


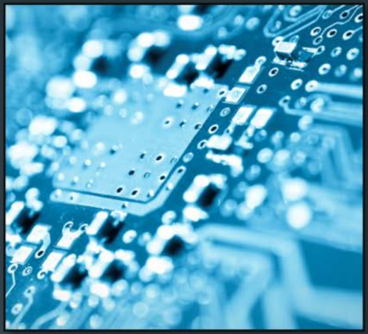

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Exhibit STKN-049

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Technical Comments on Petitioners' Rebuttal Testimony in the WaterFix Proceedings

Exhibit STKN-049

Susan Paulsen, Ph.D., P.E.

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Outline

Opinion 1: DWR's representation of hydrodynamics and velocity in the Delta misses key features of Delta flows and leads to unsupported conclusions regarding water quality impacts to the City of Stockton.

Opinion 2: DWR's opinions regarding salinity impacts at the location of Stockton's intake are incomplete and misleading. Exponent's analysis of DWR's modeling shows that the WaterFix project will have significant impacts to salinity at the City's intake location.

Opinion 3: The information provided by DWR regarding bromide is insufficient to determine impacts to Stockton but indicates that bromide concentrations will increase.

Opinion 4: The information provided by DWR regarding organic carbon is insufficient to determine impacts at Stockton's intake location but indicates that organic carbon concentrations will increase.

Opinion 5: DWR's conclusions that the WaterFix project will not impact the frequency or magnitude of *Microcystis* blooms in the future are unfounded. Our analysis indicates that the WaterFix project will increase the likelihood of *Microcystis* blooms in the future.

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Opinion 1: DWR's representation of hydrodynamics and velocity in the Delta misses key features of Delta flows and leads to unsupported conclusions regarding water quality impacts to the City of Stockton.

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1.1: Channel velocities will not change appreciably in the future because channel velocity in the central Delta is strongly influenced by tidal forcing, and tidal forcing will not change as a result of the WaterFix project. DWR’s analysis, which focuses on daily maximum flow velocity and “15-minute absolute velocity (regardless of direction),” fails to consider important hydrodynamic characteristics that impact water quality within the Delta.

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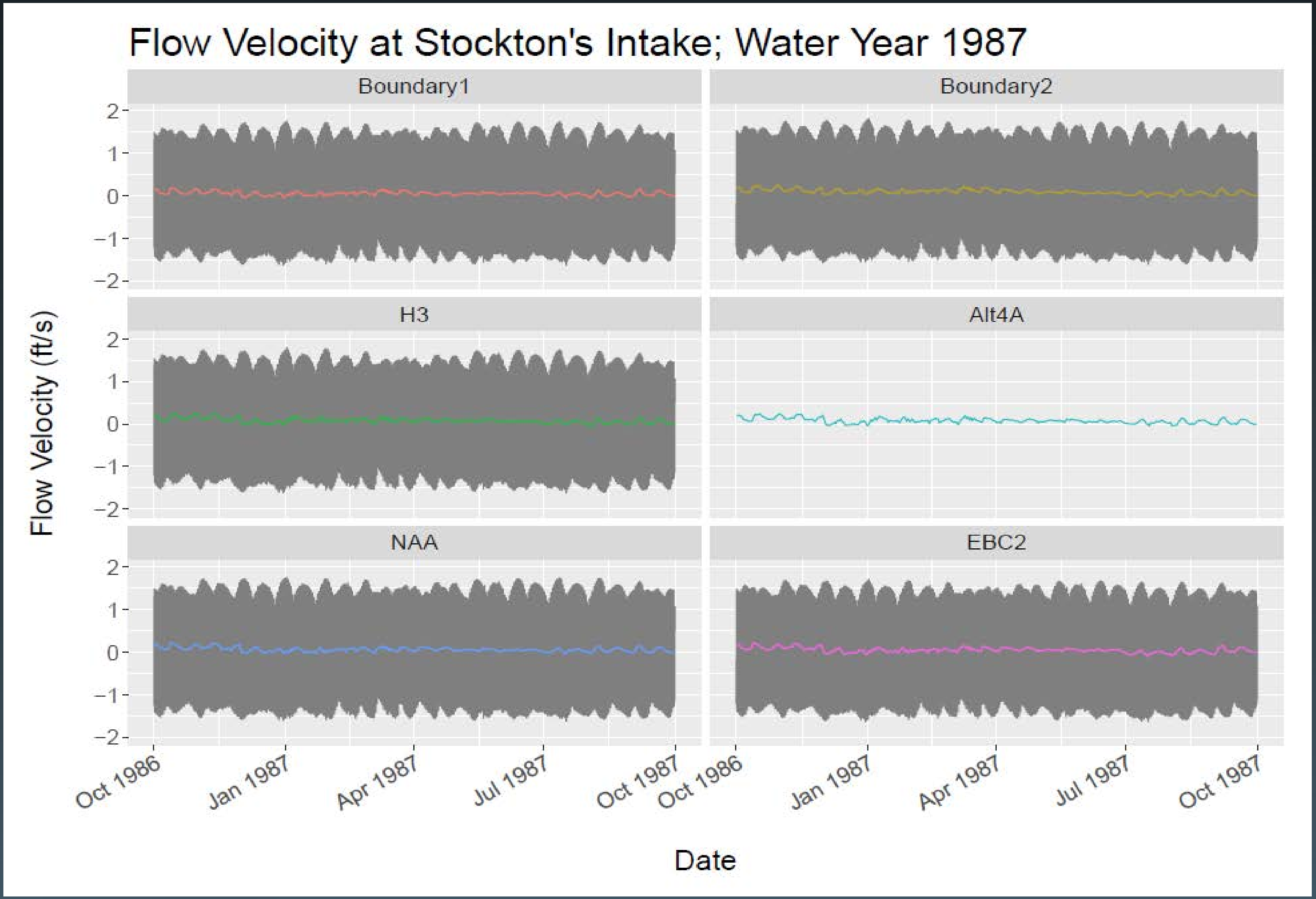

Figure 1 15-minute flow velocity (dark gray) and daily average flow velocity (colored lines) at Stockton's intake during water year 1987, a dry water year.

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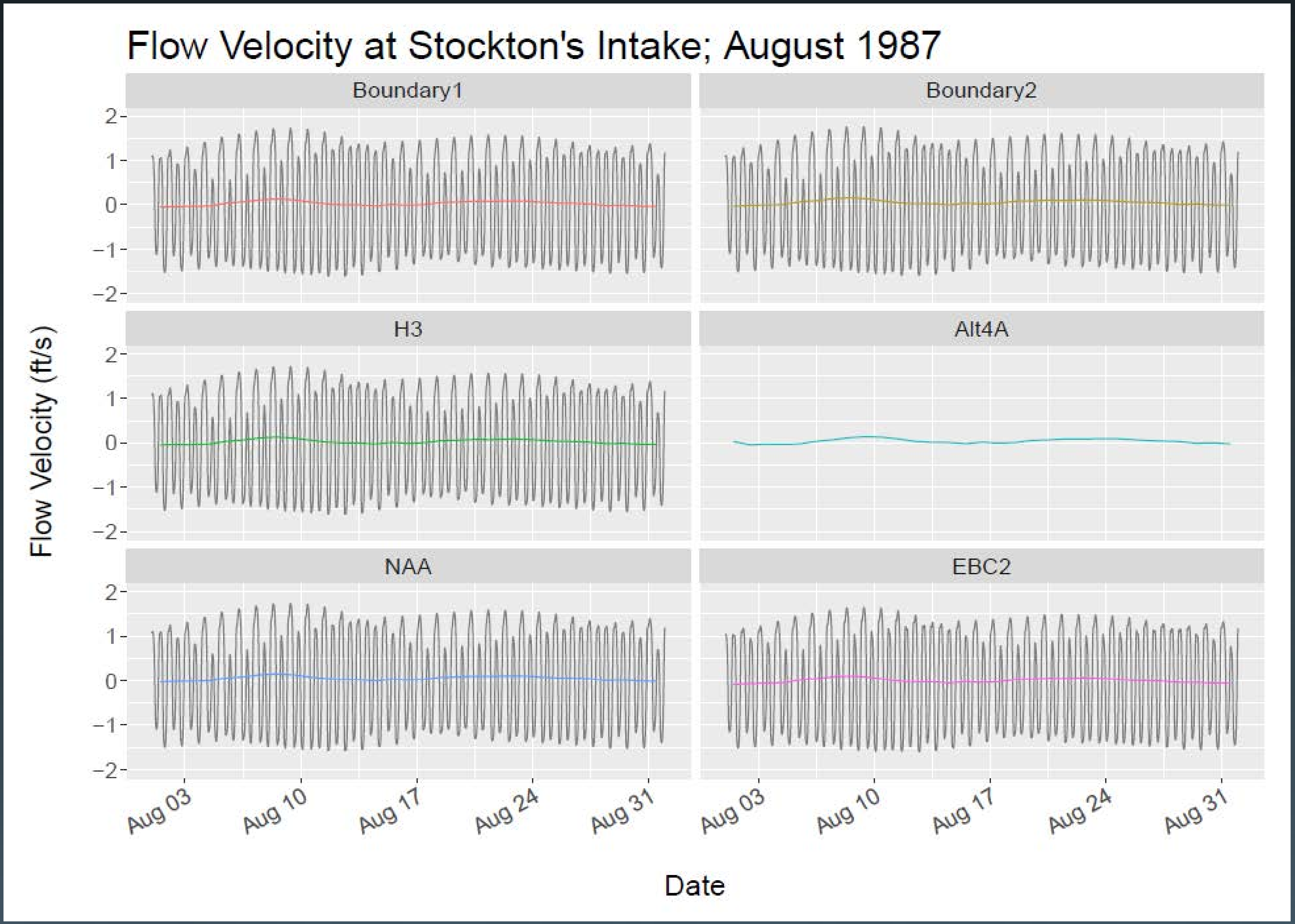

Figure 2 15-minute flow velocity (dark gray) and daily average flow velocity (colored lines) at Stockton's intake during August 1987.

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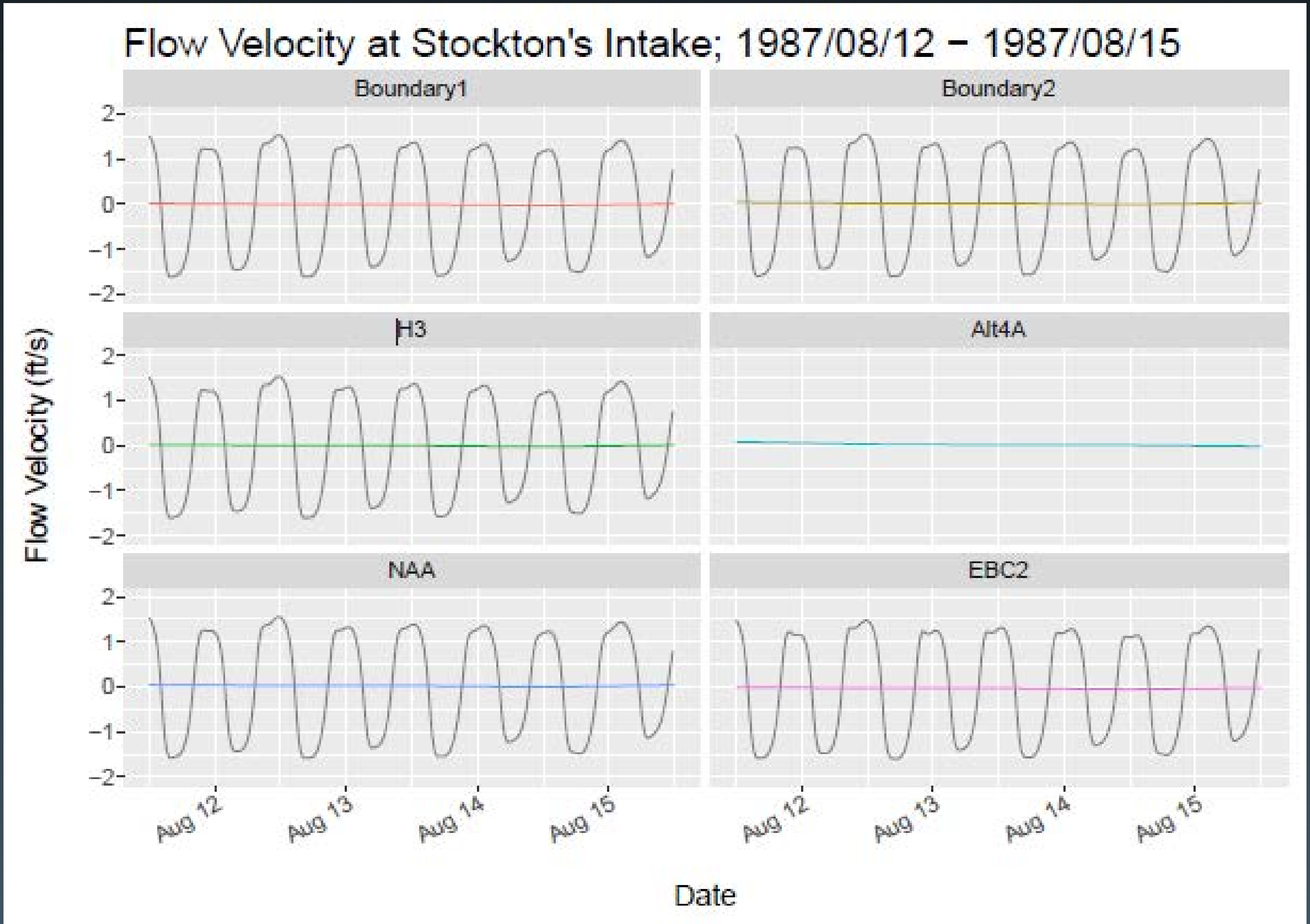

Figure 3 15-minute flow velocity (dark gray) and daily average flow velocity (colored lines) at Stockton's intake from August 11-16, 1987.

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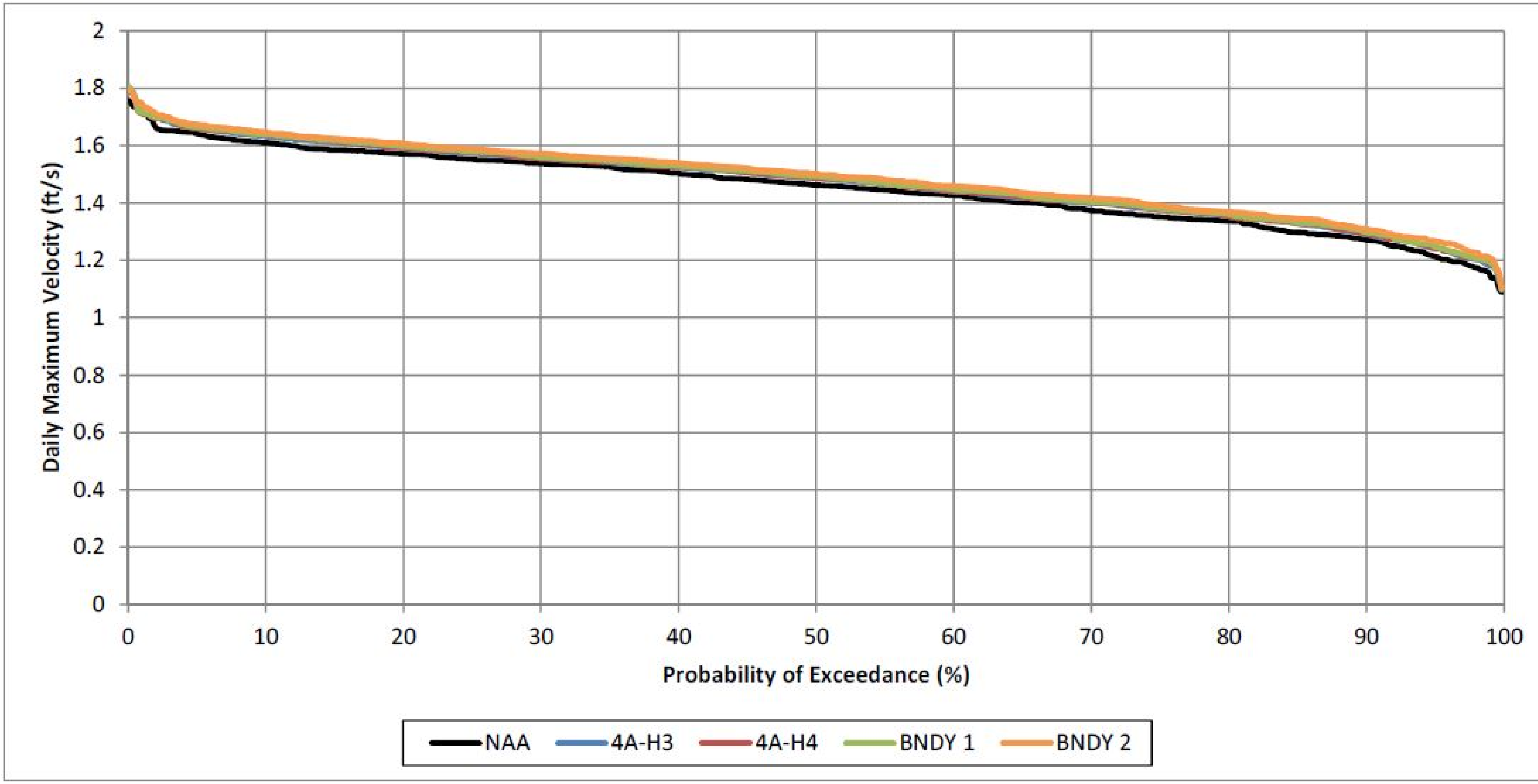

Figure 49. Probability of exceedance of daily maximum velocity in the San Joaquin River near the City of Stockton's drinking water diversion location for August of the 1976–1991 period of record modeled.

Figure 4 Figure 49 from DWR-652 at p. 59.

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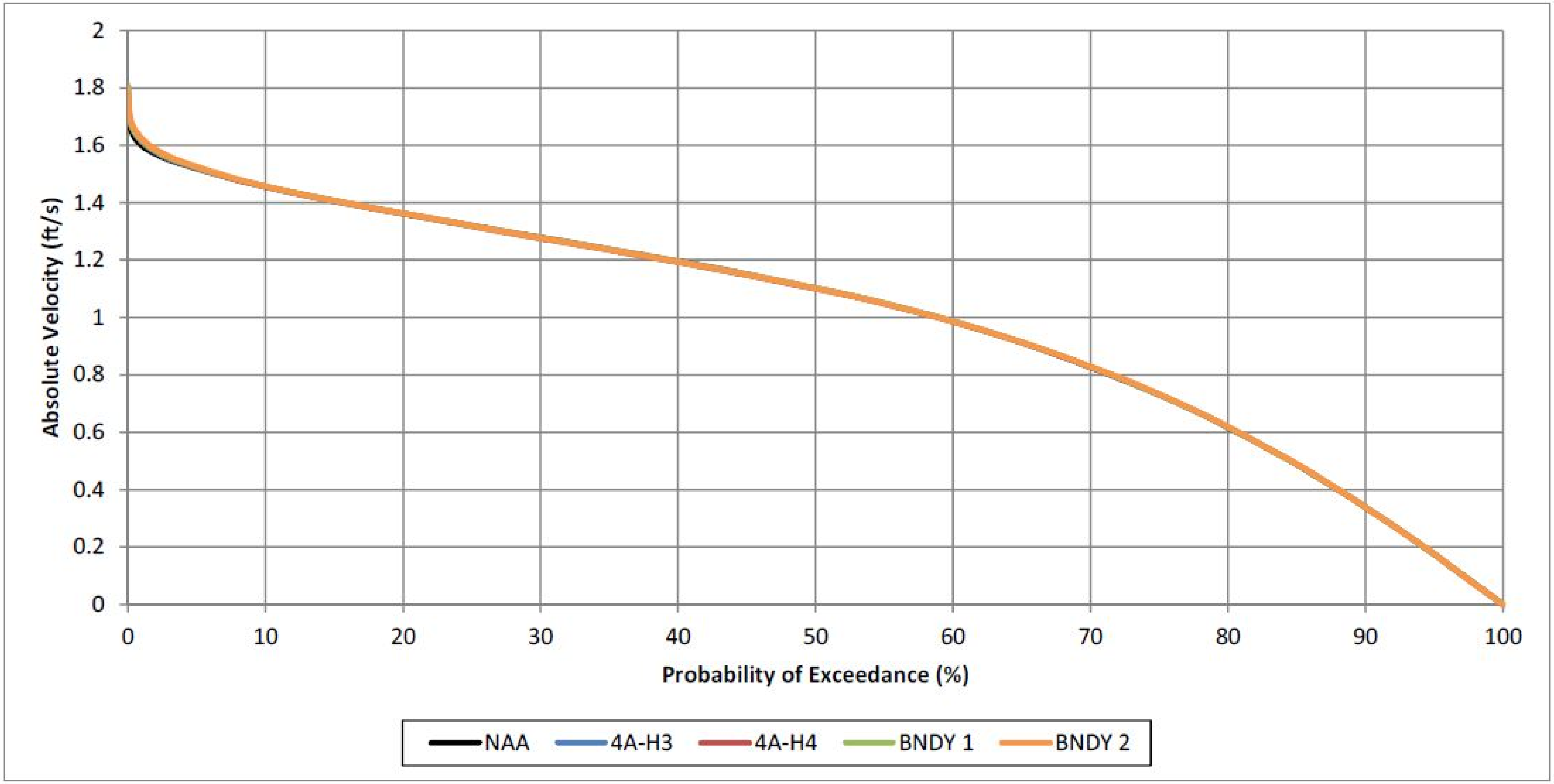

Figure 50. Probability of exceedance of absolute values of daily velocities, on a 15-minute time-step, in the San Joaquin River near the City of Stockton's drinking water diversion location for August of the 1976–1991 period of record modeled.

Figure 5 Figure 50 from DWR-652 at p. 59.

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Table 1 Table 5 from STKN-026

Table 5 Residence times of inflows to the Delta under a dry water year

Month	Monthly average residence time (days)					Percent increase from EBC2 to B1	Percent increase from EBC2 to B2	Percent increase from EBC2 to Alt4A
	EBC2	NAA	B1	B2	Alt 4A			
October	28	26.6	35.8	34.4	31.6	28%	23%	13%
November	32.3	32.3	36.5	40.2	38.6	13%	24%	20%
December	27.6	28.3	30.8	32.3	31.3	12%	17%	13%
January	31	31.7	32.9	35.9	34.2	6%	16%	10%
February	27.3	26.9	28.9	29.3	30.7	6%	7%	12%
March	24.2	24	26.4	26.1	27	9%	8%	12%
April	22.3	22.8	24.9	24.9	24.9	12%	12%	12%
May	38.2	39.3	37.1	40	39.2	-3%	5%	3%
June	36.4	36.9	37.9	40.1	37.8	4%	10%	4%
July	27.7	28.7	34.4	35.6	34.2	24%	29%	23%
August	23.2	26.7	31.1	31.8	30.9	34%	37%	33%
September	27.8	31.2	36.3	35.1	34.3	31%	26%	23%

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1.2: DWR’s analysis does not consider changes in residence time, and residence time is critical in understanding water quality impacts in the Delta, including at Stockton’s intake.

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Opinion 2: DWR's opinions regarding salinity impacts at the location of Stockton's intake are incomplete and misleading. Exponent's analysis of DWR's modeling shows that the WaterFix project will have significant impacts to salinity at the City's intake location.

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2.1 DWR's testimony regarding the FEIR/EIS analysis of salinity impacts at Stockton's intake location is incomplete and incorrect. Exponent's analysis of DWR's modeling shows that the WaterFix project will have significant impacts on the source and quality of water at Stockton's intake.

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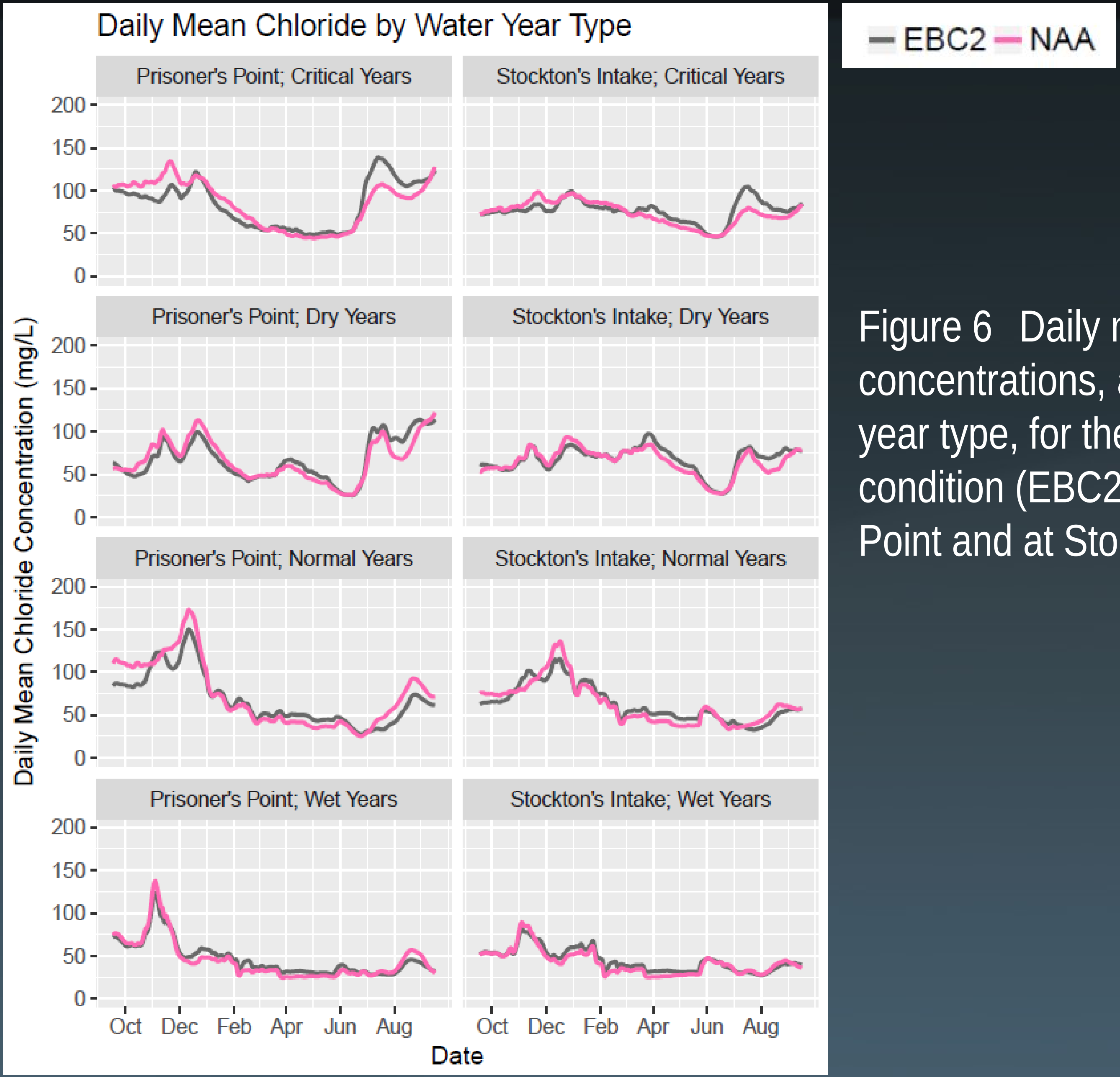

Figure 6 Daily mean chloride concentrations, averaged by hydrologic year type, for the NAA and existing condition (EBC2) scenarios at Prisoners Point and at Stockton's intake

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2.2: DWR's evaluations of chloride impacts at Stockton's intake in DWR-652 are insufficient to determine impact. A more detailed analysis of DWR's model results shows significant increases in chloride concentrations at Stockton's intake as a result of the WaterFix project.

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2.3: DWR's assertions that the primary source of chloride in the Delta is seawater intrusion is only true in some portions of the Delta, and chloride can exceed 110 mg/L at Stockton's intake even when seawater is not present. Internal sources of chloride within the Delta are important in areas of the Delta not frequently influenced by seawater intrusion.

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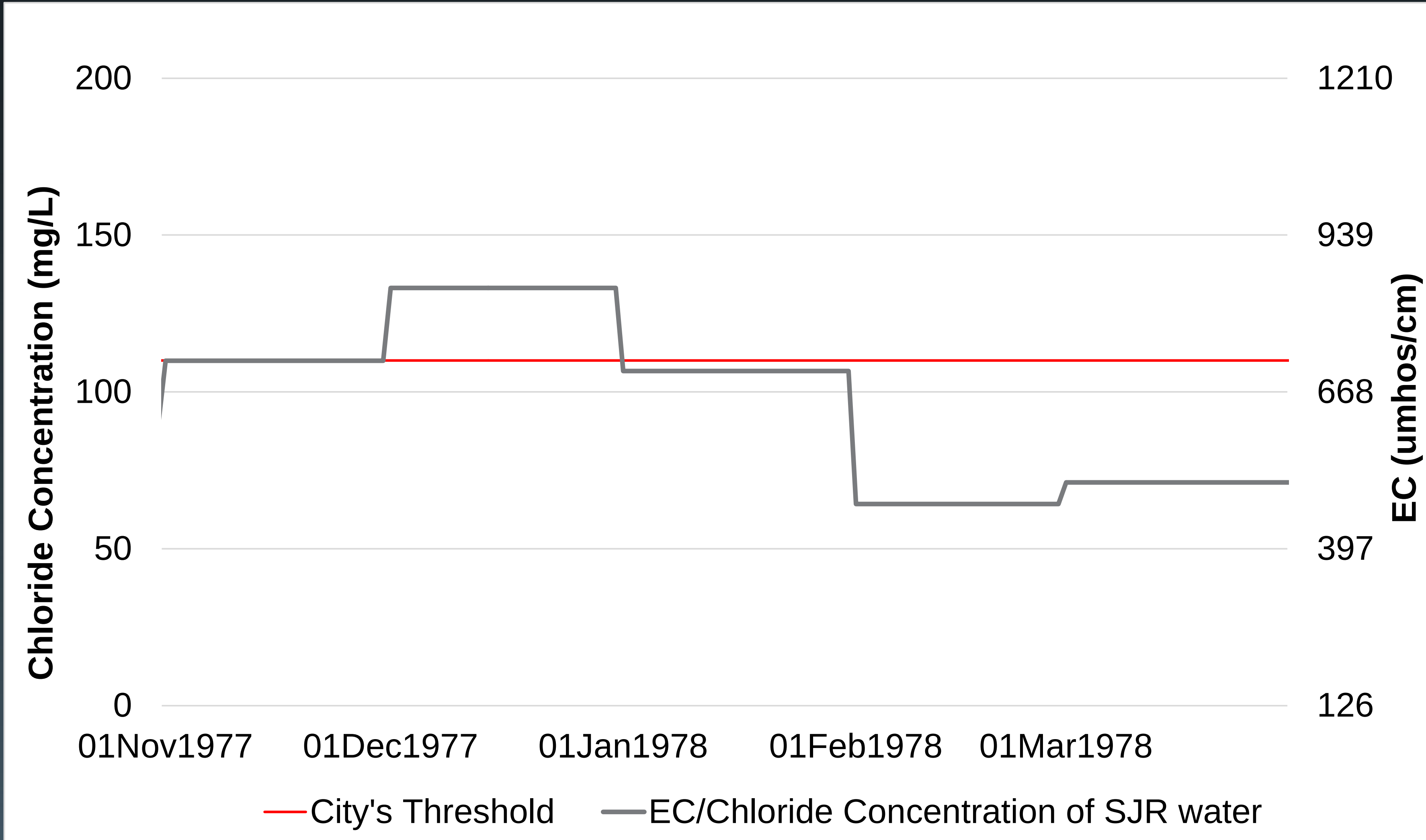

Figure 7 Chloride concentration (and EC) of the San Joaquin River at Vernalis from November 1977 to April 1978, from DSM2 model input files.

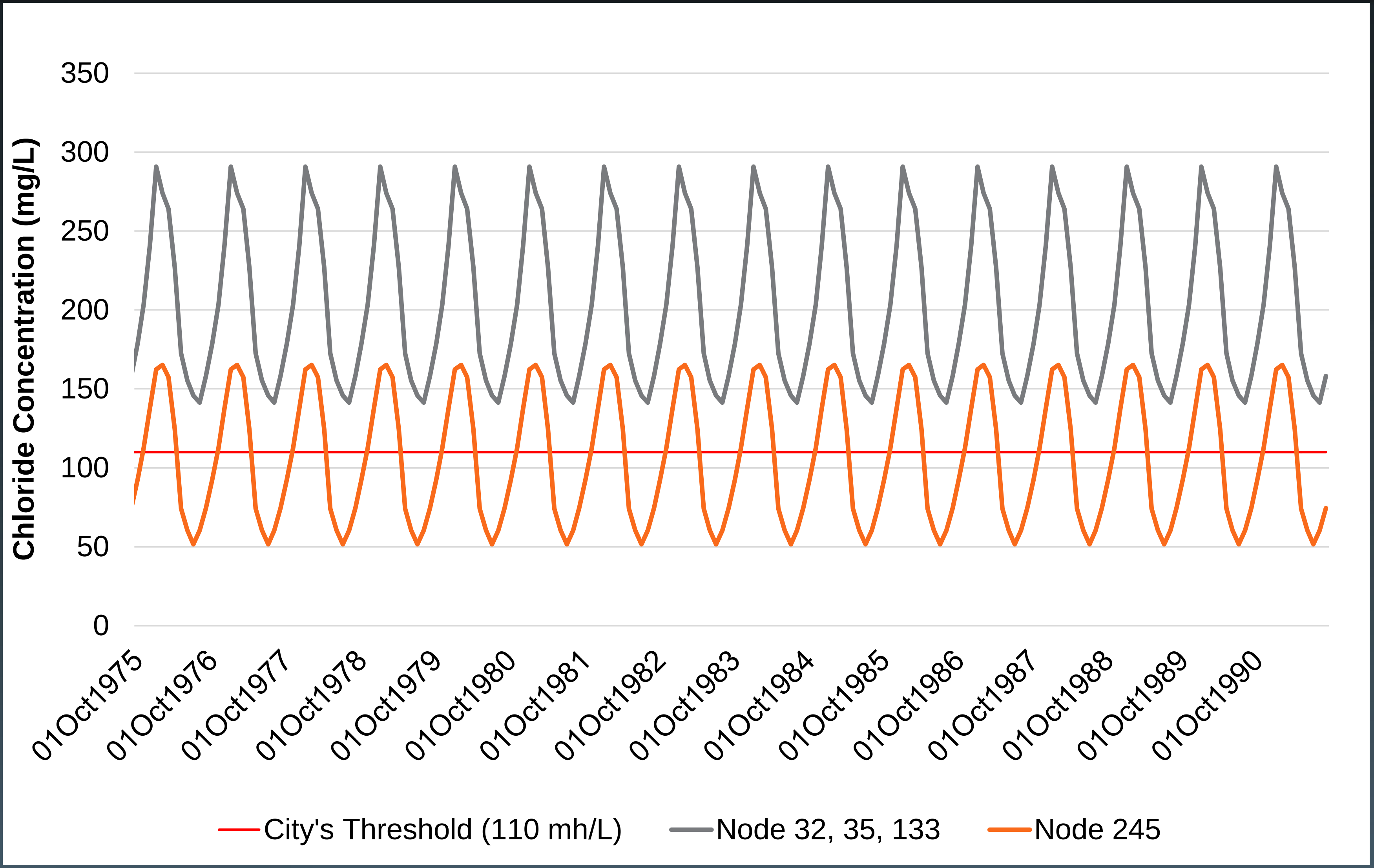

Figure 8 Chloride concentrations in agricultural drainage (DICU) simulated at DSM2 nodes 32, 35, 133, and 245, near Stockton's intake.

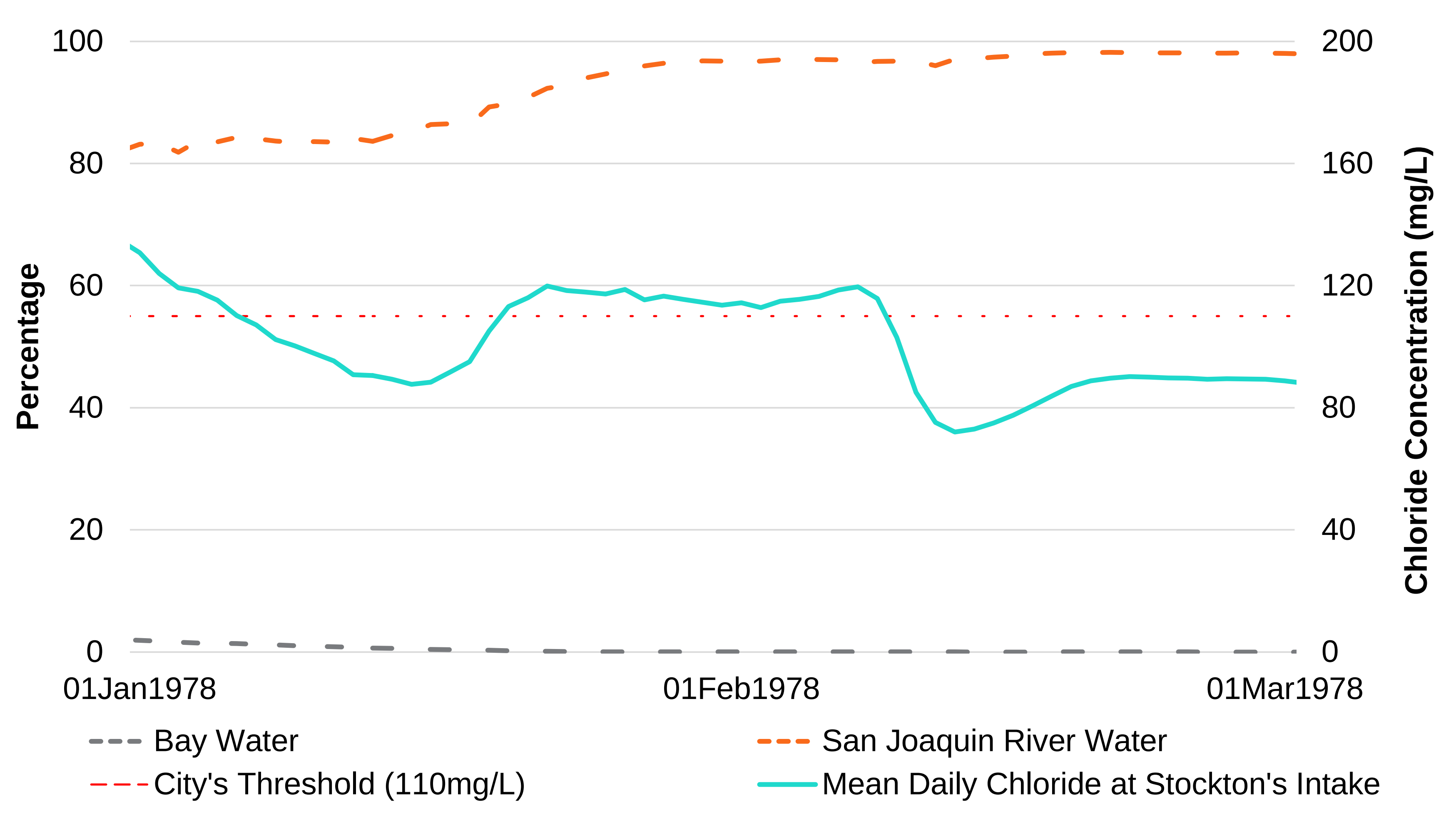

Figure 9 DSM2 model results showing the volumetric percentage of water sources and the mean daily chloride concentration at Stockton's intake.

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2.4: DWR's assertion that differences in the conversion factor used to convert EC model output to chloride may be responsible for the apparent exceedances of water quality thresholds is misleading. Our analysis shows that the conversion factors used by DWR and Exponent are similar.

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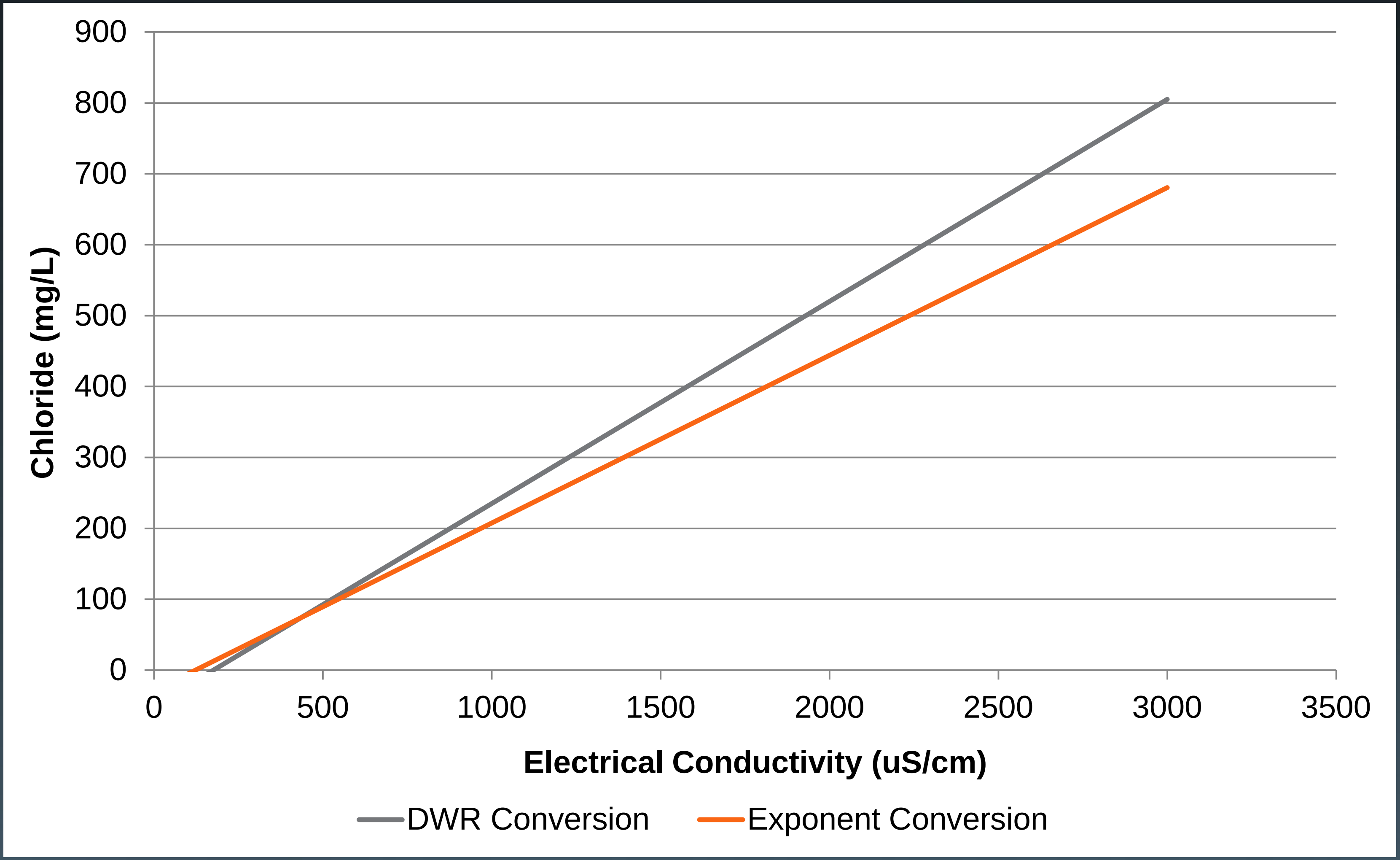

Figure 10 Comparison of EC to salinity conversion equations used by DWR and Exponent in post-processing DSM2 data.

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2.5: Similar to chloride, DWR evaluated EC using monthly average simulated EC. DWR's evaluations of EC impacts at Stockton's intake in DWR-652 are insufficient to determine impact. A more detailed analysis of DWR's model results shows significant increases in EC concentrations at Stockton's intake as a result of the WaterFix project.

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Opinion 3: The information provided by DWR regarding bromide is insufficient to determine impacts to Stockton but indicates that bromide concentrations will increase.

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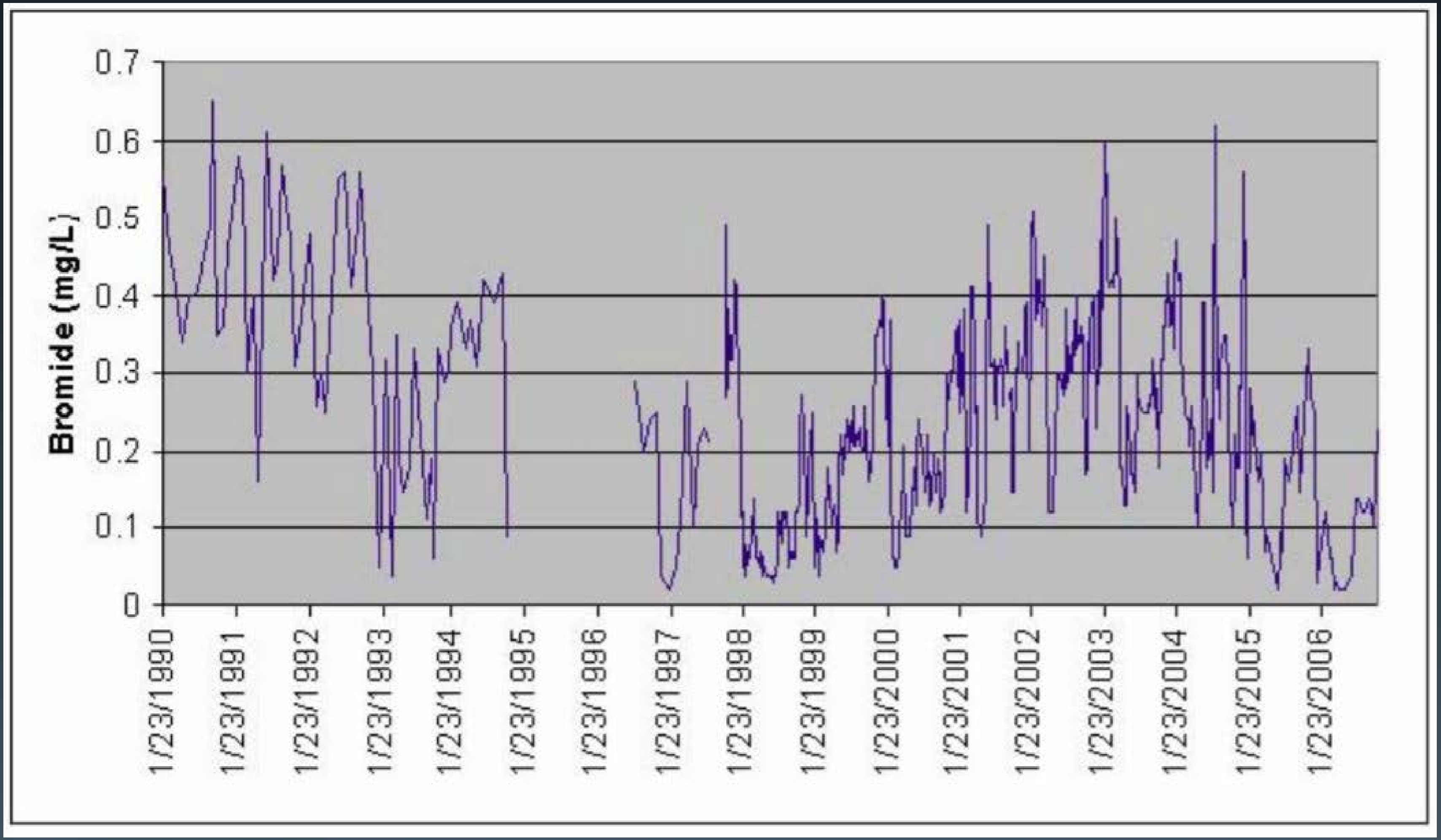

Figure 11 Bromide concentrations for the San Joaquin River near Vernalis, 1990-2006. Source: CALFED (2007), Figure 14.

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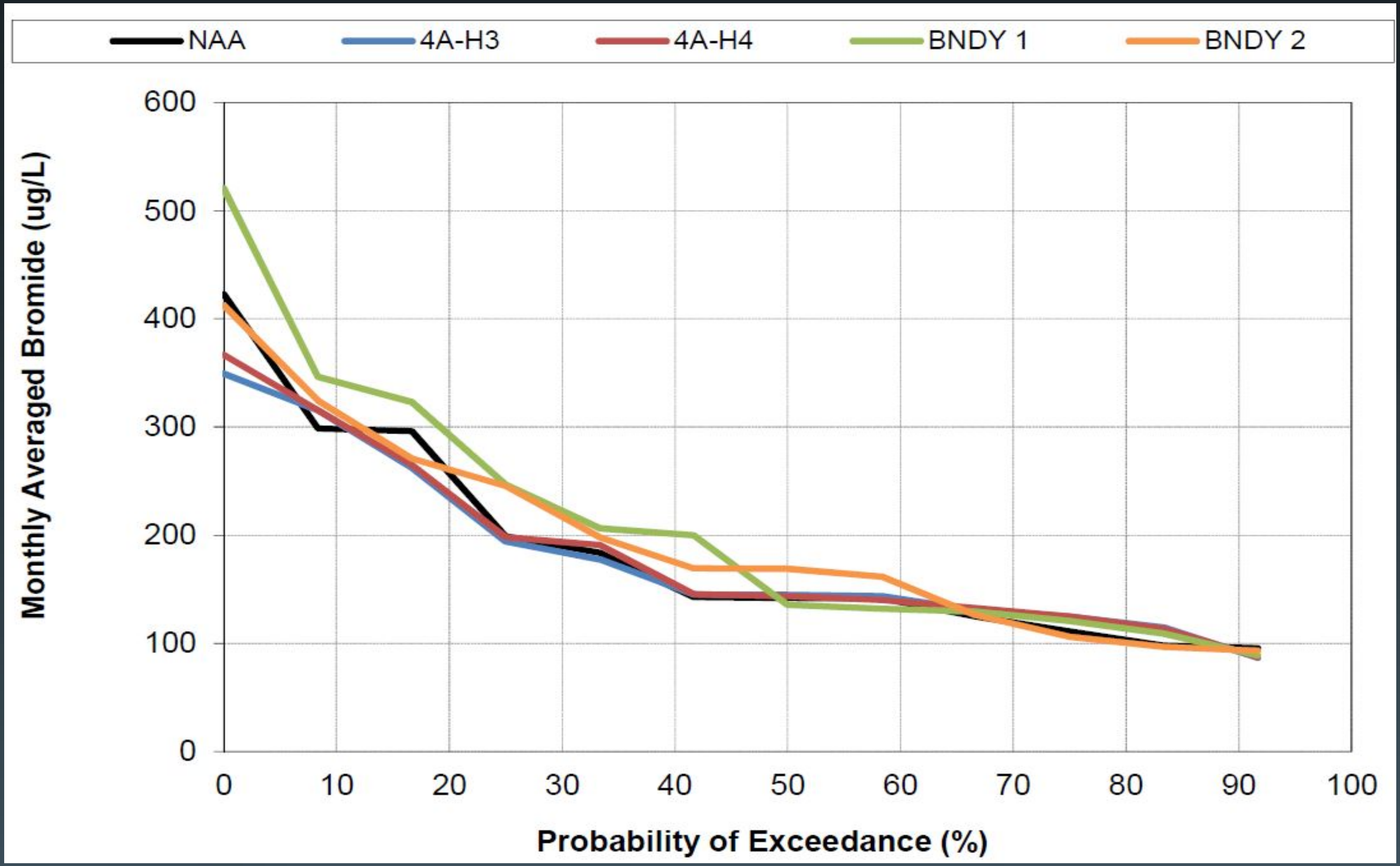

Figure 12 Probability of exceedance plot for monthly average bromide concentrations in the San Joaquin River at the City of Stockton's drinking water diversion location for below normal years (1976–1991), based on EC-to-bromide relationship. Source: DWR-652, Figure 10, p. 16.

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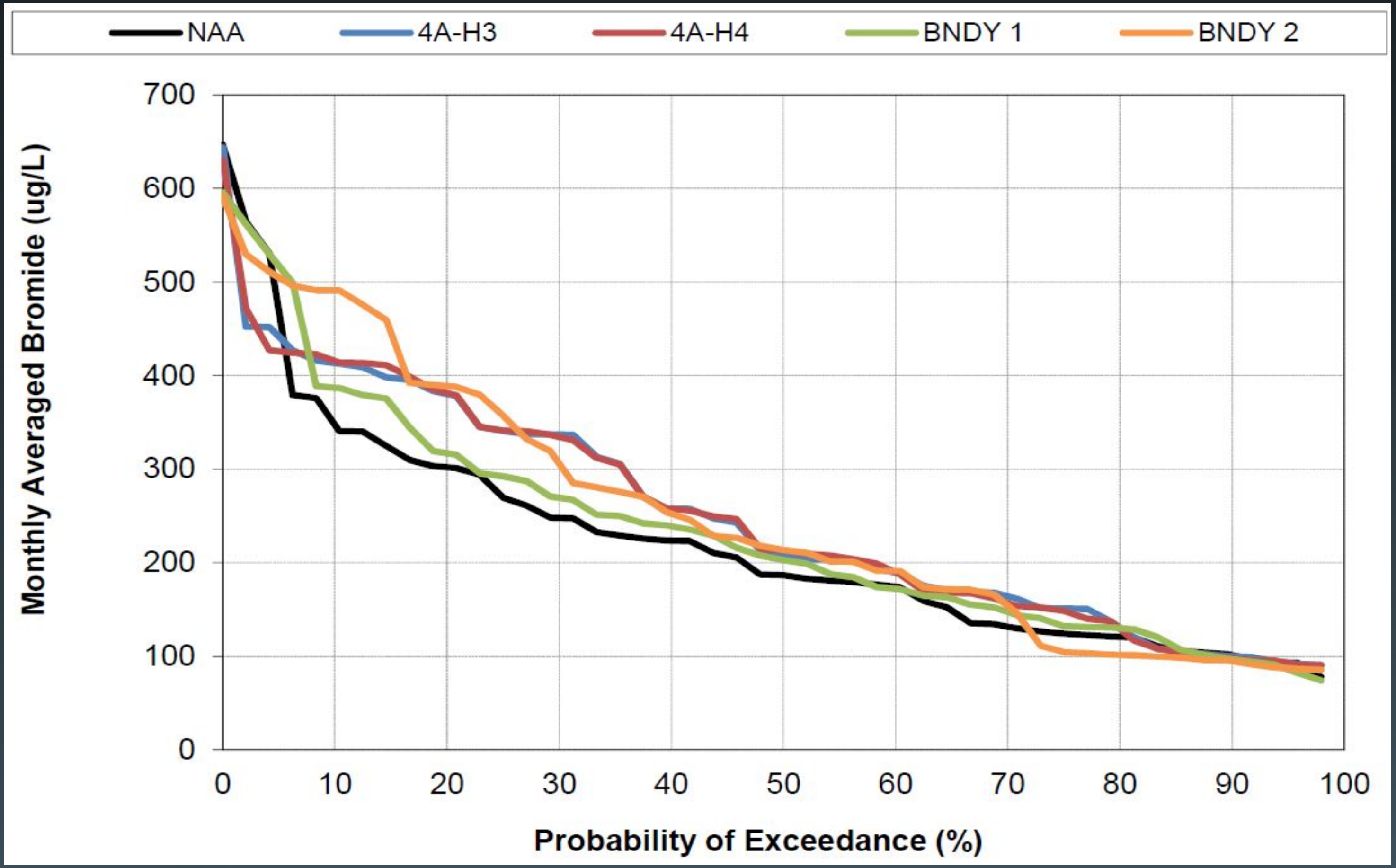

Figure 13 Probability of exceedance plot for monthly average bromide concentrations in the San Joaquin River at the City of Stockton's drinking water diversion location for dry years (1976–1991), based on EC-to-bromide relationship. Source: DWR-652, Figure 11, p. 17.

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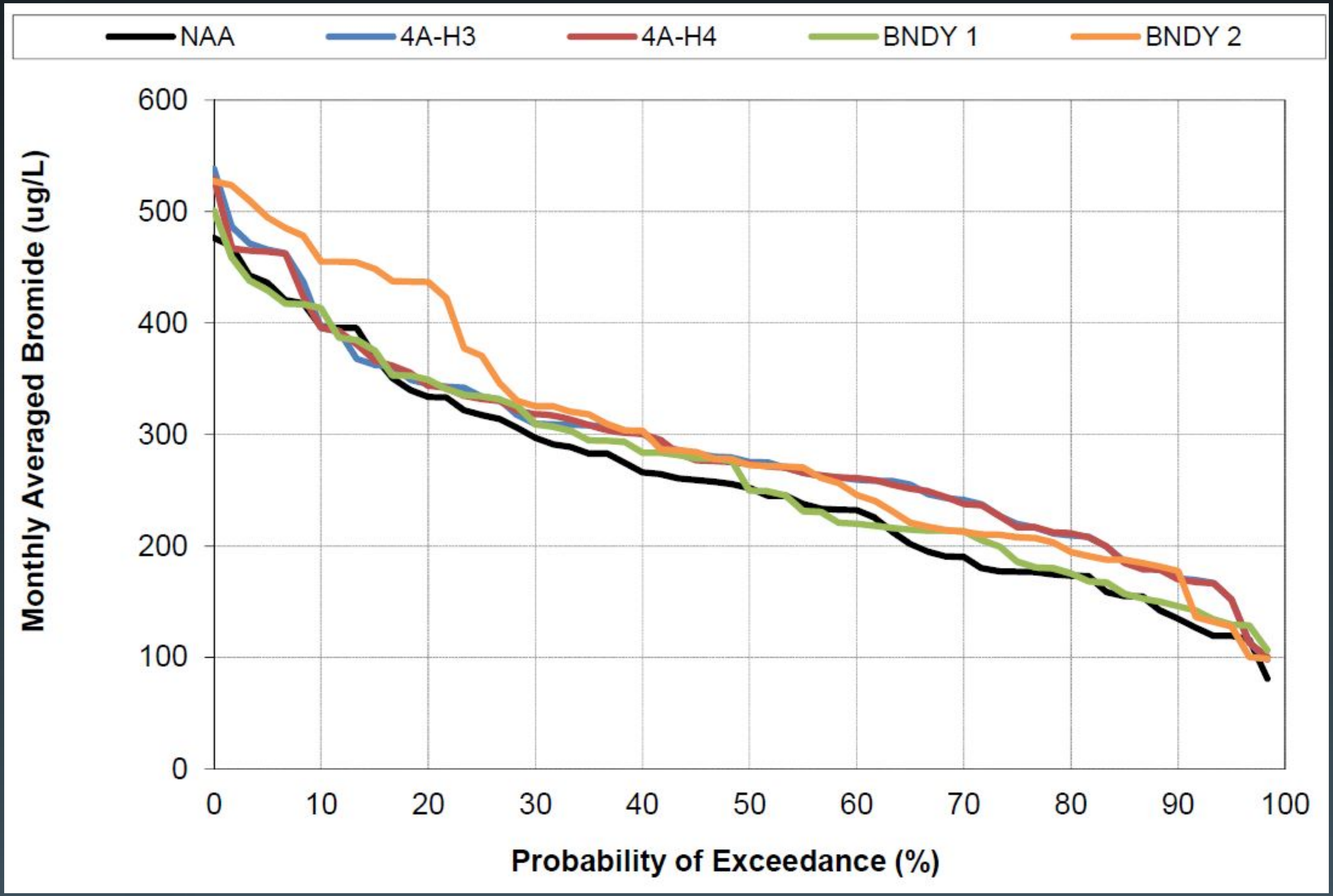

Figure 14 Probability of exceedance plot for monthly average bromide concentrations in the San Joaquin River at the City of Stockton's drinking water diversion location for critical years (1976–1991), based on EC-to-bromide relationship. Source: DWR-652, Figure 12, p. 18.

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Opinion 4: The information provided by DWR regarding organic carbon is insufficient to determine impacts at Stockton's intake location but indicates that organic carbon concentrations will increase.

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Opinion 5: DWR's conclusions that the WaterFix project will not impact the frequency or magnitude of *Microcystis* blooms in the future are unfounded. Our analysis indicates that the WaterFix project increases the likelihood of *Microcystis* blooms in the future.

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5.1: DWR oversimplifies the multiple factors which interact to promote the formation of *Microcystis* blooms within the Delta.

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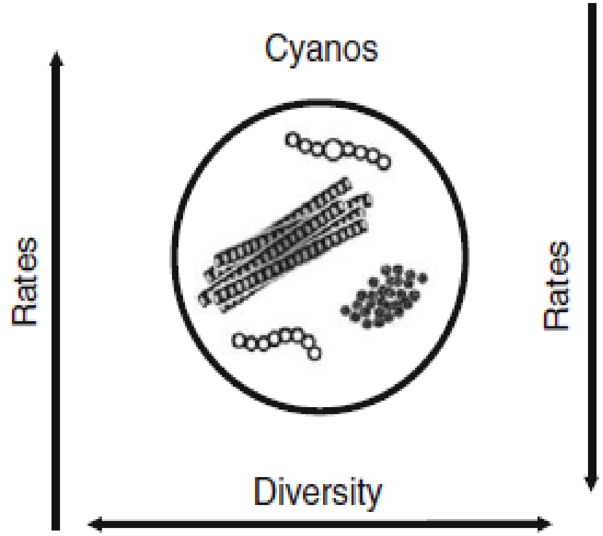
Environmental factors controlling CyanoHABs

Positive

- High P (High N for some)
- Low N (DIN, DON) (only applies to N_2 fixers)
- Low N:P Ratios
- Low turbulence
- Low water flushing-Long water residence time
- High (adequate) light
- Warm temperatures
- High dissolved organic matter
- Sufficient Fe (+ trace metals)
- Low grazing rates



Modulating factors

- Strong biogeochemical gradients (e.g. persistent stratification, stable benthos)
- Heterogeneous and diverse habitats (e.g. reefs, seagrasses, marshes, sediments, aggregates)
- Selective grazing
- "Toxin" production??

Negative

- High DIN/ total N (only applies to N_2 fixers)
- Low P (DIP)
- High N:P ratios
- High turbulence & vertical mixing
- High water flushing-Short water residence time
- Low light (for most taxa)
- Cool temperatures
- Low dissolved organic matter
- Low Fe (+ trace metals)
- High grazing rates
- Viruses (cyanophages)
- Predatory bacteria

Fig. 6 Suite of positive and negative effectors as well as modifying environmental and ecological factors that influence CyanoHAB potentials in aquatic ecosystems

Figure 16 Factors affecting CyanoHAB potentials in aquatic ecosystems, reproduced from Figure 6 of Paerl and Otten (2013)

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5.2: DWR’s testimony has improperly conflated channel velocity with residence time. Our analysis indicates that the overall velocity regime of the Delta is unlikely to change in the future, but residence times will increase with the WaterFix project.

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5.3: Because of the complex and indirect nature of velocity effects on *Microcystis* growth and accumulation, DWR's application of very limited "critical velocities" from the literature to predict effects of the WaterFix is inappropriate.

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5.4 DWR’s testimony acknowledges the effect of residence time on the potential for *Microcystis* accumulation, but suggests that because residence time is not sufficient to cause a bloom it is unimportant. This is inconsistent with known controls on bloom formation and DWR’s testimony on bloom formation in the Delta.

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5.5 Because temperature is considered an important controlling factor for *Microcystis* growth and bloom occurrence in the Delta, it is important to consider temperature on appropriate time and spatial scales when predicting the effect of the WaterFix on the Delta.

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