Regional Water Quality NEWSLETTER

DATE: Report for June 2010 Sampling conducted June 1, 2010

A Phoenix, Tempe, Glendale, Peoria, 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 plus geosmin levels above 10 ng/L in finished water lead to noticeable earthy-musty odors by customers. Currently MIB+geosmin levels are below 10 ng/L in the canals, but levels are rapidly increasing in the reservoirs.
2. Cyclocitral also causes earthy-musty taste and odors and appears to be elevated this year compared with prior years. The highest level is in the Tempe Canal at 15 ng/L. Cyclocitral can be removed by activated carbon.
3. Do you know that SRP and CAP have on-line water quality data? We want to know how you utilize this information in operation of your facilities or as consultants use the information. We want to improve access to helpful information. Please participate in our 3 question survey.
4. Deer Valley WTP is starting to pilot chlorine dioxide (ClO2) with coagulants and PAC – contact them if you want information on how its going.
5. Molecular weight data for organic carbon can be a useful tool in understanding what type of organics are being removed by different unit processes (coagulation, filtration, activated carbon, ozone). Let us know if you want some SEC-TOC samples analyzed from your facility in next month.
6. Desalination of brackish groundwaters is being piloted currently by Phoenix – they are using RO to get >92% water recovery, and are using a pellet reactor to try to control scale formation on the second, high pressure RO system. Carollo is running the pilot test.

Table 1a Summary of WTP Operations February 1, 2010

	Verde WTP	Union Hills	24th Street WTP	N.Tempe J.G. Martinez	Deer Valley	Glendale Cholla WTP [3]	Peoria Greenway WTP	Val Vista	South Tempe
	Verde River	CAP Canal	Arizona Canal					South Canal	
PAC Type and Dose			15 ppm Calgon WPH		None	None	None	5 ppm PAC	15 ppm Norit Hydrodarco
Copper Sulfate			0.5 ppm (0.2 mgCu/L)		None	none	None	0.5 ppm 12 hr per day	
PreOxidation			None		none	Chlorine while getting ozone running	none	None	
Alum Dose Alkalinity pH			50 134/110 6.8		35 [1] 142 6.9-7	25 132 6.8	25 120 7.2	40 [1] 96 6.8	25 120 7.4
Finished water DOC DOC removal[2]		2.3 mg/L 26%	2.9 mg/L 43%	4.0 23%	3.3 34%	3.1 38%	3.8 22%	2.5 mg/L 49%	3.3 32%
Average turbidity over last 7 days			7 to 10 NTU		18	13	6 to 10	5	3
Notes from operators									

[1] Ferric chloride instead of alum; plus ppm sulfuric acid; [2] Calculated based upon influent and filtered water DOC (note that DOC and not TOC is used in this calculation); [3] Sample from finished water includes a blend of surface and ground water sources sometimes

Compared to 2 years ago, now 3 facilities use ferric sulfate whereas only 1 did 2 years ago.

Table 1 - SRP/CAP OPERATIONS - Values in cfs, for June 1, 2010

System	SRP Diversions	CAP
Arizona Canal	780	0
South Canal	726	0
Pumping	64	0
Total	1570	0

- **SRP is releasing water from both Verde and Salt River Systems**. Salt River release from Saguaro Lake: 1138 cfs; Verde River release from Bartlett Lake: 500 cfs.
- **SRP has stopped releasing water over Granite Reef Dam**.
- **SRP reservoirs are >97% full.**

Taste and Odor Data

MIB plus geosmin levels above 10 ng/L in finished water lead to noticeable earthy-musty odors by customers. Currently MIB+geosmin levels are below 10 ng/L in the canals, but levels are rapidly increasing in the reservoirs.

Table 2 - Water Treatment Plants – June 1, 2010

Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
24th Street WTP Inlet	<2.0	2.4	8.8
24th Street WTP Treated	<2.0	<2.0	<2.0
Deer Valley Inlet	2.0	2.4	6.1
Deer Valley WTP Treated	2.2	2.4	6.6
Val Vista Inlet	<2.0	2.3	4.5
Val Vista WTP Treated –East	<2.0	<2.0	<2.0
Val Vista WTP Treated -West	<2.0	<2.0	<2.0
Union Hills Inlet	<2.0	2.0	<2.0
Union Hills Treated	<2.0	<2.0	<2.0
Tempe North Inlet	<2.0	2.6	7.2
Tempe North Plant Treated	2.1	2.8	6.8
Tempe South WTP	<2.0	2.1	14.8
Tempe South Plant Treated	<2.0	<2.0	4.1
Greenway WTP Inlet	<2.0	<2.0	<2.0
Greenway WTP Treated	<2.0	<2.0	2.7
Glendale WTP Inlet	<2.0	2.5	6.2
Glendale WTP Treated	<2.0	<2.0	<2.0

Cyclocitral also causes earthy-musty taste and odors and appears to be elevated this year compared with prior years. The highest level is in the Tempe Canal at 15 ng/L. Cyclocitral can be removed by activated carbon.

Table 3 - Canal Sampling – June 1, 2010

System	Sample Description	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
CAP	Waddell Canal	<2.0	<2.0	<2.0
	Union Hills Inlet	<2.0	2.0	<2.0
	CAP Canal at Cross-connect			
	Salt River @ Blue Pt Bridge	<2.0	2.1	<2.0
	Verde River @ Beeline			
AZ	AZ Canal above CAP Cross-connect			
Canal	AZ Canal below CAP Cross-connect	2.0	2.8	9.2
	AZ Canal at Highway 87	<2.0	2.4	7.3
	AZ Canal at Pima Rd.	<2.0	2.3	7.2
	AZ Canal at 56th St.	<2.0	2.4	8.0
	AZ Canal - Inlet to 24th Street WTP	<2.0	2.4	8.8
	AZ Canal - Central Avenue	<2.0	<2.0	<2.0
	AZ Canal - Inlet to Deer Valley WTP	2.0	2.4	6.1
	AZ Canal - Inlet to Glendale WTP	<2.0	2.5	6.2
South	South Canal below CAP Cross-connect			
and	South Canal at Val Vista WTP	<2.0	2.3	4.5
Tempe	Head of the Tempe Canal	2.5	2.7	5.4
Canals	Tempe Canal - Inlet to Tempe's South Plant	<2.0	2.1	14.8

Table 4 - Reservoir Samples – June 1, 2010

Sample Description	Location	MIB (ng/L)	Geosmin (ng/L)	Cyclocitral (ng/L)
Lake Pleasant (May10)	Eplimnion	<2.0	<2.0	<2.0
Lake Pleasant	Hypolimnion	<2.0	2.1	<2.0
Verde River @ Beeline				
Bartlett Reservoir	Epilimnion	13.0	11.3	<2.0
Bartlett Reservoir	Epi-near dock	10.4	12.7	<2.0
Bartlett Reservoir	Hypolimnion	<2.0	<2.0	<2.0
Salt River @ BluePt Bridge		<2.0	2.1	<2.0
Saguaro Lake	Epilimnion	25.5	4.9	<2.0
Saguaro Lake	Epi - Duplicate	26.6	5.4	<2.0
Saguaro Lake	Epi-near dock	24.0	5.8	<2.0
Saguaro Lake	Hypolimnion	2.2	<2.0	<2.0
Lake Havasu (May10)		<2.0	<2.0	<2.0
Verde River at Tangle Creek				

Organic Matter in Water Treatment Plants

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN		DOC removal (%)
24th Street WTP Inlet	5.05	0.112	2.23	0.31		
24th Street WTP Treated	2.90	0.038	1.31	0.26		43
Deer Valley Inlet	5.04	0.110	2.18	0.33		
Deer Valley WTP Treated	3.34	0.040	1.21	0.24		34
Val Vista Inlet	4.93	0.112	2.27	0.31		
Val Vista WTP Treated –East	2.90	0.039	1.36	0.28		41
Val Vista WTP Treated -West	2.53	0.036	1.41	0.22		49
Union Hills Inlet	3.12	0.041	1.32	0.45		
Union Hills Treated	2.31	0.020	0.85	0.39		26
Tempe North Inlet	5.20	0.113	2.17	0.32		
Tempe North Plant Treated	3.99	0.070	1.76	0.28		23
Tempe South WTP	4.91	0.110	2.24	0.32		
Tempe South Plant Treated	3.34	0.051	1.51	0.31		32
Greenway WTP Inlet	4.81	0.108	2.24	0.34		
Greenway WTP Treated	3.78	0.041	1.08	0.32		22
Glendale WTP Inlet	5.02	0.111	2.22	0.32		
Glendale WTP Treated	3.12	0.047	1.51	0.24		38

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)

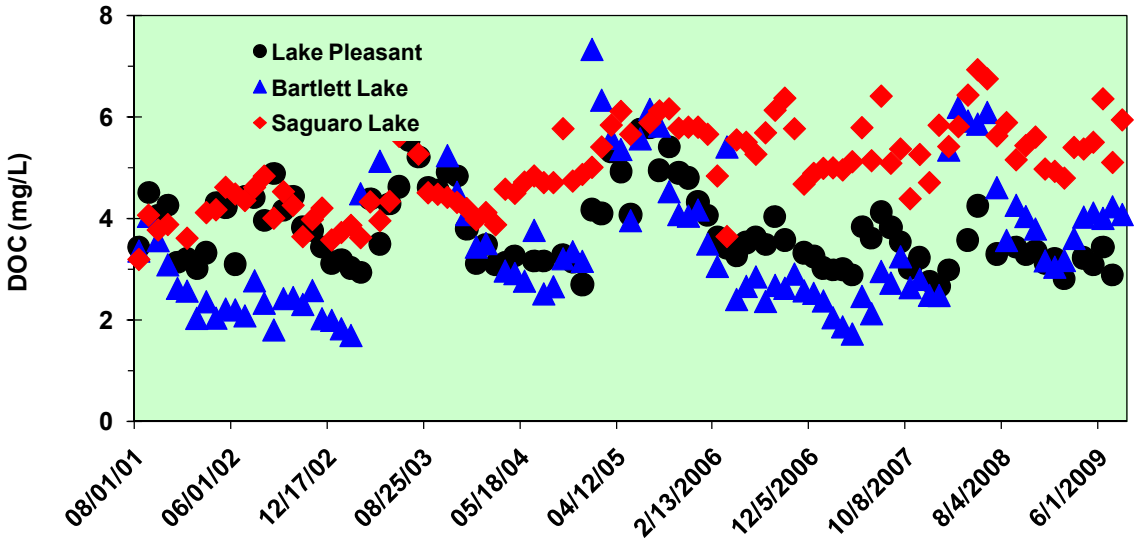
Organics in Canals

Sample Description	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Waddell Canal	**3.08**	**0.042**	**1.35**	**0.44**
Union Hills Inlet	**3.12**	**0.041**	**1.32**	**0.45**
CAP Canal at Cross-connect				
Salt River @ Blue Pt Bridge	**5.07**	**0.113**	**2.22**	**0.35**
Verde River @ Beeline				
AZ Canal above CAP Cross-connect				
AZ Canal below CAP Cross-connect	**5.04**	**0.113**	**2.24**	**0.31**
AZ Canal at Highway 87	**4.87**	**0.114**	**2.33**	**0.29**
AZ Canal at Pima Rd.	**5.03**	**0.112**	**2.22**	**0.28**
AZ Canal at 56th St.	**5.15**	**0.114**	**2.21**	**0.33**
AZ Canal - Inlet to 24th Street WTP	**5.05**	**0.112**	**2.23**	**0.31**
AZ Canal - Central Avenue	**4.98**	**0.111**	**2.23**	**0.31**
AZ Canal - Inlet to Deer Valley WTP	**5.04**	**0.110**	**2.18**	**0.33**
AZ Canal - Inlet to Glendale WTP	**5.02**	**0.111**	**2.22**	**0.32**
AZ Canal - Inlet to Greenway WTP	**4.81**	**0.108**	**2.24**	**0.34**
South Canal below CAP Cross-connect	**5.00**	**0.113**	**2.26**	**0.32**
South Canal at Val Vista WTP	**4.93**	**0.112**	**2.27**	**0.31**
Head of the Tempe Canal	**4.99**	**0.112**	**2.24**	**0.29**
Tempe Canal - Inlet to Tempe's South Plant	**4.91**	**0.110**	**2.24**	**0.32**
Chandler WTP – Inlet				

Organics in Lakes

Sample Description	Location	DOC (mg/L)	UV254 (1/cm)	SUVA (L/mg-m)	TDN
Lake Pleasant (may 2010)	Eplimnion	3.69	0.07	1.76	0.64
Lake Pleasant (may 2010)	Hypolimnion	4.19	0.08	1.79	0.58
Verde River @ Beeline					
Bartlett Reservoir	Epilimnion	5.65	0.14	2.44	0.34
Bartlett Reservoir	Hypolimnion	5.64	0.16	2.78	0.55
Salt River @ BluePt Bridge		5.07	0.11	2.22	0.35
Saguaro Lake	Epilimnion	5.78	0.11	1.97	0.46
Saguaro Lake	Epi - Duplicate	6.01	0.12	1.92	0.49
Saguaro Lake	Hypolimnion	5.54	0.12	2.09	0.51
Verde River at Tangle					
Havasu	May-10	2.78	0.04	1.36	0.59

Currently SRP is blending Salt and Verde River waters at a ratio of 70% Salt River and 30% Verde River, but throughout the week is ramping up the use of Verde River water to ~ 50%. Historically, Verde River has been "easier to treat" and forms fewer DBPs than Salt River water. Below is a long-term trend in DOC within these reservoirs:

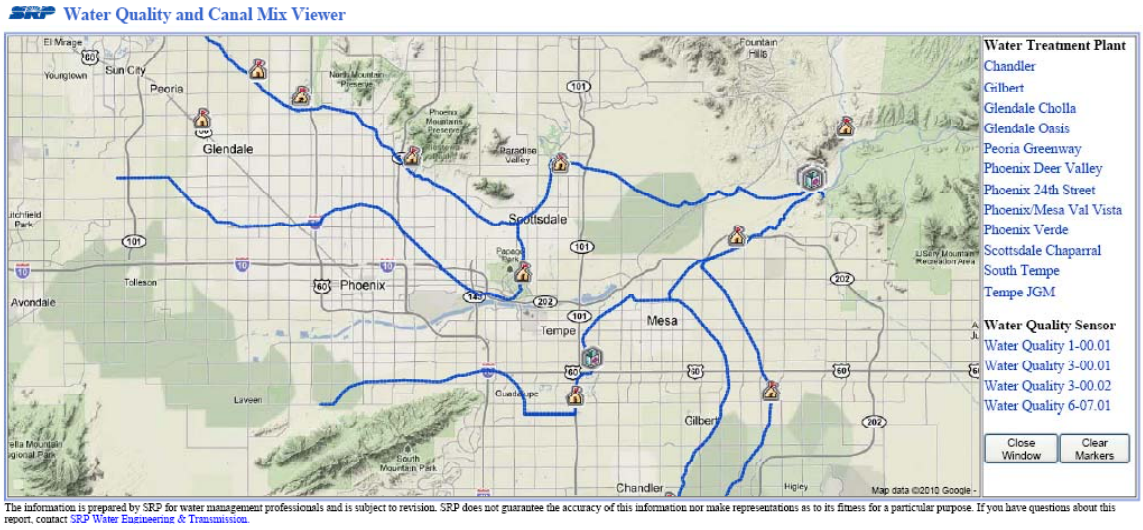


On-line Water Quality data (SURVEY – feedback requested)

Do you know that SRP and CAP have on-line water quality data? We want to know how you utilize this information in operation of your facilities or as consultants use the information. We want to improve access to helpful information.

1. **How frequently do you access the CAP on-line data?**
   Daily, weekly, monthly, never (other)?
   http://www.cap-az.com/water_quality/

2. **How frequently do you access the password protected SRP on-line data?**
   Daily, weekly, monthly, never (other)?
   http://www.srpwater.com/wtpviewer/Login.aspx?ReturnUrl=%2fwtpviewer%2fDefault.aspx



3. When you use these sites what information are you looking for?

Use of Chlorine Dioxide in the Valley

Last month we requested participation in a chlorine dioxide survey. Several responses came in. Here are some of them:

- Chlorites are a concern pertaining to use of chlorine dioxide and the MCL for chlorites.
- We generally fed 1.50 mg/L of chlorine dioxide and measured chlorites at about 0.45 mg/L consistantly. Verification and calibration of the chlorine dioxide analyzers were performed by SM-4500 E and ion chromatography.
- Our goal was not to exceed 50% of the MCL for chlorites or a chlorine dioxide residual of <0.10 mg/L. We felt it was not worth the risk of taste and odor and recognizing it was not the cure all for TTHM control let alone the ever present MCL for chlorites.
- Deer Valley will start up chlorine dioxide June 1.
- Deer Valley will be piloting chlorine dioxide and alternative coagulants and PAC this month.
- 24th Street WTP does not currently use chlorine dioxide.

Desalination

At the IWA LET2010 conference this week in Phoenix, AZ experts from around the world assembled to discuss leading edge technologies. One of the interesting concepts was the use of ion exchange with reverse osmosis to remove cations (calcium, barium), that commonly lead to scale development, with magnesium. The approach does not use external salt because the ion exchange is regenerated with magnesium in the RO retentate. This may be of particular use for hard groundwaters in Arizona. More information can be sought from Prof. Sengupta / Lehigh University.

In desalination of brackish groundwaters in Arizona, one of the major foulants emerges as silica. Unfortunately, no one at the conference had good ideas to control silica. Perhaps we need to look to natural organisms that are often a nuisance. Diatoms are a form of "algae" in our waters. They produce silica structures from silicates in water. Perhaps by understanding how they biologically synthesis solid silica forms, we can learn how to control silicate fouling of membranes.

Another emerging trend was the increasing amount of technologies being developed to recover energy from wastewater. Look for this in the future, and it appears to be beyond biogas development. This may be of particular interest to cities that currently discharge biosolids to 91st avenue WWTP.

Molecular weight of Organics
(By Jun Wang)

SEC-TOC analysis was conducted for all the samples. SEC-TOC chromatograms were shown in Figure 4-3. All the samples had similar molecular weight distributions. The responses at 21kDa (>10kDa region) are indicative of colloidal materials such as polysaccharide, proteins. There are two major sources for colloidal materials in natural water: (1) naturally formed colloidal material generated from the decomposition of plants body; (2) microbial fragments or large molecules discharged by microorganisms in the water. Because the >10kDa region includes void volume of the SEC column (about 21kDa), the peak in this region not only represent the molecules which have MW of 21kDa, but also all molecules with higher MW than 21kDa. The responses in 1kDa~10kDa represent the fulvic-like substances. This portion of organic matter is important because it was reported to be responsible for the formation of many kinds of DBPs. The responses in <1kDa represent hydrophilic materials with small size. The organic matters in this regions are difficult to be removed because their high mobility and small radius.

The averaged molecular weights, polydispersity and integrated areas (%) of three regions for all the samples were summarized in Table 4-2. River and canal samples had maximum averaged molecular weight of 3511Da (Mn: number averaged MW) and 7977Da (Mw:weight averaged MW), minimum averaged molecular weight of 467Da (Mn) and 586Da (Mw). But most samples had similar Mn (1000~2000Da) and Mw (5000~7000Da). The ratio Mw and Mn is referred to as the polydispersivity (ρ) which is a measure of sample heterogeneity (Pelekani et al. 1999). High ρ values (3~6) for river and canal samples were consistent with the fact that NOM are the mixture of complex organic matters with wide range of molecular weights.

Even though the samples had different DOC concentrations, the integrated areas of three regions were similar for all the samples. The organic matters in >10kDa region accounted for 9~17% of the DOC in the water. 59~67% of DOC had the medium MW (1kDa~10kDa). The integrated areas of <1kDa were 20~32%.

The integrated areas confirmed that the major dissolved organic matters in natural water are fulvic-like or humic-like substances with medium molecular weight. High molecular weight molecules only accounts for relatively low percentage of dissolved organic matters because they are easier to be removed by physical-chemical processes occurring in the water. For the low molecular weight molecules, their high biodegradability makes it easy for microorganisms to consume this portion of organic matters.

The integrated areas also showed the treatability of each region in water treatment plants. For three WTPs: UH, SP and GL, the integrated area of >10kDa decreased more than 50% in their effluents. And limited reduction of integrated areas could be observed in 1kDa~10kDa. In comparison, responses in <1kDa showed 50~100% increase. These results indicated that conventional water treatment processes can effectively remove the colloidal materials in the influents. The removal rates of medium size molecules are limited. Most hydrophilic materials with small size can pass through the treatment units, enter the final disinfection processes and cause DBPs formation.

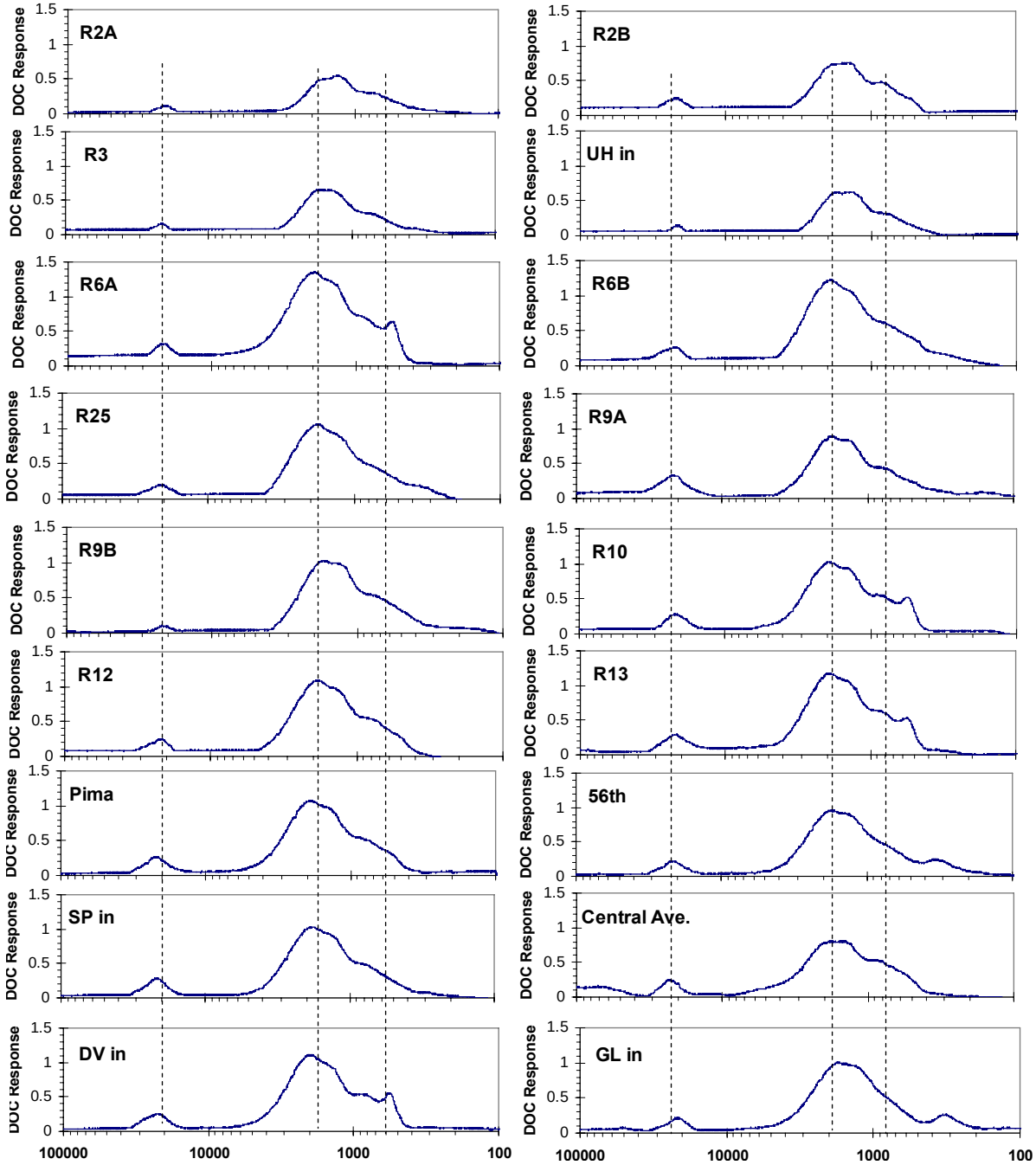


Figure 4-3.SEC-TOC chromatograms of samples collected from CAP canal, Verde River, Salt River and SRP Canal (April 2010)

Table 4-1.General Water Quality of water samples collected form CAP canal, Verde River, Salt River and SRP canal. (April 2010)

Sample		DOC (mg/L-C)	UVA_{254} (cm^{-1})	TDN (mg/L-N)	SUVA (L/mg•m)
CAP*	R2A	3.73	0.078	0.55	2.10
	R2B	3.82	0.078	0.57	2.05
	R3	3.33	0.073	0.52	2.20
	UH in	3.28	0.071	0.53	2.17
	UH out	2.70	0.034	0.50	1.25
Verde River	R6A	5.11	0.177	0.35	3.47
	R6B	5.49	0.180	0.62	3.28
	R25	4.96	0.183	0.65	3.68
Salt River	R9A	4.92	0.126	0.39	2.56
	R9B	4.75	0.129	0.53	2.72
	R10	4.64	0.125	0.36	2.70
SRP**	R12	4.74	0.149	0.47	3.14
	R13	4.81	0.148	0.52	3.07
	Pima	4.76	0.154	0.46	3.24
	56th St.	4.77	0.153	0.51	3.20
	SP in	4.81	0.157	0.56	3.26
	SP out	2.80	0.056	0.48	1.98
	Central Av.	5.10	0.148	0.98	2.90
	DV in	4.85	0.145	1.02	2.99
	GL in	4.90	0.154	0.65	3.13
	GL out	3.01	0.063	0.47	2.08

CAP*: Central Arizona Project
SRP**: Salt River Project

Table 4-2.Averaged molecular weight, polydispersity, and integrated areas of SEC-TOC chromatograms of water samples collected form CAP canal, Verde River, Salt River and SRP canal.

Sample		Mn (Da)	Mw (Da)	ρ	Fraction 1 (>10kDa)				Fraction 2 (1kDa~10kDa)				Fraction 3 (100Da~1kDa)			
					Integrated Area (%)	Mn (Da)	Mw (Da)	ρ	Integrated Area (%)	Mn (Da)	Mw (Da)	ρ	Integrated Area (%)	Mn (Da)	Mw (Da)	ρ
CAP	R2A	1132	4063	3.59	9%	22572	28971	1.28	59%	1596	1934	1.21	32%	615	672	1.09
	R2B	1513	6835	4.52	11%	24489	26520	1.08	63%	1751	2221	1.27	26%	710	752	1.06
	R3	1310	6326	4.83	13%	24398	26687	1.09	63%	1701	2168	1.28	23%	598	683	1.14
	UH in	1345	6738	5.01	15%	24586	26828	1.09	63%	1713	2201	1.29	22%	595	701	1.18
	UH out	1527	4974	3.26	6%	24288	27117	1.12	63%	1596	1987	1.24	31%	592	706	1.19
Verde River	R6A	1537	6862	4.46	14%	24588	26837	1.09	66%	1966	2530	1.29	20%	625	698	1.12
	R6B	1302	5373	4.13	14%	24144	26623	1.10	60%	1843	2272	1.23	26%	590	647	1.10
	R25	1375	5411	3.94	11%	23847	25981	1.09	63%	1785	2204	1.23	26%	663	667	1.01
Salt River	R9A	1153	6428	5.58	17%	25305	30783	1.22	57%	1663	1849	1.11	26%	495	631	1.27
	R9B	955	3324	3.48	7%	22285	23742	1.07	61%	1694	2033	1.20	32%	471	606	1.29
	R10	1395	5512	3.95	13%	23630	26204	1.11	63%	1852	2268	1.22	24%	633	686	1.08
SRP	R12	3511	4023	1.15	11%	23833	25326	1.06	65%	1762	2044	1.16	24%	534	656	1.23
	R13	1402	4955	3.53	11%	21667	23255	1.07	66%	1859	2311	1.24	23%	638	695	1.09
	Pima	1163	4220	3.63	10%	22001	25282	1.15	66%	1827	2204	1.21	24%	486	644	1.33
	56th St.	991	3569	3.60	8%	21887	25480	1.16	62%	1729	2057	1.19	30%	464	594	1.28
	SP in	1347	4450	3.30	10%	22926	25968	1.13	66%	1773	2097	1.18	24%	636	680	1.07
	SP out	467	586	1.25	4%	23522	25569	1.09	46%	1550	1950	1.26	50%	467	586	1.25
	Central Av	1331	7977	5.99	15%	30559	38400	1.26	61%	1814	2218	1.22	24%	575	669	1.16
	DV in	1265	4107	3.25	9%	23029	26492	1.15	67%	1874	2236	1.19	24%	552	665	1.20
	GL in	961	4405	4.59	6%	25164	30329	1.21	63%	1747	2118	1.21	28%	416	582	1.40
	GL out	862	2283	2.65	3%	20328	25854	1.27	55%	1572	1913	1.22	42%	521	630	1.21