

# Sites Reservoir Project Effects Analysis – Appendix A

## Mixed-Effects Modeling and Error Propagation for CHNWR and CHNSR Screen Exposure Analyses

### Appendix A1 – Estimation of Hamilton City Oxbow Inflow and Outflow

CalSim II and USRDOM do not explicitly simulate flows through the Hamilton City oxbow, either upstream or downstream of the Hamilton City Pump Station (HCPS) fish screen. However, GCID provided Hamilton City oxbow inflow, Hamilton City oxbow outflow and daily mean diversion rate data in the 2013 - 2023 Hamilton City rotary screw trap dataset (Sites Authority 2023). Daily Sacramento River flow at Hamilton City is provided by the California Data Exchange Center (CDEC, Station HMC). We used a linear mixed-effects model, fit by restricted maximum likelihood, to estimate Hamilton City oxbow inflow, ( $Q_{HCOX}$ ) as a function of Sacramento flow at Hamilton City ( $Q_{SacHC}$ ) and HCPS diversion rate ( $Q_{HCPS}$ ). We included water-year type ( $wyt$ ), as well as previous water year type ( $wytL1$ ), as random effects, with month of water year as random effects, nested in both  $wyt$  and  $wytL1$ . The formal model was:

$$\hat{Q}_{HCOX_{ijkl}} = \beta_0 + \beta_1 Q_{SacHC_{ijkl}} + \beta_2 Q_{HCPS_{ijkl}} + wyt_j + wytL1_k + month_{jl} + month_{kl} + \varepsilon_{ijkl}, \quad (A1)$$

and

$$\varepsilon_{ijkl} \sim N(0, \sigma_\varepsilon^2), \quad wyt_j \sim N(0, \sigma_{wyt}^2), \quad wytL1_k \sim N(0, \sigma_{wytL1}^2), \quad month_{jl} \sim N(0, \sigma_{month_j}^2),$$

$$month_{kl} \sim N(0, \sigma_{month_k}^2),$$

where the subscripts  $i, j, k$ , and  $l$  denote the  $i^{th}$  observation in  $wyt_j$ , following  $wytL1_k$  and in month  $l$ . We used step-backward model selection, testing models with and without each fixed effect and each random effect as well as all possible permutations with and without a  $Q_{SacHC} \times Q_{HCPS}$  interaction. The most strongly supported model as indicated by the lowest Akaike Information Criterion (AIC) score, contained all of the fixed and random effects of Model (A1), as well as a  $Q_{SacHC} \times Q_{HCPS}$  interaction. However, this model made predictions at very high  $Q_{SacHC}$  that were physically improbable when USRDOM flows were substituted for  $Q_{HCOX}$  and  $Q_{HCPS}$  (e.g., lower predicted  $Q_{HCOX}$  at higher  $Q_{HCPS}$ ). Thus, we chose Model (A1), which had a slightly higher AIC but made  $Q_{HCOX}$  predictions that conformed to a more probable reality. The marginal and conditional  $R^2$  of Model (A1), that is, the variation in  $Q_{HCOX}$  explained by the fixed effects alone and by fixed and random effects combined, were 0.94 and 0.98, respectively.

Substituting USRDOM-simulated  $Q_{SacHC}$  and  $Q_{HCPS}$  into Model (A1) produced the predictions shown in Figure A1. GCID historical data showed that HCPS diversions,  $Q_{HCPS}$ , account for the entire difference between Hamilton City oxbow inflow and outflow; thus Hamilton City oxbow outflow was calculated as  $Q_{HCOX} - Q_{HCPS}$  (Figure A1, Effects Analysis Figure 4-31).

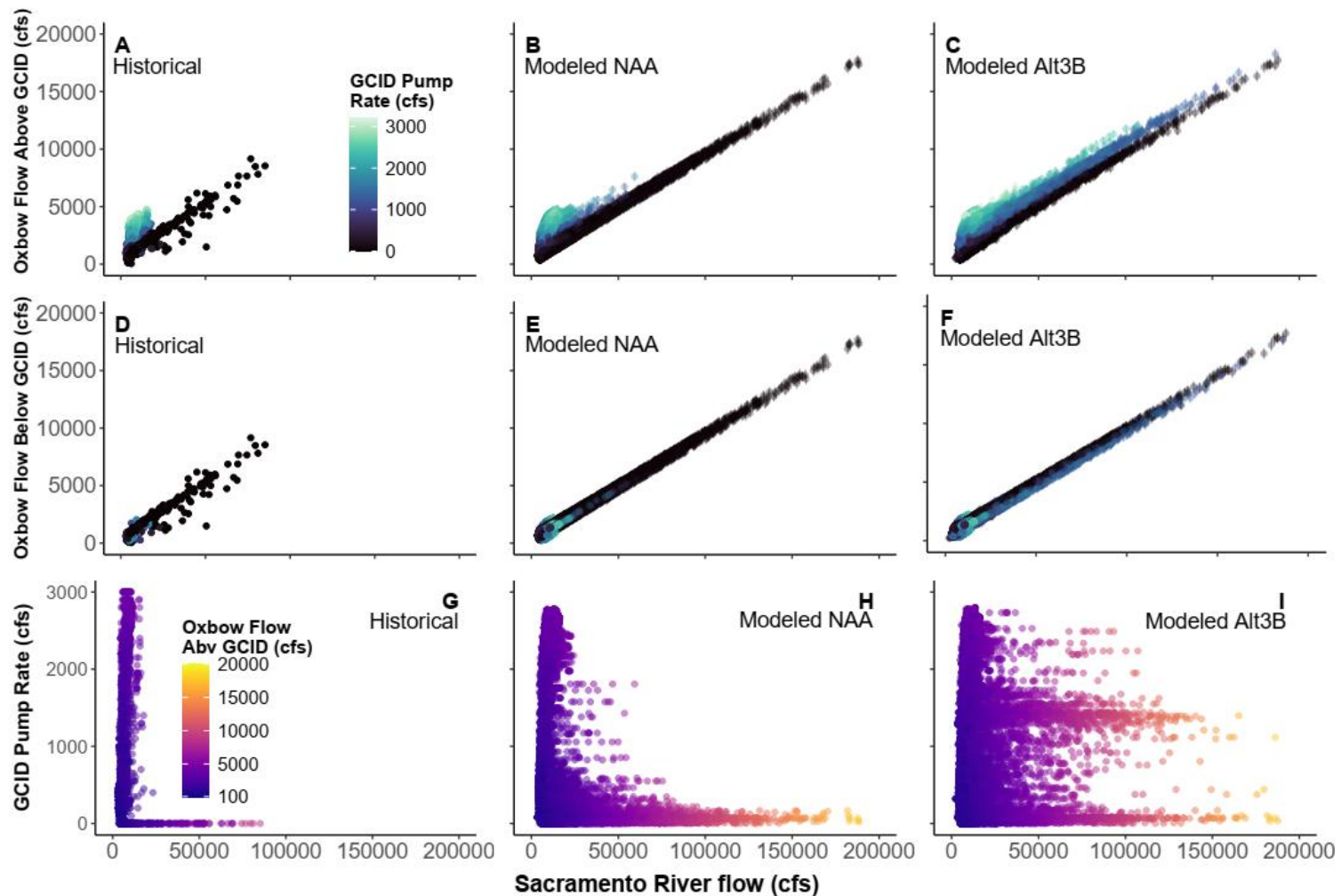


Figure A1. (Left) Historical Hamilton City oxbow flows upstream (A) and downstream (D) of the Hamilton City Pump Station (HCPS) and Glenn Colusa Irrigation District (GCID) diversion rate (G) versus Sacramento River flow. Colors in A and D indicate GCID diversion rate ( $Q_{HCPS}$ ). Colors in G indicate Hamilton City oxbow flow upstream of HCPS ( $Q_{HCOX}$ ). Historical data provided by GCID. Hamilton City oxbow inflows (panels B and C, respectively) and outflows (panels E and F, respectively) under the NAA (center) and Alt3B (right) were modeled by substituting USRDOM-simulated  $Q_{SacHC}$  and  $Q_{HCPS}$  (panels H and I) into Model (A1). NoSha and NoShaOro scenarios are not shown but are similar to Alt3B. Error bars indicate 95% prediction intervals on point estimates. USRDOM data provided in the ITP Application (Sites Authority 2023).

## Appendix A2 – Survival from Red Bluff to Hamilton City

### Estimating Reach-Specific Survival

Acoustic Telemetry studies with survival estimates were downloaded from NMFS Central Valley Acoustic Tagging database (NMFS 2024: <https://oceanview.pfeg.noaa.gov/shiny/FED/telemetry/>). Survival estimates of winter-run Chinook Salmon (CHNWR) from Livingston Stone National Fish Hatchery from 2013 - 2023 and survival estimates of CHNWR from the Battle Creek Jumpstart (a reintroduction effort) from 2019 - 2023 were downloaded. Survival estimates of fall-run and late fall-run Chinook Salmon from Coleman National Fish Hatchery from 2019 - 2023 were also downloaded, which, for this analysis, were used as spring-run surrogates. Reach-specific survival can be estimated from cumulative survival estimates as

$$S_i = \frac{\varphi_i}{\varphi_{i-1}}, \quad (\text{B1})$$

where  $\varphi_i$  is cumulative survival to receiver  $i$  and  $\varphi_{i-1}$  is survival to the receiver upstream of receiver ( $i$ ). Cumulative survival is estimated by a survivorship model and estimates are reported  $\pm 1$  standard error. The standard error of reach-specific survival can be calculated using the formula for the standard error of a quotient of two means,

$$SE_i = \frac{\varphi_i}{\varphi_{i-1}} \cdot \sqrt{\frac{se_{i-1}^2}{\varphi_{i-1}^2} + \frac{se_i^2}{\varphi_i^2}}, \quad (\text{B2})$$

where  $se_{i-1}$  and  $se_i$  are the standard errors of cumulative survival estimates to the upstream and downstream receivers, respectively.

### Imputing Reach-Specific Survival Over a Partial Reach

Survival over partial reaches, i.e. to locations in between receivers, can be calculated from reach-specific survival estimates. Survival from the top of reach  $i$  to a point  $p$  within reach  $i$  is

$$S_{i,p} = S_i^{r_{i,p}}, \quad (\text{B3})$$

$$r_{i,p} = \frac{d_{i,p}}{d_i}, \quad (\text{B4})$$

where  $d_{i,p}$  is the distance in km from the top of reach  $i$  to point  $p$  within reach  $i$  and  $d_i$  is the length of reach  $i$  in km. The standard error of  $S_{i,p}$  is calculated using the formula for the standard error of a mean raised to a power.

$$SE_{i,p} = \left| r_{i,p} \cdot S_i^{r_{i,p}-1} \cdot SE_i \right| \quad (\text{B5})$$

### Imputing Cumulative Survival Over a Partial Reach

Cumulative survival to point  $p$  within reach  $i$  is estimated by multiplying the partial reach-specific survival by the cumulative survival to the upstream receiver.

$$\varphi_{i,p} = S_{i,p} \cdot \varphi_{i-1} \quad (\text{B6})$$

The standard error of  $\varphi_{i,p}$  is calculated using the formula for the standard error of the product of two means.

$$se_{i,p} = \sqrt{(SE_{i-1}^2 \cdot \varphi_{i,p}^2) + (SE_{i,p}^2 \cdot \varphi_{i-1}^2)} \quad (\text{B7})$$

### Appendix A3 – Survival-Flow Meta-regression

The weighted, least-squares, mixed-effects model (meta-regression) used to produce Effects Analysis Figures 4-32 (CHNWR) and 4-40 (CHNSR) is of the form:

$$\hat{\varphi}_{RBHC,k} = \begin{cases} \beta_0 + \beta_1 \log_{10}(\bar{Q}_{WLK,d,k}) + \beta_2 [\log_{10}(\bar{Q}_{WLK,d,k})]^2 + \varepsilon_k + \zeta_k, & \bar{Q}_{WLK,d,k} < 10700 \\ \beta_0 + \varepsilon_k + \zeta_k, & \bar{Q}_{WLK,d,k} > 10700 \end{cases} \quad (\text{C1})$$

$$\varepsilon_k \sim N(0, \sigma_\varepsilon^2), \quad \zeta_k \sim N(0, \sigma_\zeta^2) \quad (\text{C2})$$

where  $\hat{\varphi}_{RBHC,k}$  is survival estimate  $k$  of release cohort  $k$  from Red Bluff to Hamilton City, estimated by the Central Valley Enhanced Acoustic Tagging Project survival model;  $\beta_0$  is the fixed intercept;  $\beta_1$  is the fixed slope;  $\bar{Q}_{WLK,d,k}$  is the  $d$ -day ( $d = 22$  for CHNWR;  $d = 9$  for CHNSR) flow at Wilkins Slough beginning on the release date of cohort  $k$ ;  $\varepsilon_k$  is the standard error of survival estimate  $k$ , estimated by survival model  $k$ ; and  $\zeta_k$  is the among-survival-estimate error (the random effect). This model was iteratively fit using Wilkins Slough flow averaging periods of 1 – 60 days for CHNWR and for CHNSR; the CHNWR model using the 22-day average flow had the highest R-squared value, while for CHNSR, the 9-day average was best. These averaging periods were thus used in the CHNWR and CHNSR analyses, respectively.

### References

- NMFS (2024). Central Valley enhanced acoustic tagging project. National Oceanographic and Atmospheric Administration (NOAA). Available: <https://oceanview.pfeg.noaa.gov/shiny/FED/telemetry/>. Accessed: October 2024.
- Sites Authority (2023). Sites Reservoir Project Incidental Take Permit application for operations. Prepared for Sites Project Authority. ICF.

# Sites Reservoir Project Operations Effects Analysis – Appendix B

## Water Temperature in the Sacramento River for Salmonids and Sturgeon

### Appendix B1 – Chinook Salmon

#### Chinook Salmon Juvenile Rearing and Outmigration (60 °F)

##### Red Bluff

**Table 1.** Temperature results for juvenile migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 60°F at Red Bluff for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W,S	0.2%	0.2%	0.2%	0.2%
Apr	S	21.0%	22.2%	20.9%	20.9%
May	S	40.8%	45.0%	42.1%	42.0%
Jun	S	36.7%	41.3%	38.0%	38.0%
July	-	28.4%	30.2%	28.0%	27.9%
Aug	W	31.3%	29.7%	31.2%	31.0%
Sept	W	38.6%	35.2%	38.1%	38.1%
Oct	W	9.2%	7.2%	9.1%	9.2%
Nov	W,S	0.2%	0.1%	0.2%	0.2%
Dec	W,S	0.0%	0.0%	0.0%	0.0%

**Table 2.** Temperature results for juvenile migration showing the change in the number of days in April exceeding 60°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.8	0.0	0.0	<b>16</b>	0	0
AN	0.9	0.9	0.9	<b>11</b>	<b>11</b>	<b>11</b>
BN	1.3	0.0	0.0	<b>17</b>	0	0
D	1.2	0.0	0.0	<b>10</b>	0	0
C	1.0	0.0	0.0	<b>8</b>	0	0
All Years	1.0	0.1	0.1	<b>17</b>	<b>11</b>	<b>11</b>

**Table 3.** Temperature results for juvenile migration showing the change in the number of days in May exceeding 60°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.5	1.5	1.5	<b>5</b>	<b>14</b>	<b>14</b>
AN	<b>3.7</b>	1.3	1.4	<b>14</b>	<b>14</b>	<b>14</b>
BN	<b>7.4</b>	1.5	1.5	<b>22</b>	<b>19</b>	<b>19</b>
D	<b>5.9</b>	0.4	0.3	<b>25</b>	<b>6</b>	<b>4</b>
C	<b>4.3</b>	0	0.0	<b>29</b>	0	0
All Years	<b>3.9</b>	1.0	1.0	<b>29</b>	<b>19</b>	<b>19</b>

**Table 4.** Temperature results for juvenile migration showing the change in the number of days in June exceeding 60°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.5	0.5	0.5	<b>27</b>	<b>13</b>	<b>13</b>
AN	<b>8.4</b>	0.0	0.0	<b>29</b>	0	0
BN	<b>2.0</b>	0.0	0.0	<b>20</b>	0	0
D	<b>2.1</b>	0.0	0.0	<b>9</b>	0	0
C	<b>5.9</b>	0.4	0.6	<b>25</b>	<b>2</b>	<b>3</b>
All Years	<b>3.4</b>	0.2	0.3	<b>29</b>	<b>13</b>	<b>13</b>

**Table 5.** Temperature results for juvenile migration showing the change in the number of days in July exceeding 60°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	1	0	0
AN	<b>2.9</b>	0.0	0.0	<b>22</b>	0	0
BN	0.0	0.0	0.0	0	0	0
D	<b>1.8</b>	0.0	0.0	<b>30</b>	0	0
C	<b>5.6</b>	0.4	0.3	<b>18</b>	<b>3</b>	<b>3</b>
All Years	<b>1.7</b>	0.1	0.0	<b>30</b>	<b>3</b>	<b>3</b>

**Table 6.** Temperature results for juvenile migration showing the change in the number of days in August exceeding 60°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	1	0	0
AN	0.3	0.0	0.0	<b>2</b>	0	0
BN	<b>1.9</b>	0.0	0.0	<b>27</b>	0	0
D	0.1	0.2	0.2	1	<b>3</b>	<b>3</b>
C	0.0	0.0	0.0	0	0	0
All Years	0.4	0.0	0.0	<b>27</b>	<b>3</b>	<b>3</b>

**Table 7.** Temperature results for juvenile migration showing the change in the number of days in September exceeding 60°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.3	0.0	0.0	<b>9</b>	0	0
AN	0.0	1.4	1.4	0	<b>17</b>	<b>17</b>
BN	1.3	0.0	0.0	<b>16</b>	0	0
D	0.6	0.9	0.9	<b>8</b>	<b>13</b>	<b>14</b>
C	0.0	0.0	0.0	0	0	0
All Years	0.5	0.4	0.4	<b>16</b>	<b>17</b>	<b>17</b>

## Hamilton City

**Table 8.** Temperature results for juvenile migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 60°F at Hamilton City for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W, S	1.9%	2.1%	2.0%	2.0%
Apr	S	48.7%	49.9%	49.0%	49.1%
May	S	88.9%	89.5%	89.0%	89.1%
Jun	S	98.3%	98.8%	98.0%	98.1%
July	-	100.0%	100.0%	100.0%	100.0%
Aug	W	99.6%	99.6%	99.6%	99.6%
Sept	W	90.7%	91.0%	90.6%	90.5%
Oct	W	39.5%	37.9%	40.2%	40.0%
Nov	W,S	1.2%	1.1%	1.1%	1.1%
Dec	W,S	0.0%	0.0%	0.0%	0.0%

**Table 9.** Temperature results for juvenile migration showing the change in the number of days in April exceeding 60°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.2</b>	0.0	0.0	<b>27</b>	0	0
AN	<b>3.2</b>	<b>3.2</b>	<b>3.2</b>	<b>18</b>	<b>18</b>	<b>18</b>
BN	<b>1.9</b>	0.0	0.0	<b>26</b>	0	0
D	<b>2.3</b>	0.0	0.0	<b>21</b>	0	0
C	<b>4.4</b>	0.0	0.0	<b>21</b>	0	0
All Years	<b>2.6</b>	0.5	0.5	<b>27</b>	<b>18</b>	<b>18</b>

**Table 10.** Temperature results for juvenile migration showing the change in the number of days in May exceeding 60°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.5</b>	<b>2.8</b>	<b>2.8</b>	<b>23</b>	<b>18</b>	<b>18</b>
AN	<b>3.3</b>	1.4	1.4	<b>25</b>	<b>13</b>	<b>13</b>
BN	<b>12</b>	<b>3.0</b>	<b>2.9</b>	<b>29</b>	<b>28</b>	<b>28</b>
D	<b>8.5</b>	0.4	0.3	<b>31</b>	<b>4</b>	<b>3</b>
C	<b>8.5</b>	0.0	0.0	30	0	0
All Years	<b>6.4</b>	<b>1.7</b>	<b>1.7</b>	<b>31</b>	<b>28</b>	<b>28</b>

**Table 11.** Temperature results for juvenile migration showing the change in the number of days in June exceeding 60°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>4.7</b>	<b>2.8</b>	<b>2.7</b>	<b>27</b>	<b>27</b>	<b>27</b>
AN	<b>17</b>	<b>2.7</b>	<b>2.8</b>	<b>30</b>	<b>23</b>	<b>25</b>
BN	<b>8.6</b>	0.1	0.1	<b>30</b>	1	<b>2</b>
D	<b>5.1</b>	0.1	0.1	<b>19</b>	1	1
C	<b>9.7</b>	0.3	0.3	<b>30</b>	<b>2</b>	<b>4</b>
All Years	<b>8.0</b>	1.3	1.4	<b>30</b>	<b>27</b>	<b>27</b>



**Table 12.** Temperature results for juvenile migration showing the change in the number of days in July exceeding 60°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.5	0.0	0.0	<b>9</b>	1	1
AN	<b>11</b>	0.0	0.0	<b>31</b>	0	0
BN	<b>2.2</b>	0.0	0.0	<b>27</b>	0	0
D	<b>2.1</b>	0.0	0.0	<b>31</b>	0	0
C	<b>7.4</b>	0.3	0.3	<b>31</b>	<b>4</b>	<b>4</b>
All Years	<b>3.7</b>	0.1	0.1	<b>31</b>	<b>4</b>	<b>4</b>

**Table 13.** Temperature results for juvenile migration showing the change in the number of days in August exceeding 60°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.1	0.0	0.0	<b>3</b>	0	0
AN	<b>8.3</b>	0.0	0.0	<b>31</b>	0	0
BN	<b>5.9</b>	0.0	0.0	<b>31</b>	0	0
D	0.1	0.0	0.0	1	0	0
C	0.0	0.0	0.0	0	0	0
All Years	<b>2.3</b>	0.0	0.0	<b>31</b>	0	0

**Table 14.** Temperature results for juvenile migration showing the change in the number of days in September exceeding 60°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.0	0.0	0.0	<b>25</b>	0	0
AN	<b>5.8</b>	<b>2.0</b>	<b>2.0</b>	<b>30</b>	<b>24</b>	<b>24</b>
BN	<b>2.9</b>	0.0	0.0	<b>30</b>	0	0
D	0.2	0.8	0.8	<b>3</b>	<b>15</b>	<b>15</b>
C	0.0	0.0	0.0	0	0	0
All Years	<b>1.7</b>	0.5	0.5	<b>30</b>	<b>24</b>	<b>24</b>

**Table 15.** Temperature results for juvenile migration showing the change in the number of days in October exceeding 60°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.2	1.3	1.3	<b>29</b>	<b>29</b>	<b>29</b>
AN	0.0	0.0	0.0	0	0	0
BN	<b>2.4</b>	<b>2.6</b>	<b>2.6</b>	<b>29</b>	<b>29</b>	<b>29</b>
D	0.5	0.6	0.0	<b>8</b>	<b>10</b>	0
C	0.2	0.4	0.3	<b>2</b>	<b>3</b>	<b>3</b>
All Years	1.0	1.0	0.9	<b>29</b>	<b>29</b>	<b>29</b>

### Tisdale Weir (Tisdale)

**Table 16.** Temperature results for juvenile migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 60°F at Tisdale for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W, S	3.7%	3.6%	3.7%	3.7%
Apr	S	58%	58%	58%	58%
May	S	97%	97%	97%	97%
Jun	S	100%	100%	100%	100%
July	-	100%	100%	100%	100%
Aug	W	100%	100%	100%	100%
Sept	W	100%	100%	100%	100%
Oct	W	75%	73%	75%	75%
Nov	W,S	2.3%	2.3%	2.4%	2.3%
Dec	W,S	0.0%	0.0%	0.0%	0.0%

**Table 17.** Temperature results for juvenile migration showing the change in the number of days in April exceeding 60°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.3	0	0	<b>25</b>	0	0
AN	<b>1.8</b>	<b>1.8</b>	<b>1.8</b>	<b>22</b>	<b>22</b>	<b>22</b>
BN	1.4	0	0	<b>19</b>	0	0
D	<b>1.6</b>	0	0	<b>14</b>	0	0
C	<b>5.6</b>	0	0	<b>25</b>	0	0
All Years	<b>2.1</b>	0.3	0.3	<b>25</b>	<b>22</b>	<b>22</b>

**Table 18.** Temperature results for juvenile migration showing the change in the number of days in May exceeding 60°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.4</b>	1.5	1.5	<b>28</b>	<b>12</b>	<b>12</b>
AN	<b>2.9</b>	1.3	1.3	<b>25</b>	<b>10</b>	<b>10</b>
BN	<b>6.4</b>	<b>1.9</b>	<b>1.9</b>	<b>22</b>	<b>20</b>	<b>20</b>
D	<b>5.6</b>	0.3	0.2	<b>31</b>	<b>3</b>	<b>3</b>
C	<b>9.9</b>	0	0	<b>31</b>	0	0
All Years	<b>5</b>	1.1	1	<b>31</b>	<b>20</b>	<b>20</b>

**Table 19.** Temperature results for juvenile migration showing the change in the number of days in June exceeding 60°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>4.4</b>	<b>1.8</b>	<b>1.8</b>	<b>25</b>	<b>18</b>	<b>18</b>
AN	<b>15</b>	<b>2.0</b>	<b>2.2</b>	<b>29</b>	<b>16</b>	<b>16</b>
BN	<b>7.3</b>	0.1	0.1	<b>30</b>	1	1
D	<b>2.9</b>	0.0	0.0	<b>10</b>	0	0
C	<b>9.3</b>	0.4	0.1	<b>30</b>	<b>5</b>	1
All Years	<b>6.8</b>	0.9	0.9	<b>30</b>	<b>18</b>	<b>18</b>

**Table 20.** Temperature results for juvenile migration showing the change in the number of days in August exceeding 60°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.9	0.0	0.0	<b>24</b>	0	0
AN	<b>9.5</b>	0.0	0.0	<b>31</b>	0	0
BN	<b>6.1</b>	0.0	0.0	<b>31</b>	0	0
D	0.1	0.0	0.0	1	0	0
C	0.0	0.0	0.0	0.0	0	0
All Years	<b>2.7</b>	0.0	0.0	<b>31</b>	0	0

**Table 21.** Temperature results for juvenile migration showing the change in the number of days in September exceeding 60°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.0	0.0	0.0	<b>26</b>	0	0
AN	<b>6.5</b>	<b>1.8</b>	<b>1.8</b>	<b>29</b>	<b>22</b>	<b>22</b>
BN	3.0	0.0	0.0	<b>28</b>	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	<b>1.8</b>	0.3	0.3	<b>29</b>	<b>22</b>	<b>22</b>

**Table 22.** Temperature results for juvenile migration showing the change in the number of days in October exceeding 60°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.2	1.2	1.2	<b>27</b>	<b>27</b>	<b>27</b>
AN	0.0	0.0	0.0	0	0	0
BN	<b>2.1</b>	<b>2.3</b>	<b>2.3</b>	<b>27</b>	<b>27</b>	<b>27</b>
D	0.8	0.8	0.0	<b>11</b>	<b>14</b>	0
C	0.9	0.0	0.0	<b>11</b>	0	0
All Years	1.1	0.9	0.8	<b>27</b>	<b>27</b>	<b>27</b>

## Knights Landing

**Table 23.** Temperature results for juvenile migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 60°F at Knights Landing for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W, S	4.5%	4.6%	4.6%	4.6%
Apr	S	60.2%	61.1%	60.3%	60.3%
May	S	97.9%	97.9%	97.9%	97.9%
Jun	S	100.0%	100.0%	100.0%	100.0%
July	--	100.0%	100.0%	100.0%	100.0%
Aug	W	100.0%	100.0%	100.0%	100.0%
Sept	W	100.0%	100.0%	100.0%	100.0%
Oct	W	87.0%	86.0%	86.8%	86.6%
Nov	W,S	5.3%	5.1%	5.6%	5.2%
Dec	W,S	0.0%	0.0%	0.0%	0.0%

**Table 24.** Temperature results for juvenile migration showing the change in the number of days in April exceeding 60°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.4	0.0	0.0	<b>21</b>	0	0
AN	<b>1.9</b>	<b>1.9</b>	<b>1.9</b>	<b>23</b>	<b>23</b>	<b>23</b>
BN	0.9	0.0	0.0	<b>12</b>	0	0
D	<b>1.6</b>	0.0	0.0	<b>15</b>	0	0
C	<b>4.4</b>	0.0	0.0	<b>21</b>	0	0
All Years	<b>1.9</b>	0.3	0.3	<b>23</b>	<b>23</b>	<b>23</b>

**Table 25.** Temperature results for juvenile migration showing the change in the number of days in May exceeding 60°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.6</b>	<b>1.6</b>	<b>1.7</b>	<b>26</b>	<b>12</b>	<b>13</b>
AN	<b>2.3</b>	1.3	1.3	<b>22</b>	<b>10</b>	<b>10</b>
BN	<b>4.6</b>	1.4	1.4	<b>20</b>	<b>14</b>	<b>14</b>
D	<b>5.0</b>	0.1	0.1	<b>31</b>	<b>2</b>	1
C	<b>9.9</b>	0.0	0.0	<b>31</b>	0	0
All Years	<b>4.5</b>	1.0	1.0	<b>31</b>	<b>14</b>	<b>14</b>

**Table 26.** Temperature results for juvenile migration showing the change in the number of days in June exceeding 60°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>4.9</b>	<b>2.5</b>	<b>2.5</b>	<b>25</b>	<b>19</b>	<b>19</b>
AN	<b>12.8</b>	<b>1.9</b>	<b>1.9</b>	<b>29</b>	<b>16</b>	<b>16</b>
BN	<b>6.6</b>	0.4	0.4	<b>29</b>	<b>4</b>	<b>5</b>
D	<b>2.2</b>	0.0	0.0	<b>12</b>	0	0
C	<b>7.4</b>	0.4	0.0	<b>27</b>	<b>5</b>	0
All Years	<b>6.1</b>	1.2	1.1	<b>29</b>	<b>19</b>	<b>19</b>

**Table 27.** Temperature results for juvenile migration showing the change in the number of days in August exceeding 60°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.1	0.1	0.0	<b>27</b>	<b>2</b>	1
AN	<b>9.2</b>	0.0	0.0	<b>30</b>	0	0
BN	<b>3.9</b>	0.0	0.0	<b>29</b>	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	<b>2.4</b>	0.0	0.0	<b>30</b>	<b>2</b>	1

**Table 28.** Temperature results for juvenile migration showing the change in the number of days in September exceeding 60°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.9	0.0	0.0	<b>22</b>	0	0
AN	<b>6.5</b>	1.4	1.4	<b>30</b>	<b>17</b>	<b>17</b>
BN	<b>2.9</b>	0.0	0.0	<b>24</b>	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	<b>1.7</b>	0.2	0.2	<b>30</b>	<b>17</b>	<b>17</b>

**Table 29.** Temperature results for juvenile migration showing the change in the number of days in October exceeding 60°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.3	1.2	1.2	<b>27</b>	<b>27</b>	<b>27</b>
AN	0.0	0.0	0.0	0	0	0
BN	<b>2.1</b>	<b>2.5</b>	<b>2.3</b>	<b>24</b>	<b>24</b>	<b>24</b>
D	1.0	0.9	0.0	<b>13</b>	<b>17</b>	0
C	1.3	0.0	0.0	<b>14</b>	0	0
All Years	1.2	1.0	0.8	<b>27</b>	<b>27</b>	<b>27</b>

## Chinook Salmon Adult Migration and White Sturgeon Juvenile Rearing (66 °F)

### Red Bluff

**Table 30.** Temperature results for adult migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 66°F at Red Bluff for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W,S	0.0%	0.0%	0.0%	0.0%
Apr	W,S	0.0%	0.0%	0.0%	0.0%
Jun	S	0.2%	0.2%	0.4%	0.4%
July	S	0.2%	0.4%	0.2%	0.3%
Aug	S	0.1%	0.1%	0.1%	0.1%
Sept	S	0.0%	0.0%	0.0%	0.0%
Oct	S	1.2%	0.4%	0.8%	0.8%
Nov	-	0.1%	0.0%	0.1%	0.1%
Dec	-	0.0%	0.0%	0.0%	0.0%

**Table 31.** Temperature results for adult migration showing the change in the number of days in April exceeding 66°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0	0	0	0	0	0
AN	0	0	0	0	0	0
BN	0	0	0	0	0	0
D	0	0	0	0	0	0
C	0	0	0	0	0	0
All Years	0	0	0	0	0	0

**Table 32.** Temperature results for adult migration showing the change in the number of days in May exceeding 66°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

<b>Water Year Type</b>	<b>Alt3B Avg</b>	<b>NoSha Avg</b>	<b>No ShaOro Avg</b>	<b>Alt3B Max</b>	<b>NoSha Max</b>	<b>NoShaOro Max</b>
W	0.0	0.3	0.3	1	<b>4</b>	<b>4</b>
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.1	0.1	1	<b>4</b>	<b>4</b>

**Table 33.** Temperature results for adult migration showing the change in the number of days in June exceeding 66°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

<b>Water Year Type</b>	<b>Alt3B Avg</b>	<b>NoSha Avg</b>	<b>No ShaOro Avg</b>	<b>Alt3B Max</b>	<b>NoSha Max</b>	<b>NoShaOro Max</b>
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.1	0.0	0.0	1	0	0
C	0.2	0.0	0.0	<b>2</b>	0	0
All Years	0.0	0.0	0.0	<b>2</b>	0	0

**Table 34.** Temperature results for adult migration showing the change in the number of days in July exceeding 66°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

<b>Water Year Type</b>	<b>Alt3B Avg</b>	<b>NoSha Avg</b>	<b>No ShaOro Avg</b>	<b>Alt3B Max</b>	<b>NoSha Max</b>	<b>NoShaOro Max</b>
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	0	0	0



**Table 35.** Temperature results for adult migration showing the change in the number of days in August exceeding 66°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

<b>Water Year Type</b>	<b>Alt3B Avg</b>	<b>NoSha Avg</b>	<b>No ShaOro Avg</b>	<b>Alt3B Max</b>	<b>NoSha Max</b>	<b>NoShaOro Max</b>
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	0	0	0

**Table 36.** Temperature results for adult migration showing the change in the number of days in September exceeding 66°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

<b>Water Year Type</b>	<b>Alt3B Avg</b>	<b>NoSha Avg</b>	<b>No ShaOro Avg</b>	<b>Alt3B Max</b>	<b>NoSha Max</b>	<b>NoShaOro Max</b>
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	0	0	0

**Table 37.** Temperature results for adult migration showing the change in the number of days in October exceeding 66°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

<b>Water Year Type</b>	<b>Alt3B Avg</b>	<b>NoSha Avg</b>	<b>No ShaOro Avg</b>	<b>Alt3B Max</b>	<b>NoSha Max</b>	<b>NoShaOro Max</b>
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	0	0	0

## Hamilton City

**Table 38.** Temperature results for adult migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 66°F at Hamilton City for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W,S	0.0%	0.0%	0.0%	0.0%
Apr	W,S	4.3%	4.4%	4.3%	4.3%
May	S	18.8%	21.7%	19.7%	19.8%
Jun	S	39.2%	43.0%	40.2%	40.2%
July	S	33.8%	35.2%	33.2%	33.3%
Aug	S	47.0%	44.6%	45.0%	44.7%
Sept	S	37.2%	33.8%	36.6%	36.5%
Oct	-	2.6%	1.6%	2.5%	2.5%
Nov	-	0.0%	0.0%	0.0%	0.0%
Dec	W,S	0.0%	0.0%	0.0%	0.0%

**Table 39.** Temperature results for adult migration showing the change in the number of days in April exceeding 66°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.3	0.0	0.0	<b>7</b>	0	0
AN	0.2	0.2	0.2	<b>2</b>	<b>2</b>	<b>2</b>
BN	0.4	0.0	0.0	<b>5</b>	0	0
D	0.1	0.0	0.0	1	0	0
C	0.1	0.0	0.0	1	0	0
All Years	0.2	0.0	0.0	<b>7</b>	<b>2</b>	<b>2</b>

**Table 40.** Temperature results for adult migration showing the change in the number of days in May exceeding 66°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.4	<b>1.7</b>	<b>1.7</b>	<b>5</b>	<b>17</b>	<b>17</b>
AN	<b>1.8</b>	1.1	1.1	<b>13</b>	<b>13</b>	<b>13</b>
BN	<b>4.9</b>	<b>1.6</b>	1.5	<b>19</b>	<b>13</b>	<b>12</b>
D	<b>2.1</b>	0.1	0.1	<b>15</b>	1	1
C	<b>3.1</b>	0.0	0.0	<b>18</b>	0	0
All Years	<b>2.1</b>	1.0	1.0	<b>19</b>	<b>17</b>	<b>17</b>

**Table 41.** Temperature results for adult migration showing the change in the number of days in June exceeding 66°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>3.2</b>	<b>2.7</b>	<b>2.6</b>	<b>27</b>	<b>27</b>	<b>27</b>
AN	<b>9.8</b>	<b>2.3</b>	<b>2.5</b>	<b>29</b>	<b>23</b>	<b>25</b>
BN	<b>2.2</b>	0.1	0.1	<b>21</b>	1	<b>2</b>
D	<b>2.1</b>	0.1	0.1	<b>10</b>	1	1
C	<b>6.2</b>	0.3	0.3	<b>16</b>	<b>2</b>	<b>4</b>
All Years	<b>4.2</b>	1.3	1.3	<b>29</b>	<b>27</b>	<b>27</b>

**Table 42.** Temperature results for adult migration showing the change in the number of days in July exceeding 66°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.4	0.0	0.0	<b>9</b>	1	1
AN	<b>3.8</b>	0.0	0.0	<b>29</b>	0	0
BN	0.0	0.0	0.0	0	0	0
D	<b>1.8</b>	0.0	0.0	<b>31</b>	0	0
C	<b>5.2</b>	0.3	0.3	<b>20</b>	<b>4</b>	<b>4</b>
All Years	<b>1.8</b>	0.1	0.1	<b>31</b>	<b>4</b>	<b>4</b>

**Table 43.** Temperature results for adult migration showing the change in the number of days in August exceeding 66°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.1	0.0	0.0	<b>2</b>	0	0
AN	<b>1.6</b>	0.0	0.0	<b>10</b>	0	0
BN	<b>2.8</b>	0.0	0.0	<b>29</b>	0	0
D	0.1	0.0	0.0	1	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.7	0.0	0.0	<b>29</b>	0	0

**Table 44.** Temperature results for adult migration showing the change in the number of days in September exceeding 66°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.4	0.0	0.0	<b>10</b>	0	0
AN	0.0	1.4	1.4	0	<b>17</b>	<b>17</b>
BN	1.4	0.0	0.0	<b>18</b>	0	0
D	0.2	0.8	0.8	<b>3</b>	<b>15</b>	<b>15</b>
C	0.0	0.0	0.0	0	0	0
All Years	0.4	0.4	0.4	<b>18</b>	<b>17</b>	<b>17</b>

**Table 45.** Temperature results for adult migration showing the change in the number of days in October exceeding 66°F and a >0.5°F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.2	0.1	0.0	<b>3</b>	<b>2</b>	0
C	0.0	0.3	0.3	0	<b>3</b>	<b>3</b>
All Years	0.0	0.1	0.0	<b>3</b>	<b>3</b>	<b>3</b>

### Tisdale Weir (Tisdale)

**Table 46.** Temperature results for adult migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 66°F at Tisdale for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W,S	0.0%	0.0%	0.0%	0.0%
Apr	W,S	7.2%	7.5%	7.0%	7.1%
May	S	59.8%	61.7%	60.5%	60.5%
June	S	93.2%	93.7%	92.6%	92.8%
July	S	98.6%	98.9%	98.6%	98.6%
Aug	S	99.0%	99.3%	99.1%	99.1%
Sept	-	78.5%	77.2%	77.4%	77.4%
Oct	-	10.4%	9.7%	10.8%	10.6%
Nov	-	0.0%	0.0%	0.0%	0.0%
Dec	W	0.0%	0.0%	0.0%	0.0%

**Table 47.** Temperature results for adult migration showing the change in the number of days in April exceeding 66°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.3	0.0	0.0	<b>8</b>	0	0
AN	0.1	0.1	0.1	1	1	1
BN	0.4	0.0	0.0	<b>5</b>	0	0
D	0.2	0.0	0.0	<b>3</b>	0	0
C	1.4	0.0	0.0	<b>13</b>	0	0
All Years	0.4	0.0	0.0	<b>13</b>	1	1

**Table 48.** Temperature results for adult migration showing the change in the number of days in May exceeding 66°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.0	1.3	1.3	<b>12</b>	<b>12</b>	<b>12</b>
AN	<b>2.3</b>	1.3	1.3	<b>17</b>	<b>10</b>	<b>10</b>
BN	<b>6.1</b>	<b>1.9</b>	<b>1.9</b>	<b>22</b>	<b>20</b>	<b>20</b>
D	<b>4.6</b>	0.3	0.2	<b>31</b>	<b>3</b>	<b>3</b>
C	<b>8.7</b>	0.0	0.0	<b>29</b>	0	0
All Years	<b>4.0</b>	1.0	1.0	<b>31</b>	<b>20</b>	<b>20</b>

**Table 49.** Temperature results for adult migration showing the change in the number of days in June exceeding 66°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>4.1</b>	<b>1.8</b>	<b>1.8</b>	<b>21</b>	<b>18</b>	<b>18</b>
AN	<b>15</b>	<b>2.0</b>	<b>2.2</b>	<b>28</b>	<b>16</b>	<b>16</b>
BN	<b>7.1</b>	0.1	0.1	<b>30</b>	1	1
D	<b>2.6</b>	0.0	0.0	<b>10</b>	0	0
C	<b>8.9</b>	0.4	0.1	<b>30</b>	<b>5</b>	1
All Years	<b>6.5</b>	0.9	0.9	<b>30</b>	<b>18</b>	<b>18</b>

**Table 50.** Temperature results for adult migration showing the change in the number of days in July exceeding 66°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.0</b>	0.1	0.1	<b>27</b>	<b>2</b>	<b>2</b>
AN	<b>10</b>	0.1	0.1	<b>31</b>	1	1
BN	0.4	0.0	0.0	<b>5</b>	0	0
D	1.5	0.0	0.0	<b>26</b>	0	0
C	<b>5.1</b>	0.2	0.4	<b>19</b>	<b>2</b>	<b>4</b>
All Years	<b>3.2</b>	0.1	0.1	<b>31</b>	<b>2</b>	<b>4</b>

**Table 51.** Temperature results for adult migration showing the change in the number of days in August exceeding 66°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.9	0.0	0.0	<b>24</b>	0	0
AN	<b>9.1</b>	0.0	0.0	<b>31</b>	0	0
BN	<b>6.1</b>	0.0	0.0	<b>31</b>	0	0
D	0.1	0.0	0.0	1	0	0
C	0.0	0.0	0.0	0	0	0
All Years	<b>2.7</b>	0.0	0.0	<b>31</b>	0	0

## Knights Landing

**Table 52.** Temperature results for adult migration for both Winter-run (W) and Spring-run (S) Chinook Salmon that show percentage of days exceeding 66°F at Knights Landing for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W,S	0.0%	0.0%	0.0%	0.0%
Apr	W,S	10.3%	10.7%	10.1%	10.0%
May	S	72.9%	73.5%	73.2%	73.3%
Jun	S	97.9%	98.0%	97.7%	97.8%
July	S	100.0%	100.0%	100.0%	100.0%
Aug	S	100.0%	100.0%	100.0%	100.0%
Sept	-	89.2%	89.9%	88.9%	88.9%
Oct	-	20.0%	18.5%	19.6%	19.4%
Nov	-	0.0%	0.0%	0.0%	0.0%
Dec	W	0.0%	0.0%	0.0%	0.0%

**Table 53.** Temperature results for adult migration showing the change in the number of days in April exceeding 66°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.1	0.0	0.0	<b>2</b>	0	0
AN	0.3	0.3	0.3	<b>3</b>	<b>3</b>	<b>3</b>
BN	0.3	0.0	0.0	<b>4</b>	0	0
D	0.0	0.0	0.0	0	0	0
C	1.5	0.0	0.0	<b>11</b>	0	0
All Years	0.3	0.0	0.0	<b>11</b>	<b>3</b>	<b>3</b>

**Table 54.** Temperature results for adult migration showing the change in the number of days in May exceeding 66°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.4	1.5	<b>1.6</b>	<b>12</b>	<b>12</b>	<b>13</b>
AN	<b>1.9</b>	1.2	1.2	<b>18</b>	<b>9</b>	<b>9</b>
BN	<b>4.6</b>	1.4	1.4	<b>20</b>	<b>14</b>	<b>14</b>
D	<b>4.7</b>	0.1	0.1	<b>31</b>	<b>2</b>	1
C	<b>9.3</b>	0.0	0.0	<b>31</b>	0	0
All Years	<b>3.9</b>	0.9	0.9	<b>31</b>	<b>14</b>	<b>14</b>

**Table 55.** Temperature results for adult migration showing the change in the number of days in June exceeding 66°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>4.7</b>	<b>2.5</b>	<b>2.5</b>	<b>25</b>	<b>19</b>	<b>19</b>
AN	<b>13</b>	<b>1.9</b>	<b>1.9</b>	<b>29</b>	<b>16</b>	<b>16</b>
BN	<b>6.6</b>	0.4	0.4	<b>29</b>	<b>4</b>	<b>5</b>
D	<b>2.2</b>	0.0	0.0	<b>12</b>	0	0
C	<b>7.4</b>	0.4	0.0	<b>27</b>	<b>5</b>	0
All Years	<b>6.1</b>	1.2	1.1	<b>29</b>	<b>19</b>	<b>19</b>

**Table 56.** Temperature results for adult migration showing the change in the number of days in July exceeding 66°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.3</b>	0.2	0.2	<b>28</b>	<b>4</b>	<b>4</b>
AN	<b>8.1</b>	0.3	0.3	<b>31</b>	<b>4</b>	<b>4</b>
BN	0.4	0.0	0.0	<b>2</b>	0	0
D	1.1	0.0	0.0	<b>20</b>	0	0
C	<b>4.8</b>	0.0	0.1	<b>17</b>	0	1
All Years	<b>2.9</b>	0.1	0.1	<b>31</b>	<b>4</b>	<b>4</b>

**Table 57.** Temperature results for adult migration showing the change in the number of days in August exceeding 66°F and a >0.5°F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.1	0.1	0.0	<b>27</b>	<b>2</b>	<b>1</b>
AN	<b>9.2</b>	0.0	0.0	<b>30</b>	0	0
BN	<b>3.9</b>	0.0	0.0	<b>29</b>	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	<b>2.4</b>	0.0	0.0	<b>30</b>	<b>2</b>	1

## Chinook Salmon Fish Presence (56 °F)<sup>1</sup> at Red Bluff

**Table 58.** Percentage of days exceeding 56°F at Red Bluff when Winter-run (W) and Spring-run (S) Chinook salmon are present for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W,S	3.5%	3.5%	3.5%	3.5%
Apr	W,S	57.0%	57.6%	56.7%	56.8%
Jun	W,S	85.9%	87.4%	86.0%	86.0%
July	W,S	93.7%	95.3%	93.3%	93.3%
Aug	W,S	96.8%	98.2%	96.9%	96.9%
Sept	W,S	96.6%	97.3%	96.8%	96.7%
Oct	W,S	81.6%	80.7%	81.0%	80.9%
Nov	W,S	42.9%	40.5%	43.6%	43.1%
Dec	W,S	6.3%	5.0%	6.1%	6.2%

<sup>1</sup> Order WR 90-5 (SWRCB 1990) requires the USBR to operate Keswick Dam, Shasta Dam, and the Spring Creek Power Plant to meet a daily average water temperature of 56°F at Red Bluff Diversion Dam during periods when higher temperature will be detrimental to the fishery. This 56 °F criterion was based on best available science for water temperatures necessary to support healthy spawning and egg incubation prior to publishing of Martin et al. (2015).



**Table 59.** Temperature results for when Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in March exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.2	0.0	0.0	<b>4</b>	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	<b>4</b>	0	0

**Table 60.** Temperature results for when Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in April exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.1</b>	0.0	0.0	<b>27</b>	0	0
AN	<b>1.8</b>	<b>1.8</b>	<b>1.8</b>	<b>21</b>	<b>21</b>	<b>21</b>
BN	<b>1.9</b>	0.0	0.0	<b>26</b>	0	0
D	<b>2.5</b>	0.1	0.0	<b>20</b>	1	0
C	<b>3.3</b>	0.0	0.0	<b>20</b>	0	0
All Years	<b>2.3</b>	0.3	0.3	<b>27</b>	<b>21</b>	<b>21</b>

**Table 61.** Temperature results for when Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in May exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.3	1.5	<b>1.6</b>	<b>22</b>	<b>15</b>	<b>15</b>
AN	<b>4.9</b>	1.3	1.3	<b>22</b>	<b>13</b>	<b>13</b>
BN	<b>11</b>	<b>2.2</b>	<b>2.2</b>	<b>28</b>	<b>29</b>	<b>29</b>
D	<b>9.2</b>	0.6	0.6	<b>31</b>	<b>6</b>	<b>5</b>
C	<b>5.8</b>	0.0	0.0	<b>28</b>	0	0
All Years	<b>5.9</b>	1.2	1.2	<b>31</b>	<b>29</b>	<b>29</b>

**Table 62.** Temperature results for when Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in June exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.0</b>	0.6	0.6	<b>27</b>	<b>13</b>	<b>13</b>
AN	<b>16</b>	0.0	0.0	<b>30</b>	0	0
BN	<b>8.1</b>	0.0	0.0	<b>29</b>	0	0
D	<b>5.1</b>	0.2	0.1	<b>26</b>	2	2
C	<b>8.1</b>	0.7	0.8	<b>30</b>	<b>3</b>	<b>4</b>
All Years	<b>6.7</b>	0.3	0.3	<b>30</b>	<b>13</b>	<b>13</b>

**Table 63.** Temperature results for when Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in July exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	1	0	0
AN	<b>12</b>	0.0	0.0	<b>31</b>	0	0
BN	<b>1.7</b>	0.0	0.0	<b>19</b>	0	0
D	<b>2.7</b>	0.0	0.0	<b>30</b>	0	0
C	<b>7.2</b>	0.4	0.3	<b>31</b>	<b>3</b>	<b>3</b>
All Years	<b>3.6</b>	0.1	0.0	<b>31</b>	<b>3</b>	<b>3</b>

**Table 64.** Temperature results for when Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in August exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.2	0.0	0.0	<b>3</b>	0	0
AN	<b>6.2</b>	0.0	0.0	<b>31</b>	0	0
BN	<b>4.9</b>	0.0	0.0	<b>29</b>	0	0
D	0.1	0.2	0.2	1	<b>3</b>	<b>3</b>
C	0.1	0.0	0.0	1	0	0
All Years	<b>1.8</b>	0.0	0.0	<b>31</b>	<b>3</b>	<b>3</b>

**Table 65.** Temperature results for when adult Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in September exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.7	0.0	0.0	<b>18</b>	0	0
AN	<b>3.5</b>	<b>1.7</b>	<b>1.7</b>	<b>29</b>	<b>20</b>	<b>20</b>
BN	<b>2.1</b>	0.0	0.0	<b>26</b>	0	0
D	0.6	0.9	0.9	<b>8</b>	<b>13</b>	<b>14</b>
C	0.0	0.0	0.0	0	0	0
All Years	1.2	0.4	0.5	<b>29</b>	<b>20</b>	<b>20</b>

**Table 66.** Temperature results for when Winter-run and Spring-run Chinook salmon are present showing the change in the number of days in October exceeding 56°F and a >0.5°F increase at Red Bluff for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.8	1.0	0.9	<b>19</b>	<b>21</b>	<b>19</b>
AN	0.0	0.0	0.0	0	0	0
BN	1.4	<b>1.7</b>	<b>1.8</b>	<b>19</b>	<b>24</b>	<b>25</b>
D	0.3	0.7	0.3	<b>4</b>	<b>8</b>	<b>4</b>
C	0.4	1.3	1.2	<b>3</b>	<b>9</b>	<b>7</b>
All Years	0.6	1.0	0.8	<b>19</b>	<b>24</b>	<b>25</b>

### Additional Temperature Analyses (60, 66, and 70°F) at Tisdale

Because the Tisdale Weir (Tisdale) location showed more significant temperature effects to project operations than the other locations, CDFW completed a more detailed analysis of temperature changes at that site. The additional analyses at Tisdale included evaluating the percentage of each days each month exceeding the Thermal Barrier threshold of 70 deg F and the increase in the number of days in April, May, and June that each temperature threshold is exceeded AND the temperature increase is more than 1.0 deg F, below.

**Table 67.** Percentage of days exceeding the lethal thermal barrier for Winter-run (W) and Spring-run (S) Chinook Salmon of 70°F at Tisdale for Existing Conditions (NAA), Project Alternative 3B (Alt3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro).

Month	Species	NAA	Alt3B	1A-NoSha	1A-NoShaOro
Jan	W,S	0.0%	0.0%	0.0%	0.0%
Feb	W,S	0.0%	0.0%	0.0%	0.0%
Mar	W,S	0.0%	0.0%	0.0%	0.0%
Apr	W,S	0.0%	0.0%	0.0%	0.0%
May	W,S	-	-	-	-
Jun	S	14.2%	15.5%	15.2%	15.2%
July	S	51.8%	54.1%	52.6%	52.7%
Aug	-	59.0%	57.6%	56.4%	56.3%
Sept	W,S	75.3%	73.3%	72.7%	72.5%
Oct	W,S	39.4%	35.2%	38.3%	38.3%
Nov	W,S	1.0%	1.0%	1.3%	1.2%
Dec	W,S	0.0%	0.0%	0.0%	0.0%

**Table 68.** Temperature results for when the lethal thermal barrier is exceeded showing the change in the number of days in April exceeding 70°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	0	0	0

**Table 69.** Temperature results for when the lethal thermal barrier is exceeded showing the change in the number of days in May exceeding 70°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.1	0.2	0.2	<b>2</b>	<b>2</b>	<b>2</b>
AN	0.2	0.0	0.0	<b>2</b>	0	0
BN	0.5	0.1	0.1	<b>3</b>	1	1
D	0.8	0.0	0.0	<b>5</b>	0	0
C	<b>1.9</b>	0.0	0.0	<b>15</b>	0	0
All Years	0.6	0.1	0.1	<b>15</b>	<b>2</b>	<b>2</b>

**Table 70.** Temperature results for when the lethal thermal barrier is exceeded showing the change in the number of days in June exceeding 70°F and a >0.5°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.2	0.1	0.2	<b>2</b>	<b>2</b>	<b>2</b>
AN	<b>1.8</b>	0.2	0.0	<b>8</b>	<b>2</b>	<b>2</b>
BN	0.9	0.0	0.1	<b>5</b>	0	0
D	0.3	0.0	0.0	<b>2</b>	0	0
C	0.2	0.0	0.0	<b>2</b>	0	0
All Years	0.6	0.0	0.1	<b>8</b>	<b>2</b>	<b>2</b>

**Table 71.** Temperature results for when the lethal thermal barrier for juvenile migration is exceeded showing the change in the number of days in April exceeding 60°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	1.5	1.5	1.5	<b>18</b>	<b>18</b>	<b>18</b>
BN	0.0	0.0	0.0	0	0	0
D	0.4	0.0	0.0	<b>8</b>	0	0
C	1.3	0.0	0.0	<b>15</b>	0	0
All Years	0.5	0.2	0.2	<b>18</b>	<b>18</b>	<b>18</b>

**Table 72.** Temperature results for when the lethal thermal barrier for adult migration is exceeded showing the change in the number of days in April exceeding 66°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.1	0.1	0.1	1	1	1
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.8	0.0	0.0	<b>9</b>	0	0
All Years	0.1	0.0	0.0	<b>9</b>	1	1

**Table 73.** Temperature results for when the lethal thermal barrier is exceeded showing the change in the number of days in April exceeding 70°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.0	0.0	0.0	0	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	0	0	0

**Table 74.** Temperature results for when the lethal thermal barrier for juvenile migration is exceeded showing the change in the number of days in May exceeding 60°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.3	0.0	0.0	<b>7</b>	0	0
AN	0.9	0.3	0.3	<b>11</b>	<b>3</b>	<b>3</b>
BN	0.6	0.0	0.0	<b>8</b>	0	0
D	<b>1.6</b>	0.0	0.0	<b>13</b>	0	0
C	<b>3.5</b>	0.0	0.0	<b>25</b>	0	0
All Years	1.2	0.0	0.0	<b>25</b>	<b>3</b>	<b>3</b>

**Table 75.** Temperature results for when the lethal thermal barrier for adult migration is exceeded showing the change in the number of days in May exceeding 66°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.8	0.3	0.3	<b>10</b>	<b>3</b>	<b>3</b>
BN	0.5	0.0	0.0	<b>7</b>	0	0
D	1.3	0.0	0.0	<b>13</b>	0	0
C	<b>3.4</b>	0.0	0.0	<b>25</b>	0	0
All Years	1.0	0.0	0.0	<b>25</b>	<b>3</b>	<b>3</b>

**Table 76.** Temperature results for when the lethal thermal barrier is exceeded showing the change in the number of days in May exceeding 70°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.3	0.0	0.0	<b>4</b>	0	0
D	0.2	0.0	0.0	<b>3</b>	0	0
C	<b>2.1</b>	0.0	0.0	<b>24</b>	0	0
All Years	0.4	0.0	0.0	<b>24</b>	0	0

**Table 77.** Temperature results for when the lethal thermal barrier for juvenile migration is exceeded showing the change in the number of days in June exceeding 60°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	<b>5.7</b>	0.0	0.0	<b>26</b>	0	0
BN	<b>2.2</b>	0.0	0.0	<b>15</b>	0	0
D	0.3	0.0	0.0	<b>6</b>	0	0
C	<b>2.5</b>	0.0	0.0	<b>27</b>	0	0
All Years	<b>1.6</b>	0.0	0.0	<b>27</b>	0	0

**Table 78.** Temperature results for when the lethal thermal barrier for adult migration is exceeded showing the change in the number of days in June exceeding 66°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	<b>5.7</b>	0.0	0.0	<b>26</b>	0	0
BN	<b>2.2</b>	0.0	0.0	<b>15</b>	0	0
D	0.3	0.0	0.0	<b>6</b>	0	0
C	<b>2.5</b>	0.0	0.0	<b>27</b>	0	0
All Years	<b>1.6</b>	0.0	0.0	<b>27</b>	0	0

**Table 79.** Temperature results for when the lethal thermal barrier is exceeded showing the change in the number of days in June exceeding 70°F and a >1.0°F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	<b>4.3</b>	0.0	0.0	<b>16</b>	0	0
BN	<b>1.6</b>	0.0	0.0	<b>11</b>	0	0
D	0.1	0.0	0.0	<b>2</b>	0	0
C	1.5	0.0	0.0	<b>15</b>	0	0
All Years	1.2	0.0	0.0	<b>16</b>	0	0

### Spring Flow Changes and Temperature Exceedances at Tisdale (April-June)

**Table 80a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B
1922	12,181	12,646	0	0	0	0
1928	13,391	13,406	0	0	0	0
1940	22,476	<b>18,678</b>	<b>-3</b>	0	0	0
1951	6,049	5,911	0	0	0	0
1954	20,838	20,841	0	0	0	0
1957	6,574	6,600	0	0	0	0
1973	7,642	7,635	0	0	0	0
1978	20,518	<b>16,558</b>	1	0	0	0
1980	8,709	<b>6,636</b>	<b>2</b>	<b>22</b>	1	1
1993	16,947	16,963	0	0	0	0
2000	6,348	6,339	0	0	0	0
2003	17,535	17,386	0	0	0	0



**Table 80b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha
1922	12,181	12,275	0	0	0	0
1928	13,391	13,406	0	0	0	0
1940	22,476	<b>18,668</b>	<b>-3</b>	0	0	0
1951	6,049	5,911	0	0	0	0
1954	20,838	20,842	0	0	0	0
1957	6,574	6,584	0	0	0	0
1973	7,642	7,638	0	0	0	0
1978	20,518	<b>16,548</b>	1	0	0	0
1980	8,709	<b>6,634</b>	<b>2</b>	<b>22</b>	1	1
1993	16,947	16,959	0	0	0	0
2000	6,348	6,343	0	0	0	0
2003	17,535	17,375	0	0	0	0

**Table 81a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1922	6,701	6,688	0	0	0	0	0	0
1928	8,826	<b>10,084</b>	0	<b>-28</b>	<b>-6</b>	<b>-22</b>	0	0
1940	6,159	<b>6,788</b>	0	0	0	0	0	0
1951	6,043	<b>5,594</b>	0	<b>10</b>	0	<b>10</b>	0	<b>10</b>
1954	8,403	8,653	0	0	0	0	0	0
1957	11,138	11,125	0	0	0	0	0	0
1973	6,003	<b>6,972</b>	0	0	-1	0	<b>-2</b>	0
1978	7,159	7,176	0	0	0	0	0	0
1980	5,927	5,679	0	<b>25</b>	<b>4</b>	<b>17</b>	<b>2</b>	<b>4</b>
1993	8,969	8,952	0	0	0	0	0	0
2000	5,604	5,537	0	0	0	0	0	0
2003	23,646	23,646	0	0	0	0	0	0

**Table 81b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1922	6,701	6,695	0	0	0	0	0	0
1928	8,826	8,837	0	0	0	0	0	0
1940	6,159	6,414	0	0	0	0	0	0
1951	6,043	<b>5,594</b>	0	<b>10</b>	0	<b>10</b>	0	<b>10</b>
1954	8,403	8,404	0	0	0	0	0	0
1957	11,138	11,133	0	0	0	0	0	0
1973	6,003	5,751	0	0	1	0	0	0
1978	7,159	7,170	0	0	0	0	0	0
1980	5,927	5,679	0	<b>6</b>	<b>2</b>	<b>6</b>	1	0
1993	8,969	8,950	0	0	0	0	0	0
2000	5,604	5,602	0	0	0	0	0	0
2003	23,646	23,646	0	0	0	0	0	0

**Table 82a.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1922	6,596	<b>6,095</b>	0	<b>17</b>	<b>3</b>	<b>17</b>
1928	8,866	<b>9,481</b>	0	<b>-3</b>	-1	0
1940	6,306	6,118	0	0	1	0
1951	8,393	8,533	0	0	0	0
1954	6,652	<b>5,429</b>	0	<b>28</b>	1	<b>13</b>
1957	7,592	7,627	0	<b>23</b>	<b>2</b>	<b>16</b>
1973	9,051	<b>8,345</b>	1	<b>25</b>	<b>5</b>	<b>9</b>
1978	6,128	5,955	0	<b>26</b>	<b>3</b>	<b>25</b>
1980	5,588	5,470	1	<b>5</b>	0	0
1993	10,141	10,134	0	0	0	0
2000	10,888	<b>9,867</b>	1	<b>24</b>	<b>9</b>	<b>14</b>
2003	6,736	<b>6,315</b>	0	<b>26</b>	0	<b>26</b>

**Table 82b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1922	6,596	<b>6,098</b>	0	<b>16</b>	<b>3</b>	<b>16</b>
1928	8,866	<b>10,122</b>	<b>-4</b>	<b>-27</b>	<b>-2</b>	<b>-2</b>
1940	6,306	6,289	0	0	0	0
1951	8,393	8,544	0	0	0	0
1954	6,652	6,701	0	0	0	0
1957	7,592	7,592	0	0	0	0
1973	9,051	9,104	0	0	1	0
1978	6,128	5,954	0	0	1	0
1980	5,588	5,470	0	0	0	0
1993	10,141	10,132	0	0	0	0
2000	10,888	10,880	0	0	0	0
2003	6,736	<b>6,315</b>	0	<b>8</b>	0	<b>8</b>

**Table 83a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B
1923	8,412	8,414	0	0	0	0
1935	24,307	<b>22,922</b>	0	0	0	0
1936	6,914	6,923	0	0	0	0
1937	12,045	11,972	0	0	0	0
1945	6,719	6,858	0	0	-1	0
1946	7,856	7,850	0	0	0	0
1948	22,499	22,704	0	0	0	0
1950	10,655	<b>10,103</b>	0	0	0	0
1959	8,073	8,027	0	0	0	0
1962	6,273	6,280	0	0	0	0
1966	7,740	<b>9,309</b>	<b>-2</b>	<b>-23</b>	<b>-4</b>	<b>-4</b>
1968	6,378	<b>5,378</b>	0	<b>19</b>	0	<b>5</b>
1972	8,679	8,685	0	0	0	0
1979	8,325	8,318	0	0	0	0

**Table 83b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND > 0.5°F change under NoSha
1923	8,412	8,409	0	0	0	0
1935	24,307	<b>22,931</b>	0	0	0	0
1936	6,914	6,909	0	0	0	0
1937	12,045	11,977	0	0	0	0
1945	6,719	6,837	0	0	-1	0
1946	7,856	7,849	0	0	0	0
1948	22,499	23,120	0	0	0	0
1950	10,655	10,760	0	0	0	0
1959	8,073	8,078	0	0	0	0
1962	6,273	6,274	0	0	0	0
1966	7,740	<b>8,674</b>	<b>-2</b>	<b>-21</b>	<b>-2</b>	<b>-4</b>
1968	6,378	6,379	0	0	0	0
1972	8,679	8,685	0	0	0	0
1979	8,325	8,322	0	0	0	0

**Table 84a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1923	6,278	6,116	0	0	1	0	1	0
1935	5,319	<b>4,881</b>	0	<b>21</b>	<b>4</b>	<b>19</b>	<b>2</b>	<b>9</b>
1936	5,274	5,292	0	0	0	0	1	0
1937	5,850	<b>5,516</b>	0	0	<b>2</b>	0	1	0
1945	6,322	6,181	0	0	0	0	0	0
1946	8,170	8,187	0	0	<b>5</b>	0	0	0
1948	17,209	17,210	0	0	0	0	0	0
1950	6,343	6,187	0	0	0	0	1	0
1959	6,907	6,931	0	<b>11</b>	1	<b>11</b>	0	0
1962	6,843	6,955	0	0	0	0	0	0
1966	7,584	7,760	0	<b>5</b>	<b>3</b>	<b>5</b>	0	0
1968	5,908	5,775	0	<b>22</b>	<b>2</b>	<b>22</b>	0	<b>4</b>
1972	6,158	6,080	0	<b>20</b>	<b>3</b>	<b>17</b>	<b>2</b>	<b>5</b>
1979	6,373	<b>5,940</b>	0	<b>11</b>	<b>0</b>	<b>11</b>	<b>4</b>	<b>11</b>

**Table 84b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1923	6,278	6,116	0	0	1	0	1	0
1935	5,319	<b>4,731</b>	0	<b>20</b>	<b>3</b>	<b>20</b>	1	<b>8</b>
1936	5,274	5,271	0	0	0	0	0	0
1937	5,850	<b>5,516</b>	0	0	<b>2</b>	0	1	0
1945	6,322	6,325	0	0	0	0	0	0
1946	8,170	8,166	0	0	0	0	0	0
1948	17,209	17,202	0	0	0	0	0	0
1950	6,343	6,204	0	0	0	0	1	0
1959	6,907	6,866	0	0	0	0	0	0
1962	6,843	6,843	0	0	-1	0	0	0
1966	7,584	7,517	0	-1	0	0	0	0
1968	5,908	5,808	0	0	1	0	0	0
1972	6,158	6,080	0	0	0	0	1	0
1979	6,373	<b>5,940</b>	0	6	0	6	<b>4</b>	<b>6</b>

**Table 85a.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1923	5,855	5,760	0	0	1	0
1935	5,048	4,965	0	<b>25</b>	<b>3</b>	<b>24</b>
1936	5,181	<b>4,898</b>	1	0	0	0
1937	6,624	6,931	0	0	0	0
1945	7,949	8,082	0	0	-1	0
1946	6,664	6,884	0	0	0	0
1948	6,992	7,005	0	0	0	0
1950	5,235	5,094	0	0	0	0
1959	8,284	<b>7,683</b>	0	<b>30</b>	<b>5</b>	<b>11</b>
1962	5,826	5,705	0	0	0	0
1966	8,782	9,156	1	0	1	0
1968	8,710	8,747	<b>2</b>	<b>15</b>	<b>4</b>	<b>7</b>
1972	10,902	<b>10,354</b>	<b>6</b>	<b>28</b>	1	<b>2</b>
1979	7,976	8,141	-1	1	0	1

**Table 85b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1923	5,855	5,760	0	0	1	0
1935	5,048	4,810	0	1	1	0
1936	5,181	<b>4,899</b>	1	0	0	0
1937	6,624	6,751	0	0	0	0
1945	7,949	7,947	0	0	0	0
1946	6,664	6,669	0	0	0	0
1948	6,992	7,046	0	0	0	0
1950	5,235	5,090	0	0	<b>2</b>	0
1959	8,284	8,297	0	0	0	0
1962	5,826	5,703	0	0	0	0
1966	8,782	9,115	0	0	0	0
1968	8,710	8,706	0	0	0	0
1972	10,902	10,911	0	0	0	0
1979	7,976	8,139	-1	0	0	0

**Table 86a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B
1925	13,091	13,074	0	0	0	0
1926	9,028	9,006	0	0	0	0
1930	5,050	5,045	0	<b>5</b>	<b>2</b>	<b>3</b>
1932	5,101	5,101	0	0	0	0
1939	9,592	9,817	-1	0	0	0
1944	5,703	<b>5,208</b>	<b>5</b>	<b>9</b>	0	0
1947	6,779	6,766	0	0	0	0
1949	6,610	6,642	0	0	0	0
1955	5,994	5,950	0	0	0	0
1960	10,254	9,975	0	0	0	0
1961	8,212	<b>7,348</b>	1	<b>14</b>	0	0
1964	6,604	6,620	0	0	0	0
1981	7,955	7,930	-1	0	0	0
1985	5,583	5,410	0	0	0	0
1987	9,098	9,338	0	0	0	0
1989	9,147	9,157	0	0	0	0
2001	5,361	5,321	0	0	0	0
2002	5,636	5,606	0	0	0	0

**Table 86b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Dry water year types.

<b>Water Year</b>	<b>April Average Flows (cfs) under NAA</b>	<b>April Average Flows (cfs) under NoSha</b>	<b>Change in Days &gt;60°F under NoSha</b>	<b>Days &gt;60°F AND &gt;0.5°F change under NoSha</b>	<b>Change in Days &gt;66°F under NoSha</b>	<b>Days &gt;66°F AND &gt; 0.5°F change under NoSha</b>
1925	13,091	13,078	0	0	0	0
1926	9,028	9,006	0	0	0	0
1930	5,050	5,054	0	0	0	0
1932	5,101	5,101	0	0	0	0
1939	9,592	9,817	-1	0	0	0
1944	5,703	5,750	0	0	0	0
1947	6,779	6,775	0	0	0	0
1949	6,610	6,637	0	0	0	0
1955	5,994	5,967	0	0	0	0
1960	10,254	10,578	-1	0	0	0
1961	8,212	8,092	0	0	0	0
1964	6,604	6,605	0	0	0	0
1981	7,955	7,944	-1	0	0	0
1985	5,583	5,376	0	0	0	0
1987	9,098	9,325	0	0	0	0
1989	9,147	9,172	0	0	0	0
2001	5,361	5,370	0	0	0	0
2002	5,636	5,598	0	0	0	0



**Table 87a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1925	5,586	5,629	0	0	0	0	0	0
1926	8,208	7,805	0	0	1	0	1	0
1930	4,601	<b>4,339</b>	0	<b>31</b>	<b>8</b>	<b>31</b>	<b>5</b>	<b>9</b>
1932	4,848	<b>4,555</b>	0	0	0	0	0	0
1939	7,675	<b>7,035</b>	0	<b>27</b>	<b>5</b>	<b>15</b>	<b>3</b>	<b>3</b>
1944	5,566	<b>5,870</b>	0	<b>24</b>	<b>3</b>	<b>19</b>	<b>3</b>	<b>6</b>
1947	6,441	6,354	0	<b>-2</b>	0	<b>-2</b>	0	0
1949	7,247	7,257	0	0	0	0	0	0
1955	6,746	6,924	0	0	0	0	0	0
1960	5,064	5,097	0	0	0	0	0	0
1961	7,328	7,447	0	0	0	0	0	0
1964	6,379	6,643	0	0	1	0	0	0
1981	5,985	6,003	0	<b>15</b>	<b>2</b>	<b>15</b>	<b>5</b>	<b>5</b>
1985	6,909	7,046	0	1	<b>2</b>	1	1	0
1987	6,692	<b>6,215</b>	0	<b>2</b>	<b>2</b>	1	0	0
1989	9,399	9,309	0	1	<b>3</b>	0	0	0
2001	5,998	<b>6,310</b>	0	<b>-6</b>	0	<b>-6</b>	<b>-3</b>	<b>-4</b>
2002	5,982	5,851	0	0	2	0	0	0

**Table 87b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F AND under NoSha	Days >70°F AND >0.5°F change under NoSha
1925	5,586	5,630	0	0	0	0	0	0
1926	8,208	8,203	0	0	0	0	0	0
1930	4,601	<b>4,340</b>	0	0	0	0	<b>3</b>	0
1932	4,848	<b>4,556</b>	0	0	0	0	1	0
1939	7,675	7,677	0	<b>3</b>	0	<b>3</b>	0	0
1944	5,566	5,563	0	0	1	0	0	0
1947	6,441	6,449	0	<b>3</b>	0	<b>3</b>	0	<b>2</b>
1949	7,247	7,243	0	0	0	0	0	0
1955	6,746	6,815	0	0	0	0	0	0
1960	5,064	4,986	0	0	0	0	1	0
1961	7,328	7,468	0	0	0	0	0	0
1964	6,379	6,379	0	0	0	0	0	0
1981	5,985	5,964	0	0	0	0	0	0
1985	6,909	6,913	0	0	0	0	0	0
1987	6,692	6,695	0	0	-1	0	0	0
1989	9,399	9,472	0	0	0	0	0	0
2001	5,998	6,066	0	0	0	0	-1	0
2002	5,982	5,854	0	0	1	0	0	0

**Table 88a.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1925	6,770	6,910	0	0	0	0
1926	6,845	7,057	0	<b>2</b>	-1	0
1930	5,045	4,959	0	<b>10</b>	0	<b>10</b>
1932	5,285	<b>4,958</b>	0	1	1	1
1939	8,354	8,612	1	<b>8</b>	<b>-3</b>	<b>2</b>
1944	6,816	7,022	1	<b>6</b>	1	<b>2</b>
1947	8,577	8,725	-1	0	0	0
1949	6,228	6,349	0	0	0	0
1955	8,822	9,127	0	0	0	0
1960	9,379	9,462	0	0	0	0
1961	9,072	9,201	0	0	0	0
1964	7,671	7,783	-1	<b>8</b>	<b>2</b>	<b>7</b>
1981	8,879	8,886	0	<b>3</b>	0	0
1985	8,176	8,347	0	<b>5</b>	<b>5</b>	<b>5</b>
1987	8,632	8,737	0	<b>4</b>	0	0
1989	6,272	6,372	0	0	<b>-2</b>	0
2001	7,901	<b>8,401</b>	<b>-4</b>	<b>-29</b>	<b>-3</b>	<b>-6</b>
2002	7,697	7,743	0	0	<b>2</b>	0

**Table 88b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Dry water year types.

<b>Water Year</b>	<b>June Average Flows (cfs) under NAA</b>	<b>June Average Flows (cfs) under NoSha</b>	<b>Change in Days &gt;66°F under NoSha</b>	<b>Days &gt;66°F AND &gt;0.5°F change under NoSha</b>	<b>Change in Days &gt;70°F under NoSha</b>	<b>Days &gt;70°F AND &gt;0.5°F change under NoSha</b>
1925	6,770	6,859	0	0	0	0
1926	6,845	6,867	0	0	0	0
1930	5,045	5,021	0	0	0	0
1932	5,285	5,284	0	0	0	0
1939	8,354	8,516	-1	0	-1	0
1944	6,816	6,833	0	0	0	0
1947	8,577	8,712	-1	0	0	0
1949	6,228	6,224	0	0	0	0
1955	8,822	8,907	0	0	0	0
1960	9,379	9,469	0	0	0	0
1961	9,072	9,226	0	0	0	0
1964	7,671	7,764	-1	0	0	0
1981	8,879	8,879	0	0	0	0
1985	8,176	8,337	0	0	-1	0
1987	8,632	8,737	0	0	0	0
1989	6,272	6,262	0	0	0	0
2001	7,901	8,115	-1	0	0	0
2002	7,697	7,768	0	0	0	0

**Table 89a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B
1924	4,660	<b>3,696</b>	0	<b>25</b>	<b>7</b>	<b>13</b>
1929	6,173	<b>5,185</b>	<b>2</b>	<b>19</b>	1	1
1931	5,362	<b>5,970</b>	0	<b>-25</b>	<b>-2</b>	<b>-8</b>
1933	5,801	5,786	0	0	0	0
1934	4,865	4,864	0	0	0	0
1976	5,789	5,779	0	0	0	0
1977	7,027	<b>6,065</b>	0	<b>23</b>	<b>3</b>	<b>3</b>
1988	4,530	4,499	0	0	0	0
1990	4,861	4,925	0	0	0	0
1991	8,244	8,268	0	0	0	0
1992	7,048	7,036	0	0	0	0
1994	4,447	4,463	0	0	0	0

**Table 89b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha
1924	4,660	4,658	0	0	0	0
1929	6,173	6,173	0	0	0	0
1931	5,362	<b>5,924</b>	0	<b>-20</b>	<b>-2</b>	<b>-8</b>
1933	5,801	5,786	0	0	0	0
1934	4,865	4,863	0	0	0	0
1976	5,789	5,779	0	0	0	0
1977	7,027	7,022	0	0	0	0
1988	4,530	4,514	0	0	0	0
1990	4,861	5,094	0	0	0	0
1991	8,244	8,268	0	0	0	0
1992	7,048	7,041	0	0	0	0
1994	4,447	4,459	0	0	0	0

**Table 90a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1924	4,972	4,952	0	<b>4</b>	1	2	0	0
1929	7,233	<b>6,286</b>	0	<b>31</b>	<b>7</b>	<b>26</b>	0	0
1931	4,741	4,725	0	<b>-2</b>	0	-1	-1	0
1933	7,440	7,507	0	0	-1	0	0	0
1934	6,922	6,928	0	<b>-2</b>	<b>-2</b>	-2	-1	0
1976	6,430	<b>5,634</b>	0	<b>27</b>	<b>2</b>	<b>27</b>	<b>5</b>	<b>10</b>
1977	5,137	<b>4,656</b>	0	0	1	0	0	0
1988	6,748	<b>5,846</b>	0	<b>28</b>	<b>4</b>	<b>20</b>	<b>3</b>	<b>5</b>
1990	7,043	7,035	0	0	0	0	0	0
1991	4,676	4,650	0	0	1	0	0	0
1992	6,600	<b>5,721</b>	0	<b>29</b>	0	<b>29</b>	<b>15</b>	<b>28</b>
1994	4,765	4,594	0	0	0	0	0	0

**Table 90b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Critically Dry water year types.

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1924	4,972	4,984	0	0	0	0	0	0
1929	7,233	7,232	0	0	0	0	0	0
1931	4,741	4,723	0	0	0	0	0	0
1933	7,440	7,516	0	0	0	0	0	0
1934	6,922	6,929	0	0	0	0	0	0
1976	6,430	6,420	0	0	0	0	0	0
1977	5,137	5,133	0	0	0	0	0	0
1988	6,748	6,748	0	0	0	0	0	0
1990	7,043	7,027	0	0	0	0	0	0
1991	4,676	4,649	0	0	0	0	0	0
1992	6,600	6,619	0	0	0	0	-1	0
1994	4,765	4,594	0	0	0	0	0	0

**Table 91a.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1924	5,368	5,432	0	0	0	0
1929	6,190	6,132	0	<b>6</b>	0	<b>6</b>
1931	4,860	4,763	0	0	0	0
1933	5,706	5,722	0	0	0	0
1934	6,672	6,671	-1	<b>2</b>	0	<b>2</b>
1976	7,598	7,303	0	<b>30</b>	0	<b>16</b>
1977	8,311	<b>7,182</b>	0	<b>29</b>	<b>2</b>	<b>17</b>
1988	7,930	<b>6,918</b>	1	<b>24</b>	0	<b>17</b>
1990	7,989	7,876	0	0	0	0
1991	4,885	4,793	0	0	0	0
1992	6,293	<b>5,851</b>	0	<b>12</b>	1	<b>12</b>
1994	7,342	7,336	0	<b>4</b>	1	<b>3</b>

**Table 91b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1924	5,368	5,396	0	0	0	0
1929	6,190	6,352	0	0	0	0
1931	4,860	4,780	0	0	0	0
1933	5,706	5,721	0	0	0	0
1934	6,672	6,672	-1	0	0	0
1976	7,598	7,694	0	0	0	0
1977	8,311	<b>7,788</b>	0	<b>5</b>	1	<b>5</b>
1988	7,930	7,950	0	0	0	0
1990	7,989	7,974	0	0	-1	0
1991	4,885	4,793	0	0	0	0
1992	6,293	6,307	0	0	0	0
1994	7,342	7,346	0	0	0	0

## Fall Flow Changes and Temperature Exceedances at Tisdale (August–October)

**Table 92a.** August flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1922	6,012	5,986	0	<b>31</b>	0	<b>31</b>	<b>3</b>	<b>23</b>
1928	8,874	<b>7,914</b>	0	<b>30</b>	1	<b>25</b>	0	0
1940	8,584	8,466	0	0	<b>6</b>	0	0	0
1951	7,913	8,116	0	0	0	0	0	0
1954	8,880	<b>8,396</b>	0	<b>27</b>	0	<b>27</b>	0	0
1957	6,064	6,086	0	0	0	0	0	0
1973	5,587	5,525	0	0	0	0	0	0
1978	6,056	6,044	0	1	0	1	0	1
1980	5,951	5,966	0	0	0	0	0	0
1993	6,260	<b>6,736</b>	0	<b>-24</b>	0	<b>-24</b>	0	<b>-24</b>
2000	8,070	<b>7,560</b>	0	<b>24</b>	0	<b>24</b>	<b>8</b>	<b>19</b>
2003	7,133	7,149	0	0	0	0	0	0

**Table 92b.** August flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1922	6,012	5,986	0	0	0	0	0	0
1928	8,874	8,993	0	0	0	0	0	0
1940	8,584	8,591	0	0	<b>3</b>	0	0	0
1951	7,913	8,109	0	0	0	0	0	0
1954	8,880	8,914	0	0	0	0	0	0
1957	6,064	6,053	0	0	0	0	0	0
1973	5,587	5,517	0	0	0	0	0	0
1978	6,056	6,052	0	0	0	0	0	0
1980	5,951	5,964	0	-1	0	-1	0	-1
1993	6,260	6,292	0	0	0	0	0	0
2000	8,070	8,100	0	0	0	0	0	0
2003	7,133	7,150	0	0	0	0	0	0



**Table 93a.** September flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1922	5,142	<b>7,277</b>	0	<b>-28</b>	<b>-7</b>	<b>-26</b>	<b>-11</b>	<b>-11</b>
1928	10,169	<b>8,954</b>	0	<b>28</b>	<b>2</b>	<b>2</b>	0	0
1940	8,870	9,216	0	0	1	0	0	0
1951	8,551	8,561	0	0	0	0	0	0
1954	8,824	8,477	0	<b>21</b>	<b>2</b>	<b>13</b>	0	0
1957	4,980	<b>6,314</b>	0	<b>-28</b>	<b>-15</b>	<b>-28</b>	<b>-9</b>	<b>-9</b>
1973	8,209	<b>6,950</b>	0	<b>29</b>	<b>9</b>	<b>23</b>	0	0
1978	6,100	<b>8,653</b>	0	<b>-29</b>	<b>-8</b>	<b>-29</b>	<b>-12</b>	<b>-11</b>
1980	7,362	<b>7,956</b>	0	<b>-27</b>	<b>-7</b>	<b>-21</b>	<b>-3</b>	<b>-2</b>
1993	9,646	9,501	0	-1	0	-1	0	-1
2000	9,401	<b>8,903</b>	0	0	<b>3</b>	0	0	0
2003	10,212	10,241	0	0	0	0	0	0

**Table 93b.** September flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchanges alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1922	5,142	5,145	0	0	0	0	0	0
1928	10,169	10,215	0	0	0	0	0	0
1940	8,870	8,840	0	0	1	0	0	0
1951	8,551	8,561	0	0	0	0	0	0
1954	8,824	9,029	0	0	-1	0	0	0
1957	4,980	<b>4,598</b>	0	<b>22</b>	0	<b>22</b>	<b>2</b>	<b>8</b>
1973	8,209	8,268	0	0	-1	0	0	0
1978	6,100	6,211	0	0	0	0	-1	0
1980	7,362	7,522	0	0	-1	0	-1	0
1993	9,646	9,648	0	0	0	0	0	0
2000	9,401	9,441	0	0	0	0	-1	0
2003	10,212	10,240	0	0	0	0	0	0

**Table 94a.** October flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1922	5,896	<b>7,303</b>	<b>-10</b>	<b>-19</b>	0	0	0	0
1928	7,094	7,026	<b>-5</b>	<b>-8</b>	0	0	0	0
1940	6,399	6,224	-1	0	0	0	0	0
1951	5,905	5,889	0	0	0	0	0	0
1954	5,766	5,673	0	0	0	0	0	0
1957	13,803	13,344	-1	<b>-5</b>	0	0	0	0
1973	6,076	6,046	0	<b>5</b>	0	0	0	0
1978	6,051	6,073	0	<b>-7</b>	-1	<b>-7</b>	0	0
1980	5,581	5,606	0	<b>-2</b>	0	<b>-2</b>	0	0
1993	6,879	<b>7,378</b>	0	<b>-7</b>	0	0	0	0
2000	7,301	7,303	<b>-2</b>	<b>-16</b>	-1	0	0	0

**Table 94b.** October flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchanges alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1922	5,896	<b>6,294</b>	<b>-2</b>	0	0	0	0	0
1928	7,094	6,959	0	0	0	0	0	0
1940	6,399	6,413	0	0	0	0	0	0
1951	5,905	5,889	0	0	0	0	0	0
1954	5,766	5,674	0	0	0	0	0	0
1957	13,803	13,283	0	0	0	0	0	0
1973	6,076	6,090	0	0	0	0	0	0
1978	6,051	6,059	0	0	0	0	0	0
1980	5,581	5,587	0	0	0	0	0	0
1993	6,879	6,878	0	0	0	0	0	0
2000	7,301	7,299	0	0	0	0	0	0

**Table 95a.** August flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1923	5,557	5,558	0	0	0	0	-1	0
1935	4,688	4,837	0	0	0	0	0	0
1936	4,941	4,949	0	0	0	0	0	0
1937	5,569	5,565	0	0	0	0	0	0
1945	6,364	6,244	0	0	0	0	1	0
1946	5,568	5,559	0	0	0	0	0	0
1948	5,946	5,989	0	-2	0	-2	-1	-2
1950	6,063	6,083	0	-1	0	-1	-2	0
1959	7,998	<b>7,326</b>	0	<b>29</b>	0	<b>29</b>	<b>6</b>	<b>18</b>
1962	6,620	<b>5,711</b>	0	<b>31</b>	0	<b>31</b>	<b>6</b>	<b>22</b>
1966	5,586	5,577	0	0	0	0	0	0
1968	5,558	5,425	0	<b>25</b>	0	<b>25</b>	0	<b>25</b>
1972	6,487	<b>7,102</b>	0	0	0	0	-1	0
1979	7,116	7,128	0	0	0	0	0	0

**Table 95b.** August flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1923	5,557	5,550	0	0	0	0	0	0
1935	4,688	4,683	0	0	0	0	0	0
1936	4,941	4,945	0	0	0	0	0	0
1937	5,569	5,562	0	0	0	0	0	0
1945	6,364	6,362	0	0	0	0	0	0
1946	5,568	5,560	0	0	0	0	0	0
1948	5,946	6,063	0	0	0	0	0	0
1950	6,063	6,079	0	0	0	0	-1	0
1959	7,998	8,024	0	0	0	0	0	0
1962	6,620	6,730	0	0	0	0	0	0
1966	5,586	5,569	0	0	0	0	0	0
1968	5,558	5,440	0	0	0	0	0	0
1972	6,487	<b>7,240</b>	0	<b>-28</b>	0	<b>-28</b>	<b>-5</b>	<b>-27</b>
1979	7,116	7,088	0	0	0	0	0	0

**Table 96a.** September flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1923	4,328	4,272	0	0	<b>2</b>	0	0	0
1935	4,012	4,012	0	0	0	0	0	0
1936	6,256	<b>5,927</b>	0	<b>11</b>	1	<b>11</b>	1	<b>3</b>
1937	4,291	<b>5,060</b>	0	<b>-27</b>	-1	<b>-27</b>	<b>-10</b>	<b>-18</b>
1945	4,893	4,931	0	0	0	0	0	0
1946	6,155	6,044	0	0	0	0	0	0
1948	5,783	<b>4,825</b>	0	<b>28</b>	<b>2</b>	<b>25</b>	<b>3</b>	<b>19</b>
1950	4,866	4,850	0	0	0	0	0	0
1959	6,065	6,079	0	0	0	0	-1	0
1962	4,566	<b>4,969</b>	0	<b>-8</b>	0	<b>-8</b>	0	<b>-5</b>
1966	4,613	<b>4,883</b>	0	0	0	0	-1	0
1968	5,190	<b>5,472</b>	0	1	0	1	<b>-3</b>	1
1972	4,289	<b>4,771</b>	0	<b>-21</b>	0	<b>-21</b>	<b>-2</b>	<b>-11</b>
1979	4,951	4,899	0	0	0	0	0	0

**Table 96b.** September flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1923	4,328	4,275	0	0	<b>2</b>	0	0	0
1935	4,012	4,007	0	0	0	0	1	0
1936	6,256	6,224	0	0	0	0	0	0
1937	4,291	<b>4,563</b>	0	0	0	0	<b>-3</b>	0
1945	4,893	4,933	0	0	0	0	0	0
1946	6,155	6,157	0	0	0	0	0	0
1948	5,783	5,820	0	0	0	0	0	0
1950	4,866	4,850	0	0	0	0	0	0
1959	6,065	6,098	0	0	0	0	0	0
1962	4,566	4,649	0	0	0	0	-1	0
1966	4,613	4,834	0	0	0	0	-1	0
1968	5,190	5,268	0	0	0	0	0	0
1972	4,289	4,438	0	-1	0	-1	-1	-1
1979	4,951	4,897	0	0	0	0	0	0

**Table 97a.** October flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1923	6,066	6,021	0	0	1	0	0	0
1935	3,779	3,962	-1	0	<b>-3</b>	0	0	0
1936	3,679	3,659	0	0	0	0	0	0
1937	4,864	4,937	0	<b>-3</b>	0	0	0	0
1945	5,065	<b>4,635</b>	<b>3</b>	<b>2</b>	<b>3</b>	0	0	0
1946	4,240	<b>4,470</b>	0	0	0	0	0	0
1948	5,747	<b>6,195</b>	-1	<b>3</b>	0	0	0	0
1950	6,094	6,018	0	0	0	0	0	0
1959	5,530	5,771	-1	<b>-18</b>	-1	0	0	0
1962	13,950	14,060	-1	0	0	0	0	0
1966	5,796	<b>6,317</b>	<b>-10</b>	<b>-9</b>	0	0	0	0
1968	5,231	<b>5,704</b>	0	0	-1	0	0	0
1972	6,023	<b>6,999</b>	-1	<b>-14</b>	<b>-3</b>	<b>-6</b>	0	0
1979	5,836	6,071	<b>-4</b>	0	0	0	0	0

**Table 97b.** October flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1923	6,066	6,023	0	0	0	0	0	0
1935	3,779	3,734	0	0	0	0	0	0
1936	3,679	3,670	0	0	0	0	0	0
1937	4,864	4,895	0	0	0	0	0	0
1945	5,065	<b>4,608</b>	<b>3</b>	<b>5</b>	<b>3</b>	0	0	0
1946	4,240	4,215	0	0	0	0	0	0
1948	5,747	5,748	0	0	0	0	0	0
1950	6,094	6,374	0	0	0	0	0	0
1959	5,530	5,773	0	0	0	0	0	0
1962	13,950	<b>13,250</b>	<b>5</b>	<b>3</b>	0	0	0	0
1966	5,796	5,677	<b>2</b>	0	0	0	0	0
1968	5,231	<b>5,505</b>	0	0	0	0	0	0
1972	6,023	6,041	0	0	0	0	0	0
1979	5,836	5,934	-1	0	0	0	0	0

**Table 98a.** August flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1925	5,374	<b>6,598</b>	0	<b>-31</b>	0	<b>-31</b>	<b>-13</b>	<b>-29</b>
1926	4,581	4,563	0	0	0	0	0	0
1930	4,584	<b>5,326</b>	0	<b>-30</b>	0	<b>-30</b>	0	<b>-30</b>
1932	4,454	<b>4,689</b>	0	<b>-17</b>	0	<b>-17</b>	0	<b>-17</b>
1939	5,899	<b>7,057</b>	0	<b>-31</b>	0	<b>-31</b>	<b>-13</b>	<b>-24</b>
1944	6,594	6,888	0	0	0	0	<b>2</b>	0
1947	4,762	<b>5,646</b>	0	<b>-28</b>	0	<b>-28</b>	<b>-4</b>	<b>-26</b>
1949	6,334	6,169	0	0	0	0	<b>3</b>	0
1955	6,506	<b>7,509</b>	0	<b>-30</b>	0	<b>-30</b>	<b>-5</b>	<b>-29</b>
1960	5,655	<b>6,565</b>	0	<b>-30</b>	0	<b>-30</b>	<b>-2</b>	<b>-25</b>
1961	6,098	<b>6,932</b>	0	<b>-29</b>	0	<b>-29</b>	<b>-4</b>	<b>-29</b>
1964	5,769	<b>6,070</b>	0	0	0	0	0	0
1981	6,098	6,002	0	0	0	0	0	0
1985	5,526	<b>6,491</b>	0	<b>-25</b>	0	<b>-25</b>	<b>-6</b>	<b>-25</b>
1987	6,206	<b>6,924</b>	0	<b>-15</b>	0	<b>-15</b>	<b>-3</b>	<b>-15</b>
1989	5,339	5,288	0	0	0	0	0	0
2001	4,964	<b>6,022</b>	0	<b>-31</b>	0	<b>-31</b>	0	<b>-31</b>
2002	5,459	<b>6,207</b>	0	<b>-26</b>	0	<b>-26</b>	0	<b>-26</b>

**Table 98b.** August flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1925	5,374	<b>6,234</b>	0	<b>-31</b>	0	<b>-31</b>	<b>-11</b>	<b>-29</b>
1926	4,581	4,632	0	0	0	0	0	0
1930	4,584	<b>5,487</b>	0	<b>-30</b>	0	<b>-30</b>	0	<b>-30</b>
1932	4,454	4,572	0	0	0	0	0	0
1939	5,899	<b>6,714</b>	0	<b>-25</b>	0	<b>-25</b>	<b>-3</b>	<b>-19</b>
1944	6,594	<b>7,050</b>	0	0	0	0	<b>-2</b>	0
1947	4,762	<b>5,721</b>	0	<b>-29</b>	0	<b>-29</b>	<b>-4</b>	<b>-27</b>
1949	6,334	6,324	0	0	0	0	0	0
1955	6,506	<b>7,343</b>	0	<b>-25</b>	0	<b>-25</b>	<b>-5</b>	<b>-24</b>
1960	5,655	<b>6,580</b>	0	<b>-30</b>	0	<b>-30</b>	<b>-2</b>	<b>-25</b>
1961	6,098	<b>6,967</b>	0	<b>-29</b>	0	<b>-29</b>	<b>-5</b>	<b>-29</b>
1964	5,769	<b>6,086</b>	0	0	0	0	0	0
1981	6,098	6,381	0	0	0	0	0	0
1985	5,526	<b>6,416</b>	0	<b>-31</b>	0	<b>-31</b>	<b>-5</b>	<b>-31</b>
1987	6,206	<b>7,060</b>	0	<b>-25</b>	0	<b>-25</b>	<b>-4</b>	<b>-24</b>
1989	5,339	<b>5,679</b>	0	0	0	0	0	0
2001	4,964	<b>5,847</b>	0	<b>-28</b>	0	<b>-28</b>	0	<b>-28</b>
2002	5,459	<b>6,207</b>	0	<b>-26</b>	0	<b>-26</b>	0	<b>-26</b>

**Table 99a.** September flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1925	4,795	4,817	0	<b>-2</b>	0	<b>-2</b>	0	0
1926	3,981	3,969	0	0	0	0	0	0
1930	3,565	3,564	0	<b>-4</b>	0	<b>-4</b>	0	<b>-4</b>
1932	3,937	3,929	0	-1	0	-1	0	-1
1939	4,627	4,847	0	<b>-2</b>	0	<b>-2</b>	<b>-4</b>	0
1944	4,460	<b>4,759</b>	0	0	0	0	<b>-2</b>	0
1947	4,614	4,681	0	-1	0	-1	-1	0
1949	4,914	4,837	0	0	1	0	<b>2</b>	0
1955	4,376	<b>5,074</b>	0	<b>-30</b>	<b>-2</b>	<b>-29</b>	-1	<b>-17</b>
1960	4,231	<b>5,089</b>	0	<b>-30</b>	0	<b>-30</b>	<b>-4</b>	<b>-20</b>
1961	5,143	5,381	0	-1	0	-1	0	-1
1964	4,241	<b>4,490</b>	0	0	-1	0	<b>-4</b>	0
1981	4,947	5,093	0	0	0	0	0	0
1985	3,797	<b>4,307</b>	0	<b>-20</b>	0	<b>-20</b>	<b>-8</b>	<b>-12</b>
1987	4,786	<b>5,067</b>	0	0	0	0	-1	0
1989	5,284	5,108	0	0	0	0	1	0
2001	5,880	5,887	0	-1	0	-1	1	-1
2002	4,877	<b>5,129</b>	0	-1	0	-1	0	-1



**Table 99b.** September flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1925	4,795	4,805	0	0	0	0	0	0
1926	3,981	3,971	0	0	0	0	0	0
1930	3,565	<b>3,820</b>	0	<b>-2</b>	0	<b>-2</b>	0	<b>-2</b>
1932	3,937	3,817	0	0	0	0	1	0
1939	4,627	4,845	0	0	0	0	-1	0
1944	4,460	<b>4,736</b>	0	0	0	0	-1	0
1947	4,614	<b>4,860</b>	0	<b>-2</b>	0	<b>-2</b>	<b>-2</b>	-1
1949	4,914	4,838	0	0	1	0	1	0
1955	4,376	4,573	0	-1	0	-1	0	-1
1960	4,231	<b>4,545</b>	0	-1	0	-1	-1	0
1961	5,143	<b>5,439</b>	0	-1	0	-1	0	-1
1964	4,241	<b>4,490</b>	0	0	-1	0	<b>-4</b>	0
1981	4,947	5,084	0	0	0	0	0	0
1985	3,797	3,903	0	-1	0	-1	0	-1
1987	4,786	<b>5,070</b>	0	0	0	0	-1	0
1989	5,284	5,101	0	0	0	0	1	0
2001	5,880	6,024	0	0	0	0	0	0
2002	4,877	<b>5,130</b>	0	-1	0	-1	0	-1

**Table 100a.** October flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1925	4,739	4,697	0	0	0	0	0	0
1926	4,361	<b>3,663</b>	0	<b>27</b>	<b>4</b>	<b>4</b>	0	0
1930	3,915	3,838	-1	0	0	0	0	0
1932	3,509	3,617	-1	0	0	0	0	0
1939	3,864	<b>4,073</b>	0	0	0	0	0	0
1944	4,526	<b>3,851</b>	0	<b>27</b>	<b>3</b>	<b>2</b>	0	0
1947	5,099	5,109	0	0	0	0	0	0
1949	4,709	4,693	1	0	0	0	0	0
1955	4,922	4,916	0	<b>-3</b>	0	0	0	0
1960	5,132	4,927	<b>2</b>	<b>-3</b>	-1	<b>-3</b>	0	0
1961	6,182	6,394	-1	0	0	0	0	0
1964	3,900	4,023	0	0	0	0	0	0
1981	4,868	<b>5,887</b>	<b>-4</b>	<b>-19</b>	-1	<b>-2</b>	0	0
1985	4,727	<b>4,976</b>	-1	-1	0	-1	0	0
1987	4,355	<b>4,600</b>	0	0	0	0	0	0
1989	6,195	6,199	0	0	0	0	0	0
2001	7,149	<b>6,618</b>	0	<b>11</b>	1	<b>5</b>	1	1
2002	5,105	5,345	-1	0	-1	0	0	0

**Table 100b.** October flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1925	4,739	<b>4,983</b>	0	0	0	0	0	0
1926	4,361	<b>3665</b>	0	<b>27</b>	<b>4</b>	<b>4</b>	0	0
1930	3,915	4,019	-1	0	0	0	0	0
1932	3,509	3,504	0	0	0	0	0	0
1939	3,864	<b>4,075</b>	0	0	0	0	0	0
1944	4,526	<b>3,885</b>	0	<b>27</b>	<b>5</b>	<b>2</b>	0	0
1947	5,099	5,297	0	0	0	0	0	0
1949	4,709	4,689	1	0	0	0	0	0
1955	4,922	<b>5,278</b>	0	0	0	0	0	0
1960	5,132	5,206	0	0	-1	0	0	0
1961	6,182	6,385	-1	0	-1	0	0	0
1964	3,900	4,023	0	0	0	0	0	0
1981	4,868	<b>5,629</b>	<b>-3</b>	<b>-18</b>	-1	-1	0	0
1985	4,727	<b>4,965</b>	0	0	0	0	0	0
1987	4,355	<b>4,597</b>	0	0	0	0	0	0
1989	6,195	6,203	0	0	0	0	0	0
2001	7,149	<b>6,626</b>	0	<b>14</b>	1	<b>4</b>	1	0
2002	5,105	5,345	-1	0	-1	0	0	0

**Table 101a.** August flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1924	4,965	<b>6,360</b>	0	<b>-31</b>	0	<b>-31</b>	<b>-3</b>	<b>-31</b>
1929	4,540	<b>6,346</b>	0	<b>-31</b>	0	<b>-31</b>	<b>-6</b>	<b>-31</b>
1931	5,117	5,092	0	<b>-7</b>	0	<b>-7</b>	0	<b>-7</b>
1933	4,537	4,524	0	0	0	0	0	0
1934	4,509	4,507	0	0	0	0	0	0
1976	5,402	<b>6,304</b>	0	<b>-23</b>	0	<b>-23</b>	0	<b>-23</b>
1977	6,570	<b>8,074</b>	0	<b>-29</b>	0	<b>-29</b>	0	<b>-29</b>
1988	4,918	<b>5,645</b>	0	<b>-26</b>	0	<b>-26</b>	0	<b>-26</b>
1990	4,534	4,530	0	0	0	0	0	0
1991	4,572	4,745	0	0	0	0	0	0
1992	4,585	<b>5,685</b>	0	<b>-30</b>	0	<b>-30</b>	<b>-1</b>	<b>-30</b>
1994	5,564	<b>6,429</b>	0	<b>-29</b>	0	<b>-29</b>	0	<b>-29</b>

**Table 101b.** August flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	August Average Flows (cfs) under NAA	August Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1924	4,965	<b>5,827</b>	0	<b>-31</b>	0	<b>-31</b>	0	<b>-31</b>
1929	4,540	<b>5,421</b>	0	<b>-31</b>	0	<b>-31</b>	<b>-5</b>	<b>-31</b>
1931	5,117	5,121	0	0	0	0	0	0
1933	4,537	4,527	0	0	0	0	0	0
1934	4,509	4,508	0	0	0	0	0	0
1976	5,402	<b>6,223</b>	0	<b>-25</b>	0	<b>-25</b>	0	<b>-25</b>
1977	6,570	<b>7,555</b>	0	<b>-31</b>	0	<b>-31</b>	0	<b>-31</b>
1988	4,918	<b>5,562</b>	0	<b>-2</b>	0	<b>-2</b>	0	<b>-2</b>
1990	4,534	4,499	0	0	0	0	0	0
1991	4,572	4,576	0	0	0	0	0	0
1992	4,585	4,562	0	0	0	0	0	0
1994	5,564	<b>6,469</b>	0	<b>-30</b>	0	<b>-30</b>	0	<b>-30</b>

**Table 102a.** September flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1924	4,042	<b>4,790</b>	0	<b>-30</b>	0	<b>-30</b>	<b>-5</b>	<b>-23</b>
1929	3,582	<b>4,667</b>	0	<b>-30</b>	<b>-2</b>	<b>-30</b>	<b>-5</b>	<b>-26</b>
1931	3,951	3,953	0	<b>-30</b>	0	<b>-30</b>	<b>-4</b>	<b>-27</b>
1933	3,756	3,747	0	0	0	0	0	0
1934	3,706	3,695	0	<b>-13</b>	0	<b>-13</b>	<b>-1</b>	<b>-9</b>
1976	5,141	<b>6,954</b>	0	<b>-30</b>	<b>-4</b>	<b>-30</b>	<b>-8</b>	<b>-19</b>
1977	5,989	<b>5,205</b>	0	<b>-17</b>	0	<b>-17</b>	<b>-5</b>	<b>-12</b>
1988	4,484	<b>5,068</b>	0	<b>-30</b>	<b>-2</b>	<b>-27</b>	<b>-1</b>	<b>-20</b>
1990	4,208	4,215	0	0	0	0	0	0
1991	4,430	4,603	0	0	0	0	0	0
1992	4,906	<b>5,343</b>	0	<b>-26</b>	0	<b>-26</b>	<b>-1</b>	<b>-26</b>
1994	5,884	5,874	0	<b>-1</b>	0	<b>-1</b>	0	<b>-1</b>

**Table 102b.** September flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	September Average Flows (cfs) under NAA	September Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1924	4,042	4,234	0	<b>-2</b>	0	<b>-2</b>	<b>-1</b>	<b>-2</b>
1929	3,582	<b>3,852</b>	0	<b>-2</b>	0	<b>-2</b>	0	<b>-2</b>
1931	3,951	3,952	0	0	0	0	<b>-1</b>	0
1933	3,756	3,747	0	0	0	0	1	0
1934	3,706	3,695	0	0	0	0	0	0
1976	5,141	<b>5,418</b>	0	<b>-2</b>	0	<b>-2</b>	0	<b>-2</b>
1977	5,989	6,284	0	<b>-24</b>	0	<b>-24</b>	<b>-3</b>	<b>-23</b>
1988	4,484	<b>4,771</b>	0	0	<b>-1</b>	0	0	0
1990	4,208	4,184	0	0	0	0	0	0
1991	4,430	4,418	0	0	0	0	0	0
1992	4,906	4,900	0	0	0	0	0	0
1994	5,884	6,084	0	<b>-1</b>	0	<b>-1</b>	0	<b>-1</b>

**Table 103a.** October flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under Alt3B	Change in Days >60°F under Alt3B	Days >60°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >70°F under Alt3B	Days >70°F AND >0.5°F change under Alt3B
1924	3,697	3,699	-1	<b>-3</b>	0	<b>-3</b>	0	0
1929	5,033	<b>5,968</b>	-1	<b>-28</b>	0	0	0	0
1931	5,153	5,135	0	<b>-22</b>	<b>-3</b>	<b>-6</b>	0	0
1933	5,071	5,070	0	<b>-28</b>	-1	<b>-8</b>	0	0
1934	4,963	4,971	0	<b>-31</b>	<b>-8</b>	<b>-13</b>	0	0
1976	6,493	<b>5,855</b>	1	<b>7</b>	0	0	0	0
1977	6,390	<b>6,901</b>	0	<b>-23</b>	<b>-3</b>	<b>-19</b>	<b>-4</b>	<b>-4</b>
1988	5,567	<b>6,114</b>	<b>-2</b>	<b>-10</b>	-1	<b>-2</b>	0	0
1990	5,635	5,666	0	0	-1	0	0	0
1991	4,038	4,076	0	0	0	0	1	0
1992	5,882	5,955	0	<b>-2</b>	0	<b>-2</b>	0	-1
1994	4,227	4,237	0	0	0	0	0	0

**Table 103b.** October flow (cfs) and temperature (°F) exceedances at Tisdale under No Shasta Exchange Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in green (increase).

Water Year	October Average Flows (cfs) under NAA	October Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >70°F under NoSha	Days >70°F AND >0.5°F change under NoSha
1924	3,697	3,840	-1	0	0	0	0	0
1929	5,033	<b>5,392</b>	0	0	0	0	0	0
1931	5,153	5,150	0	0	0	0	0	0
1933	5,071	5,070	0	0	0	0	1	0
1934	4,963	4,972	0	0	0	0	0	0
1976	6,493	6,533	0	0	0	0	0	0
1977	6,390	6,516	0	0	0	0	0	0
1988	5,567	5,811	0	0	0	0	0	0
1990	5,635	5,632	0	0	0	0	0	0
1991	4,038	3,893	1	0	0	0	<b>4</b>	0
1992	5,882	5,881	0	0	0	0	0	0
1994	4,227	4,238	0	0	0	0	0	0

## Appendix B2 – Sturgeon

**Table 104.** Temperature criteria used to compare Proposed Project to No Action Alternative (NAA) for White Sturgeon

Location	Temperature	Rationale/Reference	Timing
Hamilton City	62.6 °F (16 °C) <sup>A,1</sup> 68 °F (20 °C) <sup>A,3</sup>	Spawning/Egg Survival <sup>1,3</sup> Larval Survival <sup>1,3</sup>	January–June
Hamilton City	66 °F (18.9 °C) <sup>A,2</sup>	Juvenile Rearing <sup>2</sup>	Year Round
Tisdale Weir	62.6 °F (16 °C) <sup>A,1</sup> 68 °F (20 °C) <sup>A,3</sup>	Spawning/Egg Survival <sup>1,3</sup> Larval Survival <sup>1,3</sup>	January–June
Tisdale Weir	66 °F (18.9 °C) <sup>A,2</sup>	Juvenile Rearing <sup>2</sup>	Year Round
Knights Landing	62.6 °F (16 °C) <sup>A,1</sup> 68 °F (20 °C) <sup>A,3</sup>	Spawning/Egg Survival <sup>1,3</sup> Larval Survival <sup>1,3</sup>	January–June
Knights Landing	66 °F (18.9 °C) <sup>A,2</sup>	Juvenile Rearing <sup>2</sup>	Year Round

<sup>A</sup> Criterion based on the daily average temperature. The analysis uses daily averages.

<sup>1</sup> Lower bounds of the stressful range based on Wang 1985 and Hildebrand et al. 2016

<sup>2</sup> Lower bounds of the stressful range based on Israel et al. 2009

<sup>3</sup> Mortality threshold based on Wang 1985

### White Sturgeon Eggs and Larvae under Stressful Conditions (62.6 °F)

#### Hamilton City

**Table 105.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in April exceeding 62.6 °F and >0.5 °F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1.0	0.0	0.0	<b>17</b>	0	0
AN	<b>1.6</b>	<b>1.6</b>	<b>1.6</b>	<b>12</b>	<b>12</b>	<b>12</b>
BN	0.9	-0.4	0	<b>18</b>	0	0
D	1.3	0.0	0	<b>11</b>	0	0
C	0.6	-0.8	-0.9	<b>13</b>	0	0
All Years	1.1	0.1	0.1	<b>14.2</b>	<b>2.4</b>	<b>2.4</b>

**Table 106.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in May exceeding 62.6 °F and >0.5 °F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>-3.9</b>	<b>2.7</b>	<b>2.7</b>	<b>13</b>	<b>17</b>	<b>17</b>
AN	1.1	1.4	1.4	<b>16</b>	<b>13</b>	<b>13</b>
BN	<b>10.3</b>	<b>2.9</b>	<b>2.9</b>	<b>27</b>	<b>27</b>	<b>27</b>
D	<b>6.6</b>	0.3	0.2	<b>31</b>	<b>4</b>	<b>3</b>
C	<b>4.8</b>	-0.6	-0.1	<b>30</b>	0	0
All Years	<b>3.8</b>	1.3	1.4	<b>23.4</b>	<b>12.2</b>	<b>12.0</b>

**Table 107.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in June exceeding 62.6 °F and >0.5 °F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>4.1</b>	<b>2.3</b>	<b>2.3</b>	<b>27</b>	<b>27</b>	<b>27</b>
AN	<b>15.3</b>	1.4	<b>1.6</b>	<b>29</b>	<b>23</b>	<b>25</b>
BN	<b>6.4</b>	0.1	0.1	<b>27</b>	1	<b>2</b>
D	<b>2.7</b>	0.1	0.1	<b>19</b>	1	1
C	<b>9.1</b>	0.3	0.3	<b>30</b>	<b>2</b>	<b>4</b>
All Years	<b>7.5</b>	0.8	0.9	<b>26.4</b>	<b>10.8</b>	<b>11.8</b>

### Tisdale Weir (Tisdale)

**Table 108.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in April exceeding 62.6 °F and >0.5 °F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.9	0.0	0.0	<b>14</b>	0	0
AN	1.3	1.3	1.3	<b>15</b>	<b>15</b>	<b>15</b>
BN	-0.1	-1.1	0.0	<b>16</b>	0	0
D	1.3	0.0	0.0	<b>13</b>	0	0
C	<b>2.3</b>	<b>-1.7</b>	<b>-1.8</b>	<b>21</b>	0	0
All Years	1.1	-0.3	-0.1	<b>15.8</b>	<b>3.0</b>	<b>3.0</b>



**Table 109.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in May exceeding 62.6 °F and >0.5 °F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>-4.2</b>	1.5	1.5	<b>24</b>	<b>12</b>	<b>12</b>
AN	0.5	1.3	1.3	<b>24</b>	<b>10</b>	<b>10</b>
BN	<b>6.3</b>	<b>1.8</b>	<b>1.9</b>	<b>22</b>	<b>20</b>	<b>20</b>
D	<b>5.1</b>	0.3	0.2	<b>31</b>	<b>3</b>	<b>3</b>
C	<b>9.6</b>	0.0	0.0	<b>31</b>	0	0
All Years	<b>3.5</b>	1.0	1.0	<b>26.4</b>	<b>9.0</b>	<b>9.0</b>

**Table 110.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in June exceeding 62.6 °F and >0.5 °F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>3.9</b>	0.7	0.7	<b>23</b>	<b>18</b>	<b>18</b>
AN	<b>14.9</b>	-0.4	-0.3	<b>29</b>	<b>16</b>	<b>16</b>
BN	<b>7.3</b>	0.1	0.1	<b>30</b>	1	1
D	1.2	0.0	0.0	<b>10</b>	0	0
C	<b>9.3</b>	0.4	0.1	<b>30</b>	<b>5</b>	1
All Years	<b>7.3</b>	0.2	0.1	<b>24.4</b>	<b>8.0</b>	<b>7.2</b>

### Knights Landing

**Table 111.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in April exceeding 62.6 °F and >0.5 °F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	1	0	0	<b>17</b>	0	0
AN	<b>1.6</b>	<b>1.6</b>	<b>1.6</b>	<b>19</b>	<b>19</b>	<b>19</b>
BN	-0.4	-1.0	0	<b>12</b>	0	0
D	0.8	0.0	0	<b>11</b>	0	0
C	<b>2.3</b>	<b>-1.6</b>	<b>-1.8</b>	<b>21</b>	0	0
All Years	1.1	-0.2	0	<b>16</b>	<b>3.8</b>	<b>3.8</b>

**Table 112.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in May exceeding 62.6 °F and >0.5 °F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>-3.6</b>	<b>1.6</b>	<b>1.7</b>	<b>24</b>	<b>12</b>	<b>13</b>
AN	-0.9	1.3	1.3	<b>22</b>	<b>10</b>	<b>10</b>
BN	<b>4.3</b>	1.3	1.4	<b>20</b>	<b>14</b>	<b>14</b>
D	<b>4.8</b>	0.1	0.1	<b>31</b>	<b>2</b>	1
C	<b>9.5</b>	0.0	-0.1	<b>31</b>	0	0
All Years	<b>2.8</b>	0.9	0.9	<b>25.6</b>	<b>7.6</b>	<b>7.6</b>

**Table 113.** Temperature results for eggs and larvae under stressful conditions showing the change in the number of days in June exceeding 62.6 °F and >0.5 °F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>4.0</b>	1.4	1.4	<b>22</b>	<b>19</b>	<b>19</b>
AN	<b>12.3</b>	-0.4	-0.4	<b>29</b>	<b>16</b>	<b>16</b>
BN	<b>6.6</b>	0.4	0.4	<b>29</b>	<b>4</b>	<b>5</b>
D	0.5	0.0	0.0	<b>12</b>	0	0
C	<b>7.4</b>	0.4	0.0	<b>27</b>	<b>5</b>	0
All Years	<b>6.2</b>	0.4	0.3	<b>23.8</b>	<b>8.8</b>	<b>8.0</b>

## White Sturgeon Eggs and Larvae under Lethal Conditions (68 °F)

### Hamilton City

**Table 114.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in April exceeding 68 °F and >0.5 °F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.1	0.0	0.0	<b>2</b>	0	0
D	0.0	0.0	0.0	0	0	0
C	0.0	0.0	0.0	0	0	0
All Years	0.0	0.0	0.0	0.4	0.0	0.0

**Table 115.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in May exceeding 68 °F and >0.5 °F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	-1.0	1.2	1.2	<b>3</b>	<b>16</b>	<b>16</b>
AN	0.8	0.7	0.7	<b>8</b>	<b>8</b>	<b>8</b>
BN	<b>1.9</b>	0.8	0.7	<b>10</b>	<b>7</b>	<b>7</b>
D	0.2	0.0	0	<b>3</b>	0	0
C	0.3	0.0	0	<b>5</b>	0	0
All Years	0.4	0.5	0.5	<b>5.8</b>	<b>6.2</b>	<b>6.2</b>

**Table 116.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in June exceeding 68 °F and >0.5 °F increase at Hamilton City for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>2.7</b>	<b>2.3</b>	<b>2.3</b>	<b>26</b>	<b>25</b>	<b>25</b>
AN	<b>4.7</b>	<b>1.9</b>	<b>1.9</b>	<b>28</b>	<b>22</b>	<b>22</b>
BN	0.9	0.0	0	<b>12</b>	0	0
D	0.7	0.0	0	<b>10</b>	0	0
C	<b>3.5</b>	0.2	0.1	<b>10</b>	<b>2</b>	1
All Years	<b>2.5</b>	0.9	0.9	<b>17.2</b>	<b>9.8</b>	<b>9.6</b>

### Tisdale Weir (Tisdale)

**Table 117.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in April exceeding 68 °F and >0.5 °F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types.

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.2	0.0	0.0	<b>4</b>	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.2	0.0	0.0	<b>3</b>	0	0
D	0.0	0.0	0.0	0	0	0
C	-0.3	-0.3	-0.3	0	0	0
All Years	0.0	-0.1	-0.1	1.4	0.0	0

**Table 118.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in May exceeding 68 °F and >0.5 °F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	-2.6	1.1	1.1	12	12	12
AN	1.0	1.1	1.1	10	10	10
BN	4.1	1.2	1.2	17	11	11
D	2.1	0.2	0.1	14	3	1
C	5.4	0.0	0	29	0	0
All Years	2.0	0.7	0.7	16.4	7.2	6.8

**Table 119.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in June exceeding 68 °F and >0.5 °F increase at Tisdale for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	3.3	1.5	1.5	19	18	18
AN	12.6	0.8	1	26	16	16
BN	5.4	0.1	0.1	29	1	1
D	1.3	0.0	0	10	0	0
C	7.7	0.4	0.1	28	5	1
All Years	6.1	0.6	0.5	22.4	8.0	7.2

### Knights Landing

**Table 120.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in April exceeding 68 °F and >0.5 °F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	0.0	0.0	0.0	0	0	0
AN	0.0	0.0	0.0	0	0	0
BN	0.1	0.0	0.0	1	0	0
D	0.0	0.0	0.0	0	0	0
C	-0.2	-0.4	-0.5	4	0	0
All Years	0.0	-0.1	-0.1	1.0	0.0	0.0

**Table 121.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in May exceeding 68 °F and >0.5 °F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>-3.0</b>	1.2	1.3	<b>12</b>	<b>12</b>	<b>13</b>
AN	-0.7	0.9	0.9	<b>10</b>	<b>6</b>	<b>6</b>
BN	<b>4.3</b>	1.1	1.1	<b>19</b>	<b>10</b>	<b>10</b>
D	<b>2.9</b>	0.1	0.1	<b>29</b>	<b>2</b>	1
C	<b>7.8</b>	0.0	0.0	<b>26</b>	0	0
All Years	<b>2.3</b>	0.7	0.7	<b>19.2</b>	<b>6.0</b>	<b>6.0</b>

**Table 122.** Temperature results for eggs and larvae under lethal conditions showing the change in the number of days in June exceeding 68 °F and >0.5 °F increase at Knights Landing for Project Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) during Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critically Dry (C) water year types. Changes in days >5% are bolded in red (increase).

Water Year Type	Alt3B Avg	NoSha Avg	No ShaOro Avg	Alt3B Max	NoSha Max	NoShaOro Max
W	<b>3.8</b>	<b>1.7</b>	<b>1.7</b>	<b>19</b>	<b>19</b>	<b>19</b>
AN	<b>11.3</b>	-0.3	-0.3	<b>25</b>	<b>16</b>	<b>16</b>
BN	<b>6.4</b>	0.4	0.4	<b>29</b>	<b>4</b>	<b>5</b>
D	0.5	0.0	0	<b>12</b>	0	0
C	<b>7.2</b>	0.4	0	<b>27</b>	<b>5</b>	0
All Years	<b>5.8</b>	0.4	0.4	<b>22.4</b>	<b>8.8</b>	<b>8.0</b>

## Spring Flow Changes and Temperature Exceedances at Tisdale (April-June)

**Table 123a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1922	12,181	12,646	-2	0	0	0	0	0
1928	13,391	13,406	0	0	0	0	0	0
1940	22,476	<b>18,678</b>	0	0	0	0	0	0
1951	6,049	5,911	1	0	0	0	0	0
1954	20,838	20,841	0	0	0	0	0	0
1957	6,574	6,600	0	0	0	0	0	0
1973	7,642	7,635	0	0	0	0	0	0
1978	20,518	<b>16,558</b>	0	0	0	0	0	0
1980	8,709	<b>6,636</b>	<b>4</b>	<b>15</b>	1	1	0	0
1993	16,947	16,963	0	0	0	0	0	0
2000	6,348	6,339	0	0	0	0	0	0
2003	17,535	17,386	0	0	0	0	0	0

**Table 123b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1922	12,181	12,275	-1	0	0	0	0	0
1928	13,391	13,406	0	0	0	0	0	0
1940	22,476	<b>18,668</b>	0	0	0	0	0	0
1951	6,049	5,911	1	0	0	0	0	0
1954	20,838	20,842	0	0	0	0	0	0
1957	6,574	6,584	0	0	0	0	0	0
1973	7,642	7,638	0	0	0	0	0	0
1978	20,518	<b>16,548</b>	0	0	0	0	0	0
1980	8,709	<b>6,634</b>	<b>4</b>	<b>15</b>	1	1	0	0
1993	16,947	16,959	0	0	0	0	0	0
2000	6,348	6,343	0	0	0	0	0	0
2003	17,535	17,375	0	0	0	0	0	0

**Table 124a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1922	6,701	6,688	0	0	0	0	0	0
1928	8,826	<b>10,084</b>	0	<b>-28</b>	<b>-6</b>	<b>-22</b>	<b>-7</b>	<b>-7</b>
1940	6,159	<b>6,788</b>	0	0	0	0	<b>-2</b>	0
1951	6,043	<b>5,594</b>	0	10	0	<b>10</b>	0	<b>10</b>
1954	8,403	8,653	0	0	0	0	0	0
1957	11,138	11,125	0	0	0	0	0	0
1973	6,003	<b>6,972</b>	0	0	-1	0	-1	0
1978	7,159	7,176	1	0	0	0	0	0
1980	5,927	5,679	<b>2</b>	<b>24</b>	<b>4</b>	<b>17</b>	<b>3</b>	<b>9</b>
1993	8,969	8,952	0	0	0	0	0	0
2000	5,604	5,537	0	0	0	0	0	0
2003	23,646	23,646	0	0	0	0	0	0

**Table 124b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1922	6,701	6,695	0	0	0	0	0	0
1928	8,826	8,837	0	0	0	0	0	0
1940	6,159	6,414	0	0	0	0	<b>-2</b>	0
1951	6,043	<b>5,594</b>	0	<b>10</b>	0	<b>10</b>	0	<b>10</b>
1954	8,403	8,404	0	0	0	0	0	0
1957	11,138	11,133	0	0	0	0	0	0
1973	6,003	5,751	0	0	1	0	1	0
1978	7,159	7,170	1	0	0	0	0	0
1980	5,927	5,679	<b>1</b>	<b>6</b>	<b>2</b>	<b>6</b>	<b>2</b>	<b>3</b>
1993	8,969	8,950	0	0	0	0	0	0
2000	5,604	5,602	0	0	0	0	0	0
2003	23,646	23,646	0	0	0	0	0	0

**Table 125a.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1922	6,596	<b>6,095</b>	0	<b>17</b>	0	<b>17</b>	1	<b>17</b>
1928	8,866	<b>9,481</b>	0	<b>-3</b>	0	<b>-3</b>	<b>-3</b>	<b>-2</b>
1940	6,306	6,118	0	0	0	0	0	0
1951	8,393	8,533	0	0	0	0	<b>-2</b>	0
1954	6,652	<b>5,429</b>	0	<b>28</b>	0	<b>28</b>	<b>5</b>	<b>23</b>
1957	7,592	7,627	0	<b>23</b>	0	<b>23</b>	1	<b>23</b>
1973	9,051	<b>8,345</b>	0	<b>28</b>	1	<b>25</b>	<b>2</b>	<b>19</b>
1978	6,128	5,955	0	<b>26</b>	0	<b>26</b>	0	<b>26</b>
1980	5,588	5,470	0	<b>5</b>	1	<b>5</b>	0	0
1993	10,141	10,134	0	0	0	0	0	0
2000	10,888	<b>9,867</b>	0	<b>29</b>	1	<b>24</b>	<b>2</b>	<b>19</b>
2003	6,736	<b>6,315</b>	0	<b>26</b>	0	<b>26</b>	0	<b>26</b>

**Table 125b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Above Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1922	6,596	<b>6,098</b>	0	<b>16</b>	0	<b>16</b>	1	<b>16</b>
1928	8,866	<b>10,122</b>	0	<b>-29</b>	<b>-4</b>	<b>-27</b>	<b>-8</b>	<b>-14</b>
1940	6,306	6,289	0	0	0	0	0	0
1951	8,393	8,544	0	0	0	0	<b>-2</b>	0
1954	6,652	6,701	0	0	0	0	0	0
1957	7,592	7,592	0	0	0	0	0	0
1973	9,051	9,104	0	0	0	0	0	0
1978	6,128	5,954	0	0	0	0	0	0
1980	5,588	5,470	0	0	0	0	0	0
1993	10,141	10,132	0	0	0	0	0	0
2000	10,888	10,880	0	0	0	0	0	0
2003	6,736	<b>6,315</b>	0	<b>8</b>	0	<b>8</b>	0	<b>8</b>



**Table 126a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1923	8,412	8,414	0	0	0	0	0	0
1935	24,307	<b>22,922</b>	0	0	0	0	0	0
1936	6,914	6,923	0	0	0	0	0	0
1937	12,045	11,972	1	0	0	0	0	0
1945	6,719	6,858	0	0	-1	0	0	0
1946	7,856	7,850	0	0	0	0	0	0
1948	22,499	22,704	0	0	0	0	0	0
1950	10,655	<b>10,103</b>	0	0	0	0	0	0
1959	8,073	8,027	0	0	0	0	0	0
1962	6,273	6,280	0	0	0	0	0	0
1966	7,740	<b>9,309</b>	<b>-3</b>	<b>-17</b>	<b>-4</b>	<b>-4</b>	0	0
1968	6,378	<b>5,378</b>	<b>3</b>	<b>16</b>	0	<b>5</b>	1	<b>3</b>
1972	8,679	8,685	0	0	0	0	0	0
1979	8,325	8,318	0	0	0	0	0	0

**Table 126b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1923	8,412	8,409	0	0	0	0	0	0
1935	24,307	<b>22,931</b>	0	0	0	0	0	0
1936	6,914	6,909	0	0	0	0	0	0
1937	12,045	11,977	1	0	0	0	0	0
1945	6,719	6,837	0	0	-1	0	0	0
1946	7,856	7,849	0	0	0	0	0	0
1948	22,499	23,120	0	0	0	0	0	0
1950	10,655	10,760	0	0	0	0	0	0
1959	8,073	8,078	0	0	0	0	0	0
1962	6,273	6,274	0	0	0	0	0	0
1966	7,740	<b>8,674</b>	<b>-2</b>	<b>-16</b>	<b>-2</b>	<b>-4</b>	0	0
1968	6,378	6,379	0	0	0	0	0	0
1972	8,679	8,685	0	0	0	0	0	0
1979	8,325	8,322	0	0	0	0	0	0

**Table 127a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1923	6,278	6,116	0	0	1	0	0	0
1935	5,319	<b>4,881</b>	0	<b>21</b>	<b>4</b>	<b>19</b>	<b>2</b>	<b>12</b>
1936	5,274	5,292	0	0	0	0	0	0
1937	5,850	<b>5,516</b>	0	0	<b>2</b>	0	1	0
1945	6,322	6,181	1	0	0	0	0	0
1946	8,170	8,187	0	0	<b>5</b>	0	0	0
1948	17,209	17,210	0	0	0	0	0	0
1950	6,343	6,187	0	0	0	0	<b>5</b>	0
1959	6,907	6,931	0	<b>11</b>	1	<b>11</b>	<b>3</b>	<b>4</b>
1962	6,843	6,955	0	0	0	0	1	0
1966	7,584	7,760	0	<b>3</b>	<b>3</b>	<b>5</b>	<b>5</b>	<b>2</b>
1968	5,908	5,775	0	<b>22</b>	<b>2</b>	<b>22</b>	<b>5</b>	<b>17</b>
1972	6,158	6,080	0	<b>20</b>	<b>3</b>	<b>17</b>	<b>3</b>	<b>11</b>
1979	6,373	<b>5,940</b>	0	<b>11</b>	<b>0</b>	<b>11</b>	<b>2</b>	<b>11</b>

**Table 127b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Below Normal water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1923	6,278	6,116	0	0	1	0	0	0
1935	5,319	<b>4,731</b>	0	<b>20</b>	<b>3</b>	<b>20</b>	1	<b>11</b>
1936	5,274	5,271	0	0	0	0	0	0
1937	5,850	<b>5,516</b>	0	0	<b>2</b>	0	1	0
1945	6,322	6,325	0	0	0	0	0	0
1946	8,170	8,166	0	0	0	0	0	0
1948	17,209	17,202	0	0	0	0	0	0
1950	6,343	6,204	0	0	0	0	1	0
1959	6,907	6,866	0	0	0	0	0	0
1962	6,843	6,843	0	0	-1	0	0	0
1966	7,584	7,517	0	-1	0	0	<b>2</b>	0
1968	5,908	5,808	0	0	1	0	1	0
1972	6,158	6,080	0	0	0	0	0	0
1979	6,373	<b>5,940</b>	0	<b>6</b>	0	<b>6</b>	<b>2</b>	<b>6</b>

**Table 125.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Below Normal water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1923	5,855	5,760	0	0	0	0	0	0
1935	5,048	4,965	0	<b>25</b>	0	<b>25</b>	0	<b>25</b>
1936	5,181	<b>4,898</b>	0	0	1	0	1	0
1937	6,624	6,931	0	0	0	0	0	0
1945	7,949	8,082	0	0	0	0	0	0
1946	6,664	6,884	0	0	0	0	<b>-2</b>	0
1948	6,992	7,005	0	0	0	0	0	0
1950	5,235	5,094	0	0	0	0	0	0
1959	8,284	<b>7,683</b>	0	<b>30</b>	0	<b>30</b>	<b>9</b>	<b>29</b>
1962	5,826	5,705	0	0	0	0	1	0
1966	8,782	9,156	0	0	1	0	0	0
1968	8,710	8,747	0	<b>16</b>	<b>2</b>	<b>15</b>	<b>2</b>	<b>14</b>
1972	10,902	<b>10,354</b>	0	<b>30</b>	<b>6</b>	<b>28</b>	<b>4</b>	<b>7</b>
1979	7,976	8,141	0	1	-1	1	-1	1

**Table 128b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Below Normal water year types. Changes in flow >5% are bolded in red (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1923	5,855	5,760	0	0	0	0	0	0
1935	5,048	4,810	0	1	0	1	0	1
1936	5,181	<b>4,899</b>	0	0	1	0	1	0
1937	6,624	6,751	0	0	0	0	0	0
1945	7,949	7,947	0	0	0	0	0	0
1946	6,664	6,669	0	0	0	0	0	0
1948	6,992	7,046	0	0	0	0	0	0
1950	5,235	5,090	0	0	0	0	0	0
1959	8,284	8,297	0	0	0	0	0	0
1962	5,826	5,703	0	0	0	0	1	0
1966	8,782	9,115	0	0	0	0	-1	0
1968	8,710	8,706	0	0	0	0	0	0
1972	10,902	10,911	0	0	0	0	0	0
1979	7,976	8,139	0	0	-1	0	-1	0

**Table 129a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1925	13,091	13,074	0	0	0	0	0	0
1926	9,028	9,006	0	0	0	0	0	0
1930	5,050	5,045	0	<b>5</b>	<b>2</b>	<b>3</b>	0	0
1932	5,101	5,101	0	0	0	0	0	0
1939	9,592	9,817	0	0	0	0	0	0
1944	5,703	<b>5,208</b>	<b>4</b>	<b>5</b>	0	0	0	0
1947	6,779	6,766	0	0	0	0	0	0
1949	6,610	6,642	0	0	0	0	0	0
1955	5,994	5,950	0	0	0	0	0	0
1960	10,254	9,975	0	0	0	0	0	0
1961	8,212	<b>7,348</b>	<b>4</b>	<b>13</b>	0	0	0	0
1964	6,604	6,620	<b>3</b>	0	0	0	0	0
1981	7,955	7,930	0	0	0	0	0	0
1985	5,583	5,410	0	0	0	0	0	0
1987	9,098	9,338	0	0	0	0	0	0
1989	9,147	9,157	0	0	0	0	0	0
2001	5,361	5,321	0	0	0	0	0	0
2002	5,636	5,606	0	0	0	0	0	0

**Table 129b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Dry water year types. Changes in days >5% are bolded in green (decrease).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1925	13,091	13,078	0	0	0	0	0	0
1926	9,028	9,006	0	0	0	0	0	0
1930	5,050	5,054	0	0	0	0	0	0
1932	5,101	5,101	0	0	0	0	0	0
1939	9,592	9,817	<b>-2</b>	0	0	0	0	0
1944	5,703	5,750	0	0	0	0	0	0
1947	6,779	6,775	0	0	0	0	0	0
1949	6,610	6,637	0	0	0	0	0	0
1955	5,994	5,967	0	0	0	0	0	0
1960	10,254	10,578	0	0	0	0	0	0
1961	8,212	8,092	0	0	0	0	0	0
1964	6,604	6,605	0	0	0	0	0	0
1981	7,955	7,944	0	0	0	0	0	0
1985	5,583	5,376	0	0	0	0	0	0
1987	9,098	9,325	0	0	0	0	0	0
1989	9,147	9,172	0	0	0	0	0	0
2001	5,361	5,370	0	0	0	0	0	0
2002	5,636	5,598	0	0	0	0	0	0

**Table 130a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1925	5,586	5,629	0	0	0	0	1	0
1926	8,208	7,805	0	0	1	0	<b>2</b>	0
1930	4,601	<b>4,339</b>	0	<b>31</b>	<b>8</b>	<b>31</b>	1	<b>14</b>
1932	4,848	<b>4,555</b>	0	0	0	0	1	0
1939	7,675	<b>7,035</b>	0	<b>25</b>	<b>5</b>	<b>15</b>	1	<b>4</b>
1944	5,566	<b>5,870</b>	1	<b>24</b>	<b>3</b>	<b>19</b>	<b>3</b>	<b>13</b>
1947	6,441	6,354	0	<b>-2</b>	0	<b>-2</b>	-1	-1
1949	7,247	7,257	0	0	0	0	1	0
1955	6,746	6,924	0	0	0	0	-1	0
1960	5,064	5,097	1	0	0	0	0	0
1961	7,328	7,447	0	0	0	0	0	0
1964	6,379	6,643	0	0	1	0	1	0
1981	5,985	6,003	0	<b>15</b>	<b>2</b>	<b>15</b>	<b>2</b>	<b>11</b>
1985	6,909	7,046	0	1	<b>2</b>	1	<b>3</b>	1
1987	6,692	<b>6,215</b>	0	<b>2</b>	<b>2</b>	1	0	1
1989	9,399	9,309	1	1	<b>3</b>	0	1	0
2001	5,998	<b>6,310</b>	0	<b>-6</b>	0	<b>-6</b>	0	<b>-6</b>
2002	5,982	5,851	0	0	<b>2</b>	0	1	0

**Table130b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1925	5,586	5,630	0	0	0	0	0	0
1926	8,208	8,203	0	0	0	0	0	0
1930	4,601	<b>4,340</b>	0	0	0	0	0	0
1932	4,848	<b>4,556</b>	0	0	0	0	1	0
1939	7,675	7,677	0	<b>3</b>	0	<b>3</b>	0	1
1944	5,566	5,563	0	0	1	0	0	0
1947	6,441	6,449	0	<b>3</b>	0	<b>3</b>	0	<b>3</b>
1949	7,247	7,243	0	0	0	0	0	0
1955	6,746	6,815	0	0	0	0	0	0
1960	5,064	4,986	0	0	0	0	0	0
1961	7,328	7,468	0	0	0	0	0	0
1964	6,379	6,379	0	0	0	0	0	0
1981	5,985	5,964	0	0	0	0	0	0
1985	6,909	6,913	0	0	0	0	1	0
1987	6,692	6,695	0	0	-1	0	0	0
1989	9,399	9,472	-1	0	0	0	0	0
2001	5,998	6,066	0	0	0	0	0	0
2002	5,982	5,854	0	0	1	0	1	0

**Tabl 131a.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1925	6,770	6,910	0	0	0	0	0	0
1926	6,845	7,057	0	<b>2</b>	0	<b>2</b>	1	<b>2</b>
1930	5,045	4,959	0	<b>10</b>	0	<b>10</b>	0	<b>10</b>
1932	5,285	<b>4,958</b>	0	1	0	1	<b>2</b>	1
1939	8,354	8,612	0	<b>10</b>	1	<b>8</b>	1	<b>5</b>
1944	6,816	7,022	0	<b>9</b>	1	<b>6</b>	1	<b>4</b>
1947	8,577	8,725	0	0	-1	0	-1	0
1949	6,228	6,349	0	0	0	0	0	0
1955	8,822	9,127	0	0	0	0	<b>-3</b>	0
1960	9,379	9,462	0	0	0	0	1	0
1961	9,072	9,201	0	0	0	0	0	0
1964	7,671	7,783	0	<b>8</b>	-1	<b>8</b>	1	<b>8</b>
1981	8,879	8,886	0	<b>3</b>	0	<b>3</b>	<b>3</b>	<b>2</b>
1985	8,176	8,347	0	<b>5</b>	0	<b>5</b>	1	<b>5</b>
1987	8,632	8,737	0	<b>4</b>	0	<b>4</b>	<b>4</b>	<b>4</b>
1989	6,272	6,372	0	0	0	0	0	0
2001	7,901	<b>8,401</b>	0	<b>-30</b>	<b>-4</b>	<b>-29</b>	<b>-6</b>	<b>-17</b>
2002	7,697	7,743	0	0	0	0	1	0



**Table 131b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1925	6,770	6,859	0	0	0	0	0	0
1926	6,845	6,867	0	0	0	0	0	0
1930	5,045	5,021	0	0	0	0	0	0
1932	5,285	5,284	0	0	0	0	<b>2</b>	0
1939	8,354	8,516	0	0	-1	0	<b>-2</b>	0
1944	6,816	6,833	0	0	0	0	0	0
1947	8,577	8,712	0	0	-1	0	-1	0
1949	6,228	6,224	0	0	0	0	0	0
1955	8,822	8,907	0	0	0	0	0	0
1960	9,379	9,469	0	0	0	0	-1	0
1961	9,072	9,226	0	0	0	0	0	0
1964	7,671	7,764	0	0	-1	0	0	0
1981	8,879	8,879	0	0	0	0	1	0
1985	8,176	8,337	0	0	0	0	0	0
1987	8,632	8,737	0	0	0	0	-1	0
1989	6,272	6,262	0	0	0	0	0	0
2001	7,901	8,115	0	0	-1	0	0	0
2002	7,697	7,768	0	0	0	0	0	0

**Table 132a.** April flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease) and green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1924	4,660	<b>3,696</b>	<b>2</b>	<b>21</b>	<b>7</b>	<b>13</b>	0	0
1929	6,173	<b>5,185</b>	<b>3</b>	<b>11</b>	1	1	0	0
1931	5,362	<b>5,970</b>	<b>-2</b>	<b>-25</b>	<b>-2</b>	<b>-8</b>	0	<b>-3</b>
1933	5,801	5,786	-1	0	0	0	0	0
1934	4,865	4,864	0	0	0	0	<b>-2</b>	0
1976	5,789	5,779	0	0	0	0	0	0
1977	7,027	<b>6,065</b>	<b>3</b>	<b>20</b>	<b>3</b>	<b>3</b>	0	0
1988	4,530	4,499	0	0	0	0	0	0
1990	4,861	4,925	0	0	0	0	0	0
1991	8,244	8,268	0	0	0	0	0	0
1992	7,048	7,036	0	0	0	0	0	0
1994	4,447	4,463	0	0	0	0	0	0

**Table 132b.** April flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchanges Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in green (decrease). Changes in flow >5% are bolded in green (increase).

Water Year	April Average Flows (cfs) under NAA	April Average Flows (cfs) under NoSha	Change in Days >60°F under NoSha	Days >60°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1924	4,660	4,658	0	0	0	0	0	0
1929	6,173	6,173	0	0	0	0	0	0
1931	5,362	<b>5,924</b>	-1	<b>-20</b>	<b>-2</b>	<b>-8</b>	0	<b>-3</b>
1933	5,801	5,786	-1	0	0	0	0	0
1934	4,865	4,863	0	0	0	0	0	0
1976	5,789	5,779	0	0	0	0	0	0
1977	7,027	7,022	0	0	0	0	0	0
1988	4,530	4,514	0	0	0	0	0	0
1990	4,861	5,094	0	0	0	0	-1	0
1991	8,244	8,268	0	0	0	0	0	0
1992	7,048	7,041	0	0	0	0	0	0
1994	4,447	4,459	0	0	0	0	0	0

**Table 133a.** May flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1924	4,972	4,952	0	<b>4</b>	1	<b>2</b>	<b>-2</b>	0
1929	7,233	<b>6,286</b>	0	<b>31</b>	<b>7</b>	<b>26</b>	<b>3</b>	<b>3</b>
1931	4,741	4,725	0	<b>-2</b>	0	-1	0	0
1933	7,440	7,507	<b>-3</b>	0	-1	0	0	0
1934	6,922	6,928	0	<b>-2</b>	<b>-2</b>	<b>-2</b>	0	0
1976	6,430	<b>5,634</b>	0	<b>27</b>	<b>2</b>	<b>27</b>	1	<b>21</b>
1977	5,137	<b>4,656</b>	0	0	1	0	<b>2</b>	0
1988	6,748	<b>5,846</b>	<b>3</b>	<b>28</b>	<b>4</b>	<b>20</b>	<b>3</b>	<b>12</b>
1990	7,043	7,035	0	0	0	0	0	0
1991	4,676	4,650	0	0	1	0	0	0
1992	6,600	<b>5,721</b>	0	<b>29</b>	0	<b>29</b>	0	<b>29</b>
1994	4,765	4,594	0	0	0	0	0	0

**Table 133b.** May flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Critically Dry water year types.

Water Year	May Average Flows (cfs) under NAA	May Average Flows (cfs) under NoSha	Change in Days >62.6°F under NoSha	Days >62.6°F AND >0.5°F change under NoSha	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1924	4,972	4,984	0	0	0	0	0	0
1929	7,233	7,232	0	0	0	0	0	0
1931	4,741	4,723	0	0	0	0	0	0
1933	7,440	7,516	-1	0	0	0	0	0
1934	6,922	6,929	0	0	0	0	0	0
1976	6,430	6,420	0	0	0	0	0	0
1977	5,137	5,133	-1	0	0	0	-2	0
1988	6,748	6,748	0	0	0	0	0	0
1990	7,043	7,027	0	0	0	0	0	0
1991	4,676	4,649	0	0	0	0	0	0
1992	6,600	6,619	0	0	0	0	0	0
1994	4,765	4,594	0	0	0	0	0	0

**Table 134a.** June flow (cfs) and temperature (°F) exceedances at Tisdale under Project Alternative 3B (Alt3B) for Critically Dry water year types. Changes in days >5% are bolded in red (increase). Changes in flow >5% are bolded in red (decrease).

Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under Alt3B	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under Alt3B	Days >66°F AND >0.5°F change under Alt3B	Change in Days >68°F under Alt3B	Days >68°F AND >0.5°F change under Alt3B
1924	5,368	5,432	0	0	0	0	0	0
1929	6,190	6,132	0	<b>6</b>	0	<b>6</b>	<b>2</b>	<b>6</b>
1931	4,860	4,763	0	0	0	0	0	0
1933	5,706	5,722	0	0	0	0	0	0
1934	6,672	6,671	0	<b>2</b>	-1	<b>2</b>	0	<b>2</b>
1976	7,598	7,303	0	<b>30</b>	0	<b>30</b>	1	<b>19</b>
1977	8,311	<b>7,182</b>	0	<b>29</b>	0	<b>29</b>	<b>10</b>	<b>28</b>
1988	7,930	<b>6,918</b>	0	<b>28</b>	1	<b>24</b>	1	<b>21</b>
1990	7,989	7,876	0	0	0	0	0	0
1991	4,885	4,793	0	0	0	0	0	0
1992	6,293	<b>5,851</b>	0	<b>12</b>	0	<b>12</b>	0	<b>12</b>
1994	7,342	7,336	0	<b>4</b>	0	<b>4</b>	<b>2</b>	<b>4</b>

**Table 134b.** June flow (cfs) and temperature (°F) exceedances at Tisdale under the No Shasta Exchange Alternative (NoSha) for Critically Dry water year types. Changes in days >5% are bolded in red (increase) and green (decrease). Changes in flow >5% are bolded in red (decrease).

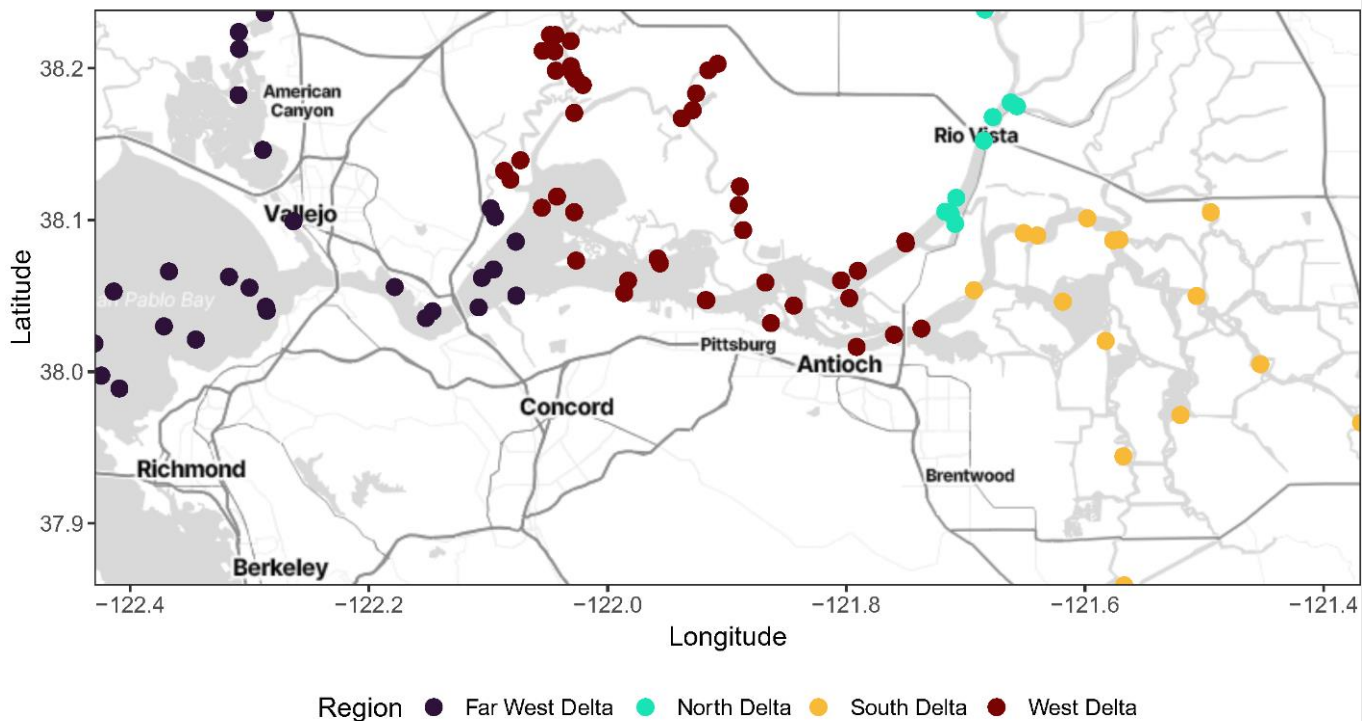
Water Year	June Average Flows (cfs) under NAA	June Average Flows (cfs) under NoSha	Change in Days >62.6°F under Alt3B	Days >62.6°F AND >0.5°F change under Alt3B	Change in Days >66°F under NoSha	Days >66°F AND >0.5°F change under NoSha	Change in Days >68°F under NoSha	Days >68°F AND >0.5°F change under NoSha
1924	5,368	5,396	0	0	0	0	0	0
1929	6,190	6,352	0	0	0	0	<b>-2</b>	0
1931	4,860	4,780	0	0	0	0	0	0
1933	5,706	5,721	0	0	0	0	0	0
1934	6,672	6,672	0	0	-1	0	0	0
1976	7,598	7,694	0	0	0	0	-1	0
1977	8,311	<b>7,788</b>	0	<b>5</b>	0	<b>5</b>	<b>4</b>	<b>5</b>
1988	7,930	7,950	0	0	0	0	0	0
1990	7,989	7,974	0	0	0	0	-1	0
1991	4,885	4,793	0	0	0	0	0	0
1992	6,293	6,307	0	0	0	0	0	0
1994	7,342	7,346	0	0	0	0	0	0

# Sites Reservoir Project Operations – Appendix C

## Delta Outflow and White Sturgeon Abundance

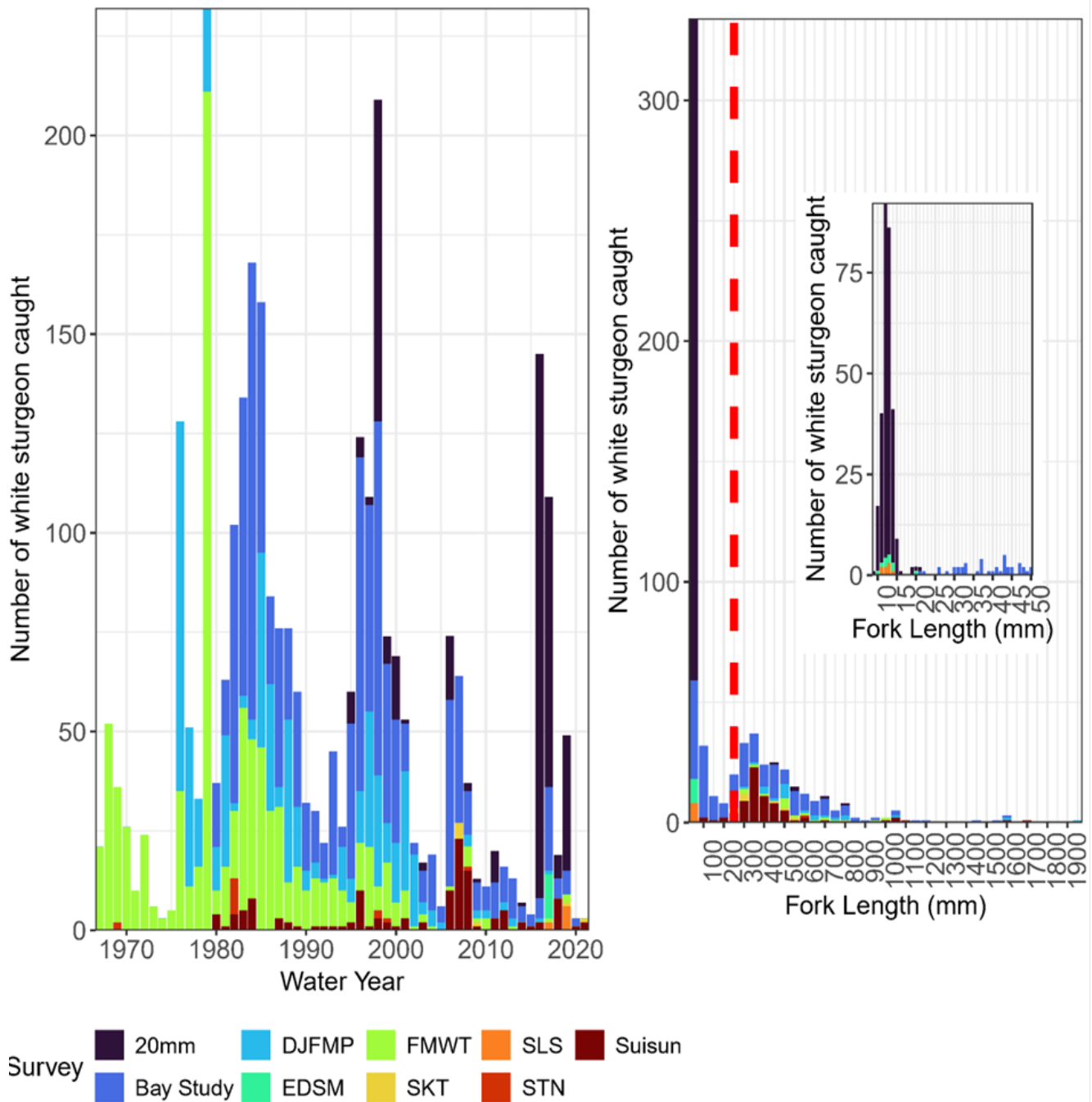
### Model Development

CDFW calculated catch per unit effort (CPUE) of young-of-year (YOY) White Sturgeon (WS) using historical catch and effort data collected by long-term juvenile fish monitoring surveys in the San Francisco Bay-Delta region (Hayman et al. 1980). When aggregated spatially across the Bay-Delta and temporally within a year, these CPUE data can be used to calculate a WS year class strength (YCS), or juvenile WS recruitment index. CDFW compiled the data of YOY WS<sup>1</sup> from the 20-mm Survey and San Francisco Bay Study Midwater Trawl and Otter Trawl survey collected by the Interagency Ecological Program between water years 2003 and 2023 (Gaeta et al. 2021), which have consistently caught YOY WS since the early 2000s (Baxter et al. 2008). Each station in the surveys is labeled with a region, depending on its relative position within the Delta: Far West Delta, West Delta, Central Delta, and South Delta (Figure 1, Figure 2).



**Figure 1.** Location of the survey stations of 20-mm Survey and Bay Study surveys within the San Francisco Estuary separated by region. The color of each dot represents the region where the station is located.

<sup>1</sup> Based on the von Bertalanffy growth curve (Blackburn et al 2019), YOY are defined as any White Sturgeon with a FL < 234mm.



**Figure 2.** Left: Total number of White Sturgeon caught by water year and survey. Right: Distribution of fork lengths of White Sturgeon caught from water year 2003 to water year 2021. The red dashed line represents the fork length of 234 mm, which corresponds to our threshold fork length to determine a young-of-year White Sturgeon based on the von Bertalanffy growth curve provided by Blackburn et al. (2019). Survey abbreviations correspond to: DJFMP (Delta Juvenile Fish Monitoring Program), FMWT (Fall Midwater Trawl), SLS (Smelt Larva Survey), EDSM (Enhanced Delta Smelt Monitoring), SKT (Spring Kodiak Trawl), and STN (Summer Towntnet Survey).

CDFW calculated CPUE using the reported volume in m<sup>3</sup> of water in each survey tow. For Bay Study Otter Trawl, the tow area (m<sup>2</sup>) is reported. To obtain the total volume of water towed, the tow area of Bay Study Otter Trawl is multiplied by the height of the otter net of 2.31 m (Gaeta et al. 2021). To quantify CPUE, we add the catch of YOYs within a region and month and divide that number by the sum of the towed volumes of each survey within that region in that month:

**Equation 1.**

$$CPUE_{region,month} = \frac{catch_{20mm,region,month} + catch_{BayMWT,region,month} + catch_{BayOT,region,month}}{volume_{20mm,region,month} + volume_{BayMWT,region,month} + volume_{BayOT,region,month}}$$

CDFW quantified the relationship between CPUE and hydrological covariates using Generalized Linear Mixed Models (GLMMs). GLMMs are flexible statistical models that account for nonnormal distributions in a response variable while also accounting for the impacts of possible random effects (Bolker et al. 2009). We constructed models where  $CPUE_{region,month}$  is the response variable, modeled separately as a function of two hydrological covariates: daily X2 (the 2 ppt isohaline in km from the Golden Gate Bridge) and daily mean Delta outflow (OUT) obtained from Dayflow (DWR 2024). Separate models for X2 and OUT were necessary, as X2 and OUT are highly correlated and could not both be included in the same model.

CPUE is usually assumed to follow a lognormal distribution (Hoyle et al. 2024). However, WS catches in these surveys are rare, which leads to a distribution with a high count of 0s that violates the assumption of a lognormal distribution. To overcome this, we assume the CPUE follows a hurdle-lognormal distribution instead (Santos et al. 2021). Distributions with hurdles assume that the probability of an observation being zero is a value called the hurdle and denoted by  $\eta$ . For nonzero values of  $x$ , the probability of an observation being  $x$  follows some distribution (lognormal in our case) truncated at zero.

CDFW modeled both the nonzero CPUE and the hurdle using a similar structure of covariates. Months are grouped into four seasons: Spring (March-May), Summer (June-August), Fall (September-November), and Winter (December-February). For each month, the season and the mean hydrological covariate were included as predictors. In addition, we incorporate the region ( $z_{region}$ ) and the survey ( $z_{survey}$ ), as well as the brood year ( $z_{BY}$ ) starting in the month of February as random effects possibly affecting year class strength due to unexplained processes.

In equation form, our model using X2 as the hydrological covariate follows the equation:

**Equation 2.**

$$\log(CPUE_{region,month}) \sim \beta_{CPUE,0} + \beta_{CPUE,X2}X2 + \beta_{CPUE,season} + z_{CPUE,BY} + z_{CPUE,region} + z_{CPUE,survey},$$

$$\text{logit}(\eta_{region,month}) \sim \beta_{\eta,0} + \beta_{\eta,X2}X2 + \beta_{\eta,season} + z_{\eta,BY} + z_{\eta,region} + z_{\eta,survey},$$

$$z_{i,j} \sim \text{Normal}(0, \sigma_{i,j})$$

For  $i = CPUE, \eta$  and  $j = BY, Region, Survey$ . We use a similar equation for the model using outflow as the hydrological covariate:

**Equation 3.**

$$\log(CPUE_{region,month}) \sim \beta_{CPUE,0} + \beta_{CPUE,OUT}OUT + \beta_{CPUE,season} + z_{CPUE,BY} + z_{CPUE,region} + z_{CPUE,survey},$$

$$\text{logit}(\eta_{region,month}) \sim \beta_{\eta,0} + \beta_{\eta,OUT}OUT + \beta_{\eta,season} + z_{\eta,BY} + z_{\eta,region} + z_{\eta,survey},$$

$$z_{i,j} \sim \text{Normal}(0, \sigma_{i,j})$$

CDFW fit the models presented in this section using Bayesian regression with the *brms* package version 2.20.4 in R version 4.3.3 (Burkner et al. 2017). Bayesian modeling is a powerful method to quantify different sources of uncertainty in the relationships between a response variable and its possible covariates. We determined the best model using Leave-One-Out cross validation (LOO) (Vehtari et al. 2016). LOO is a method to evaluate the performance of a Bayesian model by measuring the likelihood of a data point given that the Bayesian model was trained with the rest of the data. The two models, one using X2 as the covariate and the other using OUT, were statistically equivalent, based on their log-likelihoods and the high standard error relative to the mean difference (Table 1).

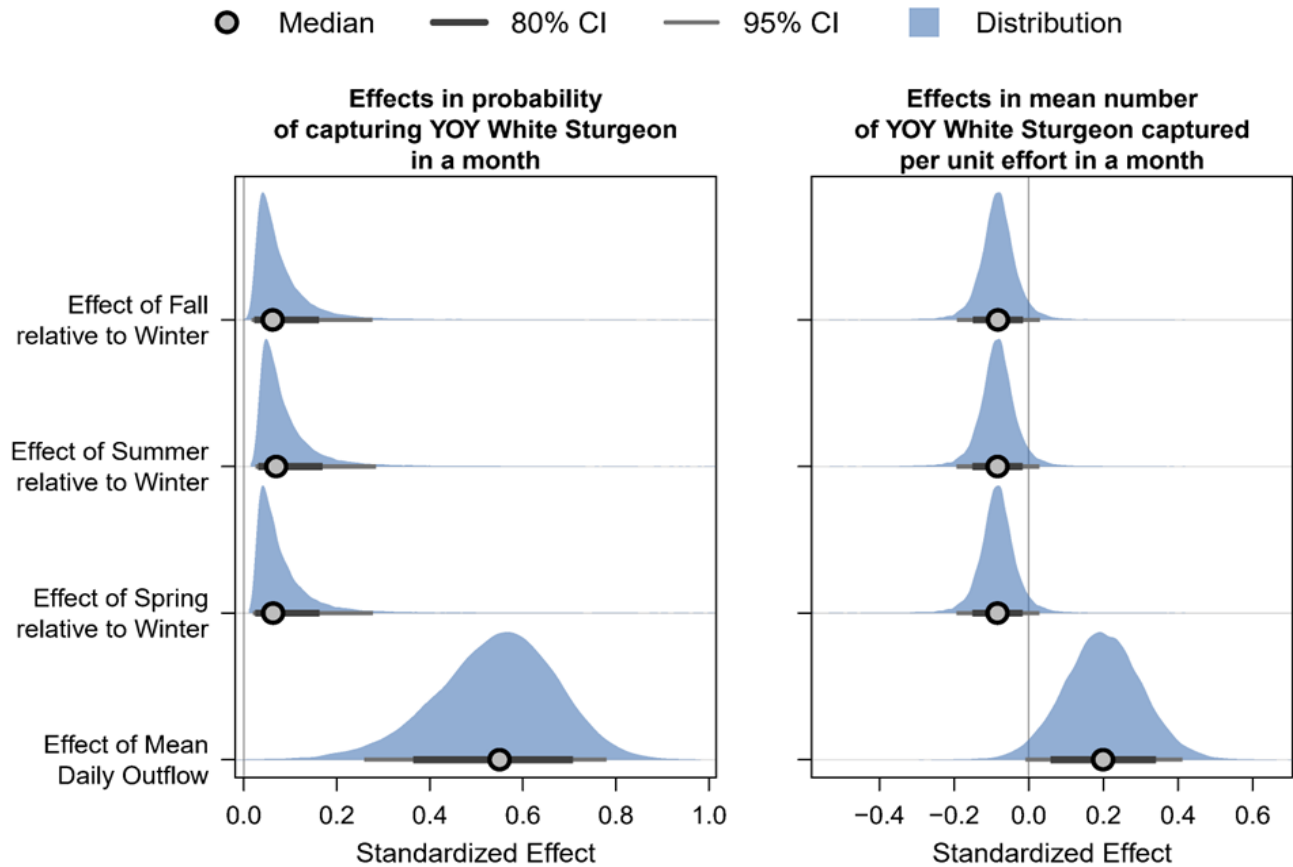
**Table 1.** Expected log-likelihood of models of year class strength dependent on different hydrological covariates estimated using the Leave-One-Out cross validation method. Included are the expected difference of log-likelihoods between a given model and the model with the highest log-likelihood, as well as its standard error.

Hydrological Covariate	Expected Log-Likelihood	Expected difference with highest likelihood model	SE of difference
Mean Monthly X2	309.03	NA	NA
Mean Monthly Outflow	307.58	1.45	3.19

CDFW normalized the posterior distributions of the best fit model to assess the effect size of each covariate in predicting their corresponding response. Distributions were normalized by dividing each of their parameter values by the difference between the maximum and the minimum parameter values sampled during the fitting process. A distribution that has an effect size further away from zero would imply that the covariate has a stronger effect (either positive or negative) on the response. On the other hand, a covariate with a posterior distribution that intersects zero at a point with higher density would have almost no impact in predicting the response. Because this model predicts the effects of the covariate on YOY WS catch probability and CPUE, and because the model includes spatial (*region*) and intra-annual, temporal (*survey* and *season*) random effects, model predictions can be considered to represent YCS, and the effects presented can be considered effects on YCS.

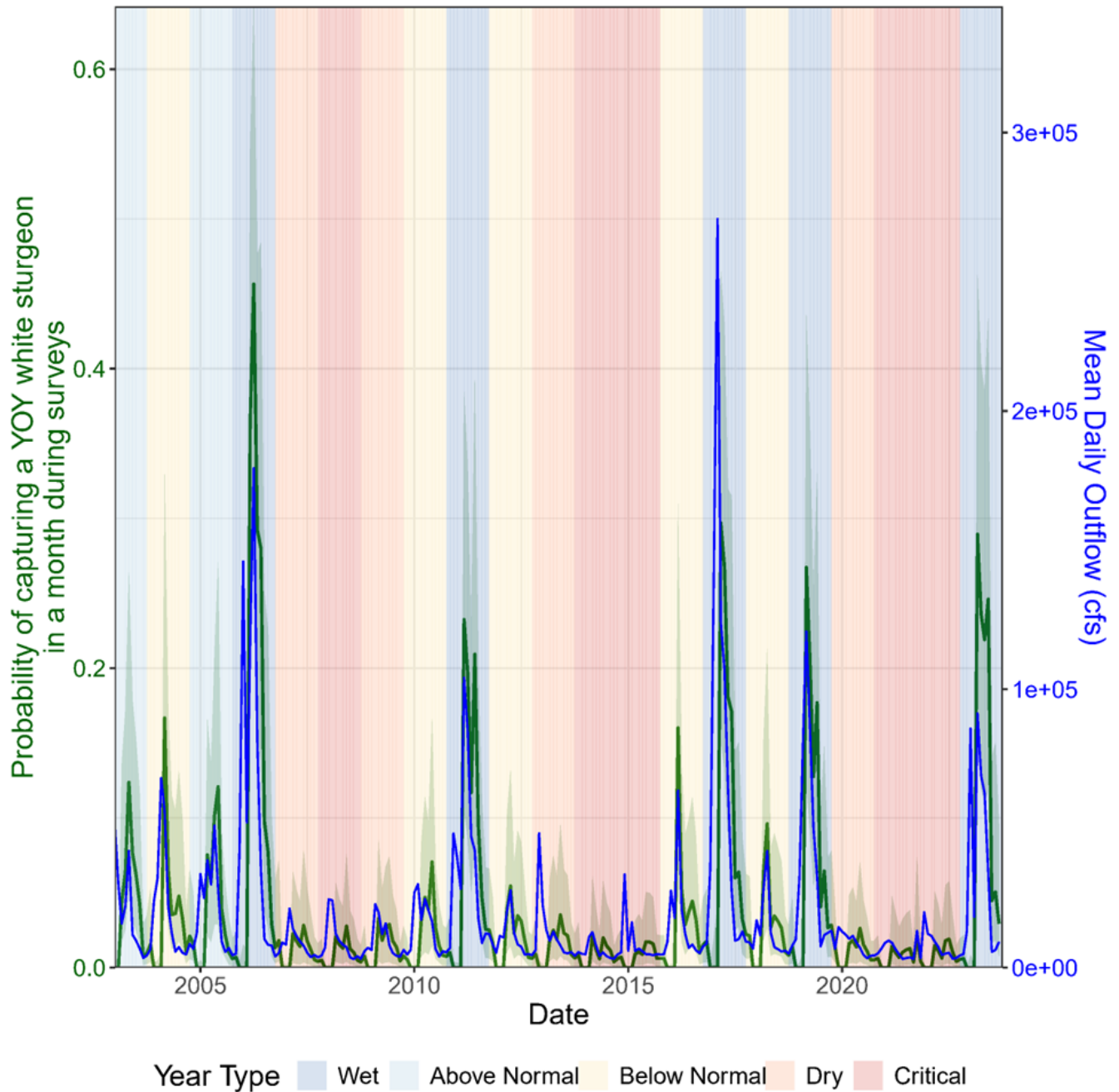


The effect size of the model that uses mean outflow as its hydrological covariate shows that the probability of catching a YOY WS is strongly associated with mean outflow, and that fall, summer and spring have a larger effect on catch probability than winter (Figure 3). Outflow has a larger effect on mean YOY WS CPUE than any season. Based on effect sizes, YOY WS are more likely to be caught in surveys during spring, summer and fall, and the number of YOY WS caught per volume of water towed is higher during months with a higher mean outflow (winter).



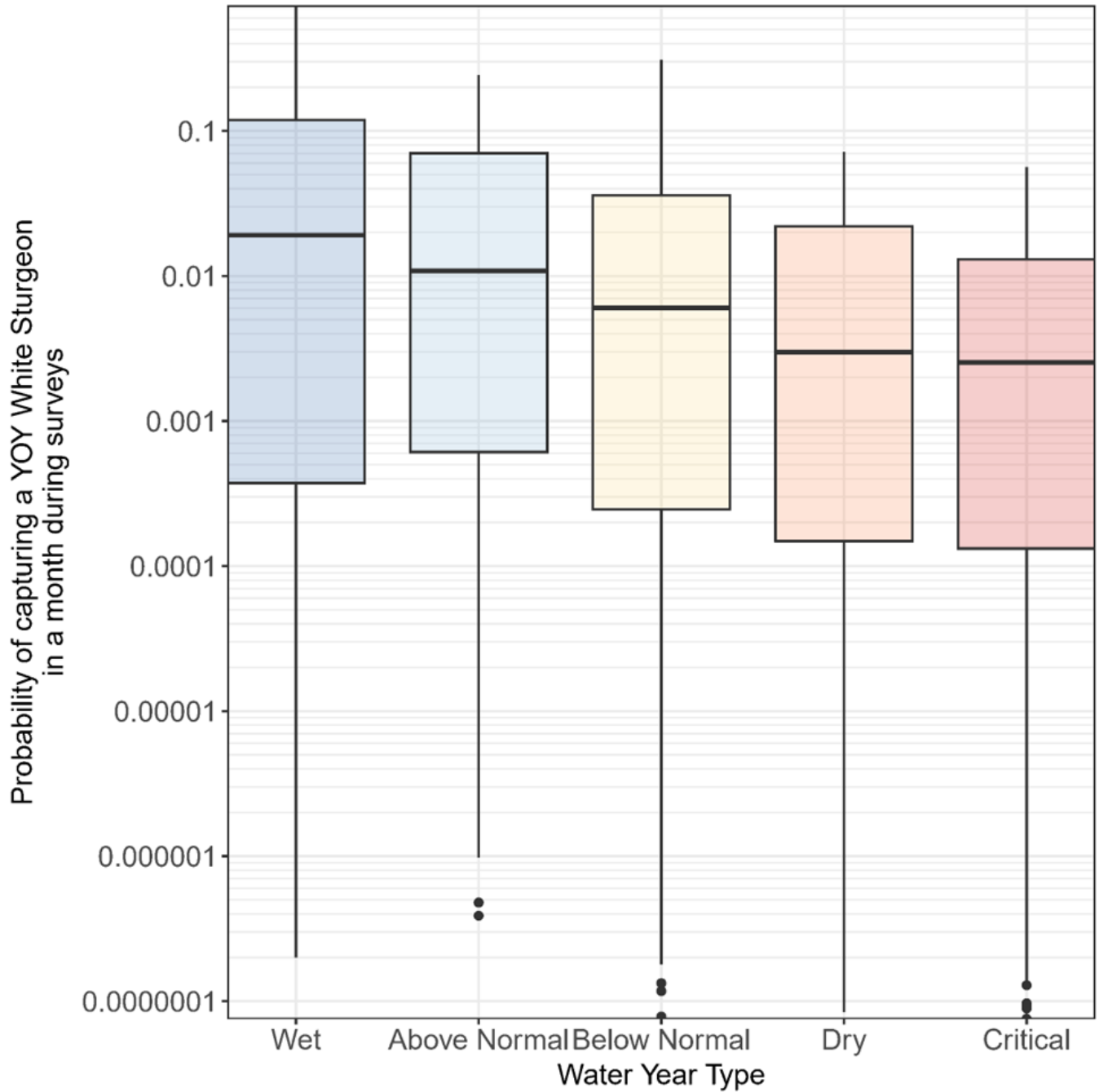
**Figure 3.** Effect size posterior distributions of the parameters of the model for the year class strength of White Sturgeon as a function of mean outflow. The vertical line corresponds to an effect size of 0; therefore, there is no effect of the variable. The effect size of seasons uses winter as the reference level, which means the effect size of a given month is relative to winter.

Based on the outflow model, we observe a higher probability of catching YOY WS in surveys occurring during high outflows (Figure 4). These events occur especially during wetter water years. We observed an increasing trend in catch probability as water years become wetter (Figure 5).

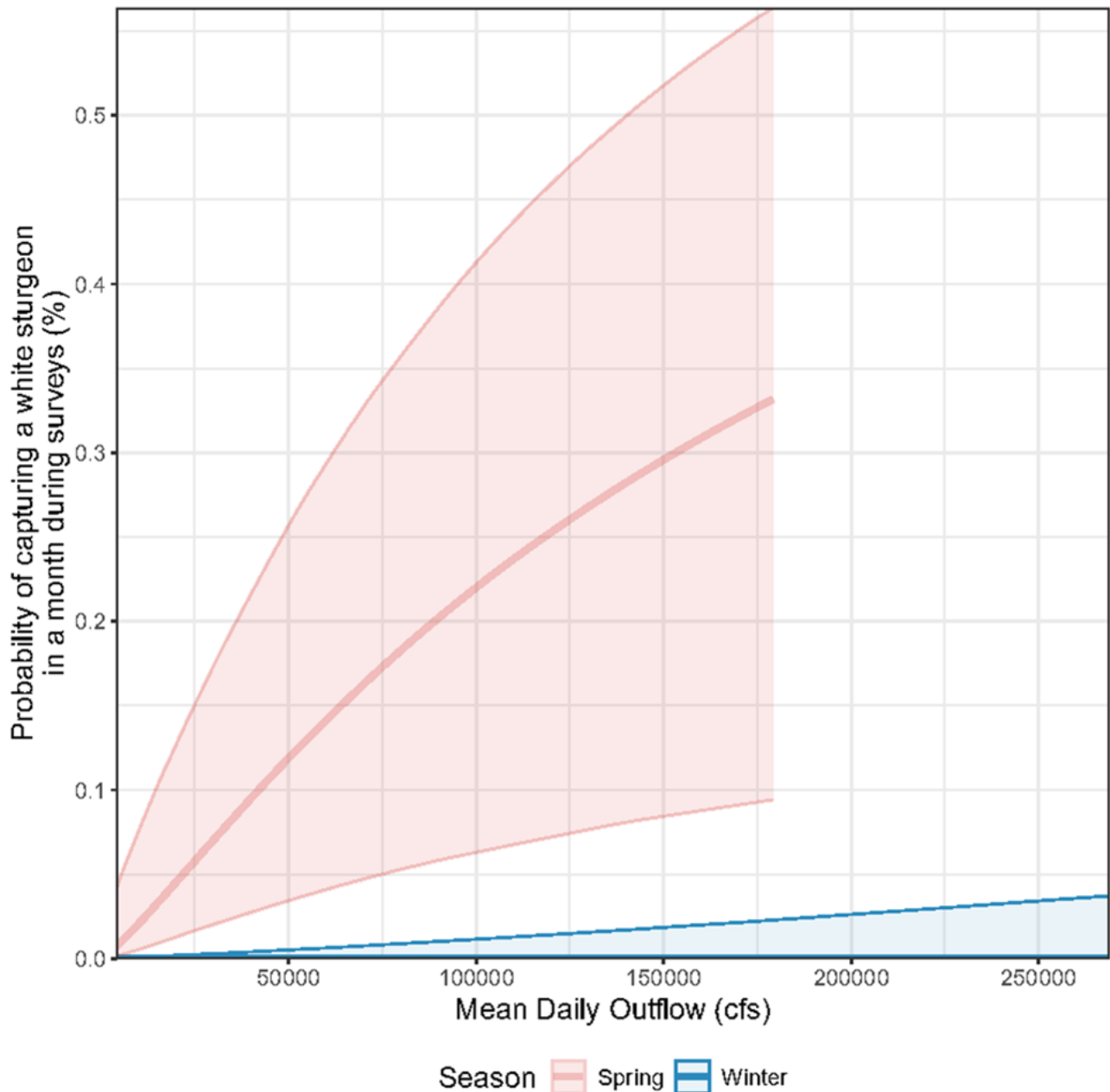


**Figure 4.** Green: predicted probability of catching a young-of-year White Sturgeon during monthly surveys during water years 2003-2023. Model uses mean monthly outflow as its hydrological covariate. Green shading indicates 95% confidence intervals. Blue: mean monthly outflow during water years 2003-2023. The background color of each water year corresponds to the water year type based on the Sacramento Valley Index.

Mean YOY WS catch probability increased with increasing mean daily outflow when mean daily outflow was allowed to vary over its observed historical range (Figure 6). However, the uncertainty in catch probability also increases with increasing outflow, which can be a result of higher outflow occurring during wetter water years (when the probability of capturing a YOY WS increases).



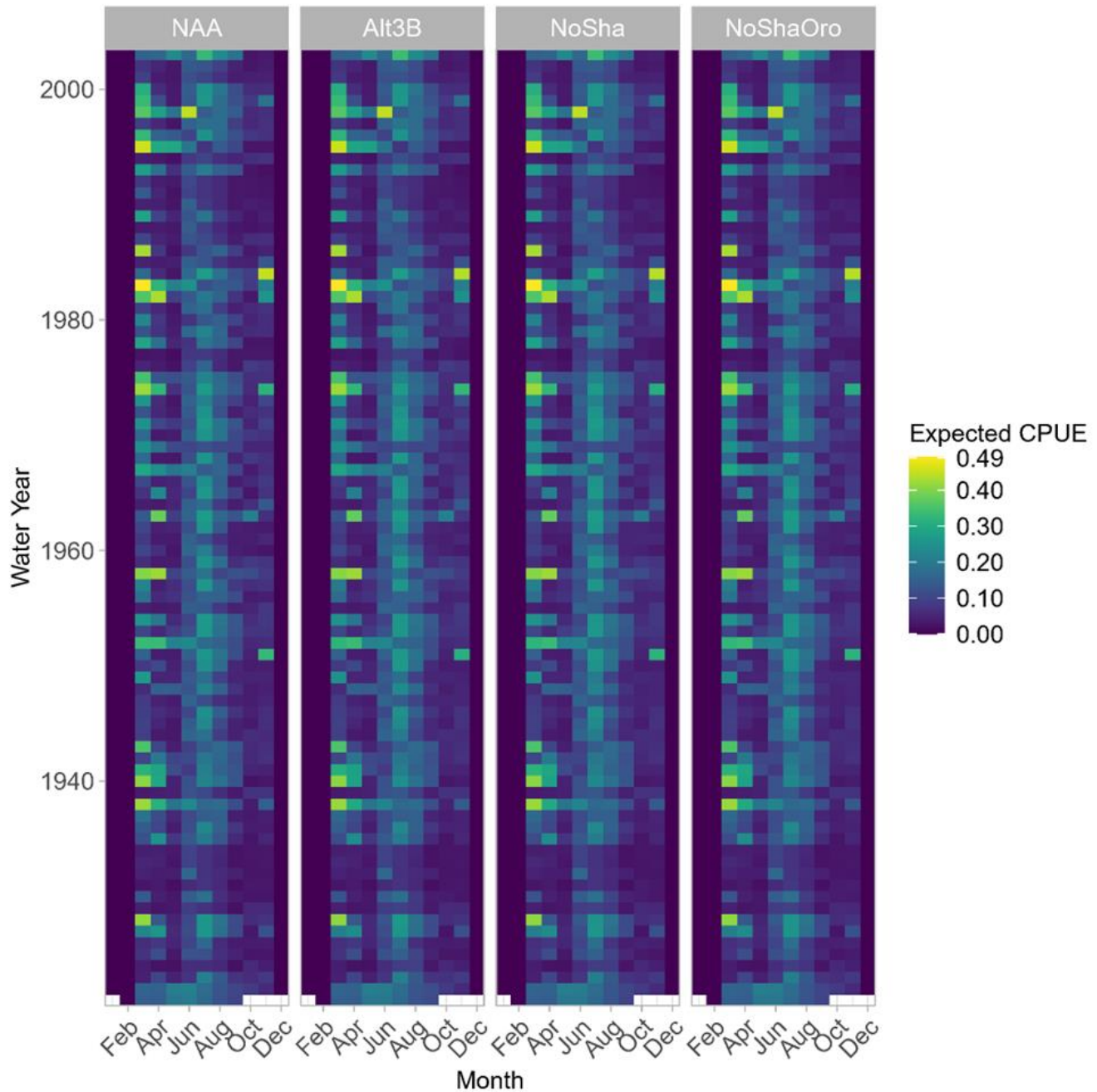
**Figure 5.** Boxplots of probability of catching a young-of-year White Sturgeon during surveys from water years 2003-2023 based on the model using mean monthly Delta outflow as its hydrological covariate. Data are aggregated by water year type, based on the Sacramento Valley Index.



**Figure 6.** Model probability of catching a young-of-year White Sturgeon during surveys as a function of the mean X2 over a calendar month within the observed range of mean outflow between calendar years 1981-2024. Shaded regions indicate 95% confidence intervals.

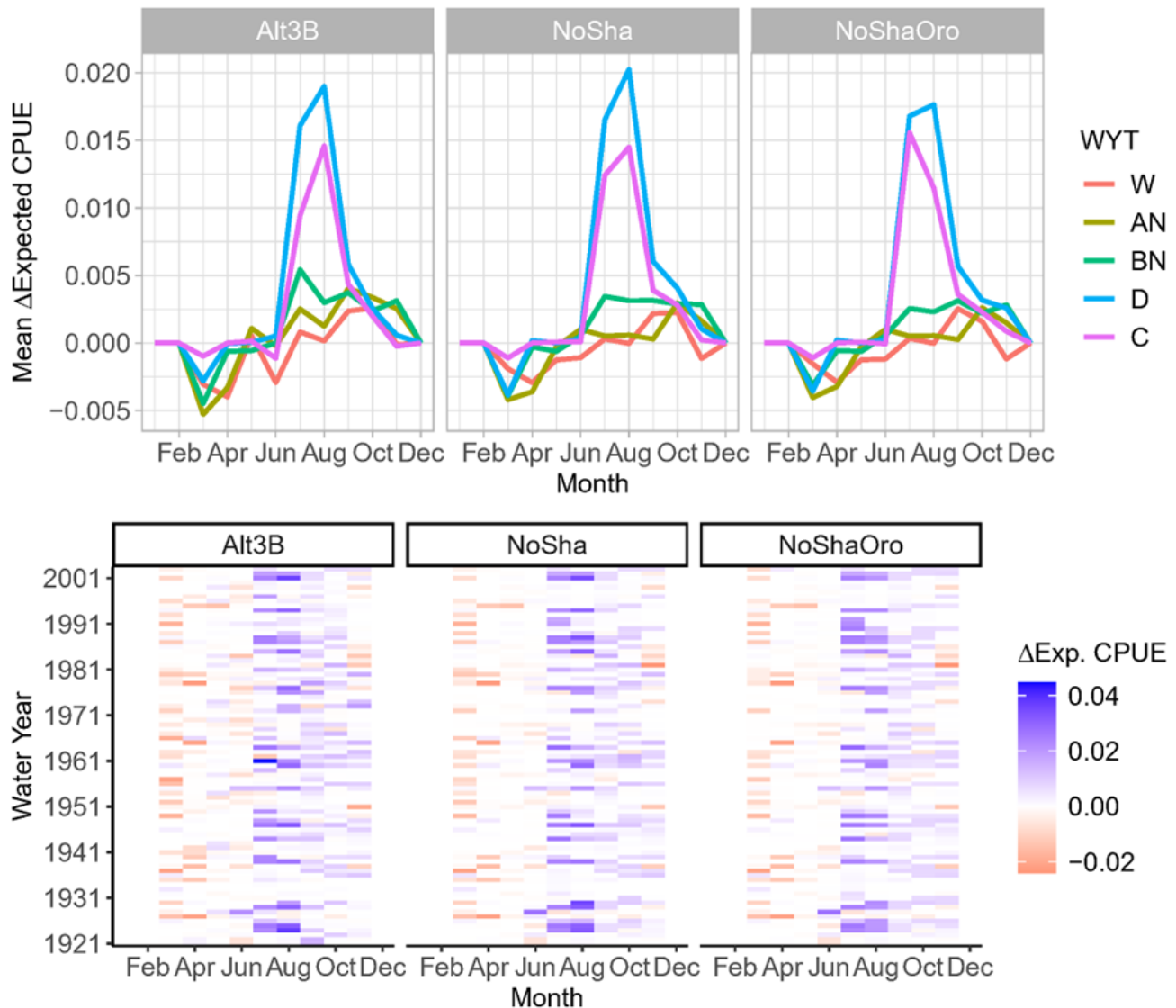
### White Sturgeon YOY Catch Under Project Alternatives

Expected CPUE (ECPUE) can be estimated by weighting the predicted catch (first part of Equation 2) by the catch probability (second part of Equation 2). CDFW substituted DSM2-simulated daily Delta outflows for the Existing Conditions (NAA), Alternative 3B (3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro) into Equation 2 to simulate the ECPUE of YOY WS by the 20-mm Survey and the San Francisco Bay Study midwater trawl and otter trawl surveys across all months, from 1921 to 2003 (Figure 7).



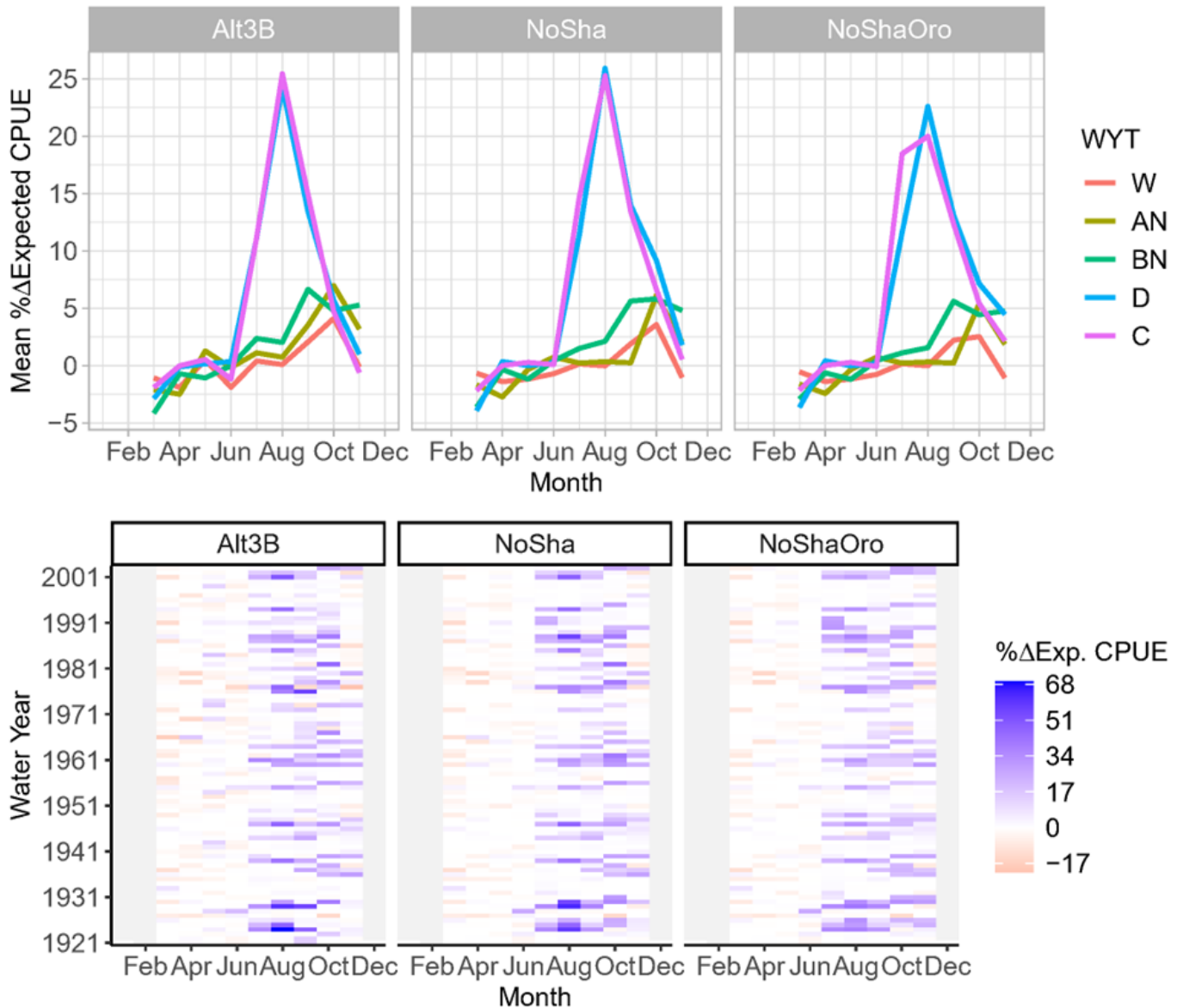
**Figure 7.** Expected YOY White Sturgeon catch-per-unit-effort (ECPUE) in the 20-mm Survey and San Francisco Bay Study midwater and otter trawl surveys from 1921 – 2003, as predicted when substituting DSM2-simulated Delta outflow under Existing Conditions (NAA), Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) into Equation 2, by month (x-axis) and water year (y-axis). Brighter colors indicate higher ECPUE.

ECPUE was frequently slightly lower under the Project than under the NAA in March – May, though to a lesser degree in critical water years, with the difference between the Project and the NAA converging on zero as the season progressed. Average ECPUE continued to be lower into June but remained near-zero in all months of wet water years. In contrast, ECPUE was mostly higher under the Project in June – November of dryer water years, and substantially so in July and August of dry and critical years (Figure 8).



**Figure 8.** (Top) Mean difference in expected catch per unit effort (ECPUE) of White Sturgeon young-of-year (YOY) in the 20-mm Survey and San Francisco Bay Study midwater and otter trawl surveys by month (x-axis) and water year type (WYT; water year types were classified using the Sacramento Valley Index and noted as Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critical (C)), as predicted when substituting DSM2-simulated Delta outflow under the Existing Conditions (NAA), Alternative 3B (Alt3B), No Shasta Exchanges (NoSha), and No Shasta or Oroville Exchanges (NoShaOro) into Equation 2. (Bottom) Difference in ECPUE of White Sturgeon YOY by month and water year (y-axis). Red shades indicate that ECPUE was lower under Project Alternatives than under the NAA, while blue shades indicate that ECPUE was higher under the Project Alternatives than under the NAA.

While March – June differences in ECPUE averaged <5%, there were 30 of the 2,976 simulated months in which ECPUE was >10% lower. In March of 1966 (below normal) and November of 1977 (critical), ECPUE was 17% and 21% lower, respectively, under Alt3B than under the NAA (Figure 9). There were 16 months in which ECPUE was >45% higher under Alt3B or NoSha than under the NAA, all in dry or critical water years. In August of 1924 (critical), ECPUE was 69% higher under Alt3B than under the NAA; in August of 1929 (also critical), ECPUE was 63% higher under NoSha than under the NAA. Trends under NoShaOro were qualitatively similar to those under Alt3B and NoSha, but both positive and negative differences were slightly smaller (Figure 9).



**Figure 9.** (Top) Mean percent difference in expected CPUE (ECPUE) of White Sturgeon young-of-year (YOY) in the 20-mm Survey and San Francisco Bay Study midwater and otter trawl surveys by month (x-axis) and water year type (WYT; water year types were classified using the Sacramento Valley Index and noted as Wet (W), Above Normal (AN), Below Normal (BN), Dry (D), and Critical (C)), as predicted when substituting DSM2-simulated Delta outflow under the Existing Conditions (NAA), Alternative 3B (3B), No Shasta Exchanges (1A-NoSha), and No Shasta or Oroville Exchanges (1A-NoShaOro) into Equation 2. (Bottom) Percent difference in ECPUE of White Sturgeon YOY by month and water year (y-axis). Red shades indicate that ECPUE was lower under Project Alternatives than under the NAA, while blue shades indicate that ECPUE was higher under the Project Alternatives than under the NAA.

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