Exponent®

Technical Comments on Petitioners' WaterFix Rebuttal Testimony

Exhibit Brentwood-121

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Exhibit Brentwood-121

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Contents

List of Figures

Acronyms and Abbreviations

DSM2	Delta Simulation Model II
DWR	Department of Water Resources
CCPP#1	Contra Costa Pumping Plant No. 1
CVP	Central Valley Project
SWP	State Water Project
EC	Electrical Conductivity
WY	Water Year
NAA	No action alternative

Sur-Rebuttal Opinion 1: DSM2 shows exceedances of D-1641 standards, and we believe these exceedances are "real."

Dr. Nader-Tehrani provided testimony during the rebuttal portion of Part 1 of the WaterFix hearing stating that "the modeled exceedances of all the scenarios presented during the hearing, including the NAA, are a result of: (1) limitations of the modeling process used in analyzing the CWF scenarios, or (2) a stressed CVP-SWP system under extreme operational conditions."[1] Further, Dr. Nader-Tehrani testified that "the modeled exceedances in D-1641 agricultural, municipal, and industrial water quality objectives are not real, and occur mainly due to a difference in the assumptions in DSM2 and CalSim II, including a difference in the size of the time-step in the two models."[2]

While all model results are, by definition, not "real," the Delta Simulation Model II (DSM2) modeling tool has been shown to be a well-accepted, well-understood tool for simulating conditions within the Delta. The ability of DSM2 to simulate Delta hydrodynamics is well-established, and DSM2 has been calibrated to optimize its ability to simulate hydrodynamic parameters within the Delta (including flow rates, velocities, and stage).[3] DSM2 has also been calibrated for salinity and can simulate salinity reasonably well at a number of Delta locations, including the western Delta, where the primary source of salinity is water from San Francisco Bay.[4] The Department of Water Resources (DWR) has calibrated the DSM2 model by simulating observed (historical) conditions, and by adjusting certain model parameters to optimize the "fit" between measured and modeled values.

DSM2 can also be used to study hypothetical conditions, and is frequently used in planning studies to evaluate the impacts of various management alternatives or potential future scenarios. By definition, historical data cannot be used directly to simulate alternative scenarios; rather, historical hydrology is typically used as the basis for planning studies, but the historical hydrology is run through an operations model that "re-operates" the system to simulate the scenarios to be evaluated. The CalSim II model is frequently used to provide DSM2 model input for planning studies. Among other outputs, CalSim II generates monthly values for Delta exports, diversions, and inflows. Monthly output values from CalSim II are then converted to "smoothed" daily values for use as DSM2 model input using a DSM2 pre-processor. Because CalSim II generates Delta inflows, exports, and diversions using a monthly time-step[5], DSM2

[1] DWR-79, p.36:8-11.

[2] DWR-79, p.45:18-21.

[3] Information on model calibration can be found on DWR's website at http://baydeltaoffice.water.ca.gov/modeling/deltamodeling/models/dsm2/dsm2.cfm. See for example, information on the 2009 calibration available at http://baydeltaoffice.water.ca.gov/downloads/DSM2_Users_Group/BDCP/DSM2_Recalibration_102709_doc.pdf. In addition, see DWR-79 Section IX.

[4] See, for example, the Sacramento-San Joaquin Delta Atlas (Antioch-214; DWR-301) at pp. 22-23, which shows the extent of salinity intrusion in the western Delta.

[5] See, for example, DWR-79, p.37-38.

input files generated from CalSim II output therefore exhibit a “stepped” appearance that, particularly for Delta inflows, is not apparent in historical (measured) data. Although Delta inflows do not typically exhibit a monthly “stepped” appearance in reality, it is my opinion and experience that if the inflows did exhibit these patterns, DSM2 would be able to simulate the tidally driven flows in the interior of the Delta that would result from monthly “stepped” inflow and export/diversion patterns. Thus, in my opinion the ability of DSM2 to simulate Delta hydrodynamics is not in question, as DSM2 is an accepted and well understood method for applying tidal forces to simulate hydrodynamics within the Delta.

In a modeling exercise such as that conducted for the WaterFix project, it is, of course, not possible to simulate exactly what hydrodynamics or salinity conditions will be on a given date in the future, and in this limited sense, I agree with Dr. Nader-Tehrani’s rebuttal testimony that the WaterFix modeling results are not “real.” Rather, hydrodynamics and salinity on a given date will be a function of antecedent conditions (starting conditions in the Delta) in addition to inflows, tides, exports and diversions, and water quality input parameters. However, each of the model scenarios evaluated for the WaterFix project uses nearly the same hydrological sequence (i.e., 1975-1991), the same tidal input sequence, the same meteorological conditions (e.g., precipitation), and the same input parameters to describe the salinity of inflows to the Delta; in addition, each of the model scenarios uses the same flow rates and salinity values to describe agricultural drainage within the Delta.[6] The primary differences between different modeled scenarios are the simulated Delta inflows, Delta exports, and Delta diversions, all of which are derived from CalSim II modeling. Thus, changes in DSM2 model results between the baseline model runs and the WaterFix scenarios are primarily a function of the differences in inflows, exports, and diversions—i.e., they are a direct function of the WaterFix project operations as compared to baseline (without WaterFix) conditions. I conclude that simulated differences in salinity (e.g., exceedances of the 250 mg/L chloride threshold at Contra Costa Pumping Plant No. 1 [CCPP#1]) for the different WaterFix operational scenarios can be used to evaluate the likely rate of exceedance of these water quality objectives for those scenarios, and that in this sense, the model results provide a “real” indication of the likely rate of exceedance.

In addition to the general testimony described above, DWR has provided rebuttal testimony describing how operators may adjust project operations in real time to avoid exceedances of D-1641 criteria.[7] As set forth in detail below, I have evaluated DWR’s rebuttal testimony, and I disagree with DWR’s conclusion that “the exceedances are mostly a result of limitations in the modeling process with a few resulting due to the extreme operating conditions.”[8] To illustrate this point, I have focused additional analysis on DSM2 model results describing salinity at CCPP#1 during the period of water year (WY) 1978–WY 1979 (above normal and below normal hydrologic year types, respectively). DSM2 model results for this time period were presented in Brentwood-102 as Figures 4 and 5, which are reproduced for convenience below (as Figures 1

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6 We reviewed the DSM2 input files for the EBC2, NAA, and Boundary 1 scenarios and identified differences that were expected between the files. For example, the NAA and Boundary 1 model scenarios include 15 cm of sea level rise and increased dispersion coefficients in channels 431, 433, and 434 of the DSM2 grid, and the NAA and Boundary 1 scenarios use different stage data at Martinez compared to EBC2. In addition, certain features of the WaterFix project, including the North Delta Diversion points, are only included in the Boundary 1 scenario.

7 See, for example, DWR-79 at p.38:21-22 and p.40:15-19.

8 DWR-79 at p.40:13-15.

and 2), and which indicate that the Boundary 1 scenario simulated chloride concentrations greater than 250 mg/L at CCPP#1 from October 13, 1977 to January 5, 1978 (a total of 85 days) and from December 29, 1978 to February 23, 1979 (a total of 57 days). In contrast, the NAA scenario exceeded this threshold from October 20, 1977 to January 5, 1978 (a total of 78 days) and from January 25, 1979 to January 31, 1979 (a total of 7 days), while the EBC2 scenario exceeded this threshold from January 1, 1978 to January 6, 1978 (a total of 6 days).

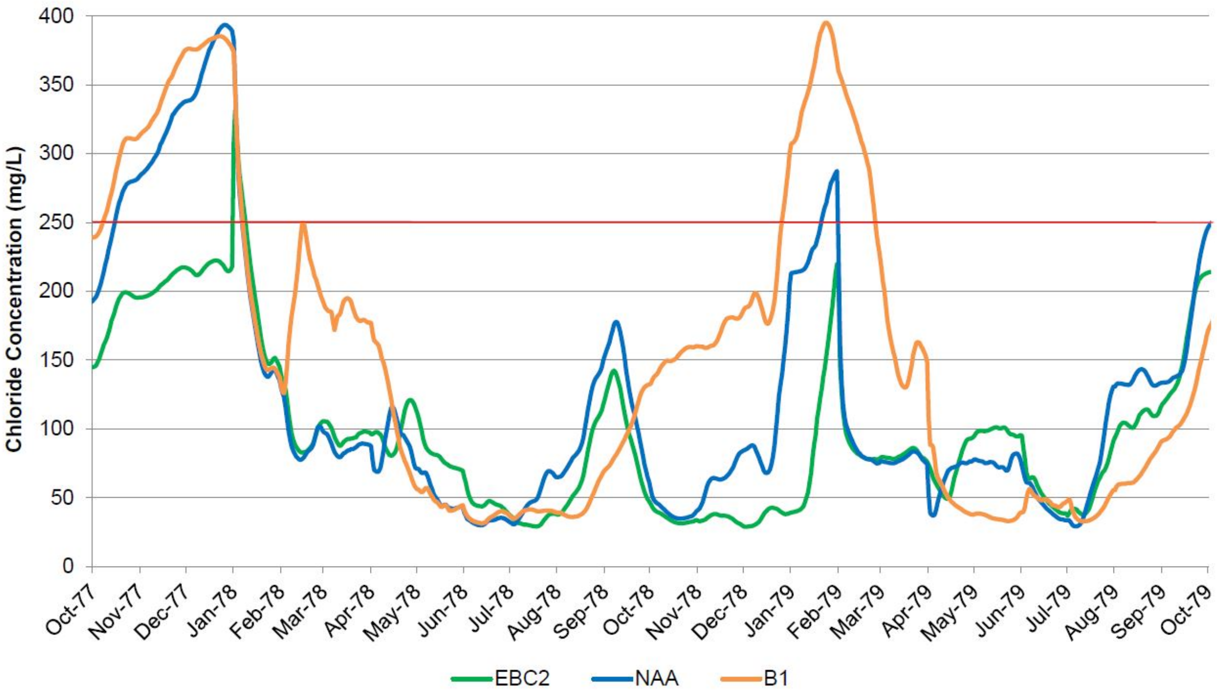

Figure 4. Daily average chloride concentrations at PP#1 for WY 1978–WY 1979, from DWR's model results. The red line indicates the 250 mg/L chloride threshold of D-1641.

Figure 1 Copy of Brentwood-102 Figure 4 showing daily average chloride concentrations at CCPP#1 for WY 1978—WY 1979 from DWR's model results.

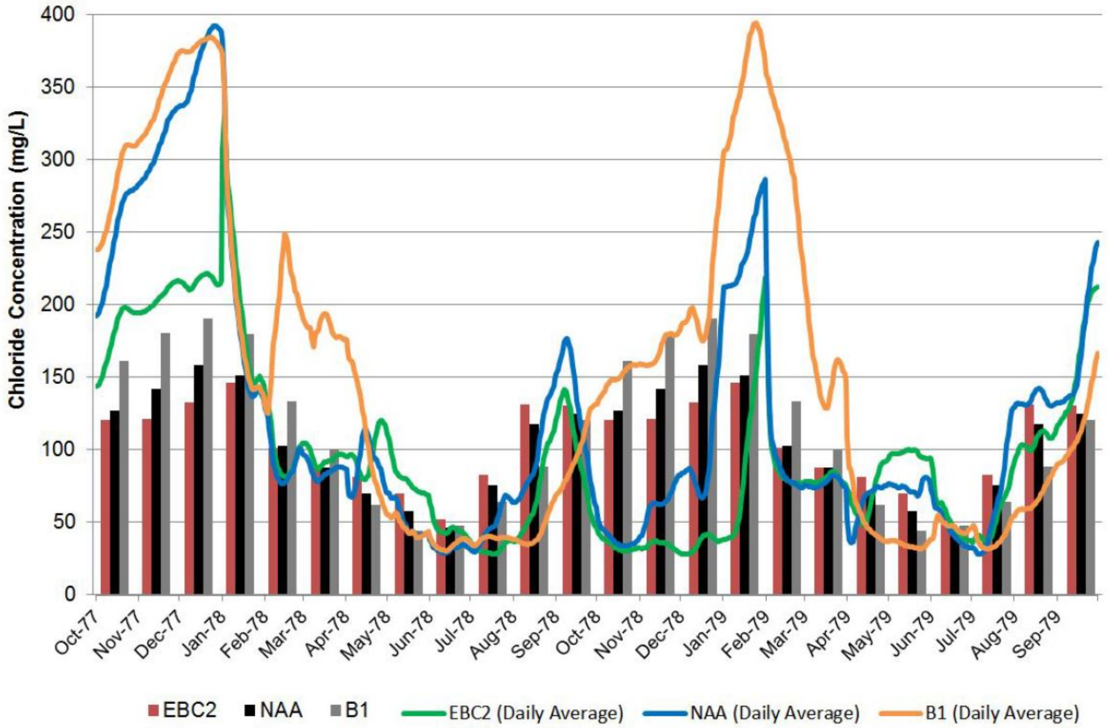

Figure 5. Daily average chloride concentrations at PP#1 for WY 1978-WY 1979 superimposed on the monthly averaged data presented in DWR-513 and recreated in Figure 3. The bars describing average salinity were repeated for each month in WY 1978 and 1979.

Figure 2 Copy of Brentwood-102 Figure 5 showing daily average chloride concentrations at CCPP#1 for WY 1978—WY 1979 superimposed on the monthly averaged data presented in DWR-513.

Dr. Nader-Tehrani explained in his rebuttal testimony that "the modeled exceedances of all the scenarios presented during the hearing, including the NAA, are a result of: (1) limitations of the modeling process used in analyzing the CWF scenarios, or (2) a stressed CVP-SWP system under extreme operational conditions." [9] Dr. Nader-Tehrani further defined "extreme operational conditions" as "simulated occurrences of storage conditions at CVP and SWP reservoirs in which storage is at 'dead pool' levels."[10] It is my understanding that "extreme conditions" occur during critical years, and did not occur during either WY 1978 or WY 1979.[11] Thus, I conclude that "extreme conditions" cannot explain the lengthy exceedances of the 250 mg/L chloride objective that were simulated for the Boundary 1 scenario in WY 1978 and WY 1979.

Excluding "extreme conditions," Dr. Nader-Tehrani's rebuttal testimony discussed three "model limitations" that he asserted explain why D-1641 standards might not be met in the modeling but could be met with real operations:

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9 DWR-79, p.36:8-11.

10 DWR-79, p.35:13-14.

11 See, for example, the summary provided in SVWU-202_errata: Table 1 shows a summary of "Stressed Conditions" for the WaterFix NAA scenario.

1. First, Dr. Nader-Tehrani stated, "within the months where the salinity standard is transitioning, there may be days where DSM2 inflows are less than the required flow to comply with the salinity standard, and more flow on other days. This results in a few days within such months where the modeled salinity exceeds the compliance standard."[12]

   However, the D-1641 250 mg/L chloride objective does not "transition" within any month – rather, it is a constant value that applies to all days of the year. Thus, I conclude that the first of Dr. Nader-Tehrani's three "model limitations" cannot explain the exceedances of the D-1641 250 mg/L chloride objective observed within the DSM2 model results.

2. Second, Dr. Nader-Tehrani discussed the "downscaling" of monthly CalSim II outputs to DSM2 input, and asserted that the "mismatch in the daily patterning of the inflows and exports, in some cases resulted in unintended salinity intrusion into the Delta. In such situations, there may be days where the DSM2 results indicate exceedance of a water quality standard."[13]

   However, exceedances of the 250 mg/L chloride objective occurred for 85 and 57 consecutive days in WY 1978 and WY 1979, respectively. Exceedances of the 250 mg/L chloride objective also occurred for lengthy periods in other years as well (e.g., for 38 days in WY 1986).[14] Dr. Nader-Tehrani testified that "downscaling" and the "mismatch in the daily patterning" may result in "days" where the DSM2 results indicate exceedance of a water quality standard. Dr. Nader-Tehrani's second explanation does not describe the lengthy exceedances of the chloride objectives shown in the DSM2 model results.

3. Third, Dr. Nader-Tehrani asserted that the ANN [artificial neural network] may cause days of exceedance at a time: "In some cases, even though the ANN predicts that the objective would be met on a monthly average basis, it can be an imperfect predictor of compliance on the time-step (e.g. daily standard) and averaging basis (e.g. 14-day running average) that these objectives need to be met. Thus when using the CalSim II results in such cases, the DSM2 results may indicate an exceedance of a salinity standard, when CalSim II does not."[15]

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[12] DWR-79, p. 38:17-20.

[13] DWR-79, p. 39:6-9.

[14] Daily average electrical conductivity (EC) was calculated by Exponent from DSM2 results and converted to salinity using the conversion equation from Guivetchi (1986) for location ROLD021 (Cl[mg/L] = -39 + (0.263*EC[μS/cm])). As discussed in Opinion 3, contrary to Dr. Nader-Tehrani's assertion in his oral testimony, this conversion factor varies only slightly from the conversion factor used by DWR, and use of the conversion factor from Guivetchi (1986) did not increase the number of days of exceedance of the 250 mg/L threshold.

[15] DWR-79, p.39:20-25.

> However, simulated exceedances of the 250 mg/L chloride objective that persist for a full month or more (e.g., up to 85 days in the Boundary 1 scenario for WY 1978) do not appear to be consistent with ANN model results indicating that the objective would be met on a monthly average basis and therefore cannot be explained by "imperfect" ANN prediction.

With respect to the exceedances simulated in the Boundary 1 model scenario, Dr. Nader-Tehrani stated that "because the Boundary 1 analysis does not include the existing requirement for Fall X2, which is in the NAA, it is not surprising to see an increase in EC or an effect on water levels during certain years. Even with these results, DWR can operate the SWP to meet the required water quality requirements."[16] Further, Dr. Nader-Tehrani concluded: "The frequency of exceedances under the CWF scenarios is similar or less than the NAA in most cases. The exceedances are mostly a result of limitations in the modeling process with a few resulting due to the extreme operational conditions. In reality, staff from DWR and Reclamation constantly monitor Delta water quality conditions and adjust operations of the SWP and CVP in real time as necessary to meet water quality objectives."[17] In my opinion and as discussed above, the simulated exceedances of the 250 mg/L chloride water quality objective at CCPP#1 cannot be explained by limitations of the modeling or extreme operational conditions. Dr. Nader-Tehrani has not conducted, to the best of my knowledge, an analysis to describe or explain how operational adjustments could be made that would avoid the long periods of exceedance that are shown in DWR's DSM2 simulation results. Further, Dr. Nader-Tehrani has not described or conducted an analysis, to my knowledge, to characterize the "water cost" that would need to be imposed upon the SWP and CVP to avoid these exceedances. Specifically, Dr. Nader-Tehrani has not described the extent to which inflows to the Delta would need to increase and/or exports from the Delta would need to decrease to avoid these exceedances. Without such analyses, it is unclear how Dr. Nader-Tehrani reached his conclusion.

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[16] DWR-79, p.5:15-18.

[17] DWR-79, p.40:12-17.

Sur-Rebuttal Opinion 2: More effective methods exist to evaluate water quality objectives than those used by DWR.

DWR used both exceedance probability diagrams and long-term averages compiled from DSM2 results to assess potential impacts of WaterFix. For example, Dr. Nader-Tehrani used a probability exceedance diagram to assess D-1641 compliance with the 250 mg/L water quality objective at CCPP#1, and he testified on rebuttal that this was the “best way” he knew how to analyze for water quality objective exceedances.[18] In my opinion, there are more effective methods to evaluate compliance with water quality objectives.

The probability exceedance curves presented by Dr. Nader-Tehrani (Figure 3, a reproduction of DWR-513 Figure C5) represent 16 years of daily average simulated chloride concentrations at CCPP#1. Although Dr. Nader-Tehrani’s stated that “sub-monthly (e.g. weekly or daily) reporting of model results are generally inappropriate,”[19] Dr. Nader-Tehrani used daily average chloride simulation results presented as cumulative probability diagrams to evaluate compliance with the D-1641 250 mg/L chloride objective. Dr. Nader-Tehrani testified that “Dr. Paulsen in her testimony for City of Brentwood and City of Antioch presented the modeling results appropriately for the most part. However, she presents daily time-series comparison of simulated electrical conductivity (EC) in Figure 4 of Exhibit Antioch-202. She also presents similar information in Exhibit Brentwood-102, Figures 4 and 5.”[20] Both Dr. Nader-Tehrani’s compliance evaluation figures (DWR-513 Figure C5) and the figures I used (Figure 4 of Antioch-202 and Figures 4 and 5 of Brentwood-102) were generated using daily average chloride concentrations calculated from the same DSM2 model runs, and the aggregate results are comparable. For example, Figure 3 (DWR-513 Figure C5) shows that the probability of exceedance of the 250 mg/L threshold at CCPP#1 for the Boundary 1 scenario is approximately 7 percent. Seven percent of the 5,844 days of the modeled record (1976 to 1991) is equivalent to 410 days. However, DWR’s analysis does not provide information that would be useful to water purveyors such as the City or to the State Water Resources Control Board, such as detail describing when these exceedances would occur, how long they would last, and to what extent the objective would be exceeded. The model results as presented in Figure 4 of Antioch-202 and Figures 4 and 5 of Brentwood-102, when expanded to show the entire 16-year modeled period (Figure 4), also show 410 days of exceedance, but indicate when, for how long, and to what extent exceedances are simulated to occur. In summary, Figure 3 and Figure 4 below were created using the identical model results, but the information in Figure 4 is more useful to a water purveyor determining impacts upon their drinking water operations, and potentially more useful to the State Water Resources Control Board seeking to determine the extent to which the WaterFix project will comply with water quality objectives.

[18] SWRCB California WaterFix Water Right Change Petition Hearing Transcript Volume 44, p. 2:23-24. May 12, 2017.

[19] DWR-79, p.31:3-4.

[20] DWR-79, p.29:9-12.

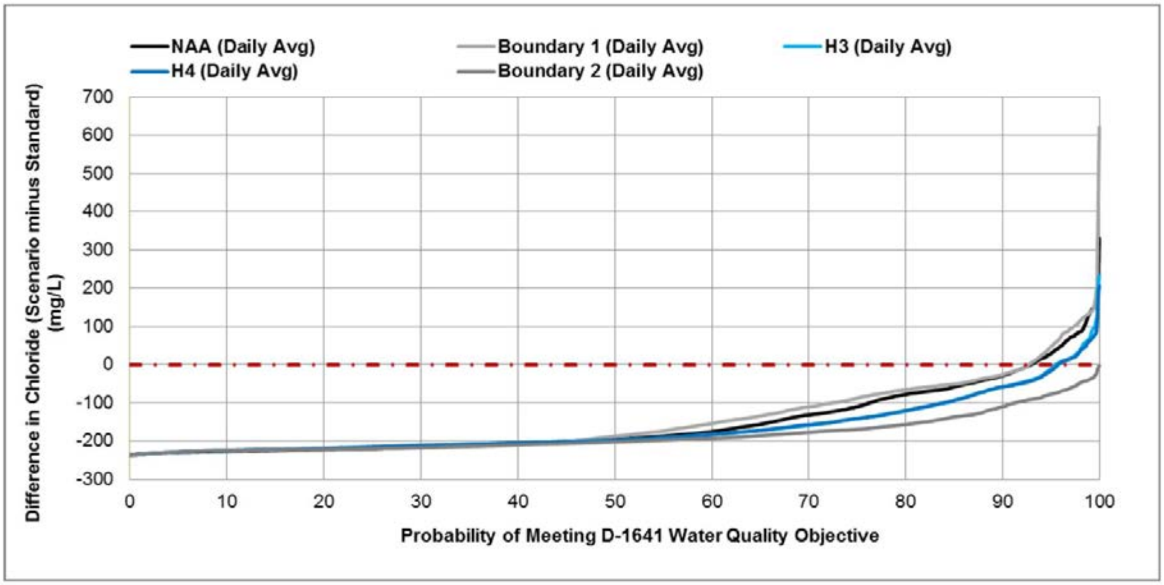

Figure 3 DWR-513 Figure C5, showing the probability of meeting the D-1641 250 mg/L chloride objective at Contra Costa Canal at Pumping Plant No. 1 (CCPP#1).

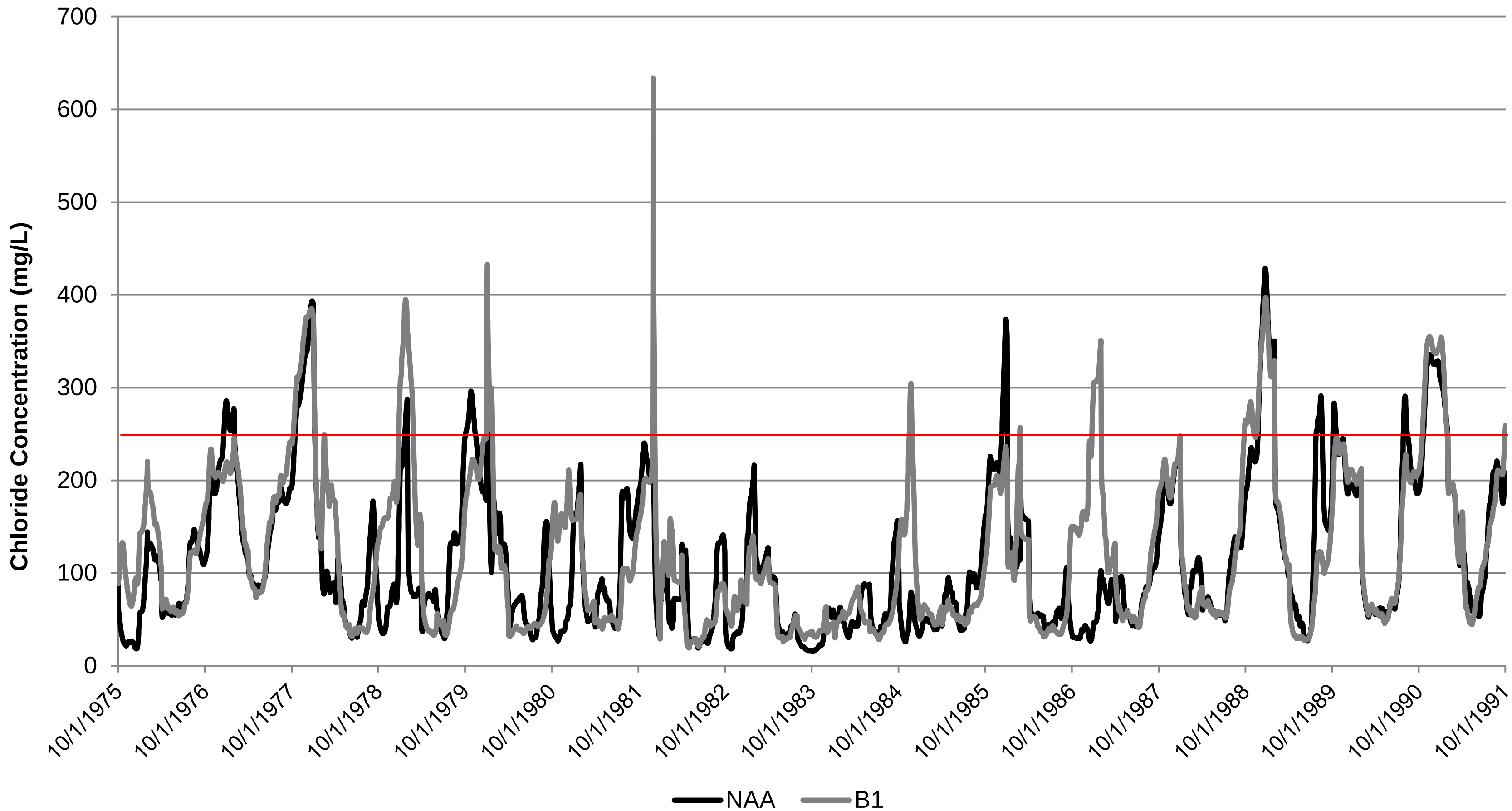

Figure 4 Daily average chloride concentrations modeled at CCPP#1 for the Boundary 1 (gray) and NAA (black) alternatives. The red line represents the 250 mg/L D-1641 water quality objective.

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Probability exceedance diagrams constructed from model output for the entire 16-year simulation period have the effect of obscuring important information; nonetheless, probability exceedance diagrams can be a valuable tool and provide useful information. Exponent generated probability exceedance diagrams describing simulated chloride concentrations at CCPP#1 by hydrologic water year type by calculating daily average chloride concentrations, separating the data by water year type, and plotting the results for each water year classification. Figure 5 shows the chloride exceedance probability for all years (1976 to 1991)[21] with the y-axis adjusted to represent the daily average modeled chloride concentration. Note that with the exception of the y-axis label, Figure 5 is indistinguishable from Figure 3 (DWR-513 Figure C5).

Additional useful information can be obtained by reviewing the model results for different hydrologic year types. For the entire 16-year simulation period (Figure 3), the 250 mg/L water quality objective will be exceeded at CCPP#1 under the Boundary 1 scenario 7 percent of the time, equivalent to about 27 days per year, on average, for a total of 410 days in the simulation period. However, during normal (i.e., above and below normal) water years, simulation results for the Boundary 1 scenario show that the 250 mg/L water quality objective will be exceeded approximately 15 percent of the time (Figure 8), or approximately 55 days per year and roughly twice as often as for the simulation period as a whole. In dry water years, simulation results for the Boundary 1 scenario show that the 250 mg/L water quality objective will be exceeded about 10 percent of the time, or about 37 days per year (Figure 7), or about 37% more frequently than for the 16-year simulation period as a whole.

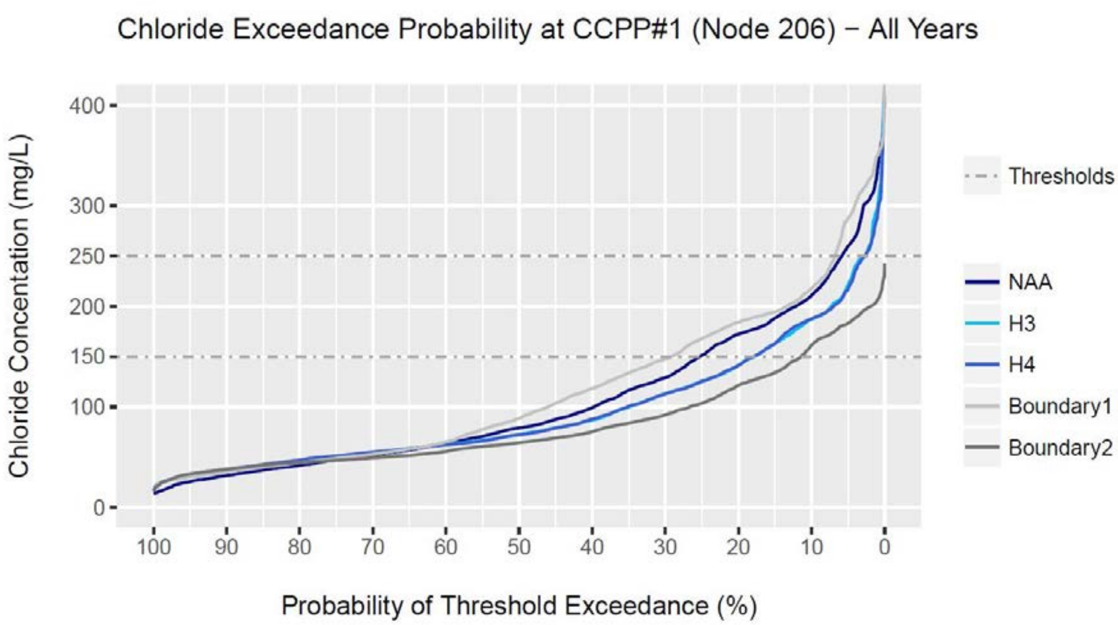

Figure 5 Probability exceedance diagram for chloride at CCPP#1 for all years (1976-1991).

[21] Exponent and DWR used different conversion factors to convert simulated EC (the direct output of the DSM2 model) into chloride concentrations. However, the difference in conversion factor is negligible and does not affect the conclusions of this analysis. See Opinion 3 for detail.

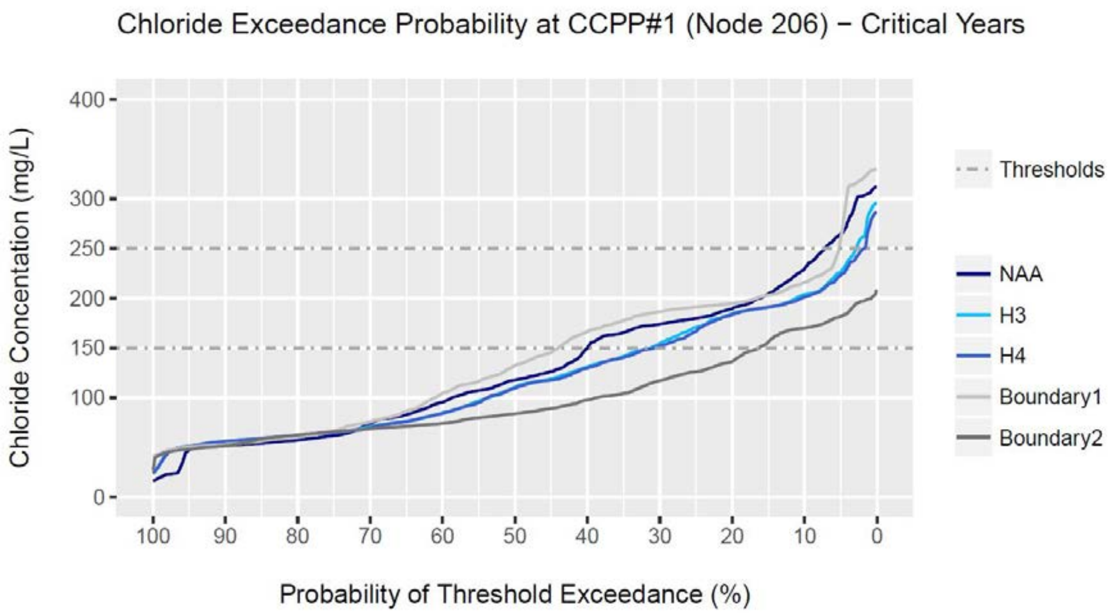

Figure 6 Probability exceedance diagram for chloride at CCPP#1 for critical years (1976, 1977, 1988, 1990, and 1991).

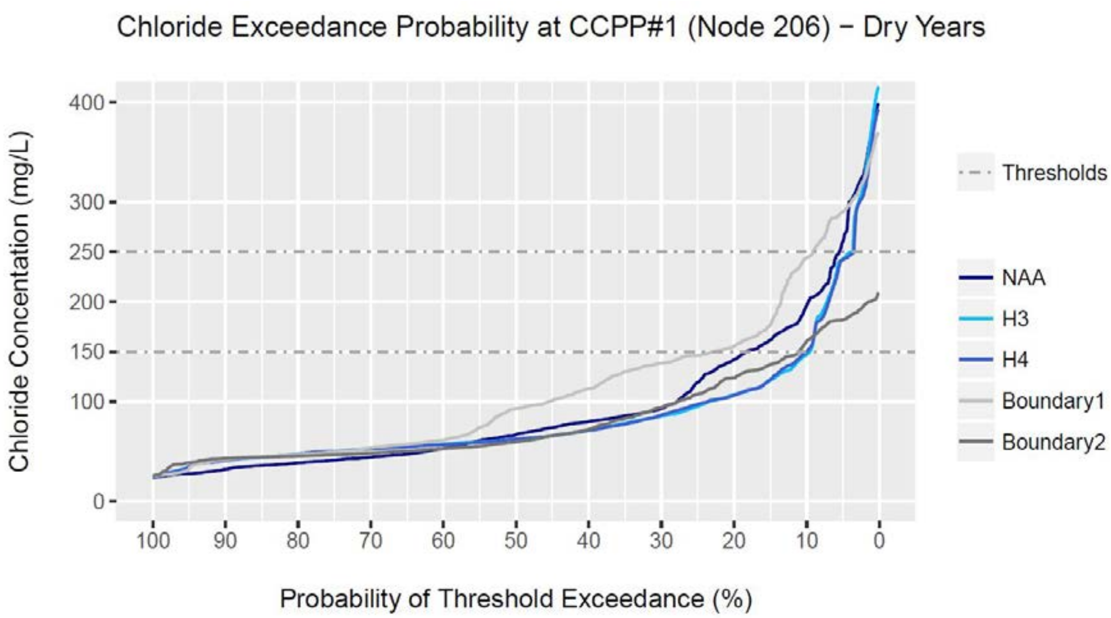

Figure 7 Probability exceedance diagram for chloride at CCPP#1 for dry years (1981, 1985, 1987, and 1989).

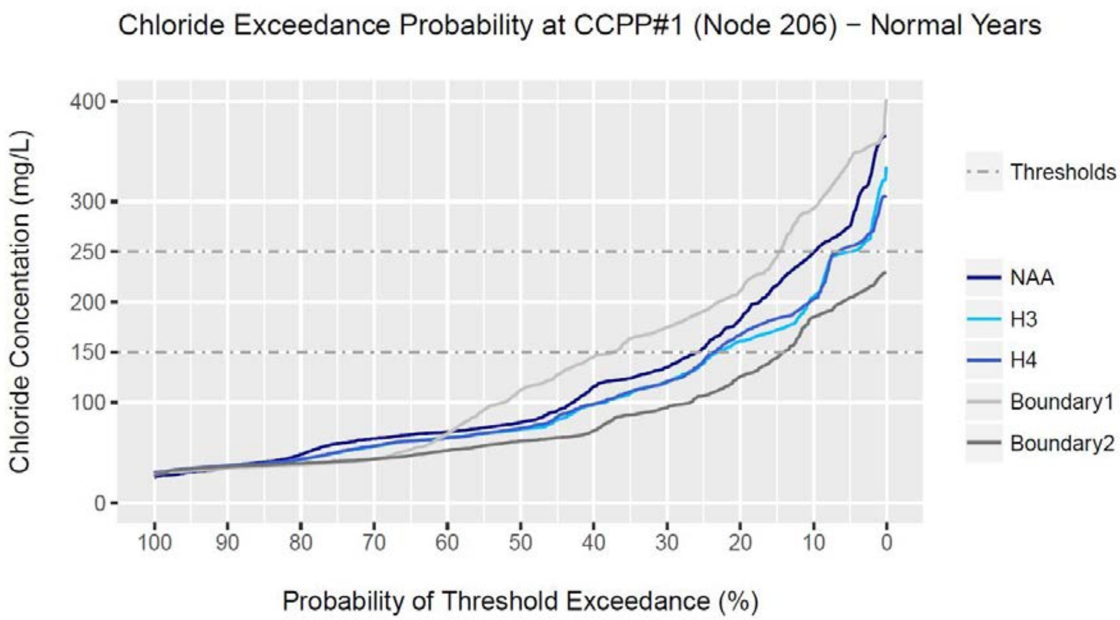

Figure 8 Probability exceedance diagram for chloride at CCPP#1 for normal (above and below normal) years (1978 – 1980).

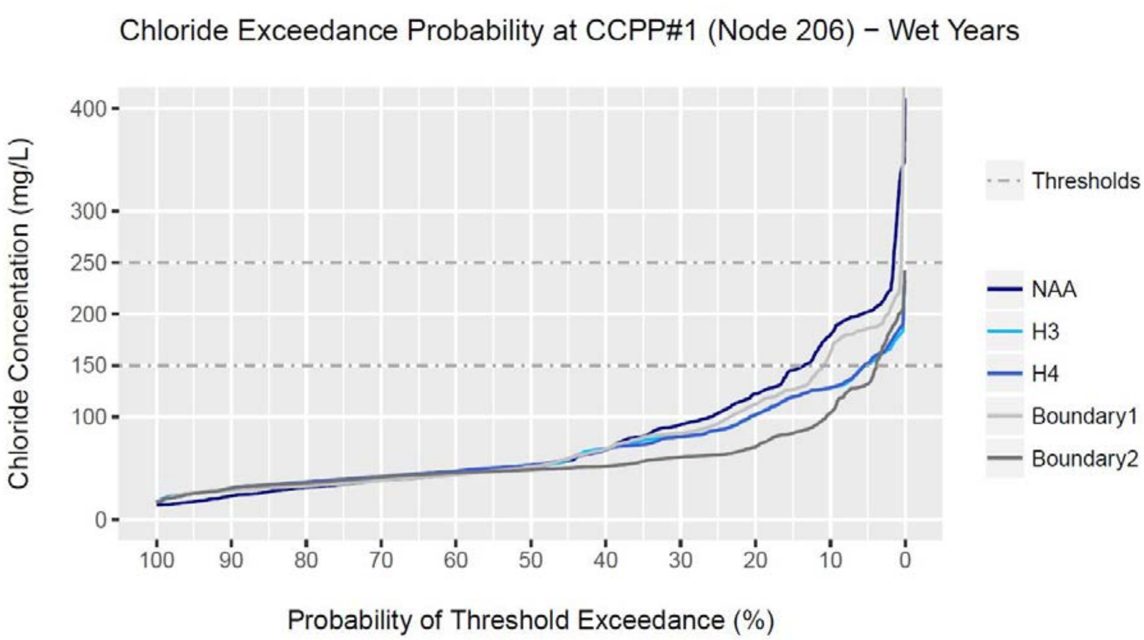

Figure 9 Probability exceedance diagram for chloride at CCPP#1 for wet years (1982 – 1984, and 1986).

Figure 6 and Figure 9 present results for critical and wet water years. During critical water years, the amount of water exported from the Delta will be less than in other year types, and the amount of water exported from the Delta in critical years will be less with the WaterFix project than without it.[22] During wet water years, Delta exports are high, but there is typically enough water to meet export and diversion demands and satisfy water quality objectives.[23]

As detailed in my prior testimony[24], wet and critical years occur 56 percent of the time in the 16-year simulation period but 45 percent of the time in the historical record (WY 1921 to WY 2015), and dry and normal years occur only 44 percent of the time in the 16-year simulation period but 55 percent of the time in this historical record. Thus, it is important to view the model results in light of the historical record and by year type to fully understand the impacts of the WaterFix project. In summary, DWR's own model simulations demonstrate, contrary to the testimony offered by Dr. Nader-Tehrani on rebuttal for the 16-year simulation period[25], that in dry and normal years, which occur approximately 55 percent of the time based on the historical record, there will be a substantial increase in the number of days per year that are expected to exceed the D-1641 250 mg/L chloride objective (the "frequency of exceedance") as a result of the Boundary 1 WaterFix operations scenario.

During dry and normal water years, water quality impacts from Boundary 1 operations are also greater relative to the NAA scenario than in other year types. Brentwood-102 Table 5 shows the number of days that the 250 mg/L daily average chloride threshold will be exceeded under various model scenarios. Brentwood-102 Table 6 summarizes this information by water year type, and the data from Brentwood-102 Table 6 are presented in Figure 10 (below). During dry and normal years, Boundary 1 will result in an additional 19 days per year (70 percent increase) and 17 days per year (31 percent increase) of exceedance on average, respectively, of the 250 mg/L water quality objective compared to NAA. As discussed in Brentwood-102, this increase in the rate of exceedance for the Boundary 1 scenario relative to the NAA is attributable to the WaterFix project and not to climate change or sea level rise.

For all of these reasons, I disagree with Dr. Nader-Tehrani's statement during his rebuttal testimony that it is best to use probability of exceedance curves to evaluate the effects of the WaterFix project, and I conclude that Dr. Nader-Tehrani's approach is incomplete. Probability of exceedance curves for the entire 16-year DSM2 period fail to provide detailed information that is important to drinking water operators and potentially to the State Water Resources Control Board. In my opinion, such plots must be used in conjunction with other analyses, such as the other plots discussed in this opinion and the detailed evaluation of model results on a long-term basis as provided in Brentwood-102, to provide a comprehensive picture of the effects of the WaterFix project.

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[22] See Brentwood-102 at p.44-45.

[23] Figure 14 of Brentwood-102 shows the total exports from the Delta from Banks and Jones pumping plants, and the proposed North Delta Diversions (NDD).

[24] SWRCB California WaterFix Water Right Change Petition Hearing Transcript Volume 35, pp.39-41. December 14, 2016.

[25] See DWR-79 Section VIII.

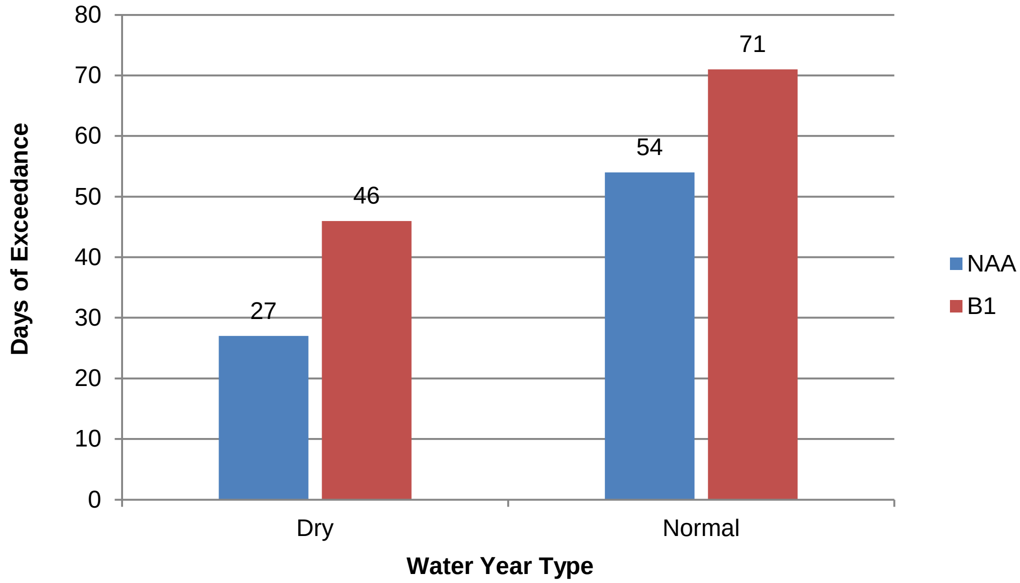

Figure 10 Average number of days per year of exceedance of the 250 mg/L water quality objective at CCPP#1. Data from Brentwood-102 Table 6 were used to develop this chart.

Sur-Rebuttal Opinion 3: The EC to chloride conversion used by Exponent is more conservative than the conversion used by DWR, and both chloride concentrations and project impacts calculated by Exponent are underestimated slightly.

Dr. Nader-Tehrani testified that "Dr. Paulsen explains in her testimony that she uses a different EC-to-chloride conversion in her analysis of WaterFix,"[26] and stated that he was "just clearly making a point that the modeling that was done for California WaterFix uses a different conversion, and therefore, when you do that, you may not get the same numbers."[27] When asked during cross-examination during rebuttal if he disagreed with the conversion factor used by Exponent, he stated, "I don't have an opinion."[28] Dr. Nader-Tehrani later stated (on redirect) that "It is extremely important that the same conversion EC-to-chloride is used in both CalSim and DSM2."[29] In response to this rebuttal testimony, I evaluated the conversion factors used by Exponent and DWR, and the difference in analysis results and conclusions that result from those conversion factors.

Exponent used an equation from Guivetchi (1986)[30], which is documented on the DWR DSM2 website[31], to convert DSM2 model output expressed as EC to an equivalent chloride concentration. In contrast, DWR utilized a conversion equation as described in DWR-509.[32] The two conversion equations are plotted in Figure 11, which shows that above a chloride level of 92.5 mg/L (i.e., at chloride concentrations that would exceed the D-1641 250 mg/L chloride objective and that would affect Brentwood's diversion operations), the conversion factor used by Exponent results in lower chloride concentrations (i.e., is more conservative) than the conversion factor used by DWR. Thus, above a chloride concentration of 92.5 mg/L, the conversion factor used by Exponent predicts <u>lower</u> chloride concentrations and <u>lower</u> water quality impacts than the conversion factor used by DWR. The difference in EC corresponding to a chloride concentration of 250 mg/L is 46 uS/cm, or about 4.3 percent.

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[26] SWRCB California WaterFix Water Right Change Petition Hearing Transcript Volume 43 p.18:6-8. May 11, 2017.

[27] SWRCB California WaterFix Water Right Change Petition Hearing Transcript Volume 43 p.18:11-15. May 11, 2017.

[28] SWRCB California WaterFix Water Right Change Petition Hearing Transcript Volume 43 p.18:19-20. May 11, 2017.

[29] SWRCB California WaterFix Water Right Change Petition Hearing Transcript Volume 43 p 151:8-9. May 11, 2017.

[30] The conversion equation for location from ROLD021 for all water year types from Guivetchi (1986) is Cl = -39 + (EC*0.263).

[31] http://www.water.ca.gov/suisun/facts/salin/index.cfm.

[32] DWR used the conversion equation of Cl = -50 + (EC*0.285) as described in DWR-509.

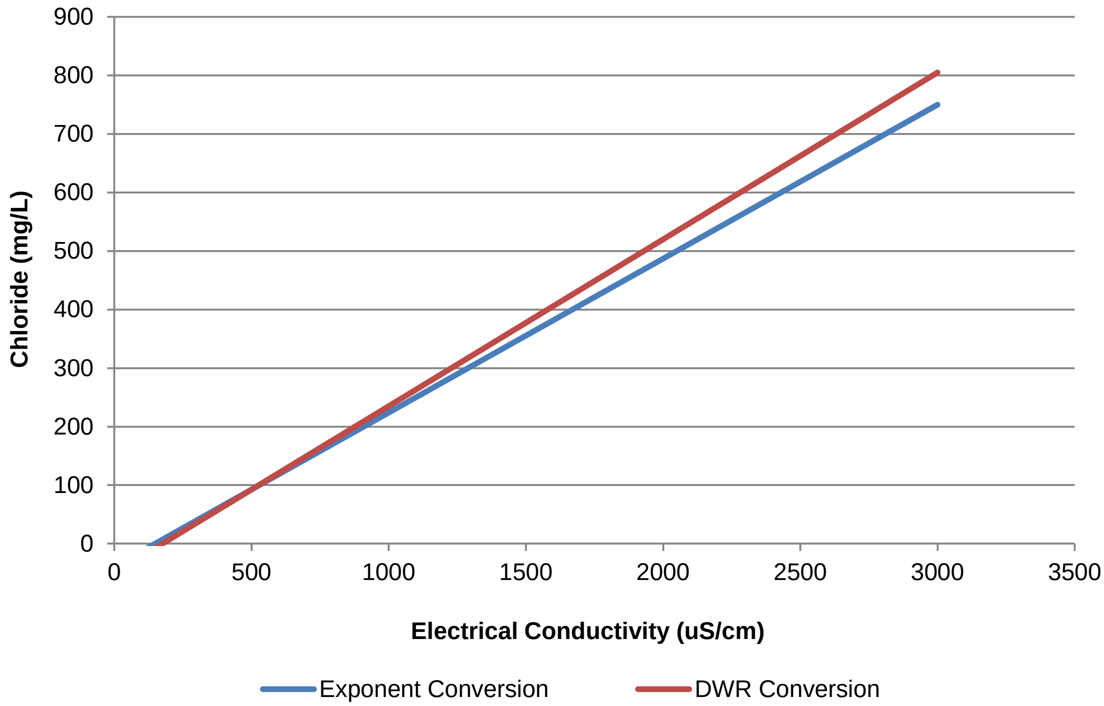
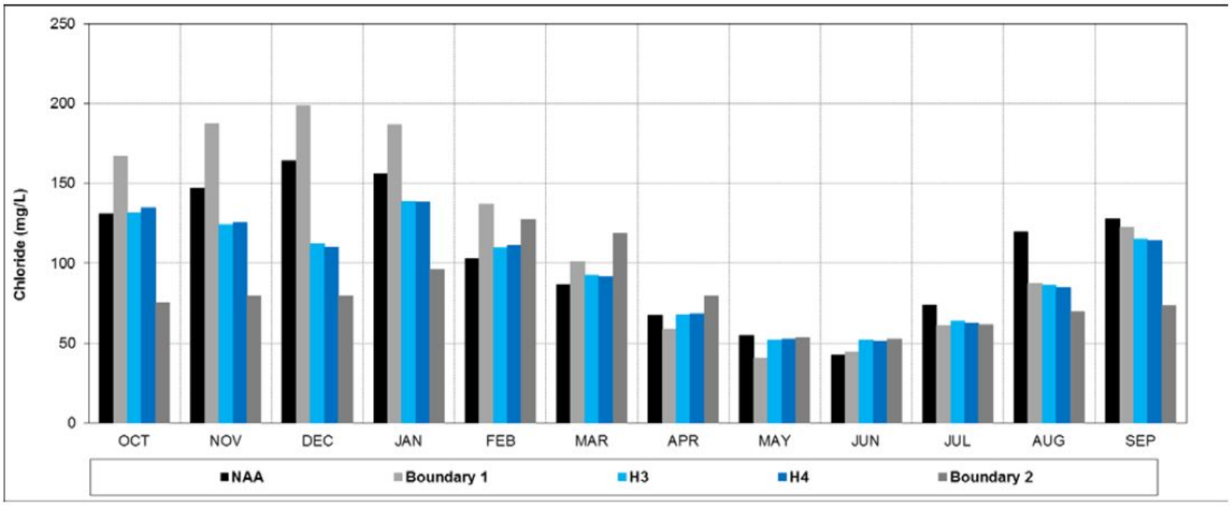


Figure 11 Comparison of the conversion factors used by Exponent and DWR in post-processing of DSM2 output data.

The difference can also be seen in figures prepared by DWR and by Exponent to compare the impacts of the WaterFix project on monthly average chloride concentrations at Contra Costa Canal. As shown in Figure 12 (reproduced from DWR-513 Figure CL1), the peak monthly average chloride concentration calculated by DWR occurs for the Boundary 1 scenario in December and is equivalent to about 200 mg/L; in contrast, Figure 13 (Brentwood-102 Figure 3) shows that the peak chloride concentration for the same scenario as calculated by Exponent was equivalent to 190 mg/L.

Figure CL1: Monthly Average Chloride Concentration at Contra Costa Canal



Model results are used for comparative purposes and not for predictive purposes

Figure 12 DWR-513 Figure CL1 showing monthly average chloride concentrations at Contra Costa Canal for the 16-year modeled period (1976-1991).

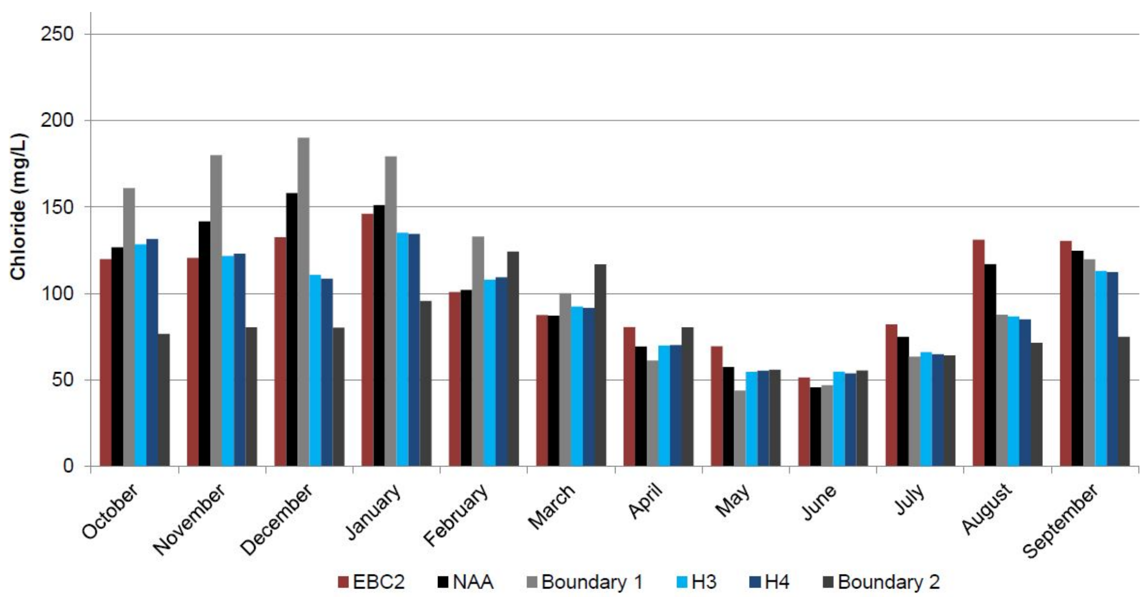


Figure 3. Monthly average chloride concentration at PP#1 from the 16-year modeled record. Note that the bars for the NAA, Boundary 1, H3, H4, and Boundary 2 scenarios were provided by DWR in DWR-513 (values may differ slightly due to different salinity conversions); Exponent has added the bar representing the existing condition (EBC2) scenario as modeled by DWR.

Figure 13 Copy of Brentwood-102 Figure 3, including the original caption noting that values differ slightly due to salinity conversions.

Based on this analysis, I conclude that the differences in conversion equations used by Exponent and DWR do not affect the analyses or conclusions presented by Exponent. If Exponent had used the same conversion equation as DWR to evaluate exceedances of D-1641 objectives or to evaluate water quality impacts to the City of Brentwood, project impacts to water quality would have been slightly more substantial.