.7	2.8	2.7	2.8	2.8	2.8	2.9	2.8	2.7	2.8
Iron, Dissolved, ICAP	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron, Total, ICAP	mg/L	ND	2.8	ND	0.19	0.24	ND	ND	ND	ND	0.20	0.19	0.063
Magnesium, Total, ICAP	mg/L	26	29	25	28	25	26	25	26	26	26	28	27
Manganese, Total, ICAP/MS	µg/L	3.4	87	3.8	7.0	2.8	3.0	3.4	3.3	4.4	14	12	6.9
Nitrate as Nitrogen by IC	mg/L	ND	0.28	0.33	0.33	0.28	0.27	ND	ND	ND	ND	ND	ND
Orthophosphate as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.021	ND	ND
Potassium, Total, ICAP	mg/L	4.5	5.5	4.3	4.8	4.2	4.5	4.2	4.4	4.8	4.8	5.0	4.7
Silica	mg/L	8.2	23	7.5	10	8.3	8.2	8.0	8.5	8.0	10	11	10
Sodium, Total, ICAP	mg/L	84	88	81	94	82	85	85	88	90	88	96	92
Specific Conductance	µS/cm	940	950	940	930	950	950	940	950	950	980	970	980
Strontium, ICAP	mg/L	1.0	1.1	1.0	1.1	0.99	1.0	0.99	1.0	1.1	1.1	1.2	1.1
Sulfate	mg/L	210	210	220	210	210	220	220	230	220	220	220	230
Total Dissolved Solids (TDS)	mg/L	620	590	600	590	600	610	580	630	630	580	640	630
Total phosphorus as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (TSS)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Turbidity	NTU	0.81	2.4	0.83	1.3	3.3	0.80	1.0	0.72	0.84	2.0	2.4	1.4
Quarterly Analytes Detected	These Results are the Priority Pollutants that are Reported by Exception as Detected by the Quarterly Samples												
Arsenic, Total, ICAP/MS	µg/L		4.2			3.1			3.7			3.1	
Benzene	µg/L		ND			3.1			ND			ND	
Chromium, Total, ICAP/MS	µg/L		2.2			ND			ND			ND	
Lead Total ICAP/MS	µg/L		2.9			ND			ND			ND	
Uranium, Total, ICAP/MS	µg/L		4.9			3.7			3.5			3.9	
Data Recovered with Hydrolab in Field			General Chemistry Data Sampled Monthly						Priority Pollutants Sampled Quarterly				
NA = Analyte not Sampled			ND = Analyte not Detected						EQ = Equipment Problem				

Table 3 Little Harquahala Grab Sample Results

Little Harquahala Pumping Plant 2014													
General Chemistry Analytes	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	°F	54.5	54.4	59.6	63.1	71.6	77.7	81.1	84.1	81.0	73.3	67.1	60.2
Dissolved Oxygen	mg/L	10.96	10.81	9.91	9.59	9.59	8.34	8.08	8.78	7.24	7.22	8.41	10.51
Specific Conductance	µS/cm	925	891	923	930	933	929	913	915	915	924	926	911
pH		8.4	8.2	8.6	8.4	7.2	8.2	8.4	8.2	8.5	8.0	8.0	7.9
Alkalinity in CaCO3 units	mg/L	130	130	130	120	120	120	130	110	120	130	130	130
Ammonia Nitrogen	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium, Total, ICAP/MS	µg/L	110	100	100	120	110	120	120	110	120	ND	130	130
Bromide	µg/L	72	71	71	74	79	73	71	74	72	81	76	73
Calcium, Total, ICAP	mg/L	73	71	71	76	74	73	69	70	72	76	74	77
Chloride	mg/L	79	78	80	78	78	80	75	78	75	78	75	81
Copper, Total, ICAP/MS	µg/L	ND	ND	ND	ND	120	ND	ND	440	ND	ND	ND	ND
Iron, Dissolved, ICAP	mg/L	ND	ND	ND	ND	ND	0.024	ND	ND	ND	ND	ND	ND
Iron, Total, ICAP	mg/L	ND	0.021	ND	0.076	0.16	ND	ND	0.64	ND	0.035	0.18	0.048
Magnesium, Total, ICAP	mg/L	26	25	25	26	26	26	26	27	25	27	27	28
Manganese, Total, ICAP/MS	µg/L	ND	3.7	3.9	4.4	2.6	2.9	4.4	5.7	7.4	ND	12	4.4
Nitrate as Nitrogen by IC	mg/L	ND	0.27	0.32	0.31	0.26	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.017	ND	ND
Potassium, Total, ICAP	mg/L	4.5	4.3	4.3	4.5	4.4	4.6	4.4	4.6	4.7	4.6	4.8	4.8
Silica	mg/L	7.9	7.7	7.0	8.5	8.2	7.8	8.0	8.6	8.1	9.2	11	10
Sodium, Total, ICAP	mg/L	85	82	79	88	88	88	88	91	86	86	92	93
Specific Conductance	µS/cm	940	940	940	930	950	960	940	950	930	980	970	980
Strontium, ICAP	mg/L	1.0	1.0	0.99	1.0	1.0	1.0	1.0	1.1	1.0	1.1	1.1	1.2
Sulfate	mg/L	220	210	220	210	210	220	220	230	220	220	220	230
Total Dissolved Solids (TDS)	mg/L	610	600	580	600	560	600	580	610	620	620	630	630
Total phosphorus as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (TSS)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Turbidity	NTU	0.49	1.9	1.3	0.69	1.4	0.65	0.41	3.1	1.0	1.9	2.7	1.4
Quarterly Analytes Detected													
These Results are the Priority Pollutants that are Reported by Exception as Detected by the Quarterly Samples													
NO QUARTERLY SAMPLES ARE TAKEN AT THIS LOCATION													

Data Recovered with Hydrolab in Field

General Chemistry Data Sampled Monthly

Priority Pollutants Sampled Quarterly

NA = Analyte not Sampled

ND = Analyte not Detected

EQ = Equipment Problem

Table 4 99th Avenue Grab Sample Results

99th Avenue Bridge 2014													
General Chemistry Analytes	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	°F	58.9	55.5	61.2	63.8	69.3	72.8	72.1	73.9	78.2	76.0	67.1	59.4
Dissolved Oxygen	mg/L	9.91	11.04	10.55	9.99	9.34	8.90	7.91	8.32	8.57	8.64	8.46	11.41
Specific Conductance	µS/cm	975	895	921	930	926	936	926	918	914	918	923	914
pH		8.4	8.3	8.4	8.5	8.4	8.3	8.4	8.4	8.2	8.2	8.1	7.9
Alkalinity in CaCO3 units	mg/L	120	130	120	120	120	120	120	110	120	130	130	130
Ammonia Nitrogen	mg/L	ND	ND	ND	ND	ND	0.14	ND	ND	ND	ND	ND	ND
Barium, Total, ICAP/MS	µg/L	100	110	100	110	100	110	100	110	120	120	130	130
Bromide	µg/L	92	68	70	73	71	70	81	84	76	79	75	72
Calcium, Total, ICAP	mg/L	71	76	72	79	72	70	67	71	72	74	78	75
Chloride	mg/L	86	78	77	79	78	82	80	84	77	81	76	84
Copper, Total, ICAP/MS	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron, Dissolved, ICAP	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron, Total, ICAP	mg/L	ND	0.024	0.021	0.088	0.020	ND	ND	ND	0.09	0.10	0.23	0.18
Magnesium, Total, ICAP	mg/L	29	27	25	27	26	26	26	28	26	27	29	27
Manganese, Total, ICAP/MS	µg/L	2.0	4.3	3.6	4.7	2.9	3.1	4.7	6.2	12	ND	11	4.8
Nitrate as Nitrogen by IC	mg/L	ND	0.26	0.31	0.32	0.26	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.011	0.016	ND
Potassium, Total, ICAP	mg/L	5.2	4.5	4.5	4.7	4.3	4.5	4.8	4.9	4.7	5.1	4.4	4.8
Silica	mg/L	8.4	8.0	7.8	8.8	7.1	7.8	7.9	8.5	8.5	9.1	9.6	9.7
Sodium, Total, ICAP	mg/L	93	86	84	92	83	84	89	93	87	93	93	92
Specific Conductance	µS/cm	990	940	940	950	960	960	970	970	970	970	980	990
Strontium, ICAP	mg/L	1.1	1.0	1.0	1.1	1.0	0.99	1.0	1.1	1.1	1.1	1.2	1.1
Sulfate	mg/L	230	210	210	210	210	220	230	240	220	230	220	240
Total Dissolved Solids (TDS)	mg/L	650	590	590	590	570	600	640	620	620	640	630	660
Total phosphorus as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (TSS)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	15	ND	15	ND
Turbidity	NTU	0.36	2.5	0.80	0.94	0.64	0.73	0.76	0.75	0.73	3.0	4.6	1.2
Quarterly Analytes Detected													
These Results are the Priority Pollutants that are Reported by Exception as Detected by the Quarterly Samples													
Arsenic, Total, ICAP/MS	µg/L		2.2			2.4			4.0			2.9	
Orthophosphate as PO4	mg/L		ND			ND			ND			0.049	
Tot DCPA Mono&Diacid Degradate	µg/L		ND			ND			ND			0.11	
Uranium, Total, ICAP/MS	µg/L		3.7			3.4			3.5			4.0	
Data Recovered with Hydrolab in Field		General Chemistry Data Sampled Monthly							Priority Pollutants Sampled Quarterly				
NA = Analyte not Sampled		ND = Analyte not Detected							EQ = Equipment Problem				

Table 5 McKellips Rd. Grab Sample Results

McKellips Rd. 2014													
General Chemistry Analytes	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	°F	57.0	56.7	61.7	65.3	68.8	73.8	75.6	74.6	79.3	76.5	67.4	59.4
Dissolved Oxygen	mg/L	10.70	11.13	10.27	10.04	9.53	9.33	9.22	9.29	9.49	8.84	8.89	11.71
Specific Conductance	µS/cm	996	891	919	931	922	936	925	920	912	918	921	911
pH		8.5	8.3	8.6	8.5	8.6	8.4	8.4	8.4	8.4	8.2	8.2	8.0
Alkalinity in CaCO3 units	mg/L	120	130	120	120	120	110	120	110	120	120	130	130
Ammonia Nitrogen	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Barium, Total, ICAP/MS	µg/L	100	110	110	120	110	110	100	110	120	130	130	140
Bromide	µg/L	92	75	71	72	70	72	80	82	74	77	70	72
Calcium, Total, ICAP	mg/L	70	73	72	73	74	70	68	73	68	76	76	74
Chloride	mg/L	86	78	77	78	79	82	80	81	77	80	79	84
Copper, Total, ICAP/MS	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	4.1	ND	ND
Iron, Dissolved, ICAP	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron, Total, ICAP	mg/L	ND	ND	ND	0.021	ND	ND	ND	ND	0.027	0.021	0.056	0.077
Magnesium, Total, ICAP	mg/L	29	26	26	26	27	26	26	30	26	27	28	27
Manganese, Total, ICAP/MS	µg/L	2.0	2.2	3.6	3.1	2.1	2.8	3.9	5.9	9.8	7.1	4.7	5.2
Nitrate as Nitrogen by IC	mg/L	ND	0.25	0.29	0.30	0.26	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P	mg/L	0.012	ND	ND	ND	ND	ND	ND	ND	ND	ND	0.014	ND
Potassium, Total, ICAP	mg/L	5.1	4.6	4.4	4.4	4.4	4.4	4.8	5.1	4.6	5.0	4.9	4.6
Silica	mg/L	7.9	7.3	6.8	7.5	7.5	7.5	7.5	8.1	7.5	8.3	9.4	9.3
Sodium, Total, ICAP	mg/L	92	85	81	85	86	84	89	99	86	93	94	91
Specific Conductance	µS/cm	990	930	930	940	950	960	970	960	960	960	980	990
Strontium, ICAP	mg/L	1.1	1.0	1.0	1.0	1.0	0.98	1.0	1.1	1.0	1.1	1.2	1.1
Sulfate	mg/L	230	210	210	210	220	220	230	240	220	230	230	240
Total Dissolved Solids (TDS)	mg/L	650	550	600	610	600	590	640	610	610	630	620	670
Total phosphorus as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (TSS)	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	10	ND	ND	ND
Turbidity	NTU	0.67	0.54	0.70	0.45	0.59	0.40	0.88	1.0	0.86	2.00	2.2	1.3
Quarterly Analytes Detected													
These Results are the Priority Pollutants that are Reported by Exception as Detected by the Quarterly Samples													
NO QUARTERLY SAMPLES ARE TAKEN AT THIS LOCATION													
Data Recovered with Hydrolab in Field				General Chemistry Data Sampled Monthly					Priority Pollutants Sampled Quarterly				
NA = Analyte not Sampled				ND = Analyte not Detected					EQ = Equipment Problem				

Table 6 Brady Pumping Plant Grab Sample Results

Brady Pumping Plant 2014													
General Chemistry Analytes	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	°F	54.2	58.8	64.3	66.9	70.2	76.2	EQ	78.0	82.6	74.3	62.5	59.2
Dissolved Oxygen	mg/L	11.70	12.35	9.64	9.77	8.72	9.09	EQ	9.21	8.98	7.37	9.50	11.39
Specific Conductance	µS/cm	917	886	926	930	920	937	EQ	921	895	914	915	901
pH		8.3	8.3	8.3	8.4	8.7	8.2	EQ	8.4	8.4	8.4	8.2	8.0
Alkalinity in CaCO3 units	mg/L	120	130	120	120	110	120	100	110	120	120	120	130
Ammonia Nitrogen	mg/L	ND	0.092	ND	ND	ND	ND	ND	0.052	ND	ND	ND	ND
Barium, Total, ICAP/MS	µg/L	110	43	100	100	110	110	110	110	120	130	130	130
Bromide	µg/L	72	74	72	72	70	77	79	83	77	81	73	74
Calcium, Total, ICAP	mg/L	69	71	68	73	71	75	70	70	67	66	68	76
Chloride	mg/L	79	78	78	79	80	83	82	82	79	79	85	84
Copper, Total, ICAP/MS	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	2.1	ND
Iron, Dissolved, ICAP	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron, Total, ICAP	mg/L	ND	0.029	0.024	0.059	ND	0.020	ND	ND	ND	0.026	ND	0.045
Magnesium, Total, ICAP	mg/L	26	26	25	26	26	27	28	28	26	25	27	28
Manganese, Total, ICAP/MS	µg/L	ND	3.6	5.2	7.4	2.5	3.8	5.5	6.3	9.4	7.0	3.6	3.3
Nitrate as Nitrogen by IC	mg/L	ND	ND	0.29	0.28	ND	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P	mg/L	ND	ND	ND	ND	ND	ND	ND	0.010	ND	ND	ND	0.014
Potassium, Total, ICAP	mg/L	4.2	4.4	4.3	4.5	4.3	4.7	4.8	4.8	4.7	4.6	4.4	4.9
Silica	mg/L	6.9	7.1	7.1	7.3	6.7	7.1	7.6	7.4	6.2	6.5	7.6	8.8
Sodium, Total, ICAP	mg/L	81	82	82	83	86	90	93	95	88	85	83	95
Specific Conductance	µS/cm	940	950	950	940	960	960	970	980	940	960	970	980
Strontium, ICAP	mg/L	0.99	1.0	0.97	1.0	1.0	1.1	1.0	1.1	1.0	1.0	1.1	1.2
Sulfate	mg/L	210	210	210	210	220	220	240	240	220	220	240	240
Total Dissolved Solids (TDS)	mg/L	560	580	580	590	590	600	600	610	610	640	600	630
Total phosphorus as P	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Suspended Solids (TSS)	mg/L	ND	ND	ND	22	ND	ND	ND	ND	ND	ND	ND	ND
Turbidity	NTU	0.48	1.8	2.3	0.85	0.45	0.49	0.67	1.4	1.2	1.5	2.0	1.6
Quarterly Analytes Detected	These Results are the Priority Pollutants that are Reported by Exception as Detected by the Quarterly Samples												
NO QUARTERLY SAMPLES ARE TAKEN AT THIS LOCATION													
Data Recovered with Hydrolab in Field			General Chemistry Data Sampled Monthly					Priority Pollutants Sampled Quarterly					
NA = Analyte not Sampled			ND = Analyte not Detected					EQ = Equipment Problem					

Table 7 San Xavier Grab Sample Results

San Xavier Pumping Plant 2014													
General Chemistry Analytes	Units	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Temperature	°F	53.7	57.8	63.2	65.4	68.3	79.9	80.8	81.6	81.8	73.0	59.3	57.1
Dissolved Oxygen	mg/L	8.82	8.82	9.18	9.37	6.84	8.27	7.03	8.02	7.28	7.52	6.84	11.42
Specific Conductance	µS/cm	912	899	925	931	928	943	895	921	873	917	939	892
pH		8.3	8.3	8.2	8.5	8.5	8.1	8.4	8.3	7.9	8.2	7.8	7.7
Alkalinity in CaCO3 units	mg/L	120	120	130	110	120	110	120	110	110	120	110	120
Ammonia Nitrogen	mg/L	ND	ND	ND	ND	ND	0.052	0.085	0.059	0.065	ND	0.27	ND
Barium, Total, ICAP/MS	µg/L	110	110	110	110	110	100	110	110	120	120	120	130
Bromide	µg/L	70	74	75	75	71	79	75	82	73	81	87	82
Calcium, Total, ICAP	mg/L	67	69	68	67	72	72	67	68	64	70	72	74
Chloride	mg/L	79	80	78	79	81	84	79	82	78	79	92	85
Copper, Total, ICAP/MS	µg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dissolved Organic Carbon	mg/L	3.3	3.2	3.0	3.1	3.0	3.1	3.1	3.1	3.1	3.1	3.8	2.9
Iron, Dissolved, ICAP	mg/L	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
Iron, Total, ICAP	mg/L	ND	ND	0.022	ND	ND	ND	0.57	0.061	ND	0.26	0.094	0.055
Magnesium, Total, ICAP	mg/L	26	27	26	25	27	27	28	28	26	28	29	28
Manganese, Total, ICAP/MS	µg/L	2.1	4.2	3.0	3.0	3.8	3.9	20	6.2	9.4	10	5.5	3.6
Nitrate as Nitrogen by IC	mg/L	ND	ND	0.25	0.24	ND	ND	ND	ND	ND	ND	ND	ND
Orthophosphate as P	mg/L	ND	ND	ND	ND	ND	ND	0.028	ND	ND	0.012	ND	ND
Potassium, Total, ICAP	mg/L	4.2	4.6	4.5	4.4	4.5	4.8	5.0	4.8	4.8	4.7	4.8	4.8
Silica	mg/L	6.1	5.2	6.5	6.5	6.9	7.4	12	7.7	6.2	8.4	6.8	8.3
Sodium, Total, ICAP	mg/L	81	86	84	81	87	91	91	92	89	92	100	94
Specific Conductance	µS/cm	930	950	950	940	960	960	930	970	920	960	1000	990
Strontium, ICAP	mg/L	0.98	1.0	1.0	0.98	1.0	1.0	1.0	1.0	1.0	1.1	1.2	1.1
Sulfate	mg/L	210	220	210	220	220	230	230	240	220	220	260	240
Total Dissolved Solids (TDS)	mg/L	560	580	590	600	590	600	570	600	590	620	620	630
Total phosphorus as P	mg/L	ND	ND	ND	ND	ND	ND	0.026	ND	ND	ND	ND	ND
Total Suspended Solids (TSS)	mg/L	ND	ND	ND	ND	ND	ND	34	ND	ND	15	ND	ND
Turbidity	NTU	1.2	1.0	1.3	0.64	0.58	3.8	12	1.8	2.4	7.5	1.9	0.67
Quarterly Analytes Detected	These Results are the Priority Pollutants that are Reported by Exception as Detected by the Quarterly Samples												
Arsenic, Total, ICAP/MS	µg/L		2.5			2.4	3.0		4.1			2.7	
Cryptosporidium	oocysts/L		ND			ND			0.1			ND	
Uranium ICAP/MS	µg/L					3.4	3.5						

Data Recovered with Hydrolab in Field

General Chemistry Data Sampled Monthly

Priority Pollutants Sampled Quarterly

NA = Analyte not Sampled

ND = Analyte not Detected

EQ = Equipment Problem

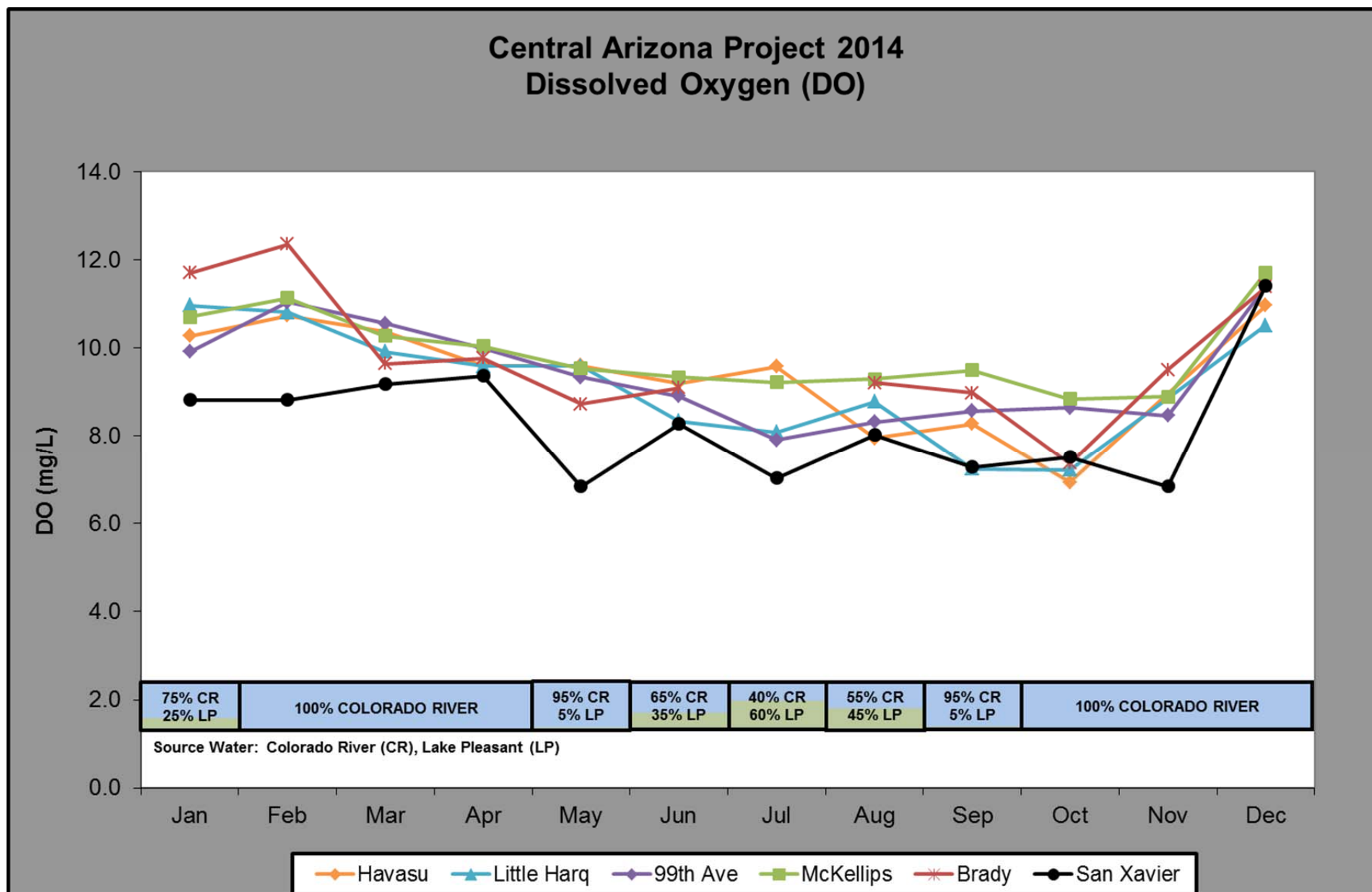


Figure 2 Canal Hydrolab Dissolved Oxygen Results

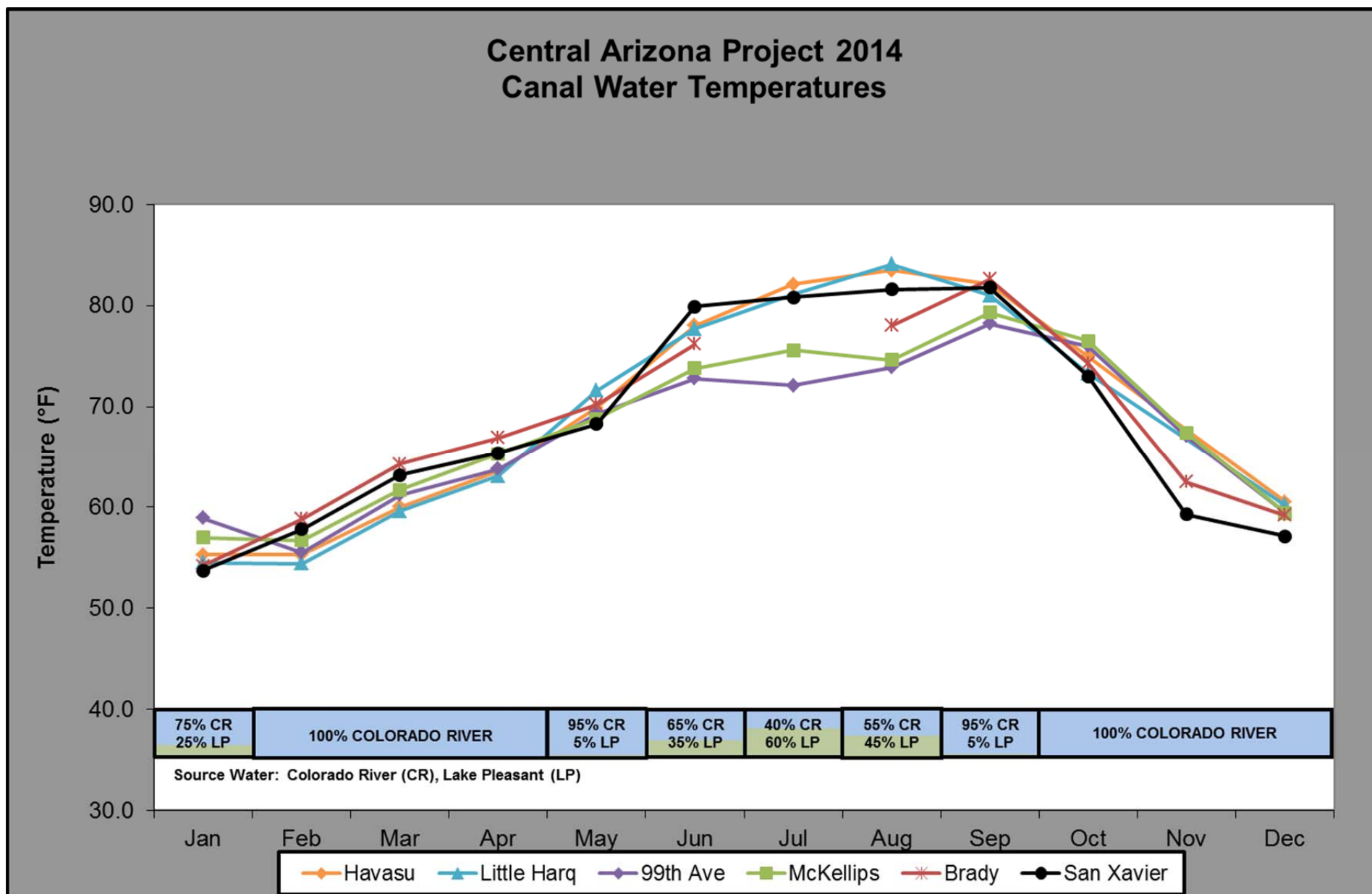


Figure 3 Canal Hydrolab Temperature Results

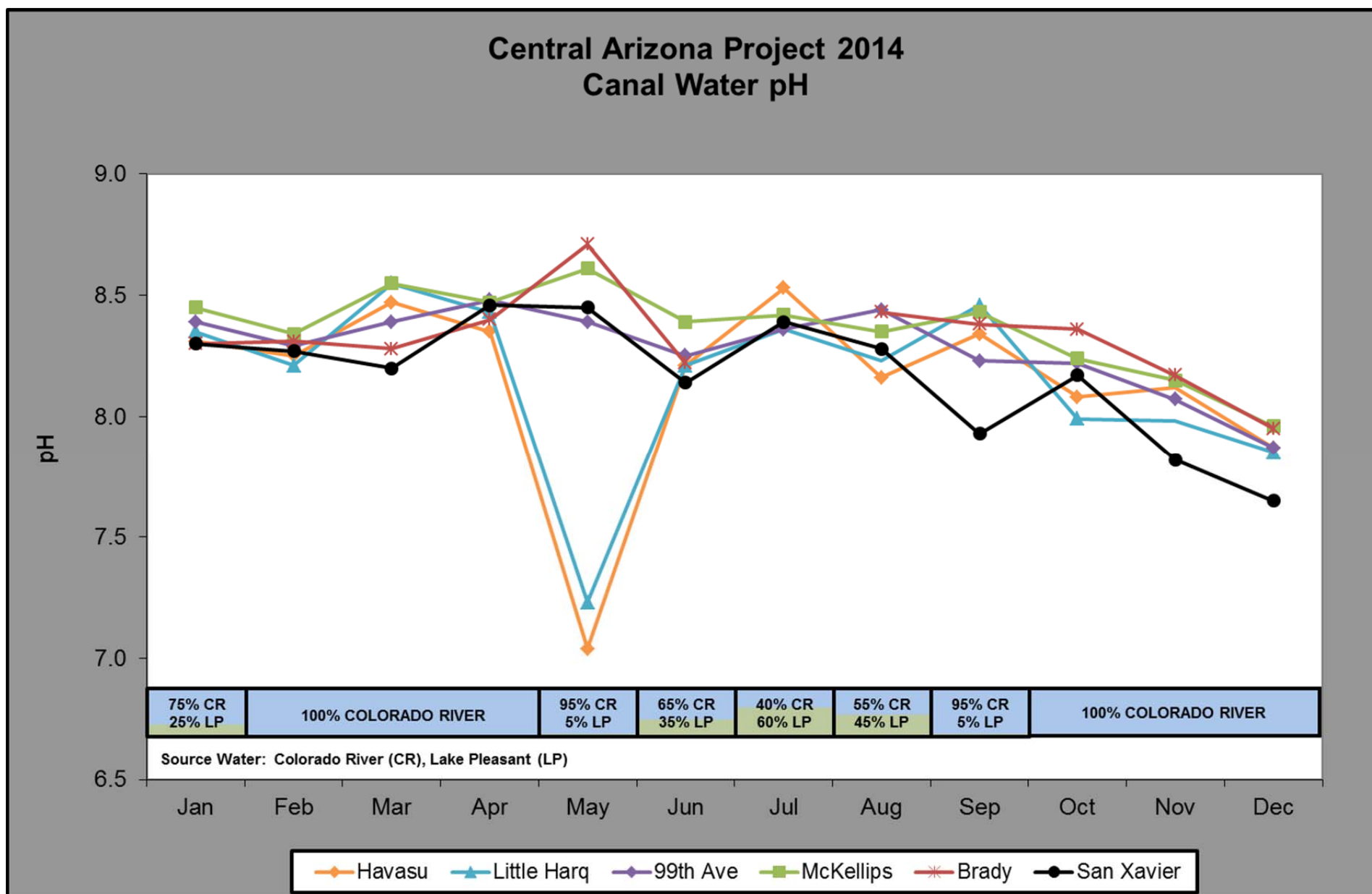


Figure 4 Canal Hydrolab pH Results

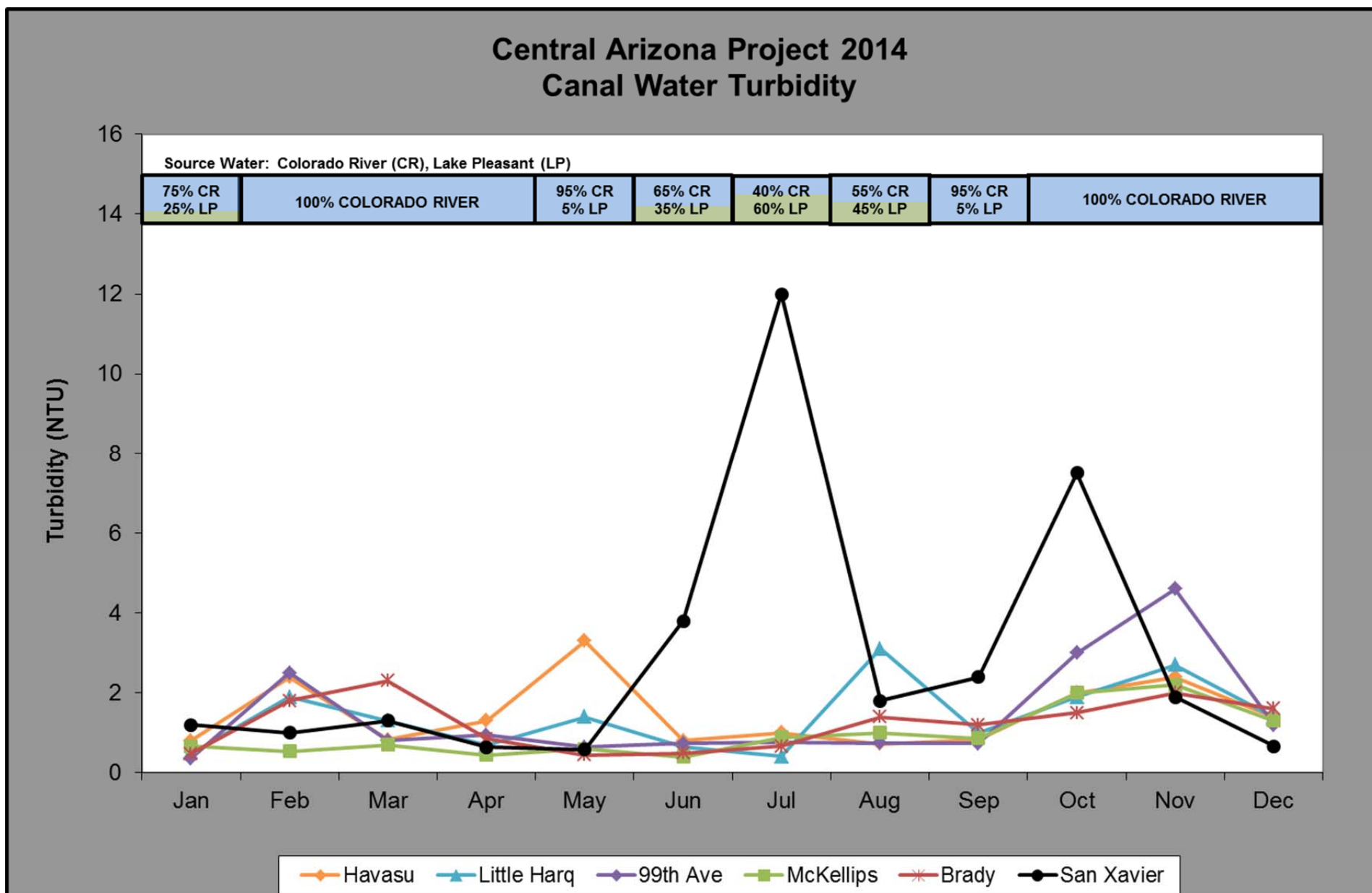


Figure 5 Canal Grab Sample Turbidity Results

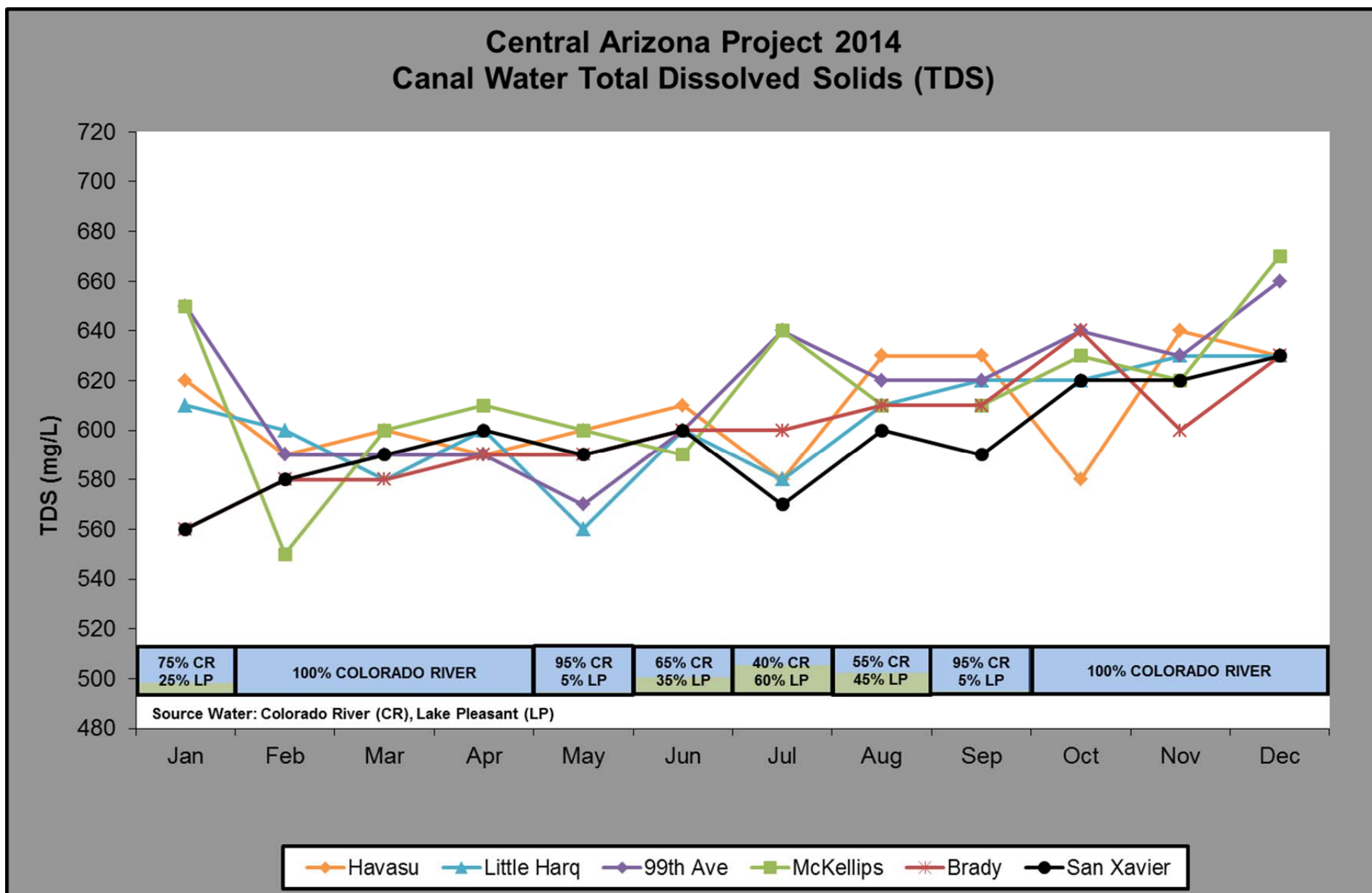


Figure 6 Canal Grab Sample Total Dissolved Solids (TDS) Results



Lake Pleasant Water Quality Data



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Lake Pleasant Reservoir Water Quality Data

The CAP aqueduct system utilizes Lake Pleasant as a seasonal pumped-storage reservoir. During a typical year, Colorado River water is pumped into the lake from October to May when water demands and electricity costs are lower. During the summer, when water demands and electricity costs are higher, water is released from the lake for customer deliveries. CAP's summer 2014 operating strategy was similar to the last three years. In an effort to maximize CAP's energy resources, releases from Lake Pleasant began in May and continued until the beginning of September. However, abnormal releases did occur in January 2014 due to scheduled canal maintenance. In order to meet customer demands during this outage, approximately 26,600 acre-feet of water was released from Lake Pleasant.

The Agua Fria River flows into Lake Pleasant, and inflows vary each year (see Figure 7). During dry years on the watershed the reservoir storage is mostly Colorado River water, and during wet years with substantial runoff, the reservoir has a blend of Colorado River and Agua Fria River water.

Water enters the lake from the Agua Fria River channel on the north end of the lake. Releases to the CAP canal are made from the Waddell Pump/Generating station located below the New Waddell Dam on the south end of the lake. Consequently, inflows from the Agua Fria are not immediately released to CAP customers from Lake Pleasant.

Lake Pleasant Sampling

The sampling dates for this location were: February 10, May 6, August 5, and November 12, 2014. The water quality of the lake represents a blend of Colorado River water and Agua Fria River water. The lake was relatively clear with turbidity levels averaging 0.8 NTU, and Total Dissolved Solids (TDS) levels averaging 633 mg/L. In years with significant runoff from the Agua Fria, the TDS levels are much lower than those in Colorado River water. Table 8 contains the Lake Pleasant grab sample results.

Lake Pleasant Depth Profiles

The largest changes in lake water chemistry are related to seasonal changes and depth. Depth profile measurements were collected at the towers at New Waddell Dam using a portable Hydrolab multi-probe water quality sensor on February 10, March 6, April 3, May 6, June 23, July 10, August 5, September 3, October 9, November 12, and December 1, 2014. The water quality parameters measured included temperature, pH, and dissolved oxygen. Figure 8 - Figure 10 contain the Lake Pleasant depth profile results.

Lake Pleasant depth profiles indicate that thermal stratification occurred in the summer months. The upper layer (epilimnion) was oxygen-rich, with a higher temperature, as well as having a slightly higher pH, conductivity, and TDS. The lower layer (hypolimnion), was lower in dissolved oxygen with lower temperatures and slightly lower pH and conductivity (which is a measure of TDS).

The oxygen deficit conditions at the lower depths may cause sediment nutrient release through the process of reduction. If the sediment/water interface is exposed to prolonged periods of anoxia, reducing conditions allow the formation of nutrients previously unavailable for organisms that cause taste and odor changes in the water. This reduction may lead to sapropel formation, a compound that is high in hydrogen sulfide and methane, and has a shiny, black color due to the presence of ferrous sulfide. This compound is responsible for the occasional "rotten-egg" odor associated with releases from the hypolimnion layer through the lower portal on the intake towers.

Nutrients, such as nitrogen and phosphorous, become unbound from their ionic association with metals, such as iron, and manganese. This process may free up nutrients, which contribute to algae blooms in the canal system. Precipitates of iron and manganese cause discolored water and treatment problems.

Typically, the degree of stratification gradually forms during spring/summer and lasts until the latter part of fall. Usually by November or December, the lake has de-stratified. This phenomenon is caused by the decrease in surface water temperatures, which increase the surface water density and result in displacement or mixing of surface water with deeper water. This mixing restores the lake to a more uniform water chemistry profile.

The intake towers at the New Waddell Dam have sets of intake portals at two different levels, which are 100 feet apart in elevation (Lower and Upper Gate). Adjustable operation of the upper and lower portals offers CAP opportunities to manage the quality of water released from the lake for customer deliveries.

From 1994 through 1997, water releases were made through the upper gates as long as possible. It was believed that this zone had the best water quality. By the end of the summer, the lake elevation was lower than the upper gates so all releases were switched over to the lower gates. At that time, the lower quality water from the bottom zone of the lake was introduced into the canal system, resulting in treatment concerns for the cities.

In 1998, a new operational scheme was used to manage the water quality from the releases at Lake Pleasant. This new scheme consisted of using only the lower portals for releases during the entire summer. The use of the lower gates during the initial releases in June allowed medium-oxygenated bottom water to be released early in the release period, while prolonging the retention of the high-oxygenated epilimnion water. This minimized the volume of anoxic water, which would have been delivered from the lake during the latter part of the summer release period.

In 2005, the lake release strategy was further modified to improve water quality for valley cities. Lake Pleasant releases were terminated in mid-September as opposed to mid-October. Termination of releases reduced the amount of anoxic water that was being delivered to the downstream treatment plants. Table 9 summarizes operations at the dam; included in the table are the approximate minimum and maximum annual elevations, and the approximate blend of Colorado River water and Lake Pleasant water that was delivered to valley cities.

Lake Pleasant Inflow

Prepared 3/11/2015

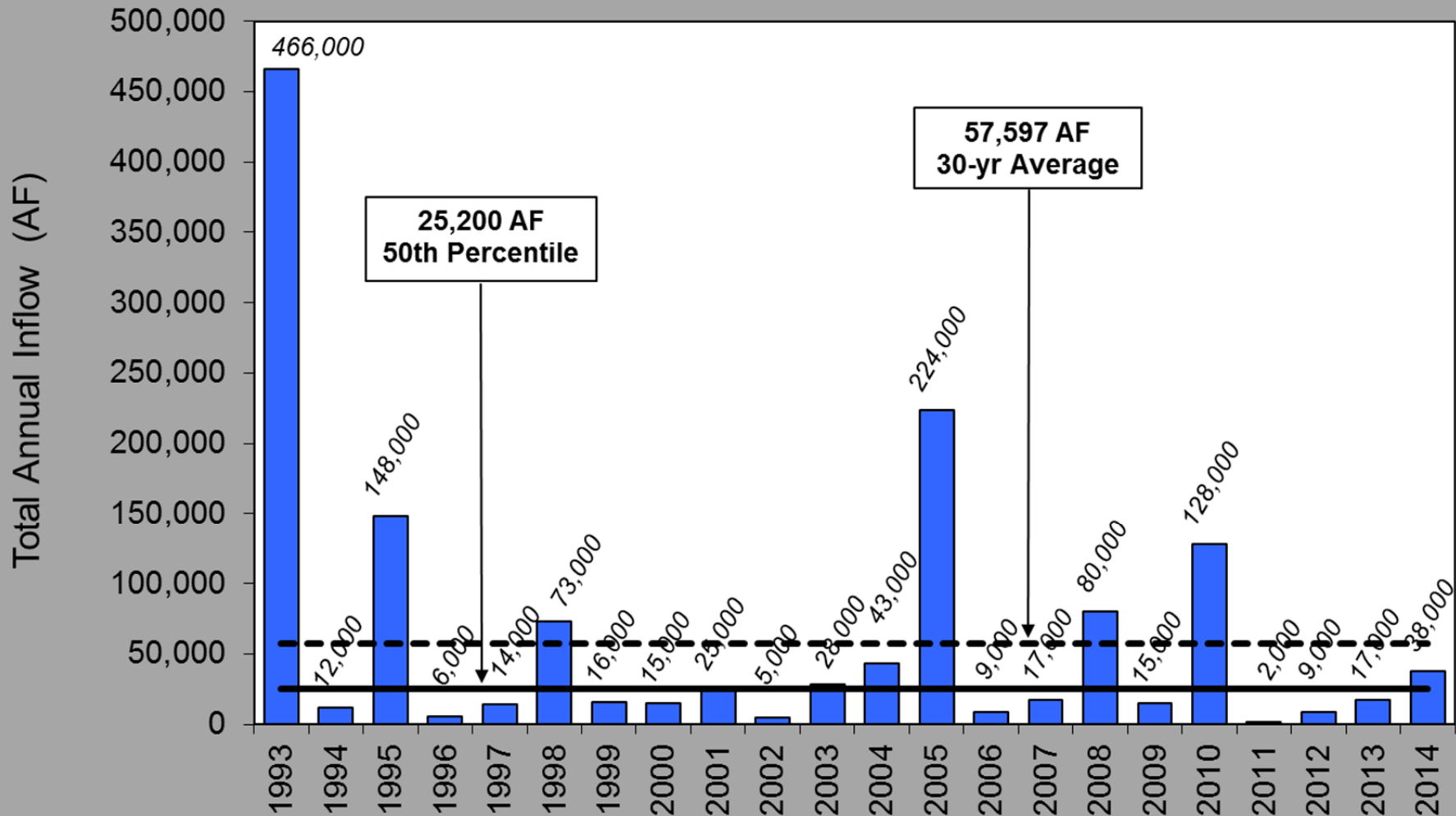


Figure 7 Lake Pleasant Agua Fria Inflows from 1993 – 2014

Table 8 Lake Pleasant Grab Sample Results

Lake Pleasant 2014 Water Quality Sampling Results					
General Chemistry Analytes	Units	10-Feb-14	6-May-14	5-Aug-14	12-Nov-14
Temperature	°F	SEE LAKE PROFILE PLOTS			
pH					
Dissolved Oxygen	mg/L				
Field Conductivity	µS/cm				
Alkalinity in CaCO3 units	mg/L	120	120	120	120
Ammonia Nitrogen	mg/L	ND	ND	ND	ND
Barium, Total, ICAP/MS	µg/L	110	110	110	120
Bromide	µg/L	83	90	99	85
Calcium, Total, ICAP	mg/L	75	70	69	72
Chloride	mg/L	84	87	88	76
Copper, Total, ICAP/MS	µg/L	ND	ND	ND	ND
Iron, Dissolved, ICAP	mg/L	ND	ND	ND	ND
Iron, Total, ICAP	mg/L	ND	ND	ND	0.050
Magnesium, Total, ICAP	mg/L	29	29	30	31
Manganese, Total, ICAP/MS	µg/L	4.2	ND	ND	11
Nitrate as Nitrogen by IC	mg/L	ND	ND	ND	ND
Orthophosphate as P	mg/L	ND	ND	ND	0.014
Potassium, Total, ICAP	mg/L	4.8	5.0	5.4	5.1
Silica	mg/L	8.3	7.5	8.3	8.2
Sodium, Total, ICAP	mg/L	92	94	100	96
Specific Conductance	µS/cm	980	1000	1000	970
Strontium, ICAP	mg/L	1.1	1.1	1.1	1.2
Sulfate	mg/L	230	230	260	220
Total Dissolved Solids (TDS)	mg/L	610	620	650	650
Total phosphorus as P	mg/L	ND	ND	ND	ND
Total Suspended Solids (TSS)	mg/L	13	ND	ND	ND
Turbidity	NTU	1.5	0.29	0.50	0.90
Quarterly Analytes Detected	These Results are the Priority Pollutants that are Reported by Exception as Detected by the Quarterly Samples				
Arsenic, Total, ICAP/MS	µg/L	2.8	3.6	4.9	4.3
Benzene	µg/L	ND	ND	1.2	ND
Mercury	µg/L	0.59	0.49	0.75	0.20
Orthophosphate as PO4	µg/L	ND	ND	ND	0.043
Tot DCPA Mono&Diacid					
Degradate	µg/L	ND	ND	0.11	0.10
Data Recovered with Hydrolab in Field		General Chemistry Data Sampled Monthly		Priority Pollutants Sampled Quarterly	
NA = Analyte not Sampled		ND = Analyte not Detected		EQ = Equipment Problem	

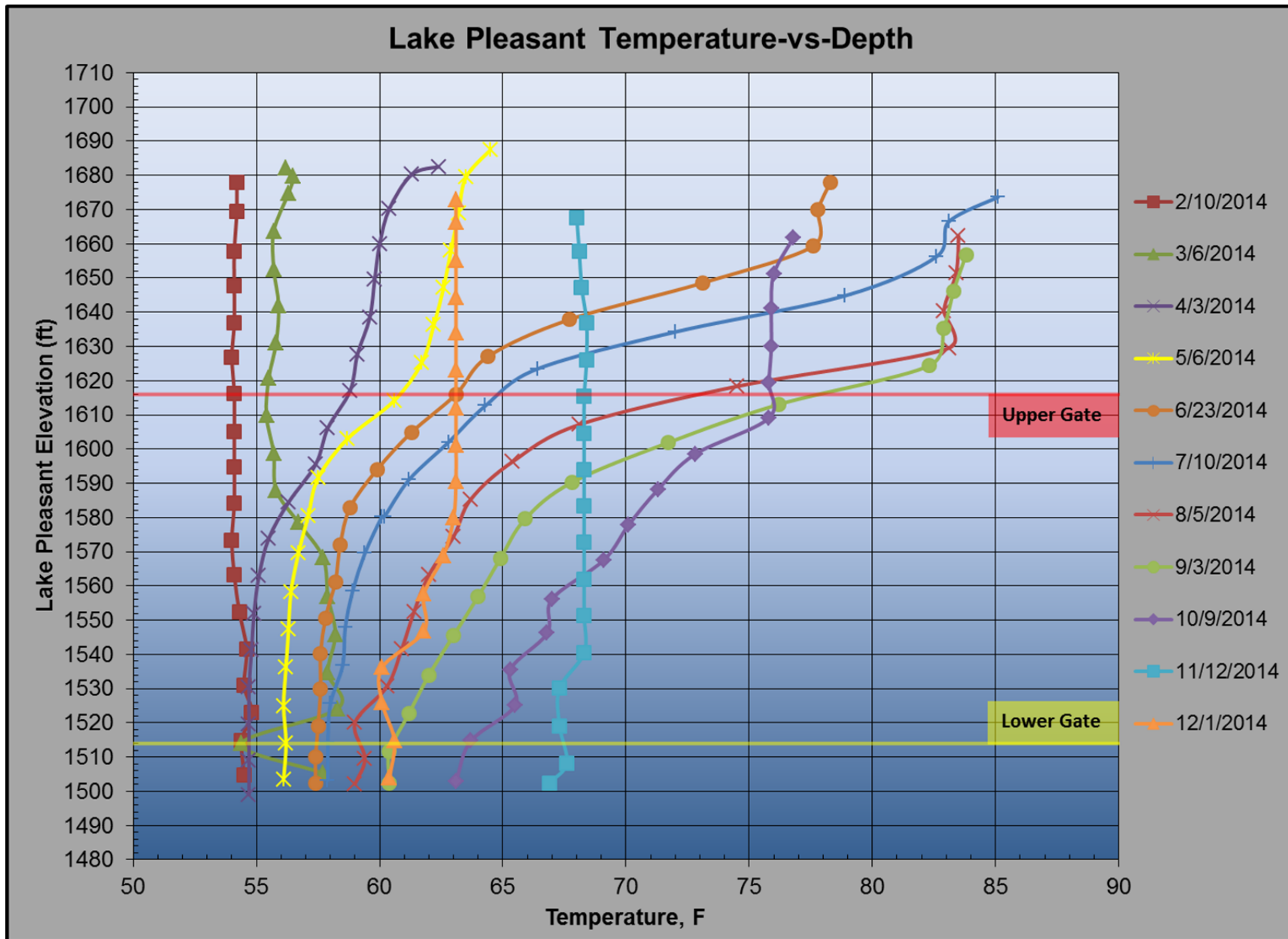


Figure 8 Lake Pleasant Depth Profile, Temperature

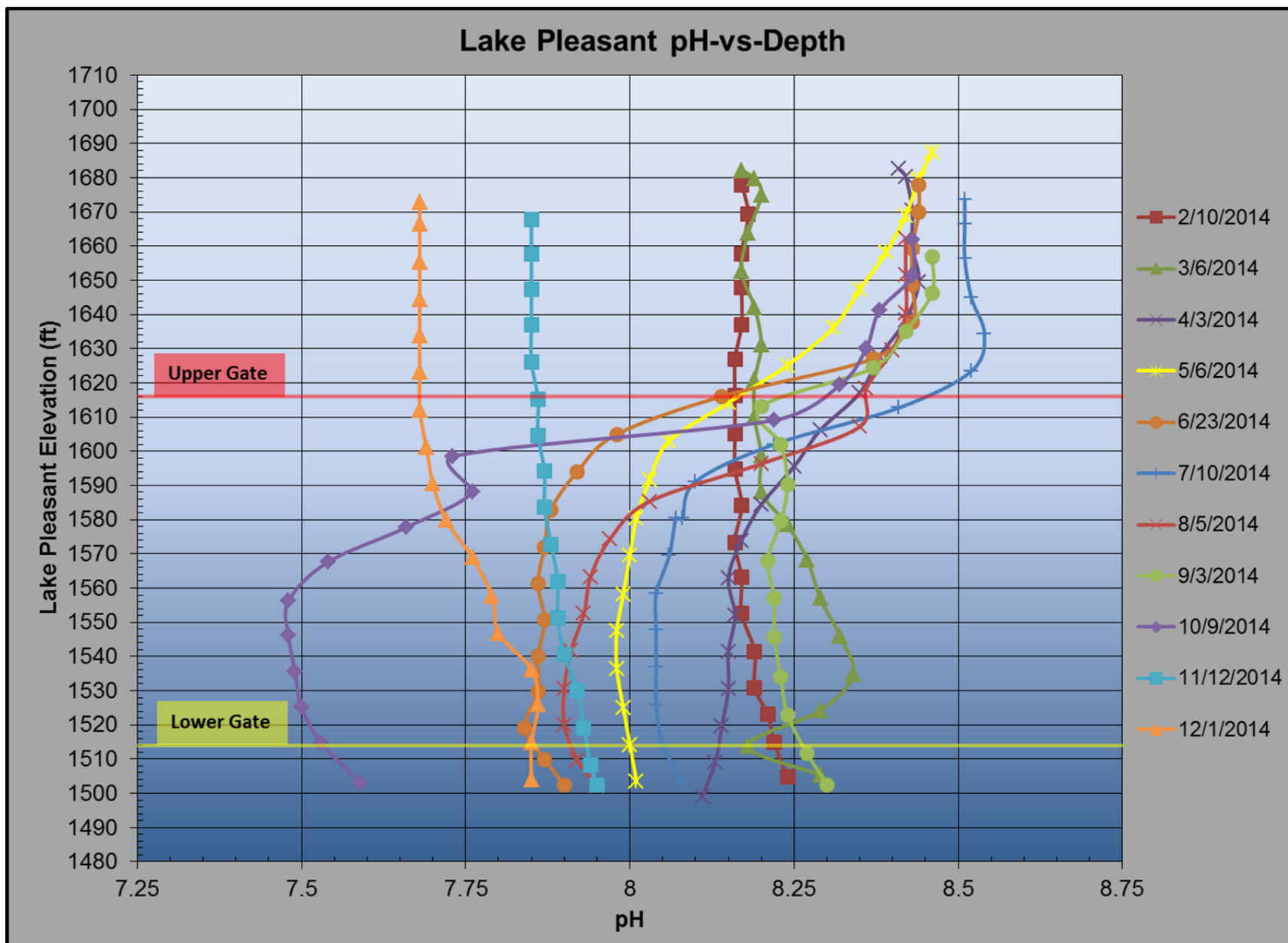


Figure 9 Lake Pleasant Depth Profile, pH

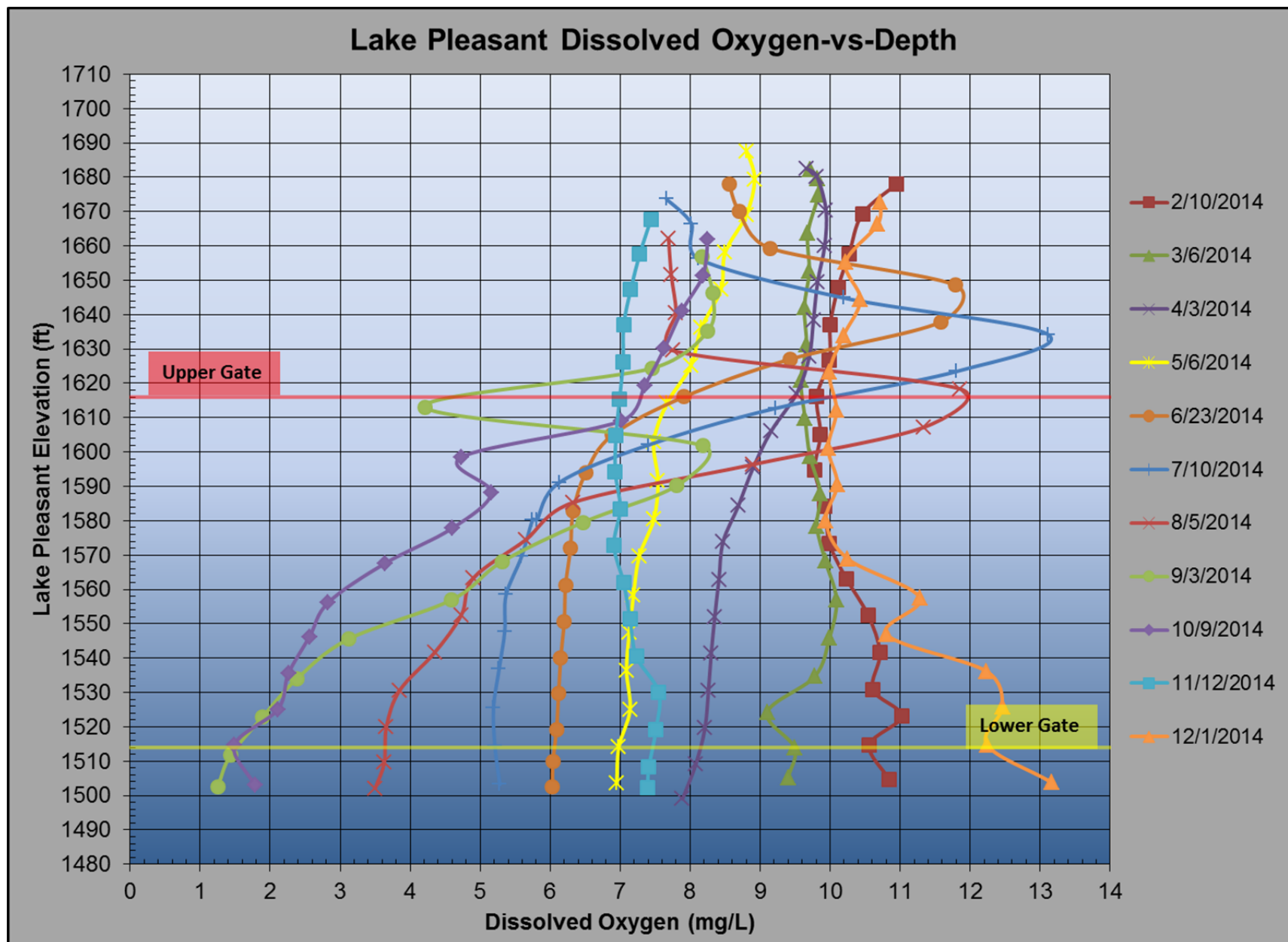


Figure 10 Lake Pleasant Depth Profile, DO

Table 9 Lake Pleasant Operations Summary

2014 Lake Pleasant Operations	
•	38,212 AF of gaged inflow (50% percentile inflow = 25,200 AF)
•	May 4, 2014 Elevation = 1687.88 (ft)
•	August 18, 2014 Elevation = 1658.94 (ft)
•	Change in Elevation = 28.94 (ft)

2014 Lake Pleasant Release Summary			
Month	Waddell Released (AF)	Pass-Thru (AF)	% Ratio
January*	26551	82012	25/75
May	9966	166358	5/95
June	64683	117709	35/65
July	93862	71124	60/40
August	67548	83922	45/55
September	5520	121463	5/95

*January releases were to accommodate a siphon outage.



General Discussion and Summary



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General Discussion

Water Quality Sampling Results

Turbidity – The suspended solids were relatively low with canal turbidity levels averaging 1.6 NTU. Average turbidity in Lake Pleasant was 0.8 NTU. The water in the canal and Lake Pleasant is very clear, and the lake bottom can be seen at depths of 25-30 feet. In general, when canal flows are lower or remain steady, the turbidity is low. When flow increases occur, the higher velocities cause an increase in turbidity levels. These increases in turbidity are usually very short in duration. Algae blooms in the canal also have an impact on turbidity. Blooms are generally localized and do not contribute significantly to the overall turbidity levels of CAP water.

TDS – Total dissolved solids represent the concentration of dissolved minerals in the water. The TDS levels in CAP water are high when compared to most groundwater sources. For the year, the average TDS was 610 mg/L in both the canal and Lake Pleasant.

pH – The average canal pH ranged from 7.0 to 8.7.

Temperature – Average canal water temperature for the year was 68.4°F with minimal differences between the Havasu, Phoenix, and Tucson areas of the canal system. However, monthly and seasonal temperatures varied considerably along the canal system. Maximum temperatures reached 84.1°F and minimum temperatures were 53.7°F.

Note: From May to September Lake Pleasant water is released for customer deliveries downstream of the Waddell Turnout. Lake Pleasant water is generally cooler than normal canal water, therefore lower canal water temperatures are observed at downstream sampling locations.

DO – The average dissolved oxygen levels were fairly uniform throughout the canal system. The sampling locations had an average DO of approximately 9.3 mg/L for 2014. DO measurements ranged from 6.8 mg/L to 12.4 mg/L. Fluctuations in DO followed the canal water temperature trends with an inverse relationship. Lower levels of DO exist in Lake Pleasant at lower elevations in the late summer. Water released from the lake quickly aerates and mixes, establishing saturated conditions by the time it reaches the main canal.

Metals – Dissolved heavy metals were detected in both the canal and in Lake Pleasant. Arsenic was consistently detected in the canal with an average concentration of 3.1 µg/L and at Lake Pleasant, where the average concentration was 3.9 µg/L.

Chromium and lead were detected at the Lake Havasu sampling point once during the year (see Table 2). Heavy metals detected in Lake Pleasant included arsenic and mercury; the measured ranges were 2.8 – 4.9 µg/L, and 0.20 – 0.75 µg/L, respectively.

Uranium – In 2013, the City of Phoenix and ASU reported measuring elevated levels of uranium in CAP water. After further sampling and analysis, CAP and ASU concluded that the uranium detected was well below the EPA's Maximum Contaminant Level. However, because of these events, CAP has added uranium to its list of priority pollutants. The current sampling program consists of quarterly uranium testing on samples collected at some locations. The average concentration of uranium detected in the canal was 3.8 µg/L. More information regarding uranium in Arizona waterways can be found in the 2013 August and November issues of the Regional Water Quality Newsletter, published by ASU:

<http://faculty.engineering.asu.edu/pwesterhoff/research/regional-water-quality-issues/regional-water-quality-newsletter/>

VOC's – Benzene was detected once at both Lake Havasu and Lake Pleasant with concentrations of 3.1 µg/L and 1.2 µg/L, respectively.

Herbicides – Herbicides were detected in Lake Pleasant and at the 99th Avenue Bridge.

Pathogens – A significant amount of public drinking water in the urban areas of central and southern Arizona is treated CAP water. One of the biggest concerns is the presence of pathogens in treated water, including Giardia and Cryptosporidium. In 2014, all tests for Giardia had non-detect results. Cryptosporidium was detected once in August 2014 at San Xavier Pumping Plant at the minimum detectable level. This may have been due to monsoonal activity. It was not detected during subsequent sampling in November 2014.

Table 10 Water Quality Measurements and Regulatory Levels

SUMMARY OF WATER QUALITY ANALYTES AND REGULATORY LEVELS (Regulatory Levels are Drinking Water Standards)					
Analyte	Units	Range of Measured Values	Average Value	US EPA Maximum Contaminant Level (MCL) (Health-based)	US EPA Secondary Maximum Contaminant Level (Aesthetics-based)
Temperature	°F	53.7 – 84.1	68.4	-	-
pH		7.0 – 8.7	8.2	-	6.5 – 8.5
Dissolved Oxygen	mg/L	6.8 – 12.4	9.3	-	-
Field conductivity	µS/cm	873 - 1201	923	-	-
Alkalinity in CaCO ₃ units	mg/L	100 -130	121	-	-
Ammonia Nitrogen	mg/L	ND - 0.27	Note 1	-	-
Barium, Total, ICAP/MS	µg/L	43 - 150	114	2000	-
Bromide	µg/L	68 - 99	77	-	-
Calcium, Total, ICAP	mg/L	64 - 85	72	-	-
Chloride	mg/L	75 - 92	80	-	250
Copper, Total, ICAP/MS	µg/L	ND – 440	Note 1	1300	1000
Dissolved Organic	mg/L	2.7 – 3.8	3.0	-	-
Iron, Dissolved ICAP	mg/L	ND – 0.024	Note 1		
Iron, Total, ICAP	mg/L	ND – 2.8	Note 1	-	0.3
Magnesium, Total, ICAP	mg/L	25 – 31	27	-	-
Manganese, Total, ICAP	µg/L	ND – 87	Note 1	-	50
Nitrate as Nitrogen by IC	mg/L	ND – 0.33	Note 1	10	-
Orthophosphate-P	mg/L	ND – 0.028	Note 1	-	-
Potassium, Total, ICAP	mg/L	4.2 – 5.5	4.7	-	-
Silica	mg/L	5.2 – 23	8.2	-	-
Sodium, Total, ICAP	mg/L	79 – 100	89	-	-
Specific Conductance	µS/cm	920 – 1000	961	-	-
Strontium, ICAP	mg/L	0.97 – 1.2	1.1	-	-
Sulfate	mg/L	210 – 260	224	-	250
Total Dissolved Solids	mg/L	550 – 670	610	-	500
Total phosphorus-P	mg/L	ND – 0.026	Note 1	-	-
Total Suspended Solids	mg/L	ND – 34	Note 1	-	-
Turbidity	NTU	0.30 – 12	1.5	-	-
Metals / Priority Pollutants					
Arsenic	µg/L	2.2 – 4.9	3.3	10	-
Chromium	µg/L	ND – 2.2	Note 1	100	-
Lead	µg/L	ND – 2.9	Note 1	-	-
Mercury	µg/L	0.50 – 1.4	1.1	2	-
Uranium	µg/L	3.4 – 4.9	3.8	30	-
VOC's					
Benzene	µg/L	ND – 3.1	Note 1	5	-

Note 1: Average value was not calculated due to test species not being detected consistently throughout the year.
See attached summary tables of priority pollutant results for locations and measured amounts.

Water Quality Impact from Bill Williams River

As previously mentioned, the CAP aqueduct system begins at Lake Havasu. Figure 11 identifies the intake for the Mark Wilmer Pumping Plant, which is located in a bay-like feature just south of the mouth of the Bill Williams River where it empties into Lake Havasu.

The Bill Williams River, together with its headwaters at Alamo Lake, handles runoff for the majority of the drainage area of west central Arizona. Elevated discharges in the Bill Williams River mobilize more sediment and can generate a turbidity plume in Lake Havasu. During periods of heavy rainfall and runoff, the water quality tends to be low in TDS but very turbid with high concentrations of organic matter and suspended sediments. Over the past years, experimental releases from Alamo Dam have been intended to support ecological studies, improve environmentally sensitive management of the river corridor, and support the development of a predictive relationship between the operation of Alamo Dam and downstream flows and their impact on Lake Havasu and the Colorado River.

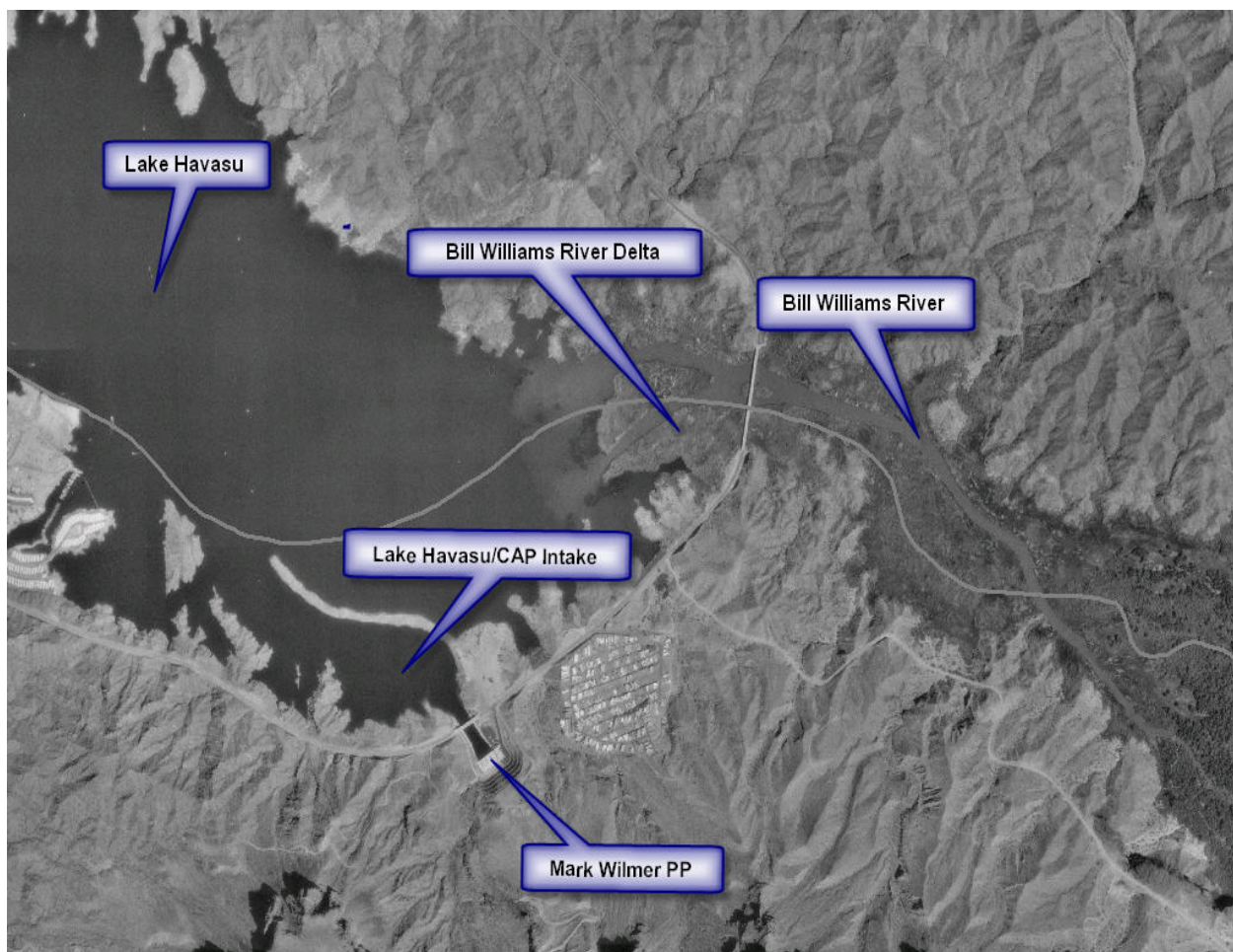


Figure 11 Aerial Photo of CAP Intake and Bill Williams River

In March of 2010 a 3,000 cfs pulse release from Alamo Dam lasted approximately 36 hours. Releases were reduced to 2000 cfs for a sustained period. These releases from Alamo Dam had a negative impact on CAP and its customers. The release caused turbidity levels at the CAP intake to spike to about 50 NTU. Two of CAP's recharge facilities were shut down to avoid adversely impacting infiltration rates. In addition, agricultural customers had problems with drip irrigation systems plugging up. Increased turbidity in CAP water also causes issues for the municipal water treatment plants. Under these conditions, if possible, CAP curtails pumping from Lake Havasu until the water quality improves.

There were no experimental releases from Alamo Dam or any significant discharges from the Bill Williams River during 2014.

Taste and Odor Research Program

Municipal water treatment plants, which treat water supplies from the CAP and SRP systems, have experienced seasonal taste and odor episodes. The water has been described as having a “musty-moldy-earthly” taste or odor, which is suspected of being associated with biological activity in reservoirs and canal systems. Water treatment plants can treat this water with activated carbon to reduce or eliminate the offensive tastes and odors, however treatments have significant cost.

Compounds produced by Cyanobacteria (blue-green algae) are the suspected causes of the taste and odor problems. Two compounds of concern are Geosmin and 2-methylisoborneol (MIB) which can produce odors at levels as low as 1 part per trillion (ppt). The taste and odor constituents are an aesthetic problem and do not present a health concern at these extremely low levels. MIB detected in samples from several treatment plants appear to be due to planktonic Oscillatoria and both planktonic and periphytic Lyngbya. Geosmin detected in samples appear to come from periphytic Anabaena and Lyngbya.

An ongoing cooperative research and implementation program led by ASU has been monitoring the levels of MIB, Geosmin, Cyclocitral, Dissolved Organic Carbon (DOC), UV254, and Total Dissolved Nitrogen (TDN) in the CAP and SRP canal systems. The title of the project is *"Reducing Taste and Odor and Other Algae-Related Problems for Surface Water Supplies in Arid Environments."*

This project publishes a monthly newsletter, which contains sampling results and recommendations for treatment of MIB and Geosmin. A summary of the project, newsletters distributed from January 2006 – April 2014, and a final report are available at:

<http://faculty.engineering.asu.edu/pwesterhoff/research/regional-water-quality-issues/regional-water-quality-newsletter/>

Data gathered by the ASU project show CAP water typically to be a very low source of MIB and Geosmin to valley cities. CAP water has the potential of being used as a taste

and odor management tool. In the project final report, the following recommendation was made regarding CAP water:

“CAP water generally has lower concentrations of MIB than SRP water. This provides an opportunity for blending the two source waters to reduce MIB concentrations in water delivered to the treatment plants. For most years, using more SRP water early in the season, and more CAP water later in the season, would improve the quality of water delivered to Phoenix’s municipal customers.”

MIB, Geosmin, and Cyclocitral data gathered by the ASU project from Lake Pleasant and the CAP canal is presented in Table 11.

Perchlorate

Perchlorate sampling was included in the group of priority pollutants sampled by CAP in 2014. It was not detected in any of the samples from the canal, Lake Pleasant, or Lake Havasu. In addition to CAWCD's sampling efforts, the Nevada Division of Environmental Protection (NDEP) has collected perchlorate data at Willow Beach, Arizona located directly upstream of the Mark Wilmer Pumping Plant. Data collected at Willow Beach provides a reasonable indicator of perchlorate concentrations observed in Colorado River water.

According to the report by the Lake Mead Water Quality Forum on October 28, 2014, the perchlorate concentrations measured at Willow Beach continue to remain at or less than 2.1 ppb since December 2008. The perchlorate concentration for September 2014 was 0.8 ppb at Willow Beach and 1.0 ppb at the Whitsett sampling point. This is the most recent data that is available.

Concentrations have steadily declined from a high value of 9.7 ppb in June 1999 to the most recent values as a result of ongoing remediation efforts at the Tronox LLC facility (formerly Kerr-McGee). At this location a perchlorate treatment system consisting of a fluidized bed reactor is operating. Approximately 4,303 tons of perchlorate have been removed from the environment through September 30, 2014 by this system.

The October 28, 2014 perchlorate summary notes are available at:
http://ndep.nv.gov/forum/docs/PerchlorateSummary_10_28_14.pdf

Also, the EPA has additional information about perchlorate available on the web at:
<http://water.epa.gov/drink/contaminants/unregulated/perchlorate.cfm>

Colorado River Basin Salinity Control Program

The Colorado River is used by approximately 40 million people for domestic and industrial uses in the United States and is used to irrigate approximately 5.5 million acres of land. Modeling by Reclamation shows that the quantifiable damages from high salinity water are approximately \$300 million dollars per year to U.S. users, with projections that damages could increase to more than \$500 million by 2030 if the Program were not to continue to be aggressively implemented.

In 1975, the seven Colorado River Basin states adopted, and subsequently EPA approved, a salinity standard for the Colorado River. That standard is composed of numeric criteria for total dissolved solids and a plan of implementation to meet the criteria. The numeric criteria were selected as the 1972 salinity levels at the three Lower Basin monitoring locations: below Hoover Dam (723 mg/L), below Parker Dam (747 mg/L) and at Imperial Dam (879 mg/L). Since the program's implementation, salinity in the river has been reduced by approximately 100 mg/L. For CAP customers this translates to 220,000 tons of salt that did not enter the CAP service area in 2014.

CAP participates with Arizona and the other Basin States and Federal Agencies in the implementation of the Program. CAP also worked with the Colorado River Basin Salinity Control Forum and the Forum's technical workgroup to address funding and other issues associated with program implementation.

Table 11 CAP Canal Sampling Results for MIB, Geosmin and Cyclocitral (ASU)

CAP Canal Sampling Results for MIB, Geosmin and Cyclocitral Data Collected by ASU as Part of Project: <i>"Reducing Taste and Odor and Other Algae-Related Problems for Surface Water Supplies in Arid Environments"</i> (All units in ng/L)																		
Newsletter Month	Lake Pleasant (epilimnion)			Lake Pleasant (hypolimnion)			Waddell Canal			CAP/SRP Inter-Connect			Union Hills Inlet*			Union Hills Outlet*		
	MIB	GSMN	Cyclocitral	MIB	GSMN	Cyclocitral	MIB	GSMN	Cyclocitral	MIB	GSMN	Cyclocitral	MIB	GSMN	Cyclocitral	MIB	GSMN	Cyclocitral
Jan 2014	3.2	<2.0	<2.0	4.1	<2.0	<2.0	<2.0	2.9	<2.0				<2.0	2.1	<2.0	<2.0	2.1	<2.0
Feb 2014	4.2	<2.0	<2.0	4.8	<2.0	<2.0	2.2	3.1	<2.0	<2.0	2.7	<2.0	<2.0	2.6	<2.0	<2.0	2.7	<2.0
Mar 2014	4.2	<2.0	<2.0	4.1	2.1	<2.0	<2.0	2.4	<2.0	<2.0	2.4	<2.0						
Apr 2014																		
May 2014	3.1	<2.0	<2.0	4.7	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Jun 2014	5.6	<2.0	<2.0	4.6	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Jul 2014	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Aug 2014	2.3	<2.0	<2.0	3.6	<2.0	<2.0	<2.0	<2.0	<2.0	3.5	<2.0	<2.0	3.6	<2.0	<2.0	2.8	<2.0	<2.0
Sep 2014	10.2	<2.0	<2.0	3.2	<2.0	<2.0	4.2	<2.0	<2.0	5.1	<2.0	<2.0	4.8	<2.0	<2.0	3.9	<2.0	<2.0
Oct 2014	<2.0	<2.0	<2.0	42.2	<2.0	<2.0	4.4	2.6	<2.0	4.6	<2.0	<2.0	4.9	<2.0	<2.0	4.2	<2.0	<2.0
Nov 2014	<2.0	<2.0	<2.0	38.0	<2.0	<2.0	3.8	2.1	2.8	3.9	2.2	<2.0	2.0	<2.0	2.3	3.7	<2.0	<2.0
Dec 2014	3.9	<2.0	<2.0	4.5	<2.0	<2.0	2.4	<2.0	<2.0	<2.0	2.8	<2.0	2.5	2.0	<2.0	2.8	<2.0	<2.0
* City of Phoenix, Union Hills Water Treatment Plant																		

Groundwater Recharge Projects – Water Quality

CAWCD has developed and currently operates six recharge projects:

1. Pima Mine Road Recharge Project
2. Lower Santa Cruz Recharge Project
3. Agua Fria Recharge Project
4. Hieroglyphic Mountain Recharge Project
5. Tonopah Desert Recharge Project
6. Superstition Mountains Recharge Project

The Tucson Active Management Area (AMA) recharge facilities have a cumulative operational capacity of 72,000 acre-feet per year and include the Pima Mine Road and Lower Santa Cruz Recharge Projects. In the Phoenix AMA, there are four facilities: the Tonopah Desert, Hieroglyphic Mountains, Agua Fria, and Superstition Mountains Recharge Projects, with a combined annual operational capacity of 235,000 acre-feet.

A portion of the permitting process and regulatory compliance for these projects requires periodic water quality monitoring. The sampling results are compiled into an annual report, which is a matter of public record and is submitted to the Arizona Department of Water Resources. Copies of the reports or portions of the reports are available by contacting:

Tim Gorey
CAP Water Control Department
(623) 869-2109
tgorey@cap-az.com

Summary

This report has presented and discussed a variety of parameters in the CAP water quality monitoring program. CAP is sensitive to customer needs, and as changes in water quality issues occur, the water quality monitoring and sampling program will be revised accordingly. The data will then be published in future annual water quality reports.

For further information, or questions, please contact:

Marcus Shapiro	(623) 869-2528	mshapiro@cap-az.com
Patrick Dent	(623) 869-2581	pdent@cap-az.com