Regional Water Quality NEWSLETTER

DATE: Report for August 2013
A Tempe, Glendale, Peoria, Chandler, Phoenix, ADEQ, CAP, SRP, Epcor
ASU Regional Water Quality Partnership

http://enpub.fulton.asu.edu/pwest/tasteandodor.htm

SUMMARY: EVALUATION AND RECOMMENDATIONS

1. **RSVP to p.westerhoff@asu.edu requested by August 30th** for our 2013 Annual Water Quality Workshop – Friday September 20th from 830-1130am at the PERA Club. Topics tentative include the following (email me what else you would want to hear about):
    - Overview of water quality in 2012-2013 in the water supply system
    - Unique T&O challenges this year on the Consolidated Canal
    - Forest fires in Arizona: Past and future impacts on water quality
    - Hexavalent chromium occurrence in surface waters, treatment and transformations in distribution systems
    - Water treatment plant polymers and GAC
    - Predictions of GAC utilization rates based upon reservoir DOC levels
    - Liposomes: what are they and how do they affect headloss?

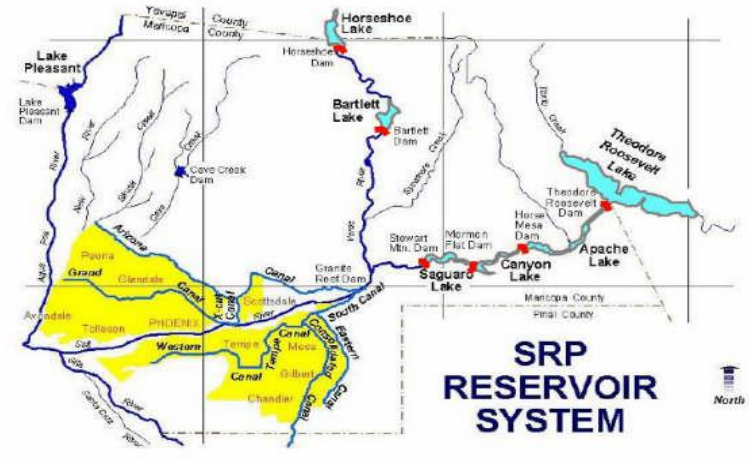
2. Taste and odor levels are VERY high in the upper part of Saguaro Lake (~40 ngMIB /L), but low in deeper parts of the reservoir where water is withdrawn for drinking water supplies. Influent raw drinking water contains ~ 5ng/L MIB now and most water treatment plants are doing a good job removing this odorant.
3. **Evidence of quagga mussels found in Arizona Canal** – read a news report about what SRP is finding
4. On a quarterly basis we are collecting and analyzing by ICP-MS a suite of metals at key locations. In early 2013 the City of Phoenix had observed Uranium in CAP waters, confirmed by our data – and here too we continue to see the highest levels of 238U in Lake Pleasant, Waddell Canal and in Lake Havasu – so clearly this is a Colorado River water source. We have been trying to use this data to explore how to track water sources, and influences of large disturbances (e.g., forest fires).

Quick Update of Water Supplies for August 2013
(during day of sampling – August 5th)

Source	Trend in supply	Discharge to water supply system	Flow into SRP Canal System	Dissolved organic carbon Concentration (mg/L) **
Salt River	Reservoirs at 55% full	967 cfs	672 cfs into **Arizona Canal**	4.0 mg/L
Verde River	Reservoirs At 62% full	110 cfs	432 cfs into **South Canal** **(90% Verde River Water)**	4.1 mg/L
Colorado River	Lake Pleasant is 50% full (Lake Powell is 46% full)	Lake Pleasant is releasing water into the CAP canal	48 cfs of **CAP water** into Arizona Canal	2.8 mg/L
Groundwater	Generally increasing due to recharge	361 cfs pumping by SRP	361 cfs **Groundwater Pumping** into SRP Canals	0.5 to 1 mg/L

*Concentration of these taste and odor compounds in the upper [lower] levels of the terminal reservoir (Saguaro Lake on the Salt River; Bartlett Lake on the Verde River; Lake Pleasant on the CAP system
**Concentration of DOC in the terminal reservoir
*** On paper cities are receiving CAP water in the SRP canals, but as a method of "paying back" from the last drought for excess CAP deliveries – SRP is delivering wet water only from the Salt and Verde Rivers
Data from the following websites:

- http://www.srpwater.com/dwr/
- http://www.cap-az.com/index.php/departments/water-operations/lake-pleasant
- http://lakepowell.water-data.com/



Dissolved Organic Carbon In Reservoirs and Treatment Plants

DOC = Dissolved organic carbon
UV254 = ultraviolet absorbance at 254 nm (an indicator of aromatic carbon content)
SUVA = UV254/DOC
TDN = Total dissolved nitrogen (mgN/L)

Reservoir Samples

Table 4 - Reservoir Samples – August 3 & 4, 2013

Reservoir sampling conducted monthly. CAP is sampling Lake Pleasant and Havasu, and USGS is sampling Verde River at Tangle and Salt River above Roosevelt on slightly different days than the other reservoirs.

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Havasu (Jul)		--	--	--	--
Lake Pleasant (Jul)	Epilimnion	2.9	0.049	1.7	0.4
	Hypolimnion	3.7	0.046	1.3	0.3
Verde River (Jul)	@ Tangle	1.2	0.031	2.6	0.3
Verde River	@ Beeline Hwy	3.1	0.09	2.9	0.4
Bartlett Reservoir	Epilimnion	4.7	0.102	2.2	0.3
	Hypolimnion	5.0	0.148	2.9	0.4
Saguaro Lake	Epilimnion	4.6	0.074	1.6	0.3
	Epi - Duplicate	5.0	0.076	1.5	0.4
	Hypolimnion	4.0	0.070	1.8	0.3
Salt River	@ Blue Point Bridge	4.2	0.067	1.6	0.4

Organic Matter in Canal

Table 3 - Rivers and Canals – August 2, 2013

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Waddell Canal	3.7	0.047	1.3	0.5
Anthem WTP Inlet	2.9	0.044	1.5	0.5
Union Hills Inlet	2.9	0.046	1.6	0.4
CAP Salt-Gila Pump Station (Jul)	5.0	0.051	1.0	0.5
CAP Mesa Turnout (Jul)	2.5	0.048	1.9	0.6
CAP Canal at Cross-connect	3.1	0.049	1.6	0.4
Salt River @ Blue Pt Bridge	4.2	0.067	1.6	0.4
Verde River @ Beeline	3.1	0.090	2.9	0.4
AZ Canal above CAP Cross-connect	3.9	0.067	1.7	0.4
AZ Canal below CAP Cross-connect	3.9	0.067	1.7	0.4
AZ Canal at Highway 87	3.7	0.069	1.8	2.4
AZ Canal at Pima Rd.	3.8	0.070	1.9	0.4
AZ Canal at 56th St.	3.7	0.069	1.9	0.5
AZ Canal - Central Avenue	3.7	0.070	1.9	0.4
AZ Canal - Inlet to Glendale WTP	3.5	0.067	1.9	1.0
AZ Canal - Inlet to GreenwayWTP	2.8	0.028	1.0	0.7
South Canal below CAP Cross-connect	3.8	0.071	1.9	0.4
Head of the Tempe Canal	3.1	0.058	1.9	0.4
Tempe Canal - Inlet to Tempe's South Plant	2.1	0.039	1.9	1.9
Head of the Consolidated Canal	3.0	0.058	1.9	0.5
Middle of the Consolidated Canal	3.9	0.040	1.0	0.6
Chandler WTP – Inlet	2.0	0.038	1.9	2.6

Organics at the Water Treatment Plants

Table 2 - Water Treatment Plants – August 2, 2013

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN	DOC removal (%)
Union Hills Inlet	2.9	0.046	1.6	0.4	
Union Hills Treated	2.5	0.026	1.0	0.4	13
Tempe North Inlet	3.7	0.070	1.9	0.5	
Tempe North Plant Treated	2.9	0.034	1.2	0.4	22
Tempe South Inlet	2.1	0.039	1.9	1.8	
Tempe South Plant Treated	1.7	0.017	1.0	1.7	17
Greenway WTP Inlet	2.8	0.028	1.0	0.7	
Greenway WTP Treated	2.3	0.021	0.9	0.7	19
Glendale WTP Inlet	3.5	0.067	1.9	1.0	
Glendale WTP Treated	3.7	0.032	0.9	0.5	-6
Anthem WTP Inlet	2.9	0.044	1.5	0.5	
Anthem WTP Treated	2.8	0.043	1.5	0.5	4
Chandler WTP Inlet	2.0	0.038	1.9	2.6	
Chandler WTP Treated	1.7	0.027	1.6	2.6	16

Taste and Odor

MIB, Geosmin and Cyclocitral are compounds naturally produced by algae in our reservoirs and canals, usually when the water is warmer and algae are growing/decaying more rapidly. They are non toxic, but detectable to consumers of water because of their earthy-musty-moldy odor. The human nose can detect these in drinking water because the compounds are semi-volatile. Since compounds are more volatile from warmer water, these tend to be more noticable in the summer and fall. The human nose can detect roughly 10 ng/L of these compounds. Our team collects samples from the water sources and raw/treated WTP samples.

Table 4 - Reservoir Samples – August 6, 2013

Sample Description	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Lake Pleasant (July)	Eplimnion	**<2.0**	**<2.0**	**<2.0**
Lake Pleasant (July)	Hypolimnion	**4.3**	**<2.0**	**<2.0**
Verde River @ Beeline		**13.2**	**6.9**	**<2.0**
Bartlett Reservoir	Epilimnion	**11.9**	**<2.0**	**<2.0**
Bartlett Reservoir	Epi-near dock	**17.5**	**<2.0**	**<2.0**
Bartlett Reservoir	Hypolimnion	**<2.0**	**<2.0**	**<2.0**
Salt River @ BluePt Bridge		**3.8**	**<2.0**	**<2.0**
Saguaro Lake	Epilimnion	**40.9**	**2.2**	**<2.0**
Saguaro Lake	Epi - Duplicate	**44.3**	**2.6**	**<2.0**
Saguaro Lake	Epi-near dock	**39.3**	**<2.0**	**<2.0**
Saguaro Lake	Hypolimnion	**3.7**	**<2.0**	**<2.0**
Lake Havasu (July)		**2.2**	**2.2**	**<2.0**
Verde River at Tangle Creek (June)		**<2.0**	**<2.0**	**<2.0**
Roosevelt at Salt River Inlet (May)		**<2.0**	**<2.0**	**<2.0**

Quarterly Lake Sampling - August 6 -7, 2013

Sample Description	Location	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Roosevelt Lake	Site 1	Eplimnion	4.4	<2.0	<2.0
Roosevelt Lake	Site 1	Hypolimnion	4.4	<2.0	<2.0
Roosevelt Lake	Site 2	Eplimnion	6.1	<2.0	<2.0
Roosevelt Lake	Site 2	Hypolimnion	<2.0	<2.0	<2.0
Apache Lake	Site 1	Eplimnion	17.2	<2.0	<2.0
Apache Lake	Site 1	Hypolimnion	2.4	<2.0	<2.0
Apache Lake	Site 2	Eplimnion	5.2	<2.0	<2.0
Apache Lake	Site 2	Hypolimnion	<2.0	<2.0	<2.0
Canyon Lake	Site 1	Eplimnion	4.6	<2.0	<2.0
Canyon Lake	Site 1	Hypolimnion	2.2	<2.0	<2.0
Canyon Lake	Site 2	Eplimnion	4.7	<2.0	<2.0
Canyon Lake	Site 2	Hypolimnion	2.4	<2.0	<2.0

Table 2 - Water Treatment Plants – August 5, 2013

Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Union Hills Inlet	2.5	<2.0	<2.0
Union Hills Treated	3.3	<2.0	<2.0
Tempe North Inlet	5.9	<2.0	<2.0
Tempe North Plant Treated	5.5	<2.0	<2.0
Tempe South WTP	2.5	<2.0	<2.0
Tempe South Plant Treated	2.5	<2.0	<2.0
Anthem Inlet	<2.0	<2.0	<2.0
Anthem Treated	<2.0	<2.0	<2.0
Chandler Inlet	3.5	<2.0	<2.0
Chandler Treated	<2.0	<2.0	<2.0
Greenway WTP Inlet	10.6	9.1	<2.0
Greenway WTP Treated	<2.0	<2.0	<2.0
Glendale WTP Inlet	4.7	<2.0	<2.0
Glendale WTP Treated	<2.0	<2.0	<2.0

Table 3 - Canal Sampling – August 5, 2013

System	Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
CAP	Waddell Canal	<2.0	<2.0	<2.0
	Union Hills Inlet	2.5	<2.0	<2.0
	CAP Canal at Cross-connect	4.5	2.0	<2.0
AZ Canal	Salt River @ Blue Pt Bridge	3.8	<2.0	<2.0
	Verde River @ Beeline	13.2	6.9	<2.0
	AZ Canal above CAP Cross-connect	5.1	<2.0	<2.0
	AZ Canal below CAP Cross-connect	5.3	2.3	<2.0
	AZ Canal at Highway 87	6.6	<2.0	<2.0
	AZ Canal at Pima Rd.	8.2	2.4	<2.0
	AZ Canal at 56th St.	5.7	<2.0	<2.0
	AZ Canal - Central Avenue	6.3	2.8	<2.0
	AZ Canal - Inlet to Glendale WTP	4.7	<2.0	<2.0
	Head of the Consolidated Canal	5.1	<2.0	<2.0
	Middle of the Consolidated Canal	2.6	<2.0	<2.0
South Tempe Canals	South Canal below CAP Cross-connect	5.6	2.1	<2.0
	Head of the Tempe Canal	4.9	<2.0	<2.0
	Tempe Canal - Inlet to Tempe's South Plant	2.5	<2.0	<2.0
	Mesa Turnout (July)	2.1	<2.0	<2.0
	Salt-Gila Pump (July)	2.4	<2.0	<2.0

Evidence of quagga mussels found in Arizona Canal

By Mark Estes

7/31/2013

Page Image

Image Caption

Arizona Canal and Camelback Mountain

Page Content

Employees have found the first evidence of adult invasive mussels in SRP's canal system. Management is assessing the situation in collaboration with federal and state agencies.

In early July, SRP crews found evidence of quagga mussel settlement during a routine inspection of monitoring points along the Arizona Canal — at Arizona Falls and at the Crosscut Canal just upstream of the Crosscut hydroelectric generating unit.

"Both checkpoints contained a very small amount of adult mussels — about four at Arizona Falls and less than 20 in the Crosscut Canal," said Nina Mullins, Senior Director, Shareholder Operations.

Quagga mussels are an invasive species about the size of a fingernail. Hard surfaces found in pipes, aqueducts, trash racks, water intakes, dams and power plants are susceptible to mussel settlement. Rapid growth and prolific reproduction of the mussels can lead to increased facility maintenance as well as environmental impacts to lake and river ecosystems.

Indications revealed that the mussels found in the Arizona Canal were recent arrivals at both areas.
Inspection points on canals and laterals in the SRP system south of the Salt River remain free of the mussels, although the discovery in the Arizona Canal may indicate adaptation to SRP canal system conditions. There is no evidence of quagga mussels in the SRP reservoir system.

SRP is coordinating with the U.S. Bureau of Reclamation and other federal and state agencies to evaluate methods of reducing the impact and spread of the mussels.

“Although the quagga mussel numbers are very few, we want to continue to safeguard our water transmission and delivery facilities for the benefit of all our water customers and municipal partners,” Mullins said.

Adult quagga mussels were spotted three times before near SRP water facilities. The first was in 2008 at the SRP-Central Arizona Project (CAP) Interconnect Facility, where SRP takes occasional deliveries of CAP water. Mussels were again found at the SRP-CAP Interconnect in 2009 and 2013.

Quagga mussels were inadvertently introduced into Lake Mead and have spread along the Colorado River since first detected in 2007. They now can be found in Mohave, Havasu and Pleasant lakes, and they are assumed to be present in the CAP system.

SRP partners with the U.S. Forest Service and the Bureau of Reclamation to support the “Don’t Move a Mussel” campaign to limit the spread of quagga mussels in Arizona’s waterways. It is very important that boaters continue to “clean, drain and dry” their boats to prevent introducing quagga mussels to the reservoir system.

Metals in the Watershed

On a quarterly basis we are collecting and analyzing by ICP-MS a suite of metals at key locations. In early 2013 the City of Phoenix had observed Uranium in CAP waters, confirmed by our data – and here too we continue to see the highest levels of 238U in Lake Pleasant, Waddell Canal and in Lake Havasu – so clearly this is a Colorado River water source. We have been trying to use this data to explore how to track water sources, and influences of large disturbances (e.g., forest fires).

May Quarterly Samples	7Li	9Be	23Na	24Mg	27Al	39K	44Ca	51V	52Cr	55Mn	56Fe	59Co	60Ni
	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb	ppb
Blank	-0.074	0.01	1.652	0.054	0.101	1.081	0.181	-0.018	-0.004	0.026	-0.093	0.008	0.009
Caynon Lake - Site 1A	104	0.04	162800	15870	10	5741	37120	2.3	0.22	6.2	26.0	0.05	1.0
Caynon Lake - Site 1B	100	0.08	159500	15850	14	5874	37890	2.4	0.05	9.9	21.5	0.11	1.0
Caynon Lake - Site 2A	101	0.08	159900	15320	11	5755	37730	2.4	0.03	18.6	25.9	0.11	1.0
Caynon Lake - Site 2B	100	0.02	158900	15380	10	5772	38000	2.3	-0.01	17.9	18.9	0.05	0.9
Apache Lake - Site 1A	116	0.01	158900	17030	4	6422	40600	2.6	0.01	2.5	8.9	0.07	1.0
Apache Lake - Site 1B	112	0.03	157600	16630	27	6242	42160	2.4	0.07	7.8	47.0	0.09	1.0
Apache Lake - Site 2A	112	0.07	157200	16750	0	6351	40420	2.4	0.01	1.7	4.2	0.05	0.9
Apache Lake - Site 2B	108	0.30	155300	16390	4	6237	40550	2.3	0.26	2.9	10.2	0.08	1.0
Roosevelt Lake- Site 1A	102	0.13	154900	14930	73	5818	35720	4.8	0.94	6.5	75.0	0.14	1.1
Roosevelt Lake- Site 1B	119	0.07	153900	17620	96	7099	41090	3.3	0.24	13.0	90.2	0.12	1.3
Roosevelt Lake- Site 2A	105	0.09	153900	16310	39	6146	38830	4.1	0.09	2.8	25.0	0.10	1.0
Roosevelt Lake- Site 2B	124	-0.02	153000	18520	61	7258	42010	3.3	0.92	6.2	55.4	0.08	1.2
Waddell Canal (R3)	33	-0.02	81090	25870	5	4772	54570	3.2	-0.02	1.0	6.3	0.08	1.5
Salt River @ Blue Pt Bridge (R10)	96	-0.02	150500	15490	15	5897	39080	2.1	-0.02	44.9	33.4	0.06	0.8
Verde River @ Beeline Hwy (R25)	22	0.05	34970	29070	171	3216	31050	8.9	0.26	35.9	176.6	0.20	1.4
Lake Pleasant - Epilimnion	36	0.15	88970	28500	31	5258	53780	3.9	0.09	4.2	43.0	0.09	1.5
Lake Pleasant - Hypolimnion	36	0.15	88700	28390	-2	5215	53680	-4.2	16.02	3.0	0.7	0.09	1.5
ASU tap water	35	0.00	74500	26920	18	4075	40140	3.2	0.09	0.5	9.4	0.08	4.1
Lake Havasu	32	0.02	79420	25320	19	4599	54360	2.9	0.12	1.4	29.0	0.08	1.4

May Quarterly Samples	65Cu	66Zn	75As	82Se	88Sr	107Ag	111Cd	202Hg	205Tl	208Pb	232Th	238U
Caynon Lake - Site 1A	59.1	8.1	4.0	2	498	-0.03	0.20	3.43	0.01	0.1	-42.9	11
Caynon Lake - Site 1B	84.5	7.7	4.0	3	500	-0.03	0.23	1.82	0.06	0.2	-45.7	11
Caynon Lake - Site 2A	1.1	4.7	4.0	4	489	-0.04	0.17	1.21	0.04	0.0	-44.1	11
Caynon Lake - Site 2B	0.9	4.7	4.1	8	489	-0.04	0.04	0.85	-0.02	-0.1	-44.2	10
Apache Lake - Site 1A	1.5	5.1	4.1	4	547	-0.04	0.11	0.62	0.00	-0.1	-45.7	12
Apache Lake - Site 1B	0.7	5.5	4.2	4	545	-0.04	0.03	0.46	0.02	0.0	-43.6	11
Apache Lake - Site 2A	0.8	7.3	4.4	8	541	-0.04	0.02	0.34	-0.01	-0.1	-43.5	11
Apache Lake - Site 2B	0.9	6.4	6.7	60	537	-0.03	0.11	0.26	0.00	-0.1	-28.5	11
Roosevelt Lake- Site 1A	1.6	8.6	12.1	179	479	-0.04	0.09	0.18	-0.01	0.0	-23.6	10
Roosevelt Lake- Site 1B	2.1	7.9	3.9	25	575	-0.04	0.19	0.12	-0.02	0.0	-27.9	12
Roosevelt Lake- Site 2A	1.2	7.3	4.3	22	521	-0.04	0.03	0.07	-0.01	-0.1	-37.9	11
Roosevelt Lake- Site 2B	8.0	4.2	11.6	178	608	-0.04	0.09	0.03	-0.02	0.0	-29.4	12
Waddell Canal (R3)	1.3	4.4	2.5	6	1058	-0.04	-0.02	0.00	-0.02	-0.1	-43.9	31
Salt River @ Blue Pt Bridge (R10)	0.6	1.8	4.1	6	506	-0.04	-0.02	-0.03	-0.02	-0.1	-43.2	10
Verde River @ Beeline Hwy (R25)	1.9	3.1	15.3	6	697	-0.04	0.00	-0.05	-0.02	0.2	-10.8	15
Lake Pleasant - Epilimnion	1.2	2.2	3.7	16	1120	-0.04	0.02	0.02	-0.02	0.0	-18.8	35
Lake Pleasant - Hypolimnion	1.2	0.6	3.4	14	1113	-0.04	0.04	0.03	-0.02	-0.1	-37.2	35
ASU tap water	1940.0	54.5	1.5	7	809	-0.04	0.03	-0.09	-0.02	0.6	-45.4	12
Lake Havasu	1.1	0.6	2.9	17	1052	-0.04	-0.01	-0.12	-0.02	0.0	-29.7	32