REGIONAL WATER QUALITY NEWSLETTER

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Sampling conducted June 2 & 3 2008

From the Phoenix, Tempe, Glendale, CAP, SRP – ASU Regional Water Quality Partnership

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

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SUMMARY: EVALUATION AND RECOMMENDATIONS

1. MIB & Geosmin concentrations are starting to increase in the reservoirs, but not in the canals. The usual Taste and Odor season in the Canals starts around mid-July. This year it looks like SRP is shifting between Salt and Verde River water blends, and because of differences in salt content may cause algae to release MIB or geosmin in the canals. We will be monitoring for this.
2. Dissolved organic carbon levels are elevated this year, compared to the last several years. That means that there is a greater risk to exceed DBP regulations for trihalomethanes in distribution systems this year. SUVA levels of raw water are higher than in years, which makes DOC easier to remove by coagulation, but is also an indicator of DBP formation potential. Phoenix is adding PAC to help mitigate this, while other cities are using GAC.
3. One concept gaining notice is decentralized treatment to remove DBPs at far locations in distribution systems. While GAC and Air stripping are potentials, a short description of an idea to use advanced oxidation processes (AOPs) instead as a decentralized treatment process is outlined.

Table 1 Summary of WTP Operations

	Verde WTP	Union Hills	24th Street WTP	N.Tempe J.G. Martinez	Deer Valley	Glendale Cholla WTP [3]	Val Vista	South Tempe	Chandler WTP
Location	**Verde River**	**CAP**	**Arizona Canal System**				**South Canal System**		
PAC Type and Dose		none	Calgon WPH 12.6 ppm		15 ppm Calgon	None	12 ppm	None	
Copper Sulfate		None	0.1 ppm		None	None	0.25 ppm for 12 hr /day	None	
PreOxidation		none	none		None	24 hours at 4.5 ppm 2 days at 1.0 ppm 4 days @ 0.0 ppm	None	None	
Alum Dose Alkalinity pH		7 + 1.75 poly 123	67 135/106 6.8		60 137/95 6.8	30 138 6.8	60 106 7.9	29 112 7.26	
Finished water DOC DOC removal[2]		2.67 mg/L 18%	3.35 mg/L 44%	4.7 21%	3.59 mg/L 39%	3.97 mg/L 33	3.4 mg/L 42%	4.78 mg/L 17%	
Average turbidity over last 7 days		< 2 NTU	15 NTU		16 NTU	15 NTU	25 NTU	9.5	
Recommendations									

[1] Ferric chloride instead of alum; plus 2.25 ppm polymer (308)

[2] Calculated based upon influent and filtered water DOC (note that DOC – not TOC – is used in this calculation)

[3] Sample from finished water includes a blend of surface and ground water sources

SRP/CAP OPERATIONS **-** Values in cfs, for June 3, 2008

System	SRP Diversions	CAP
Arizona Canal	756	83
South Canal	678	0
Pumping	91	0
Total	1525	83

- **SRP is releasing water from both Verde and Salt River Systems**. Salt River release from Saguaro Lake: 603 cfs; Verde River release from Bartlett Lake: 950 cfs.
- Lake Roosevelt is 96% full and the Verde River system is 85% full. Flow over Granite Reef dam into the Salt River Channel = 0 cfs.
- CAP plans to start releasing Lake Pleasant Water into the CAP canal in June 2008. Depending upon T&O levels later this summer CAP will cease release of Lake Pleasant water as appropriate.

SRP has been changing which river system water is released from over the past week:

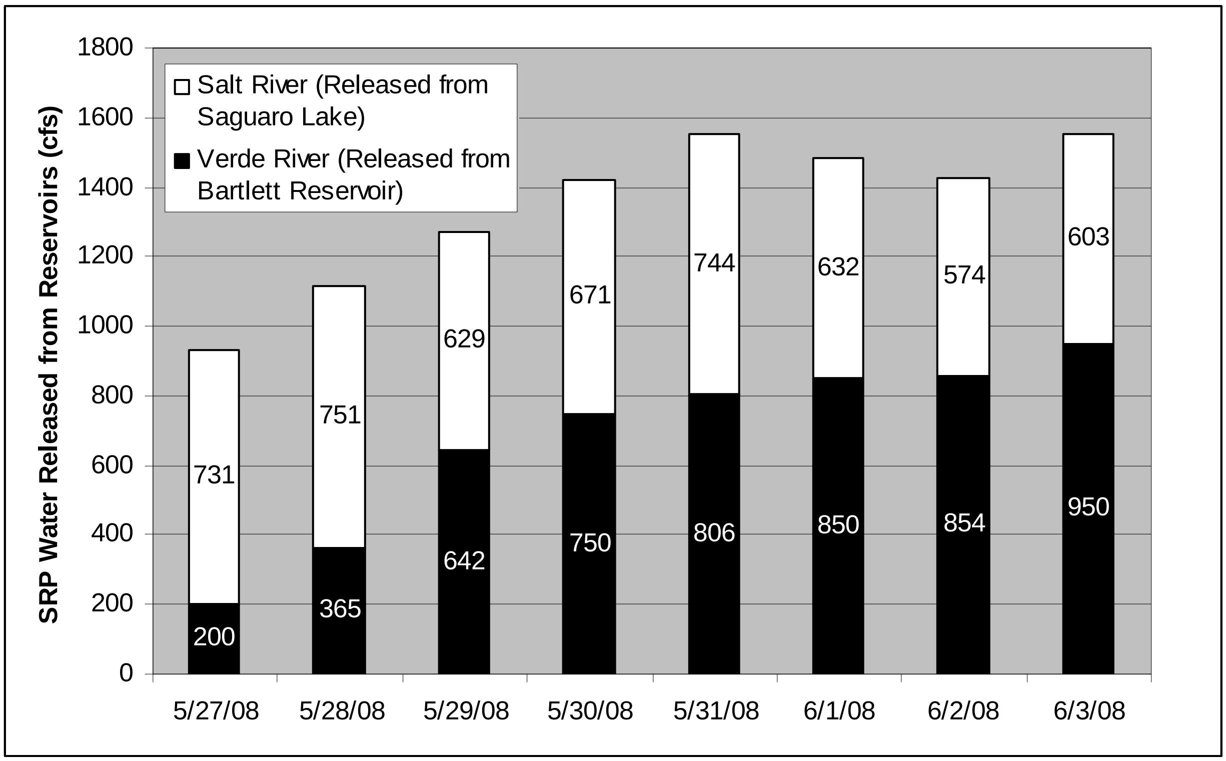

Table 2 - Water Treatment Plants – June 2, 2008

Sample Description	MIB (ng/L)	Geosmin (ng/L)
24th Street WTP Inlet	<2.0	<2.0
24th Street WTP Treated	<2.0	<2.0
Deer Valley Inlet	<2.0	<2.0
Deer Valley WTP Treated	<2.0	<2.0
Val Vista Inlet	<2.0	2.0
Val Vista WTP Treated –East	<2.0	<2.0
Val Vista WTP Treated -West	<2.0	<2.0
Union Hills Inlet	<2.0	3.2
Union Hills Treated	<2.0	<2.0
Tempe North Inlet	<2.0	<2.0
Tempe North Plant Treated	2.4	5.0
Tempe South WTP	<2.0	<2.0
Tempe South Plant Treated	<2.0	4.6
Tempe South Plant Treated (Lab)		
Glendale WTP Inlet	2.6	3.5
Glendale WTP Treated	<2.0	<2.0
Glendale WTP Treated (Lab)		

MIB & Geosmin are taste and odor compounds, detectable by the human nose in drinking water at 10 to 15 ng/L for the sum of MIB + Geosmin concentrations.

Table 3 - Canal Sampling – June 2, 2008

System	Sample Description	MIB (ng/L)	Geosmin (ng/L)
CAP	Waddell Canal	<2.0	3.3
	Union Hills Inlet	<2.0	<2.0
	CAP Canal at Cross-connect	2.4	3.4
AZ Canal	Salt River @ Blue Pt Bridge	<2.0	<2.0
	Verde River @ Beeline	<2.0	<2.0
	AZ Canal above CAP Cross-connect	<2.0	2.8
	AZ Canal below CAP Cross-connect	<2.0	<2.0
	AZ Canal at Highway 87	<2.0	2.8
	AZ Canal at Pima Rd.	<2.0	<2.0
	AZ Canal at 56th St.	<2.0	3.0
	AZ Canal - Inlet to 24th Street WTP	<2.0	<2.0
	AZ Canal - Central Avenue	<2.0	<2.0
	AZ Canal - Inlet to Deer Valley WTP	<2.0	<2.0
	AZ Canal - Inlet to Glendale WTP	2.6	3.5
South and Tempe Canals	South Canal below CAP Cross-connect	<2.0	5.0
	South Canal at Val Vista WTP	<2.0	2.0
	Head of the Tempe Canal	3.8	2.5
	Tempe Canal - Inlet to Tempe's South Plant	<2.0	<2.0
	Chandler WTP – Inlet		

Table 4 - Reservoir Samples –June 3, 2008

Sample Description	Location	MIB (ng/L)	Geosmin (ng/L)
Lake Pleasant (May08)	Eplimnion	<2.0	<2.0
Lake Pleasant (May08)	Hypolimnio	<2.0	<2.0
Verde River @ Beeline		<2.0	<2.0
Bartlett Reservoir	Epilimnion	<2.0	<2.0
Bartlett Reservoir	Epi-near dock	<2.0	<2.0
Bartlett Reservoir	Hypolimnio	10.9	3.5
Salt River @ BluePt Bridge		<2.0	<2.0
Saguaro Lake	Epilimnion	13.5	3.2
Saguaro Lake	Epi - Duplicate	7.4	4.6
Saguaro Lake	Epi-near doc	4.3	3.4
Saguaro Lake	Hypolimnio	8.4	<2.0
Verde River at Tangle Creek (28May08)		<2.0	<2.0
Havasu (May08)		<2.0	3.2

Table 5 - Water Treatment Plants – June 3,, 2008

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN	DOC removal (%)
24th Street WTP Inlet	5.99	0.15	2.4	0.643	
24th Street WTP Treated	3.35	0.05	1.5	0.533	44
Deer Valley Inlet	5.88	0.15	2.5	0.633	
Deer Valley WTP Treated	3.59	0.05	1.5	0.532	39
Val Vista Inlet	5.89	0.16	2.65	0.681	
Val Vista WTP Treated –East	3.25	0.05	1.48	0.594	45
Val Vista WTP Treated -West	3.51	0.06	1.62	0.583	40
Union Hills Inlet	3.25	0.04	1.25	0.584	
Union Hills Treated	2.67	0.02	0.89	0.526	18
Tempe North Inlet	5.94	0.15	2.50	0.635	
Tempe North Plant Treated	4.70	0.09	1.92	0.595	21
Tempe South WTP	5.77	0.15	2.62	0.596	
Tempe South Plant Treated	4.78	0.10	2.02	0.585	17
Glendale WTP Inlet	5.93	0.15	2.5	0.602	
Glendale WTP Treated	3.97	0.08	1.9	1.316	33

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)

Table 6 - Canal Sampling – June 3, 2008

System	Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
CAP	Waddell Canal	3.33	0.041	1.24	0.598
	Union Hills Inlet	3.25	0.041	1.25	0.584
	CAP Canal at Cross-connect	3.27	0.041	1.26	0.567
AZ Canal	Salt River @ Blue Pt Bridge	6.12	0.123	2.01	0.751
	Verde River @ Beeline	5.80	0.178	3.06	0.688
	AZ Canal above CAP Cross-connect	6.00	0.154	2.56	0.656
	AZ Canal below CAP Cross-connect	5.56	0.133	2.38	0.637
	AZ Canal at Highway 87	5.91	0.145	2.46	0.639
	AZ Canal at Pima Rd.	5.98	0.145	2.43	0.567
	AZ Canal at 56th St.	5.89	0.146	2.49	0.630
	AZ Canal - Inlet to 24th Street WTP	5.99	0.146	2.44	0.643
	AZ Canal - Central Avenue	5.82	0.145	2.50	0.627
	AZ Canal - Inlet to Deer Valley WTP	5.88	0.146	2.48	0.633
	AZ Canal - Inlet to Glendale WTP	5.93	0.146	2.47	0.602
South and Tempe Canals	South Canal below CAP Cross-connect	5.81	0.154	2.66	0.628
	South Canal at Val Vista WTP	5.89	0.156	2.65	0.681
	Head of the Tempe Canal	5.76	0.152	2.64	0.660
	Tempe Canal - Inlet to Tempe's South Plant	5.77	0.151	2.62	0.596
	Chandler WTP – Inlet				

Table 7 - Reservoir Samples – June 3, 2008

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Lake Pleasant (May 2008)	Eplimnion	4.26	0.060	1.42	0.567
Lake Pleasant (May 2008)	Hypolimnion	4.24	0.061	1.44	0.545
Verde River @ Beeline		5.80	0.178	3.06	0.688
Bartlett Reservoir	Epilimnion	6.10	0.164	2.69	0.590
Bartlett Reservoir	Epi-near dock				
Bartlett Reservoir	Hypolimnion	6.42	0.138	2.15	0.431
Salt River @ BluePt Bridge		6.12	0.123	2.01	0.751
Saguaro Lake	Epilimnion	6.76	0.125	1.85	0.510
Saguaro Lake	Epi - Duplicate	6.42	0.124	1.93	0.440
Saguaro Lake	Epi-near doc				
Saguaro Lake	Hypolimnion	6.71	0.125	1.86	0.971
Verde River at Tangle (May 2008)		1.55	0.033	2.14	0.159
Havasu (May 2008)		3.18	0.042	1.32	0.640

Are Advanced Oxidation Processes (AOPs) Worth Considering for Drinking Water?

What is an AOP?
Advanced oxidation processes (AOPs) involve any number of process which produce hydroxyl radicals (HO) through abstraction of a hydrogen from a water molecule (H_2O), which is a highly reactive oxidant. Common means of producing HO is by a combination of ozone and hydrogen peroxide, UV irradiation and hydrogen peroxide, or UV irradiation and titanium dioxide. Therefore AOPs do consume electrical energy. UV dosages for producing HO radicals are ~ 10 to 20 times higher than UV dosages being used for disinfection alone.

Hydroxyl radicals (HO) are useful because as oxidants they can oxidize both trace organics (e.g., T&O compounds, pharmaceuticals) as well as bulk organics, including DBP precursors).

Where would AOPs be used in a drinking water treatment plant?
AOPs are not yet widely used in surface drinking water plants, but may be considered as a means of providing disinfection and oxidation with a small "footprint" and very little, if any harmful by-products. AOPs would generally be used before a biological filter, so if any biodegradable organics are produced they would be removed. In this way AOPs would make the water more biostable and significantly reduce subsequent chlorine demands.

Traditionally AOPs have been used for treating groundwaters contaminated with VOCs or other organic pollutants. Now they are being widely considered in conjunction with reverse osmosis for water reuse applications to destroy organics that pass through RO, of which there can be many.

Could AOPs be used in a drinking water distribution system (decentralized treatment) to reduce preformed DBPs?

Although not yet studied – it may be possible implement AOPs at points far away from a water treatment plant to reduce THM or HAA formation (i.e., localized DBP reduction). As cities grow, the travel times in water distribution systems increase. Longer travel time (i.e., longer water "age") results in high levels of disinfection by-products (DBPs) being formed because of reactions between chemical disinfectants (chlorine or chloramines) and dissolved organic matter (DOM) and biofilms in water distribution systems. Providing decentralized treatment to remove DBPs at points further away from centralized water treatment plants is increasingly being viewed as a viable alternative.

Decentralized treatment using compact, automated technologies distributed over a wastewater or stormwater collection network (with or without reuse) or as part of a drinking water distribution network may present a number of advantages. For example, a number of water utilities are expected to have difficulty in meeting Stage II Disinfection Byproduct Rule at all points in the distribution system. Westerhoff was recently a technical advisor on an AwwaRF project "Localized Treatment for Disinfection By-Products", where decentralized treatment using GAC and air stripping confirmed THMs could be marginally cost effective to strip and some of the HAAs were biodegradable on GAC. However, removals of unregulated nitrogen-based DBPs (N-DBPs), that are orders of magnitude more cytotoxic and genotoxic than currently regulated carbonaceous DBPs (C-DBPs) was not studied. Since some N-DBPs are quite photoreactive and all DBPs are reactive with hydroxyl radicals, UV- and other catalytic oxidation based technologies may be particularly well suited for their decentralized treatment because they have a small footprint, require minimal maintenance, and are self-enclosed. ASU has proposed this novel technical approach to the USEPA for funding, but plans to conduct preliminary experiments this summer into its viability. If you are interested in participating, please let us know.