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Review of the DWR 60/40 Modeling Rule and Its Implications for Controlling the Low-DO Problem in the DWSC

Kathy Kelly
DWR Modeling

Kathy,

Thanks for your comments on the July 2004 SJR DWSC flow situation. In connection with your statement that, *"Our hydraulic modelers use a 'rule of thumb' flow split of about 60/40, 60% of the Vernalis flow going to Old River and 40% going downstream,"* I have examined the USGS data for SJR at Vernalis and SJR Garwood (which is just upstream of the DWSC) for the last half of July 2004 in order to see how well the 60/40 rule applies to recent conditions. I have recently sent you and others the USGS SJR Garwood data for the month of July, noting that some of the flows in the SJR DWSC were extremely low. I have examined the DWR records ("Delta Hydrologic Conditions") for the last half of July, which are attached (Attachment 1) and available at http://wwwoco.water.ca.gov/cmplmon/reports/hydro.html). These records list the SJR Vernalis flows. Except for two days (July 28 and 29), the SJR Vernalis flows were all above 1,000 cfs, with the highest flow occurring on July 19, of 1,270 cfs. Many of the flows were on the order of 1,100 cfs. The two low days (July 28 and 29) had flows of 973 and 982 cfs. In summary, during the last two weeks of July, the SJR at Vernalis flow was typically around 1,100 cfs. Based on the 75-year USGS record, the 2004 flows are somewhat below the 75-year mean daily flow (see http://waterdata.usgs.gov/nwis/dv?format=gif&period=200&site_no=11303500), but generally above 1,000 cfs. The mean record flow for this period is between 1,200 and 1,300 cfs.

I have attached a copy of the SJR DWSC flows for July (Attachment 2). These data are the same that I recently sent to you and others. Examination of the SJR DWSC flows for the last half of July shows that there was a period in late July where there were three days (July 27, 28 and 29) when the net SJR flow through the DWSC was negative – i.e., upstream to the Head of Old River. During this period none of the Vernalis flow proceeded through the DWSC. There were also several days in late July where the SJR DWSC net downstream flow was a few cfs. It is apparent, at least during late July 2004, that the 60/40 rule does not apply, since all of the SJR Vernalis water was drawn into the South Delta at HOR. Within the South Delta the SJR Vernalis water was either exported by the export projects or consumed by South Delta irrigated agriculture.

Over the past year I have been trying to get an estimate from several members of DWR staff of irrigated agricultural use of water in the Delta. While I understand there is an input-output model for irrigated agricultural use of water in the overall Delta, I have been informed by DWR staff that it is not designed to estimate irrigated agricultural use of water in regions of the Delta.

With respect to the South Delta, Alex Hildebrand indicated that there is about 200 cfs of irrigated agricultural tailwater discharged to South Delta channels during the irrigation season. From some crude estimates based on salt balance on irrigated agriculture EC concentrations in the water taken for irrigation from the Delta channels and the tailwater discharged back to these channels, it is estimated that there is about a 3-to-1 increase in EC concentrations across at least some Delta irrigated agricultural fields. This does not represent an increase in salt load to the Delta channels by irrigated agriculture, but reflects the consumption of water by irrigated agriculture. To the extent that this applies to the South Delta, this could mean that there is on the order of 600 cfs of water being used by irrigated agriculture in the South Delta during the irrigation season. I discussed these issues in a report,

> Lee, G. F.; Jones-Lee, A. and Burr, K., "Results of the August 5, 2003, Tour of the South Delta Channels," Report of G. Fred Lee & Associates, El Macero, CA (2004), http://www.members.aol.com/duklee2307/South-Delta-Tour.pdf

which was sent in draft form to over 50 people for their review and comment. If you or others have better estimates of consumption of water by South and Central Delta irrigated agriculture during the months June through September (i.e., the irrigation season), please bring this information to my attention. It will be helpful in predicting the impact of greater DWSC flows and their associated constituents into the Central Delta.

As I have discussed in my previous writings, there are periods of the year such as in the winter (January, February, March) where essentially all of the SJR Vernalis water is drawn to the export pumps – i.e., there is no irrigated agricultural consumption of water in the South Delta. These very low SJR DWSC flows contribute to the severe low-DO problems that have been found in the SJR DWSC during the winter months. As I have discussed (Lee, 2004; Lee and Jones-Lee, 2004), any further diversions of SJR Vernalis water into the South Delta during these months, such as those that are proposed in the interim DIP, will cause even greater low-DO problems in the DWSC than have been found in the past couple of years under current export operations. Further, once the permanent HOR barrier is installed in 2007, unless this operable barrier is operated to allow most of the SJR Vernalis water to pass through the DWSC, the final DIP and its associated increased project exports will also contribute to further DO problems than have been occurring recently under the current export operations.

The DWR "Delta Hydrologic Conditions" for late July (see Attachment 1) shows that during late July the Tracy pumping plant was pumping on the order of about 4,400 cfs, while Clifton Court pumped from about 6,000 to about 7,100 cfs, for a combined total of about 10,000 to 11,000 cfs. This means that most of the water exported during late July was Sacramento River water drawn to the South Delta by the export projects.

As I have discussed in my previous writings, the reason that the export projects' export of South Delta water through the HOR is strongly adverse to the DO conditions in the DWSC is that it increases the travel time of water and any oxygen demand that enters the DWSC from upstream and local sources (see "Figure 7" attached, from Lee and Jones-Lee, 2003). On the attached figure, the UVM flows are the USGS flow measurements at Garwood. As shown in Figure 7, any SJR DWSC flows (UVM flows) below about 1,000 cfs greatly increase the travel time of water and oxygen demand in the critical reach of the DWSC – i.e., Channel Point to Turner Cut. This becomes especially acute with flows below about 300 cfs, such as occurred during July 2004. Under these flows, even minimal amounts of oxygen demand added to the DWSC (such as would occur in the SJR even without the oxygen demand load contributions from Mud and Salt Slough) will lead to DO depressions in the DWSC below the WQO.

As I indicated in my recent email on July 2004 flows, during July 2004 the DWR RRI DO monitoring station showed that the DO concentrations in the near-surface waters were less than 3 mg/L, with some values as low as 2 mg/L. Any DO concentration at any time below 5 mg/L is a violation of a water quality objective and is recognized as being harmful to aquatic life populations, including fish. DO concentrations below about 3 mg/L are known to be toxic/lethal to some forms of aquatic life, including some forms of sensitive fish.

As discussed in previous correspondence, SJR DWSC flows above about 1,500 cfs shorten the travel time for exertion of oxygen demand in the critical reach to a few days, with the result that most of the oxygen demand added to the SJR upstream of the DWSC will be transported through the critical reach into the Central Delta via Turner Cut, and thereby greatly reduce and may eliminate most of the DO problems that occur in the DWSC. This is especially true since the city of Stockton has agreed to limit their wastewater ammonia discharges to 2 mg/L. As I have discussed, from the studies that we conducted in 2003, transporting the algal-related oxygen demand into the Central Delta under most and possibly all conditions does not lead to low-DO problems in this area because the DWSC water that enters Turner Cut is mixed with low-oxygen-demand Sacramento River water. Further, the algae that are present in the DWSC water that passes into Turner Cut will add to the Central Delta food web that is being adversely impacted by the export projects' bringing low-nutrient Sacramento River water through the Central Delta. All of these issues have been discussed in detail in my previous writings, which are on my website in the San Joaquin River Watershed section (http://www.gfredlee.com/psjriv2.htm).

Therefore, in order to readily eliminate avoidable costs of aeration of the DWSC, the interim DIP, which allows an increase in export of South Delta water before the permanent HOR barrier is in place, should not be implemented. Further, once the HOR permanent barrier is in place, it should be operated to allow only minimal flows of SJR Vernalis water into the South Delta at HOR. Continuing the 60/40 split when it actually occurs after the permanent HOR barrier is in place will cause greater DO depletion in the DWSC than is necessary. It is important to note that passing as much of the SJR Vernalis water through the DWSC as possible does not limit in any way the ability of the export projects to export South Delta water to Central and Southern California and to the Bay Region. The difference is that the path that the SJR Vernalis water takes is through the DWSC to Turner Cut, then into the Central Delta and then to the South Delta, rather than through Old River at HOR.

Again, thanks for your comments. They helped bring out the issues that need to be properly evaluated in implementing the DIP.

Fred

References

Lee, G. F., "SJR DWSC DO for 2004," Report of G. Fred Lee & Associates, El Macero, CA, July (2004).
http://www.members.aol.com/duklee2307/SJR-DWSC-DO-Flow-Jan-July-2004.pdf

Lee, G. F. and Jones-Lee, A., "Synthesis and Discussion of Findings on the Causes and Factors Influencing Low DO in the San Joaquin River Deep Water Ship Channel Near Stockton, CA: Including 2002 Data," Report Submitted to SJR DO TMDL Steering Committee and CALFED Bay-Delta Program, G. Fred Lee & Associates, El Macero, CA, March (2003).
http://www.gfredlee.com/SynthesisRpt3-21-03.pdf

Lee, G. F. and Jones-Lee, A., "Comments on the CBDA Delta Improvements Package," Comments submitted to California Bay-Delta Authority by G. Fred Lee & Associates, El Macero, CA, June (2004). http://www.members.aol.com/apple27298/DIPcomments.pdf

Attachment 1

California Department of Water Resources -- Division of Operations and Maintenance -- Operations Control Office

Delta Hydrologic Conditions

Date	Sacramento River + SRTP	Yolo Bypass	East Side	San Joaquin River	Rainfall	Clifton Court Intake	Tracy Pumping Plant	CCWD total	Barker Slough Pumping	BBID

07/12/2004	21379	0	254	1178	0.00	7172	4355	252	108	21
07/13/2004	21690	0	257	1100	0.00	7169	4349	246	113	57
07/14/2004	21750	0	267	1084	0.00	7151	4359	326	109	50
07/15/2004	21826	0	265	1070	0.00	7170	4345	426	110	51
07/16/2004	21747	0	258	1022	0.00	7175	4355	421	118	45
07/17/2004	21696	0	249	1065	0.00	7153	4352	427	109	38
07/18/2004	22031	0	241	1153	0.00	6993	4371	425	108	38
07/19/2004	22039	0	240	1270	0.00	6949	4388	430	108	55
07/20/2004	21940	0	242	1257	0.00	7004	4356	433	105	44
07/21/2004	21335	0	237	1215	0.00	6607	4389	435	117	50
07/22/2004	20482	0	238	1182	0.00	7147	4438	431	120	51
07/23/2004	20105	0	268	1151	0.00	6989	4331	435	124	63
07/24/2004	20715	0	274	1091	0.00	6642	4492	436	113	50
07/25/2004	20976	0	280	1114	0.00	7142	4560	372	108	50
07/26/2004	20383	0	282	1148	0.00	7180	4572	248	110	72
07/27/2004	20123	0	259	1009	0.00	7175	4581	248	110	75
07/28/2004	20305	0	247	973	0.00	6675	4409	244	117	75
07/29/2004	20518	0	246	982	0.00	6677	4675	248	120	67
07/30/2004	20194	0	256	1016	0.00	5990	4321	242	118	55
07/31/2004	20040	0	267	1071	0.00	6489	4340	243	108	50
08/01/2004	19645	0	256	1100	0.00	6677	4335	244	110	50
08/02/2004	19342	0	251	1140	0.00	6398	4272	243	101	74
08/03/2004	19657	0	250	1076	0.00	6830	4410	241	97	12
08/04/2004	19436	0	239	1090	0.00	7177	4516	248	101	39
08/05/2004	19476	0	225	1090	0.00	7170	4488	240	102	51
08/06/2004	19385	0	225	1091	0.00	5677	4432	258	111	74
08/07/2004	19187	0	236	1084	0.00	5670	4438	261	113	50
08/08/2004	18850	0	247	1114	0.00	5679	4423	252	112	50
08/09/2004	18665	0	251	1109	0.00	5675	4403	257	111	0
08/10/2004	18602	0	253	1037	0.00	5780	4433	254	109	58
08/11/2004	18474	0	261	1021	0.00	5773	4484	249	110	57

Sacramento River - cfs, flow measured at Freeport plus Sacramento Treatment Plant effluent.
Yolo Bypass - cfs, combined measurements of Cache Creek at Rumsey, Freemont Weir, and Sacramento Weir.
East Side Streams - cfs, combined stream flows of Consumnes River at Michigan Bar, Mokelumne River at Woodbridge, misc. streams estimated from Dry Creek at Galt, and Calaveras River based on releases from New Hogan Dam.
San Joaquin River - cfs, flow measured at Vernalis.
Rainfall - inches, precipitation measured at Stockton Fire Station #4.
All export facilities' flows are in cfs.

For more information call Operations Compliance and Studies Section at (916) 574-2655
mailto:hinojosa@water.ca.gov
http://wwwoco.water.ca.gov/cgi-bin/index.pl

Operations Compliance and Studies Section **PRELIMINARY DATA** 08/12/04 7:05:52 AM
Page 1 of 2

Attachment 2

File Generated On: 09-Aug-2004 16:03:07
File Created By: Catherine Ruhl
Data saved to file: W:\DataDrive\Data Requests\huber\stk_2004_07_prelim.dat

Station: San Joaquin River at Garwood Bridge (Stockton)
Postive Direction: North towards confluence

Column 1: Date and Time Stamp: YYYY/MM/DD HH:MM
Column 2: Tidally Averaged Discharge, Daily Flow Estimate, cfs
Column 3: Comments

"2004/07/01", 448,
"2004/07/02", 334,
"2004/07/03", 324,
"2004/07/04", 429,
"2004/07/05", 467,
"2004/07/06", 432,
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"2004/07/08", 270,
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"2004/07/11", 275,
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"2004/07/13", 110,
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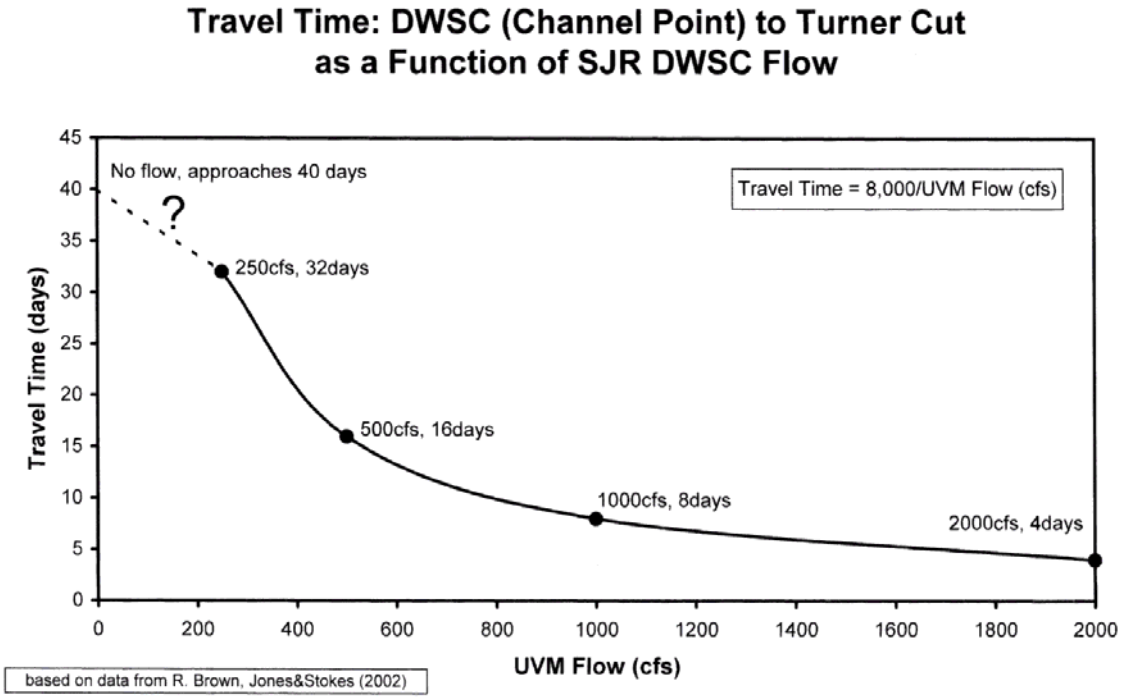
"2004/07/15", 106,
"2004/07/16", 36,
"2004/07/17", 67,
"2004/07/18", 234,
"2004/07/19", 278,
"2004/07/20", 339,
"2004/07/21", 338,
"2004/07/22", 288,
"2004/07/23", 330,
"2004/07/24", 225,
"2004/07/25", 292,
"2004/07/26", 2,
"2004/07/27", -188,
"2004/07/28", -121,
"2004/07/29", -27,
"2004/07/30", 52,
"2004/07/31", 193,

Figure 7


Travel Time: DWSC (Channel Point) to Turner Cut
as a Function of SJR DWSC Flow
No flow, approaches 40 days
?
Travel Time = 8,000/UVM Flow (cfs)
250cfs, 32days
500cfs, 16days
1000cfs, 8days
2000cfs, 4days
Travel Time (days)
UVM Flow (cfs)
0
5
10
15
20
25
30
35
40
45
0
200
400
600
800
1000
1200
1400
1600
1800
2000
based on data from R. Brown, Jones&Stokes (2002)