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BEFORE THE

CALIFORNIA STATE WATER RESOURCES CONTROL BOARD

HEARING IN THE MATTER OF CALIFORNIA DEPARTMENT OF WATER RESOURCES AND UNITED STATES BUREAU OF RECLAMATION REQUEST FOR A CHANGE IN POINT OF DIVERSION FOR CALIFORNIA WATER FIX	**SUR-REBUTTAL TESTIMONY OF PARVIZ NADER-TEHRANI**

I, Parviz Nader-Tehrani, do hereby declare:

My sur-rebuttal testimony is in response to rebuttal testimony submitted by the Cities of Antioch (Antioch-301 and Antioch-302) and Stockton (STKN-026) and South Delta Water Agency, et al. (SDWA-257).

A. City of Antioch

1. **CWF scenarios H3, H4 and Boundary 2 result in similar or fewer number of days with chloride concentrations greater than 250 mg/L at Antioch, compared to the No Action Alternative. CWF scenario Boundary 1 is not representative of scenarios H3, H4 and Boundary 2.**

Dr. Paulsen focuses the main part of her rebuttal testimony on Boundary 1 scenario, even though during the cross-examination she stated that she has looked at model results for all CWF operational scenarios. As an example, in Antioch Exhibit 302,

Table 11 page 34, Dr. Paulsen has listed the number of days per year water is considered not usable at Antioch intake per description from the 1968 Agreement. Table 11 only shows results for Boundary 1 in comparison to NAA and EBC2 scenarios. I have created Table 1 below, showing number of days in each water year simulated (1976-1991) where the daily average chloride concentration is above 250 mg/l. In terms of comparison to the exceedance this threshold, it is clear that all CWF operational scenarios except Boundary 1 show similar or better water quality results in comparison to NAA for most years. The only exception is 1988 where H3 and H4 show a higher number of days (by at least 5 days) where the 250 mg/l daily average chloride concentration is exceeded. It should be mentioned that exceedance of the 250 mg/l chloride concentration at Antioch is not considered an exceedance of the D-1641 water quality objective provided that this threshold is met at Contra Costa Canal.

Table 1- Number of days in each water year, where the 250 mg/l daily average chloride concentration is not met at the City of Antioch Intake. Red color shading indicates an increased exceedance of the 250 mg/l threshold by 5 days or more in a given water year relative to NAA. Green color shading indicates a reduced exceedance of the 250 mg/l threshold by 5 days or more in a given water year relative to NAA.

WY	NAA	B1	H3	H4	B2
1976	262	356	250	244	161
1977	365	365	365	365	363
1978	196	198	174	173	163
1979	205	214	199	201	167
1980	189	203	168	164	148
1981	264	268	251	254	198
1982	119	150	108	107	99
1983	0	3	0	0	0
1984	90	148	84	81	80
1985	190	245	164	157	141
1986	182	209	183	183	147
1987	218	288	182	184	150
1988	288	313	311	311	271
1989	271	272	272	272	211
1990	313	314	297	296	281
1991	309	314	312	312	310
Total	3461	3860	3320	3304	2890

When looking at the full 16-year simulation period, the total number of days of exceedance of the 250 mg/l daily average chloride concentration at City of Antioch is lower under H3, H4, and Boundary 2 scenarios relative to NAA as indicated in the table above.

I have shown previously that the 250 mg/l and the 150 mg/l daily average chloride concentration D-1641 water quality objectives at Contra Costa Canal are met at similar or higher probability for all CWF operational scenarios (See DWR 513, Figures C5-C6 pages 9 and 10). I have also shown in DWR Exhibit 79 (see Pages 5-10) that increases in chloride concentration at Antioch under Boundary 1 scenario compared to the No Action Alternative is mostly because Boundary 1 did not include the USFWS Fall X2 criteria unlike the No Action Alternative.

2. Effect of CCWD Settlement Agreement on water quality at Antioch was fully analyzed in the Final EIR/EIS for the CWF.

During cross-examination Dr. Paulsen responded that she did not have enough information available to determine whether there would be impacts due to the CCWD settlement agreement related to the CWF (Volume 47, at 108:16-108:21). Also, Dr. Paulsen incorrectly presumed that the analyses included in the CWF FEIRS Appendix 31B was based on the analysis presented in Exhibit DWR-512. On similar lines, Dr. Paulsen responded to Mr. Jackson inaccurately that there wasn't information presented for Collinsville location (Volume 47, at 161:11-161:18).

Dr. Paulsen is wrong in her assertions that there was not enough information presented in the FEIRS with respect to the effects of the CCWD settlement agreement on the salinity at these locations. Contrary to what Dr. Paulsen said, the FEIRS included detailed salinity results at Antioch, Collinsville, Rock Slough, Port Chicago, Mallard Slough, Emmaton, Jersey Point and Rio Vista locations. Appendix 31B of the FEIRS presented monthly exceedance plots of electrical conductivity at Antioch location for Alternative 2D, 4A, and 5A (see Figures 167, 168 and 169 in Section 31B-2.3.6.5 *Antioch* of the FEIRS).

These plots are included below as Figures 1a, 1b, 1c and 1d, for Alternative 4A. Each curve in these plots includes 16 data points representing results for 16 individual years.

As noted in the Appendix 31B, the CCWD settlement agreement for CWF was analyzed using two options to cover the range of operations that could result with the settlement agreement. The detailed analyses presented in Appendix 31B show how the CVP-SWP system operations (storage, diversions, flows) and Delta hydrodynamics (water levels and flows) and salinity would be affected due to the settlement agreement. The appendix describes in detail how the analyses were conducted in section 31B.2.3 *Settlement Agreement Operations* of the FEIRS. The results included in Appendix 31B compare the Alternatives with the settlement agreement (Mitigation through Freeport intake and Mitigation through BDCP/CWF intakes in the figures) with the Alternatives without the settlement agreement (without Mitigation in the figures).

Salinity results for Antioch included in Figures 1a through 1d, show conclusively that including CCWD settlement agreement in the Alternative 4A has minimal to no effect on the salinity at this location. Even though Dr. Paulsen refers to Appendix 31B from the FEIRS (Antioch-301), it appears that Dr. Paulsen did not fully review the information included in this appendix, and arrived at incorrect conclusions about the effects of the CCWD settlement agreement.

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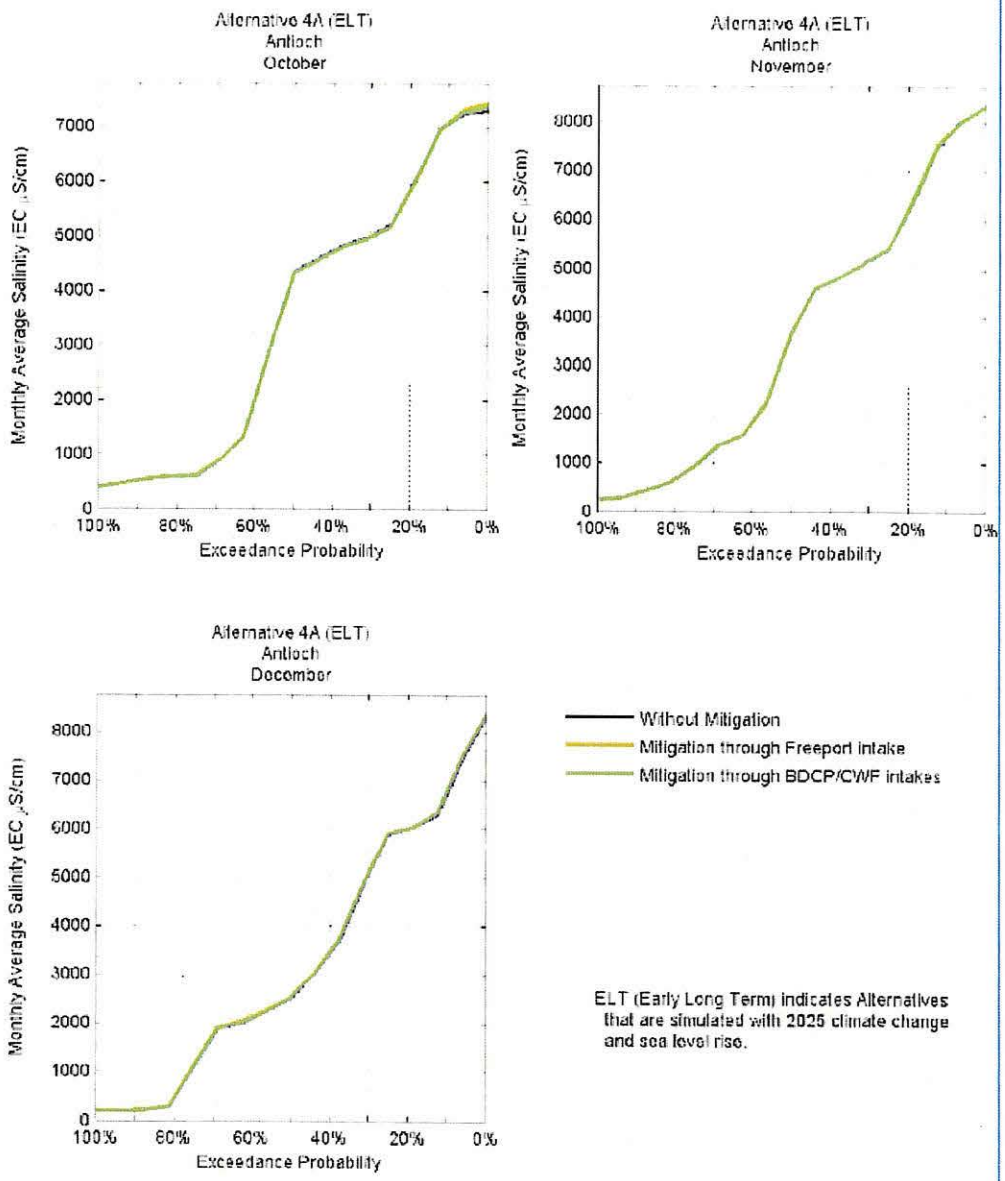
Figure 1a: Probability of exceedance of monthly salinity at Antioch for Alternative 4A (ELT) during October, November, and December.

Alternative 4A (ELT)

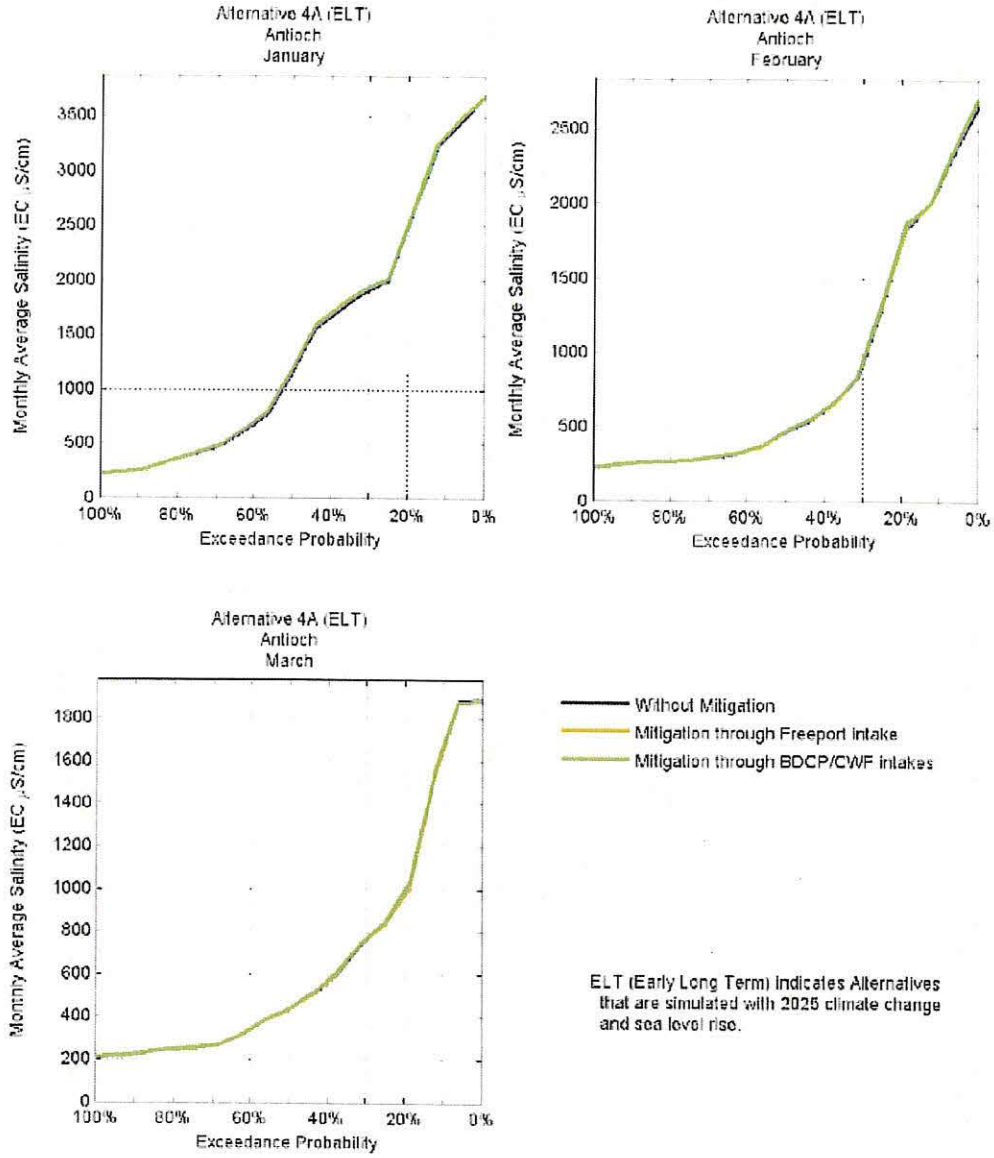
Figure 168 Exceedance Probability for Antioch Salinity for Alternative 4A (ELT)



Bay Delta Conservation Plan/California WaterFix
Final EIR/EIS
31B-2-541
2016
ICF 00139.14

Figure 1b: Probability of exceedance of monthly salinity at Antioch for Alternative 4A (ELT) during January, February, and March.

(continued)



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Final EIR/EIS
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B. City of Stockton

1. Dr. Paulsen used data from previous versions of the EIR/S that do not apply to California WaterFix.

In Stockton Exhibit 26, Page 29 through 32 Dr. Paulsen cites results from FEIR/EIS for a number of Alternatives including Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3,4,5,6A, 6B, 6c, 7,8,9, 4A, 2D, and 5A. Specifically on Page 31, Dr. Paulsen states:

> DWR found that Alternatives 1A, 1B, 1C, 2A, 2B, 2C, 3, 4, 5, 6A, 6B, 6C, 7, 8, and 9 would have significant adverse impacts with respect to chloride concentrations at the Contra Costa Pumping Plant #1 (FEIR/EIS Figure 8-0a). Only Alternatives 4A, 2D, and 5A were found to have no significant impact/no adverse effects (FEIR/EIS Figure 8-0a). Thus, operation of the Project to Boundaries 1 and 2, which DWR states are represented by scenarios 1A, 3, and 8, would also have significant/adverse impacts.

Similarly, in Antioch 302 page 43, Dr. Paulsen cites FEIRS Appendix 5E, which identifies that the impacts of Boundary 1 fall within the range of impacts for Alternative 1A and 3. In both exhibits referenced above she goes on to point out that Boundary 1 should also have the same impact as Alternative 1A and 3. However, Dr. Paulsen does not provide a complete summary of the information presented in the FEIRS Appendix 5E as to why the impact conclusion for salinity is less than significant unlike Alternative 1A and 3. Dr. Paulsen fails to discuss a very important and pertinent point contained within the information she reviewed that all alternatives she cites, except for Alternatives 4A, 2D, and 5A, were assumed to include 65,000 acres of restoration. Furthermore, all these alternatives, except for Alternatives 4A, 2D, and 5A, were simulated at LLT (Late Long Term, 2060 climate change and 45 cm of sea level rise). Dr. Paulsen's testimony based on that analysis is wrong.

The FEIR/EIS clearly explains that the primary reason for the water quality degradation (especially in Western Delta) for these alternatives was the inclusion of the 65,000 acres of restoration, which was the conservation measure 4 (CM4) of the BDCP (FEIRS Appendix 5E pages 5E-172 to 5E-173). Given that the BDCP CM4 restoration was

no longer part of the CWF, it is unreasonable to associate the effects of restoration to the CWF Alternatives without the CM4 restoration. CWF Alternatives 4A, 2D and 5A were simulated at ELT (Early Long Term, 2025 climate change, 15 cm sea level rise) and did not include any restoration areas. The effect of restoration on the salinity conditions in the Delta is discussed in detail in the DEIRS Appendix 5A and FEIRS Appendix 5A, as well as in the FEIRS Appendix 8H Attachment 1. As Dr. Paulsen indicated, none of the three CWF alternatives 4A, 2D and 5A show any significant impacts or adverse effects with respect to chloride concentrations at the Contra Costa Canal. To be clear, when it comes to the incremental changes in water quality at Contra Costa Canal due to CWF, there is no similarity between Boundary 1 or 2 and Alternatives 1A, and 3 contrary to what Dr. Paulsen claims.

2. Dr. Paulsen, in her testimony for Stockton (STKN-26) overestimated the chloride concentrations at the City's intake location, and the effects of CWF scenarios on the City of Stockton's operations.

As has been mentioned before, DSM2 simulates water quality in terms of electrical conductivity (EC). A number of cities operate based on specific chloride concentration. One way to get estimates for chloride concentrations is to use appropriate EC to chloride conversions. In Stockton Exhibit 26, Dr. Paulsen used Guivetchi (1986) (Exhibit Antioch 205) to estimate chloride concentrations:

$$CL = -28.9 + 0.23647 \times EC$$

In Antioch 205, page 6 of PDF, there is a map showing locations for which EC-Chloride conversions were made available (See Figure 2 for a more detailed portion of the map):

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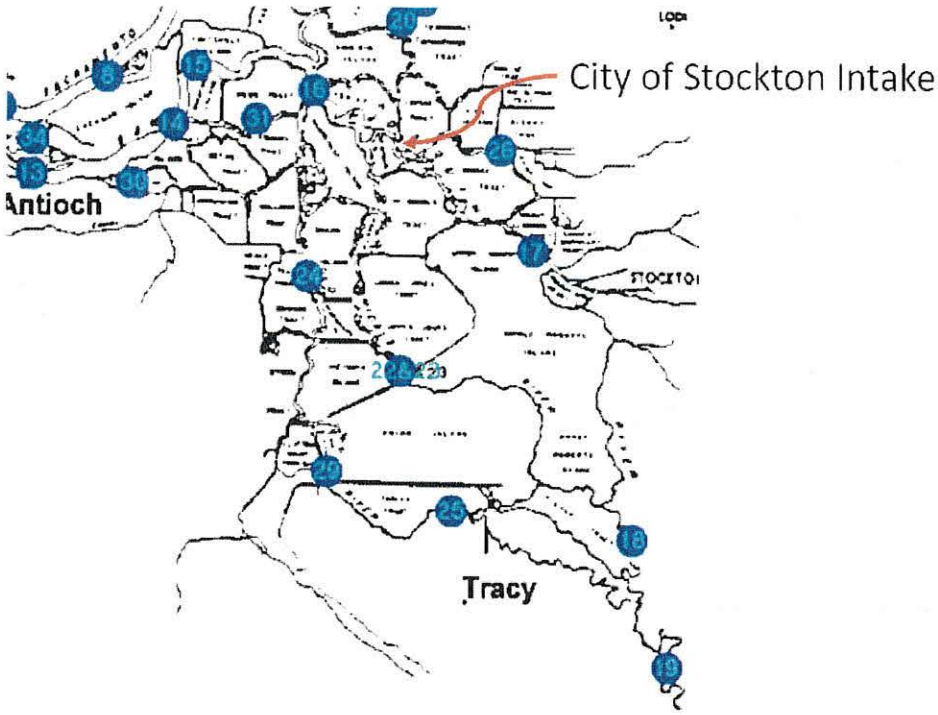

Figure 2 – Selected Locations for which EC-Chloride Conversion Equations are presented in Guivetchi (1986)

As can be seen, there is no location available right at the City of Stockton Intake. Upon closer examination, I found out that Dr. Paulsen has used the EC-Chloride conversion equation corresponding to the station labeled 16 (RSAN035), which is downstream of the Stockton's intake location. Another choice Dr. Paulsen could have made was station 17 (RSAN056), which is just upstream of the Stockton's intake location:

CL= -17.07 + 0.182888 EC

When you compare the EC-Chloride conversion equation for stations 16 and 17, you will find that there is a noticeable difference in the estimates of chloride concentration for the same EC values. As an example, let's assume that for a given day, the daily average EC is 650. If we use the equation Dr. Paulsen used (Station 16), you will get chloride concentration of 124.8 mg/l and if you use equation for station 17, you will get 101.8 mg/l.

That represents a 22% difference. One would overestimate the chloride concentrations at City of Stockton's intake if one uses the equation that Dr. Paulsen used. This is extremely important as Dr. Paulsen uses an absolute preference of 110 mg/l daily average at city of Stockton Intake to establish an impact to the city's operation.

It is also important to note that in general as you get closer to the San Francisco Bay, one would find a higher ratio of Chloride to EC. As an example, at San Joaquin River at Jersey Point (Station labeled 14 in Figure 1), the suggested EC to Chloride conversion in Guivetchi (1986) is

$$CL = -43.11 + 0.284828 \times EC$$

So for the same example used before (EC=650) one would obtain a chloride concentration of 142 mg/l which is substantially higher than those obtained for stations in the vicinity of the City of Stockton Intake.

In Stockton-26, Dr. Paulsen included a discussion on the difference in water quality at Buckley Cove and the City of Stockton Intake. On Figure 3, Page 20, Dr. Paulsen showed computed chloride concentration at Buckley Cove during water year 1981. It appears that Dr. Paulsen used the same EC-Chloride conversion equation for Buckley Cove (in proximity of Station 17) as she did for City's intake (Station 16). I believe this is a completely incorrect choice, as Buckley Cove is actually very close to Station 17 (See Figure 1, earlier page). Earlier I demonstrated that the results can be overestimated by more than 20% when the conversion equation for station 16 is used to estimate chloride concentration at a location near Station 17. There are other examples where Dr. Paulsen calculates chloride concentration at Buckley Cove. Examples include Figure 8, Page 25, and multiple Figures in Appendix C including PDF pages 72 through 76 and pages 94 to 98. I believe Dr. Paulsen's estimates of chloride concentration at Buckley Cove are overestimated and any analysis and conclusions presented in her testimony based on these results are therefore flawed.

In Stockton Exhibit 26, Pages 33-34 (See STKN-026 Figure 9), Dr. Paulsen makes

the point that CWF scenarios increase the contribution of San Joaquin River (See STKN-026 Figure 9, Page 34 a dry water year example) at Stockton's intake location. She also shows the contribution from Martinez in STKN-026 Figure 9, but the scale Dr. Paulsen used is too small to really detect any changes. My Figure 3 shows the Martinez volumetric contribution at City of Stockton's Intake computed using DSM2 finger-printing analysis based on long term monthly averages for 1976-1991 in a finer scale. It is clear to see that for H3, H4, and Boundary 2 scenarios, the volumetric contribution from Martinez representing seawater intrusion is reduced relative to NAA during all months.

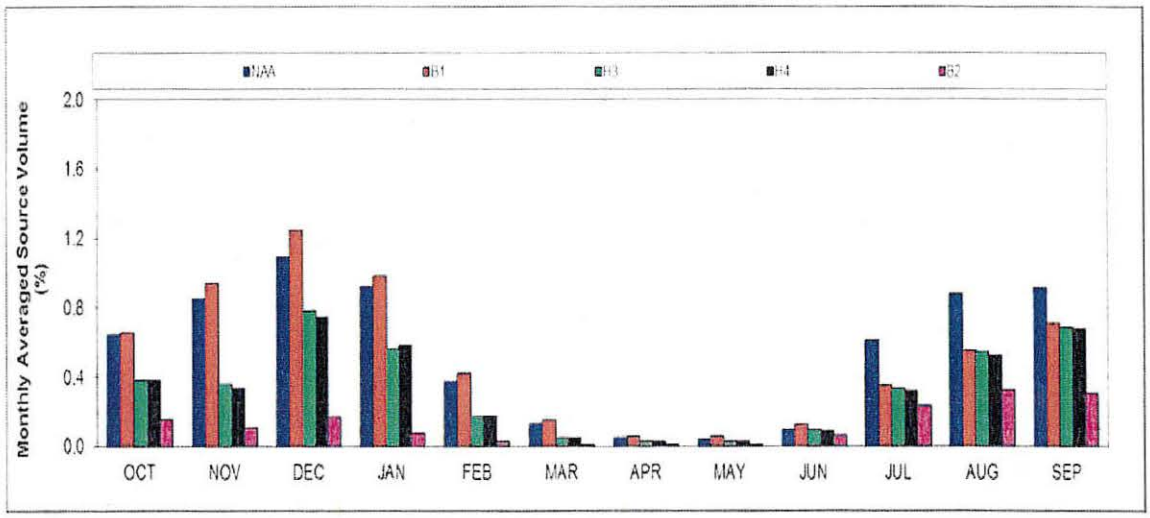

Figure 3- Source Water Finger-Print from Martinez Long Term Monthly Average (1976-1991) at City of Stockton's Intake Location

Based on this information, it is my opinion that EC to Chloride relationship for City's intake under H3, H4, and especially for Boundary 2 would be closer to that of Guivetchi's Station 17 than Station 16. Thus the conversion equation that Dr. Paulsen used in her testimony is incorrect and her results are flawed.

Figures 4 and 5 show the probability of exceedance for chloride concentration at City of Stockton's intake based on EC to Chloride conversion equations for stations 16 and 17. Results from Figure 4 (based on EC-Chloride conversion for Station 16) suggest that 10 to 14% of times chloride concentrations can exceed 110 mg/l (110 mg/L is the

preference that Dr. Paulsen used in her testimony for Stockton in STKN-26). However, results from Figure 5 (based on EC-Chloride conversion for Station 17) suggest that only about 3 percent of times chloride concentrations can exceed 110 mg/l. Because of the fact that under H3, H4 and Boundary 2 there is expected to be a lower Martinez and higher San Joaquin River volumetric contribution, it is my opinion that results shown in Figure 4 better represent the expected chloride concentrations at the City of Stockton Intake for H3, H4, and Boundary 2 scenarios (subject to the issues related to modeling anomalies I had discussed earlier in my case-in-chief testimony).

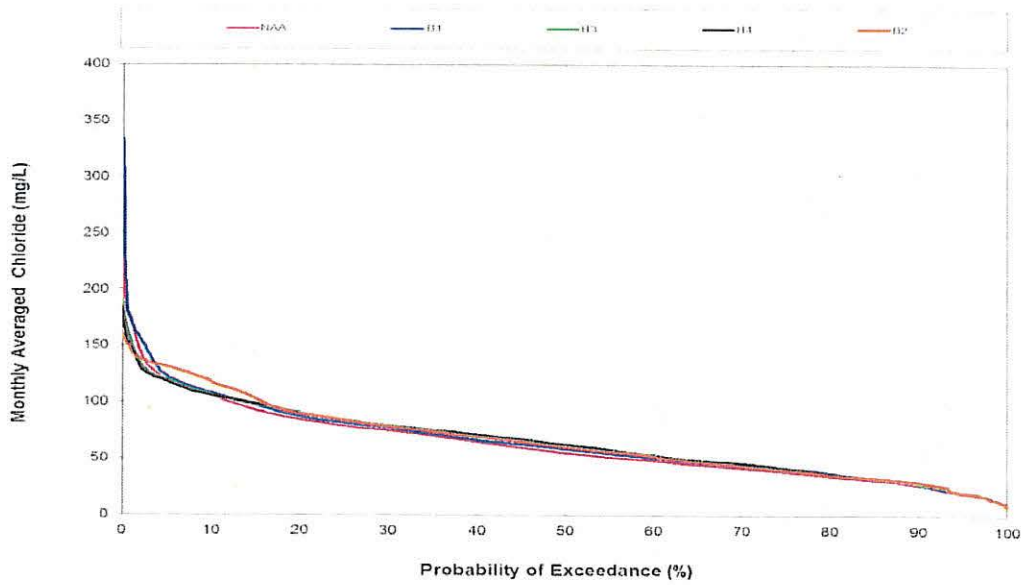

Figure 4- Probability of exceedance for daily average chloride concentration at the City of Stockton's intake using EC-Chloride conversion equation for Station 16

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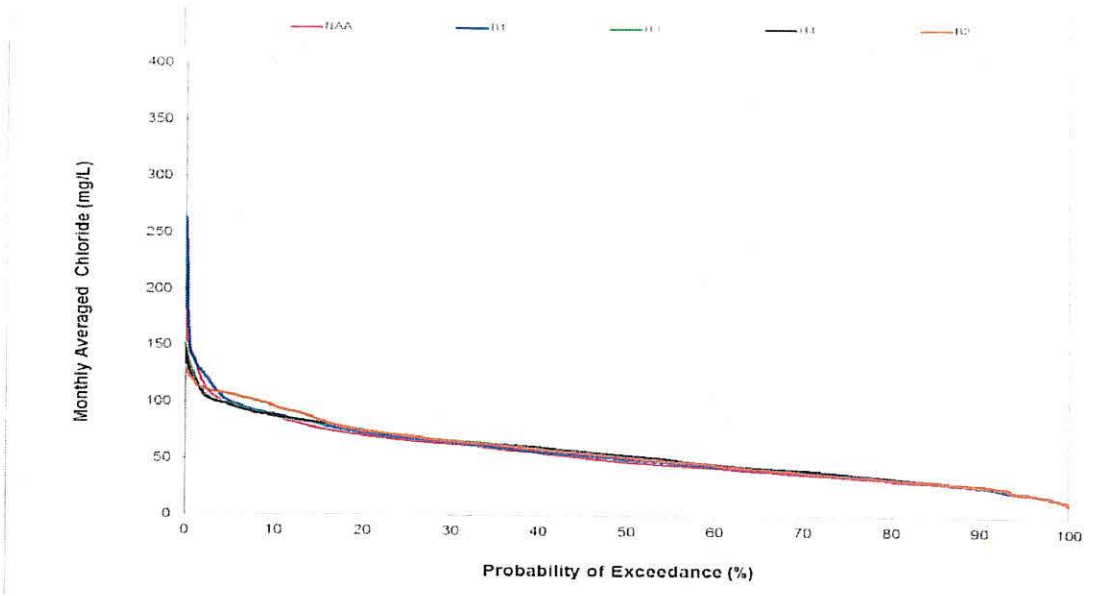

Figure 5- Probability of exceedance for daily average chloride concentration at the City of Stockton's intake using EC-Chloride conversion equation for Station 17

So, in summary, it is my belief that the choice Dr. Paulsen made for the EC-Chloride conversion at City of Stockton's intake has a tendency to overestimate the chloride concentrations, and the effects of CWF scenarios on the City of Stockton's operations.

3. Dr. Paulsen's Finger-Printing Analysis at Buckley Cove is Flawed.

On page 21 of Stockton Exhibit 26, Dr. Paulsen explains that she reran DSM2 to perform a finger-printing analysis for City of Stockton Intake and Buckley Cove. It appears that the finger-printing results for Buckley Cove are incorrect. As an example, STKN-26 Figure 5 on page 23 shows the volumetric contribution for all major sources at Buckley Cove for NAA and EBC2 (EBC2 is NAA without climate change and sea level rise). According to this Figure, there is a lower contribution from San Joaquin River under NAA compared to EBC2 for most months. It also shows that there is a lower volumetric contribution from Agricultural Drainage for the months of July through August under NAA compared to EBC2. If this is correct, then I would have expected an increase in

volumetric contribution for either Sacramento River or Martinez for NAA relative to EBC2, since the total volumetric contribution for all sources combined would have to add up to 100%. Instead, the results show no change in Sacramento River or Martinez volumetric contribution, which clearly show that the results cannot be accurate. Dr. Paulsen presents and discusses the finger-printing analysis at Buckley Cove throughout the report, and all the Figures I saw, seem to be incorrect, and therefore any analysis using this information would be considered questionable. Examples include, Figures (no figure numbers shown) in PDF pages 62 through 65.

C. South Delta Water Agency, et al.

Mr. Burke presents DSM2 results for water level reductions throughout South Delta for all the locations marked in Figure 1 in SDWA Exhibit 257 as shown below:

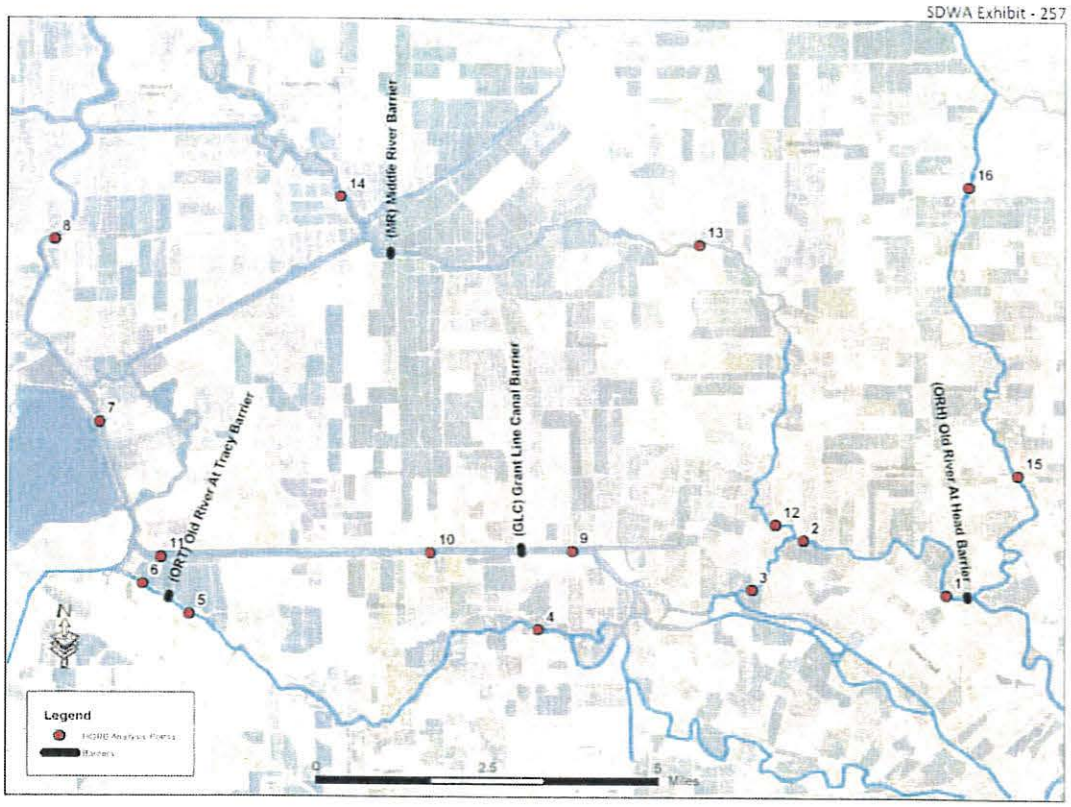

Figure 1 Location of Analysis Points

HORB Impact Analysis

Page 5

It is my opinion that any water level changes observed in South Delta is mainly attributed to a difference in the operation of Head of Old River Gate under CWF scenario Alt 4A compared to the NAA. In other words, the water levels in South Delta are not directly affected by the proposed North Delta diversions.

Here are a number of comments I have with regards to information presented by Mr. Burke in his testimony (Exhibit SDWA 257):

1. I believe Mr. Burke is using DSM2 model results in an inappropriate manner where he presents a daily time-series of water level changes between Alt 4A and NAA at a number of locations. Examples include Figure 2 (Page 6), Figure 3 (Page 7) and Figures (No Figure number) in PDF pages 35, 37, and 39.

2. Mr. Burke shows stage difference probability plots at locations throughout the Delta. One example is shown below (Exhibit SDWA-257, Figure 4, page 8). There are two main issues with this figure:

a. This figure is incomplete and only shows the reduction in water levels for the months where the head of Old River gate operation is different between Alternative 4A and NAA. It specifically excludes June 16 through September 16, which are considered prime irrigation months.

b. This Figure by itself does not provide much value as it does not indicate whether the relative reductions in water levels occur during the times when water levels are high or low. The actual water levels matter in determining any alleged impact. It would be best to show probability plots based on the actual water levels and not the reduction in water levels, as one would readily see the extent of water level reductions in relation to actual water levels. This later method is how the Petitioners presented the data.

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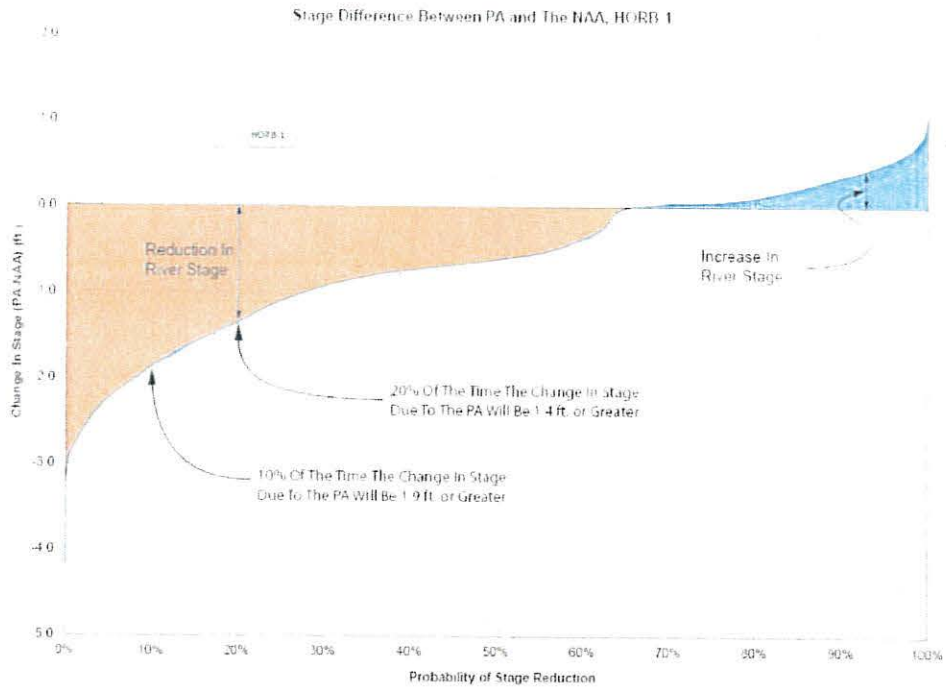

Figure 4 Stage Difference Probability Plot for Site HORB-1

HORB Impact Analysis Page 8

3. The largest reductions in water level are reported at locations labeled HORB1 and HORB2 (Stations 1 and 2 in SDWA-257 Figure 1). Based on conversations I have had with Mark Holderman, Chief of the south Delta Branch at the Department of Water Resources, there have rarely been any complaints by local farmers in the area regarding water levels in this stretch of the river.

4. Other than at locations labeled 1, 2, 3, and 12 in Figure 1, SDWA 257, downstream and closest to the proposed Head of Old River Gate, the reductions in water level under Alt 4A relative to NAA are quite low. In my case-in-chief testimony (DWR 513, Figure W5, Page 15) I showed that the changes in water level based on probability distribution at Old River at Tracy Road (near station labeled 4) for all CWF operational scenarios relative to NAA were negligibly small.

5. On Page 22, Section 7.3, Mr. Burke discusses the subject of impacts of flushing flow on water quality, and yet Mr. Burke does not show a single water quality plot. In my testimony (DWR 513, Figures EC5 and EC6, page 3), I presented water quality plots at Old River at Tracy Road and at San Joaquin River at Brandt Bridge. I only noticed some increases in EC at Old River Tracy Road for Boundary 2 scenario for the months of March through May. I also explained that these increases are due to the assumption that the Head of Old River Gate was completely closed for those three months under Boundary 2 scenario. I also explained that based on the information provided in the CWF BA (SWRCB-104 Chapter 3, section 3.3.2.3), the actual Head of Old River Gate operation will be based on water quality and fish presence in real time. Due to difficulties in modeling fish presence, certain assumptions had to be made in DSM2 with regards to operation of the Head of Old River Gate. Contrary to Mr. Burke's statements in response to cross-examination as to his lack of knowledge of gate operations (May 18, 2017 Transcript, Vol. 45, at 191:3-191:15), for the Alternative 4A that Mr. Burke presented in SDWA 257, the Head of Old River Gate was modeled to allow 50% of the flow that would have entered with the Gate completely open, based on the assumptions from the fish agencies (SWRCB-104 Appendix 5B). The modeled operations of the Head of Old River Gates represent the consensus thinking by the Petitioners and the Fishery Agencies as to the likely operations, which include a commitment to adjusting the gates in real-time for fish presence and water quality concerns.

6. The NAA includes the anticipated regulatory framework based on the 2008 USFWS Biological Opinion, which does not include installation of the head of Old River barrier in the Spring. On Page 2, Table 2, Mr. Burke claims that the modeling for CWF NAA included the head of Old River Spring barrier operation (April 16 – May 15). This is in fact incorrect. As noted in the DWR-515 Table 4, the NAA is modeled with the head of Old River barrier only installed in the fall months per 2008 USFWS Delta Smelt BiOp Action 5 in the NAA and not installed in April or May. Based on information I received from Mark

Holderman (Exhibit DWR-942), there has been a Spring head of Old River barrier installed since 1992, but not necessarily every year. Since the Biological Opinions have been issued, the Spring head of Old River barrier has continued to be installed in several years at the request of the fisheries agencies, starting from late March to early April with removal occurring in June (total length of operation about 2 months). It is my opinion that the local farmers in the area have experienced conditions under a spring barrier for many years now. The result of this distinction between the modeling assumptions and actual operations is that the modeling results are conservative and represent, in my opinion, larger reductions in water levels than what will likely occur under California Water Fix during April and May. In other words, the modeled water levels would be noticeably lower in the NAA if the Spring head of Old River barrier operation was included.

7. Figures 6 through 8 in SDWA 257 show photos of a location along Middle River representing low water level problems in the area. All these pictures were all taken at a single location (near Undine Bridge) in 2007, a single year ten years ago. My understanding is that all these pictures are taken at low tide. It is important to note that the daily tidal amplitude in the area is around 2 feet, and that the low tide in the area last only for a few hours, but this occurs twice a day currently and it will continue to occur with or without California WaterFix.

8. Water levels in South Delta channels are increased by the temporary agricultural barriers installed by DWR. In SDWA-257 there is very little information given about the operation of the three temporary agricultural barriers (Middle River, Grant Line Canal, and Old River). These three barriers have been installed during irrigation season for more than 25 years now. In recent years, the installation for these three barriers typically starts around middle or late March, and the complete removal typically occurs middle to late November. These three agricultural barriers are designed to create higher water levels in South Delta area (upstream of the barriers). It should be noted that all three photos showing low water levels in Middle River were taken at times when the agricultural barriers

were not installed. Based on my understanding of the hydrodynamics of the South Delta area, I believe it is very unlikely to have low water levels in the main reaches of South Delta, such as those depicted in SDWA-257 Figures 6 through 8 during the times when the agricultural barriers are operated. Figure 6 of this testimony shows the probability distribution for minimum daily stage at Middle River at Undine Road for all months for the entire 16 years of simulation (1976-1991). This figure shows some reduction in top 15-20% probability. The magnitude of the minimum daily stage in this range represent fairly high water levels, mostly occurring during higher flow periods. At highest probability levels (lowest water levels), the reduction in water levels is much lower (0.1-0.2 foot). As I stated earlier, I believe the reductions in water level would have been lower if the modeling for NAA included the head of Old River barrier Spring operation. Figure 7 of this testimony shows similar information except that it represents probability distribution of minimum daily water levels for the months of June through November in the same 16 year period. This corresponds to the time period for which the modeling included the operation of the temporary agricultural barriers. It is clear that there is very little change in water levels except only at higher probabilities (highest 8-12% probabilities). Also, the lowest water levels are about a foot and a half higher than those reflected in Figure 6. This is further proof that the temporary agricultural barriers raise the daily minimum water level in the area.

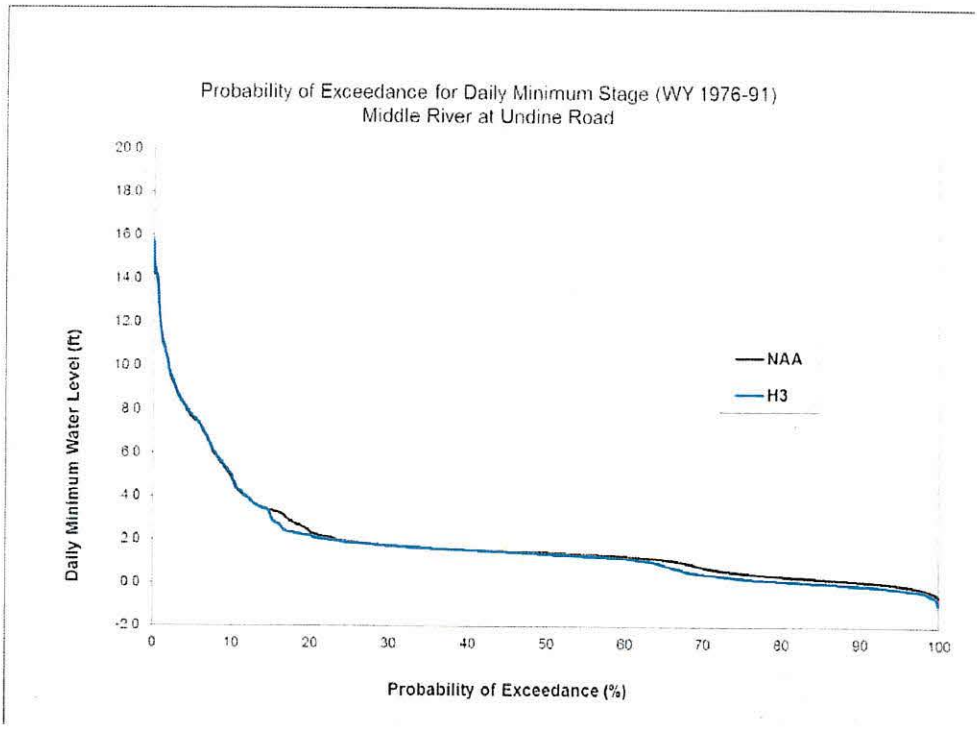

Figure 6- Probability of Exceedance for Daily Minimum Stage at Middle River at Undine Road

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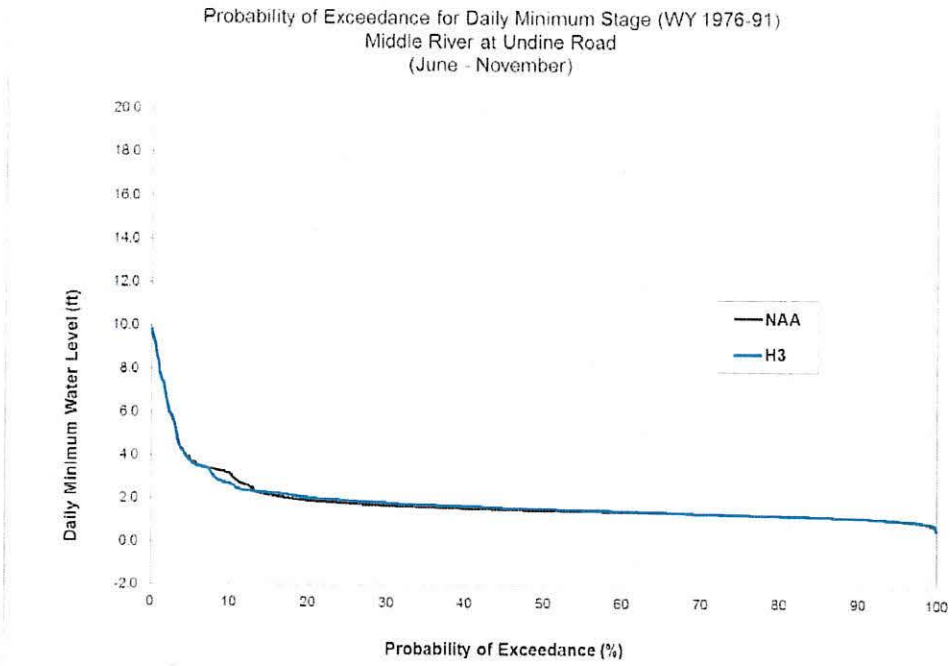

Figure 7- Probability of Exceedance for Daily Minimum Stage at Middle River at Undine Road (June through November)

Executed on June 9, 2017 in Sacramento, California.

Parviz Nader-Tehrani

Parviz Nader-Tehrani