Quantifying the Extent of Tidal Habitat Restoration Needed for Mitigation Measure CMP (specifically CMP-25: *Tidal Habitat Restoration to Mitigate North Delta Hydrodynamic Effects on Chinook Salmon Juveniles*) Using Bay-Delta SCHISM

1 Introduction

A potential impact of the proposed North Delta Diversions (NDD) for the Delta Conveyance Project (DCP) is an increase in the frequency of Sacramento River reverse flows under low flow conditions, compared to existing conditions. While proposed NDD operational criteria are intended to minimize effects to listed species, further mitigation of flow reductions downstream of the proposed intakes, through tidal habitat restoration, is proposed.

Frequency of Sacramento River flow reversals at Georgiana Slough is important because of its effect on routing and through-Delta survival of downstream-migrating juvenile salmonids. Studies have shown that: 1) as proportionally more Sacramento River water enters Georgiana Slough the number of outmigrating juvenile salmonids routed into Georgiana Slough increases (Cavallo et al. 2015; Perry et al. 2018; Hance et al. 2022); and 2) survival for juvenile salmonids using the Georgiana Slough route is reduced relative to survival for juvenile salmonids remaining in the Sacramento River (Perry et al. 2018; Hance et al. 2022). There are existing measures such as the Georgiana Slough Salmonid Migratory Barrier currently implemented to minimize the impacts due to potential tidal entrainment of the salmonids into Georgiana Slough.

The proposed DCP mitigation approach focuses on offsetting the incremental hydrodynamic effects of the project alternatives. The details of this tidal habitat restoration will be refined in coordination with fisheries agencies (California Department of Fish and Wildlife, National Marine Fisheries Service, and US Fish and Wildlife Service) and the goal of this technical memorandum is to estimate the general location and area needed to offset the incremental effects of the proposed project. Although beyond the scope of this memo, the functional benefit of the proposed hydrodynamic mitigation at providing additional rearing habitat for listed aquatic species is also considerable.

This document summarizes modeling conducted to estimate the extent of restoration areas needed to mitigate potential hydrodynamics-related effects of the proposed North Delta Diversions. The modeling investigation used Bay-Delta SCHISM (Ateljevich et al. 2014), a three-dimensional hydrodynamic model of the Delta, to assess the impact of the DCP on reverse flows at Georgiana Slough.

2 Assumptions and Methodology

2.1 Scenario Assumptions

The following Bay-Delta SCHISM runs were conducted to assess the impact of the DCP on reverse flows at Georgiana Slough. The impact was analyzed as change in duration (minutes/day) relative to baseline

conditions to test the effectiveness of conceptual mitigation actions. All the scenarios analyzed assumed tidal inundation of a currently leveed Ryer Island, in the Delta, through a breach along Cache Slough:

- Baseline (No inundation and no DCP)
- DCP Only
- DCP with 1/4th Ryer Inundation ≈ 3,000 ac
- DCP with 5/16th Ryer Inundation ≈ 3,750 ac
- DCP with 3/8th Ryer Inundation ≈ 4,500 ac

The modeling exploration summarized in this memo is conceptual and only serves to estimate the mitigation extent; it is not intending to earmark Ryer Island for restoration. Ryer Island was chosen because it is located in a region of the Delta, the Cache Slough Complex, identified as good rearing habitat for native fish (including Chinook Salmon [San Francisco Estuary Institute 2020], and Delta Smelt [Hobbs et al. 2017), because it has been shown through past modeling efforts (e.g., RMA 2020) to absorb tidal energy that would have otherwise contributed to reversing flows on the lower Sacramento River, and because it is large enough to test a variety of restoration scales.

2.2 Boundary Conditions

Assumed operations (i.e., SCHISM boundary flows) are consistent with the Proposed Project CalSim 3 model. CalSim 3 outputs were used as boundary conditions for Bay-Delta SCHISM.

- Analysis was conducted from December – June, the main downstream migration period for juvenile salmonids
- Simulation periods were water years 2007, 2010 and 2013

A preliminary analysis was conducted using DSM2 output from the existing conditions baseline and the proposed DCP Bethany alternative. Increase in Reversals at Sacramento River Below Georgiana Slough with DCP compared to the baseline were calculated for WY 2007-2015. 15-minute flow output at a DSM2 node downstream of Georgiana Slough junction was used to calculate proportion of the day when there were reverse flows with and without the proposed project. Three years with the greatest increase in reversals in the December through May period were selected to perform SCHISM analysis.

2.3 NDD Boundary

15-min NDD DSM2 outputs were used for the NDD boundary conditions in the SCHISM. 15-min DSM2 NDD outputs provide a sub-daily representation of the potential NDD operations taking into account factors such as the daily diversion volume, sweeping velocity, diversion ramping rates, and day-night operations.

The diversion operation at the north Delta intakes is dynamically simulated in DSM2 such that the daily amounts specified by CalSim 3 are diverted while subjecting each intake to the proposed sweeping velocity and the ramping criteria. A maximum of 3,000 cfs (or 1,500 cfs) is withdrawn at each intake while meeting a sweeping velocity requirement of 0.4 feet per second downstream of each intake. The intakes are operated if the daily diversion volume specified by CalSim 3 is not diverted. Once the specified volume is diverted for the day, the diversions at the intakes are shut off until the following day. The remaining volume for the day will be diverted such that operation of the upstream intake (Intake B) is prioritized over the downstream one (Intake C). Intake diversions are ramped over a 90-minute period to allow smooth transitions when they are turned on or off. In the situation where the specified volume

is not diverted by the end of the day (due to not meeting the velocity criteria), the “unmet” diversion volume is carried forward to the following day, and this process continues until the amount of north Delta diversion specified by CalSim 3 is met in DSM2. In general, the amount of north Delta diversion specified by CalSim 3 is met in DSM2 within the month, however, there could be some daily fluctuations caused by specific tidal conditions.

An operating rule is added in DSM2 to generally operate the three north Delta intakes during daytime hours (6:00 a.m.–6:00 p.m.) to the extent possible (except during the months of July–September). This modified operation is only possible when the amount of north Delta diversion specified by CalSim 3 is somewhat less than half the total combined capacity of the intakes.

3 Results

3.1 Summary of Key Findings

- Tidal habitat restoration in the Cache Slough Complex is an effective mechanism for reducing tidal flow reversals in the Sacramento River at Georgiana Slough
    - Tidal restoration areal extent and breach location(s) influenced the effectiveness of offsetting tidal flow reversals..
- Approximately 3000 acres of restoration would mitigate increases in tidal reversals with DCP diversions.
- Proposed restoration would also reduce tidal flow reversals during periods without DCP diversions.