The Budd Inlet model runs from Jan 25th to September 15th. This is how the model was originally configured as part of the Budd Inlet Scientific Study (BISS) completed by LOTT in 1997. Since the model covers the critical season (August and September), Ecology has not extended the model to cover the Sep 16 - Jan 24 time gap. To substantiate this we've looked at data from two sources.

First, we used data from Ecology's Long Term Marine Water Quality Monitoring Program. We extracted data from station BUD002 and BUD005 in Budd Inlet, shown in the map below. Data was available for station 5 each year between 1989 and 2016 and station 2 had data from 1989, 1990, 1994-1999, 2002, and 2014. Samples were taken every 0.5 meters, twice monthly. In our analysis we filtered out samples five meters and above, in order to focus on lower depths where DO is likely to be lowest.

Figure 1. Location of Marine Water Sampling Stations in Budd Inlet, used for data analysis.

Figures 2 and 3 show the available data plotted in a monthly timeseries. As can be seen in the plots below, DO reaches its lowest point in early August (at station 5) and in early September (station 2). The three months with lowest DO are July, August, and September at both stations.

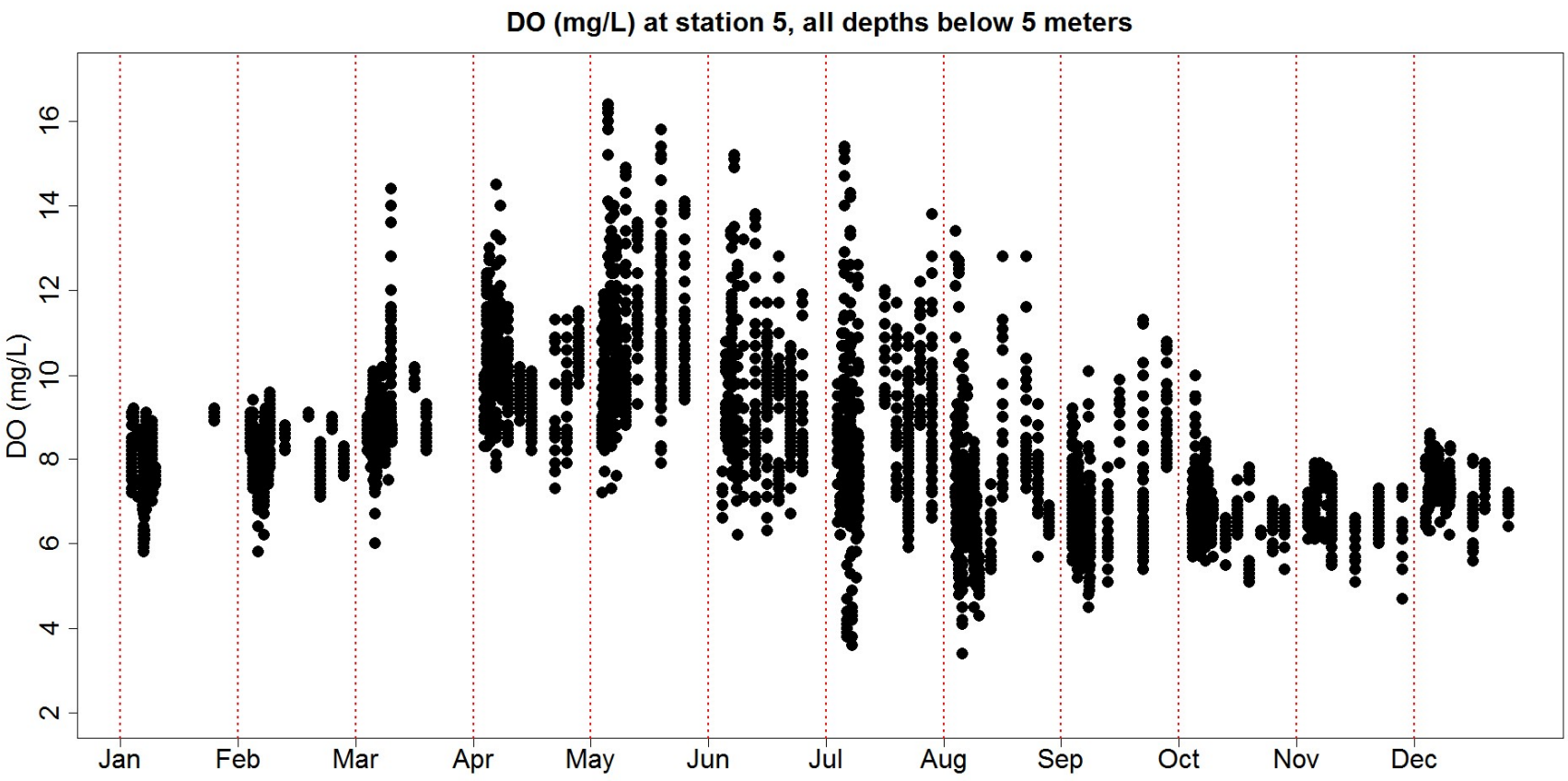


Figure 2. Dissolved oxygen at station 5 in Budd Inlet. Source: Washington State Marine Water Monitoring Program.

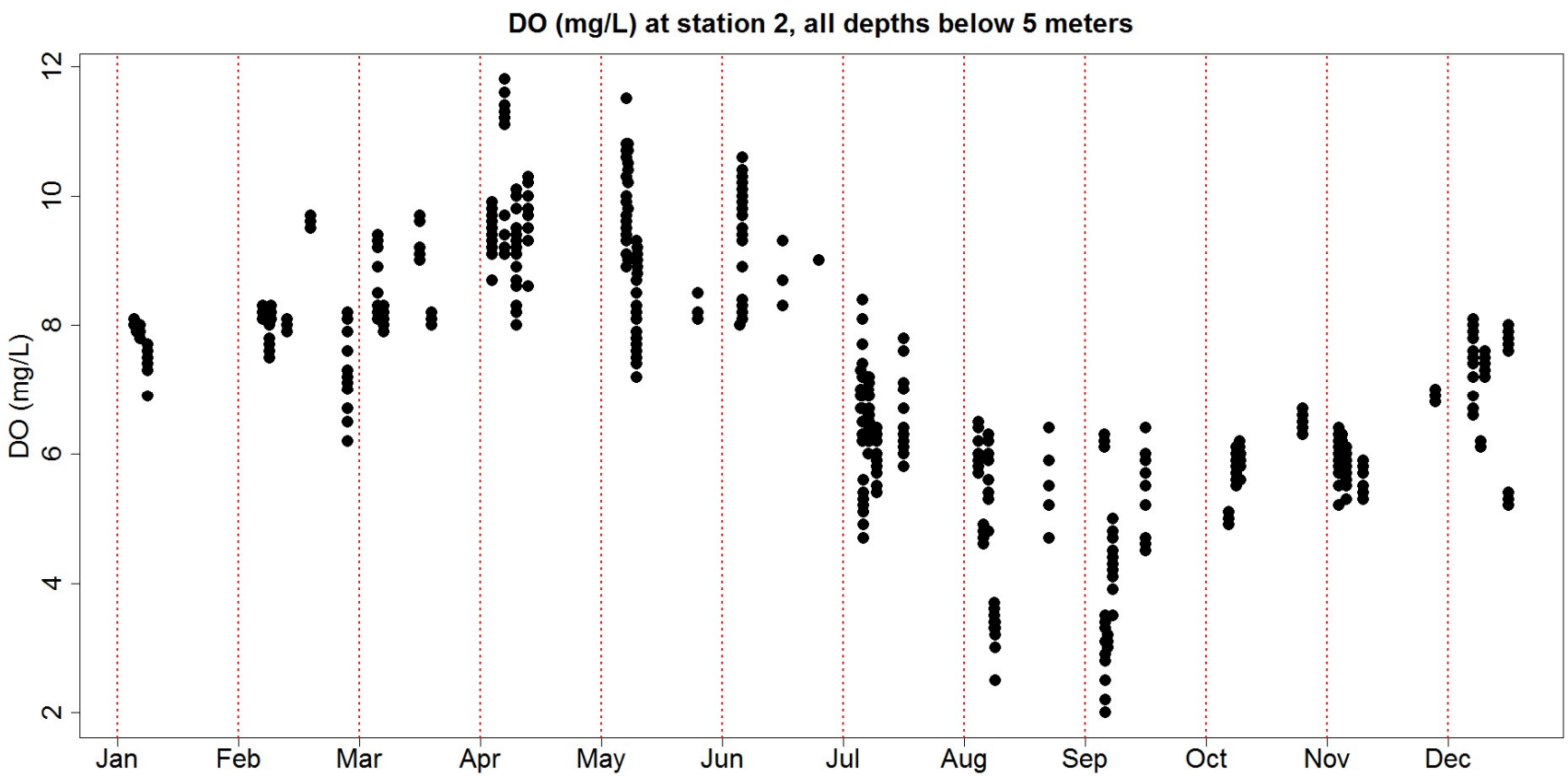


Figure 3. Dissolved oxygen at station 2 in Budd Inlet. Source: Washington State Marine Water Monitoring Program.

Additionally, we used the Salish Sea Model to predict DO in East Bay. We used data for point 8805 of the Salish Sea Model, shown below.

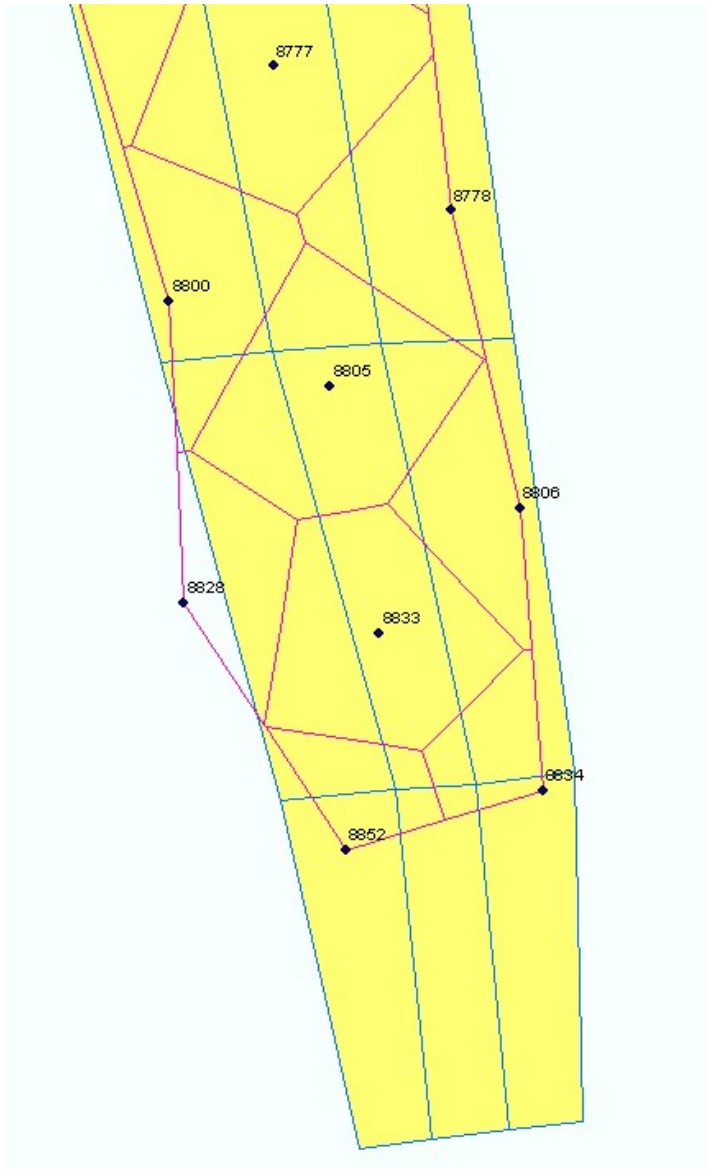
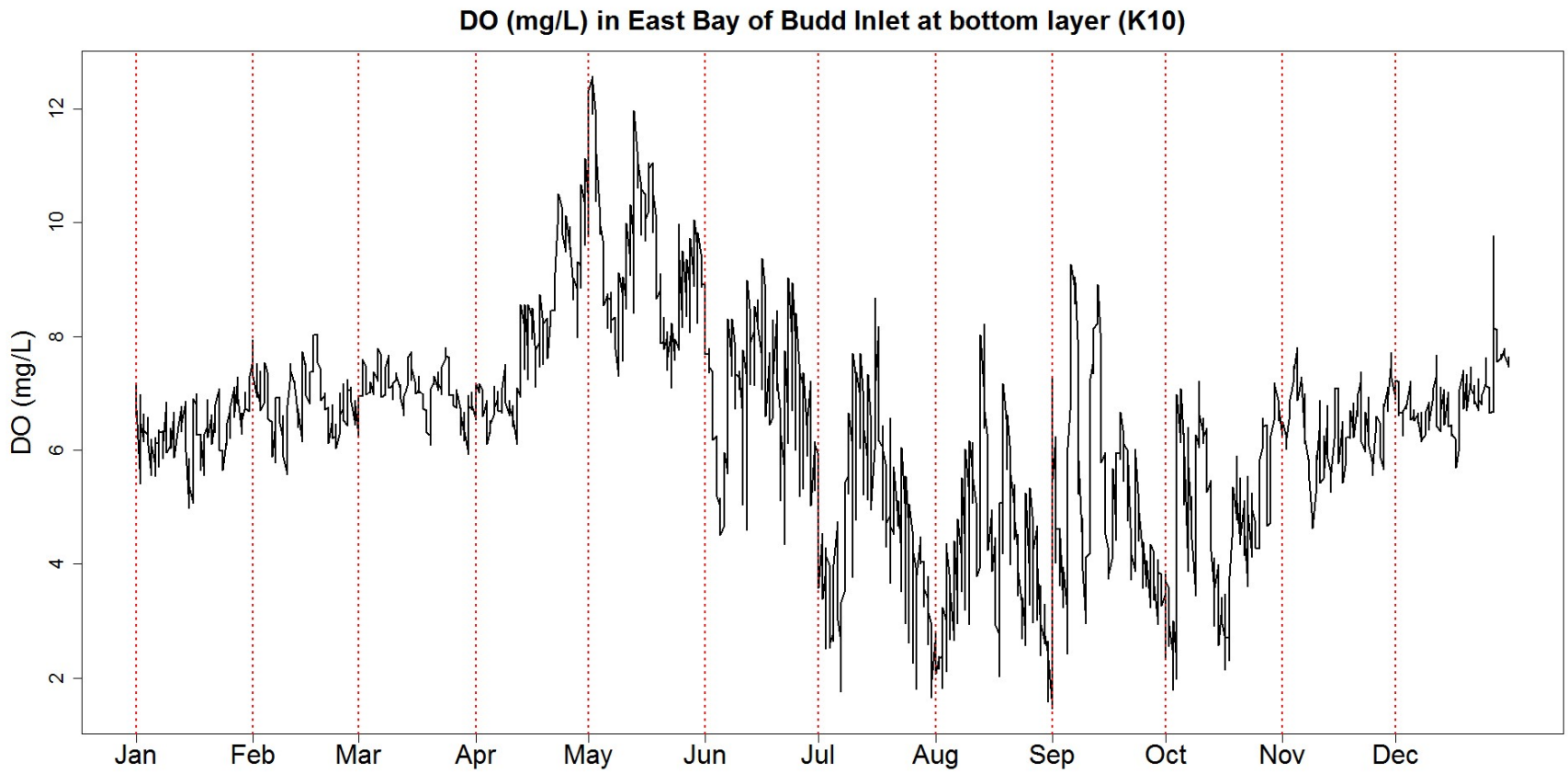


Figure 4. Location of predicted Budd Inlet DO values from the Salish Sea Model.

As shown in Figure 5, the Salish Sea Model predicts that the annual minimum DO occurs in early September, before rising throughout October.


DO (mg/L) in East Bay of Budd Inlet at bottom layer (K10)
DO (mg/L)
2
4
6
8
10
12
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec

While the worst DO is in August and early September during the time the model runs, all TMDL allocations will include at least April through October and the vast majority of allocations created for the Budd Inlet TMDL will be annual (by annual we mean that the same allocation will need to be met year round). Annual allocations will include DES, nonpoint sources, stormwater, and the external aggregated allocation that will be divided as part of the larger Puget Sound Nutrient Source Reduction Project.

Methods for addressing dissolved oxygen depletion caused by nonpoint, stormwater, and DES are more likely best suited for permanent (year round) implementation. The specifics of these allocations will be determined as we complete and implement the TMDL. Seasonal allocations could be an option if they are shown to protect water quality in a manner that is equivalent or better than annual allocations.

Determining the specifics of the external aggregate allocation will occur after the TMDL is completed through the Puget Sound Nutrient Source Reduction Project. The TMDL will set aggregate annual reductions that will need to be complied with, however, more specific seasonal allocations may also be created in the larger Puget Sound project.

LOTT's allocation will vary by month. LOTT has the ability to move between treatment methods by modifying their operations, making monthly allocations a viable option. LOTT already has variable monthly effluent limits (338 pounds TIN per day April, May, and October and 288 pounds per day June – September) which the TMDL will maintain. Additional reductions may be required; we are currently considering various reduced discharges in August and September. Our modeling has shown that wintertime discharges from LOTT have little carry over effect into the summer months when DO is at its lowest. Conversations with LOTT have indicated that wintertime reductions are much harder to meet due to increased runoff and that reductions in the drier summer months are more feasible. Finally, since LOTT is such a small contributor towards DO depletion in Budd Inlet we feel it is appropriate to focus their efforts during the critical period.