North Totten Inlet Mussel Culture
ITRC Review Comments on Technical Studies

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March 6, 2008

I have reviewed the discussion of the currents in the vicinity of the North Totten site in the Executive Summary and the Baseline information, as well as the data report from Evans-Hamilton. The Executive Summary refers to Brooks (2006), which did not come with the rest of the material to this reviewer; based on what is written in the Summary I have some serious concerns about the analysis of the EH current measurements that were done in Brooks 2006.

1. Baseline Information and the Evans-Hamilton Data Report

I seriously question that the 60cm x 60cm panels would provide adequate drag to overcome the drag on the remainder of the rig and give an accurate measure of the current at 15m and perhaps even at 7.5m. Open-ocean drogued drifters designed to track currents at depths in excess of 10m have considerably larger sails – for example, a Metocean GPS drifter with a drogue depth of 15m uses a tubular sail 6m long. Even shallow drifters for coastal applications, such as Pacific Gyre's Microstar (rated for 1 – 5 meter drogue depths), use larger sail than the drifters used in this study, and the Microstar is not recommended for drogue depths greater than 5m. Thus the near-bottom velocities measured with the drifters used here may not be representative and could be influenced by currents higher up in the water column.

Also, current velocity measured by the drifter is the velocity experienced by the drifter (in an ideal measurement); i.e. at the location of the drifter. During the ebb tide deployment shown in Figure 25 (p. 41), drifters move away from the release site and enter into the entrance channel of the Inlet where the currents are stronger. That they do get flushed away during the course of the spring ebb tide is, of course, a good thing; however the current velocities estimated from drifter displacement should not be construed as the current velocities at the North Totten site. Doing so would at the least create a positive bias towards higher currents in the estimate of peak current speeds, such as shown in Figures 25 and 28; from the ADCP measurements it indeed appears that such a positive bias is present. Moreover it is not clear, from the limited drifter study, how routinely such flushing out of water column from the North Totten site occurs.

A better assessment of the local current environment at the North Totten site can be made from the in-situ ADCP measurements by Evans-Hamilton (EH) reported in their Totten Inlet Circulation Study data report. Their Figure 39 shows vertically averaged current on the third panel; the first panel, which shows the vertical profile, indicate that the vertical average is a reasonable representation of currents at all depths (hence my concern about the drifter not properly drogued may be moot). The current record covers two spring-neap cycles; the maximum speed of the current (admittedly from visual inspection) is about 20 cm/s, occasionally touching 25 cm/s; thus the maximum current speeds estimated from the drifter study and tabulated in Table 11 (p.38) is not routinely attained at the North Totten site.

2. Executive Summary − Totten Inlet baseline studies completed by Aquatic Environmental Sciences in 2002 and 2003

The wording of the Executive Summary with regards to currents in the vicinity of the North Totten site is confusing to the point of possibly misleading. The statement that "(t)he North Totten Inlet site is very well flushed with a mean current speed of 16.3 cm/sec oriented parallel to the shoreline" would be read by oceanographers that there is a *mean current* parallel to the shore of that magnitude; this is not at all apparent from EH's Figure 39. It is likely what is meant here is the mean (or root-mean-square) speed of the tidal current; it should be stated so. This statement is followed by "Maximum current speed was 84.3 cm/sec at 3.0m depth"; but no such speed is evident in the top panel of Evans-Hamilton's Figure 39 that

shows current magnitude (it would have registered in an orange color). Such a value, if real, must have been a rare outlier and does not characterize a typical condition at the site at all; thus citing this particular value in an executive summary is highly misleading. In all of this I cannot help suspecting a bias towards representing the North Totten site as a higher-velocity environment than it actually is. There's no conclusion regarding flushing timescale in the report, nor is there any mention of dispersion in Dana Passage.

It is still possible that the site is sufficiently well flushed so that local water column and sedimentary influence from the mussel rafts will not be significant. The best way to quantify this would be to perform a careful analysis of EH's ADCP data and characterize it in terms of mean and tidal currents.

In order to assess potential adverse impact of the proposed mussel rafts on surrounding water columns and the remainder of the inlet, it is necessary to establish connectivity of sites around the Inlet to the proposed raft site, and the time scale of the connectivity. This can be done easily, reasonably and effectively by tracking drogues, but the drogue deployments need be of sufficient duration and coverage: those reported in the documents were not. We strongly suggest that at least a scaled-down version (as described below) of the drogue deployment described in the Suggested Experimental Setup (Item #3) be performed. Because the Evans-Hamilton ADCP measurement shows relatively small vertical shear, at least over the part of the water column that would be occupied by the rafts, surface or near-surface deployments will suffice; drogue release should be focused on the proposed mussel raft site and cover a complete tidal cycle (i.e. a release each at high tide, maximum ebb, low tide, maximum flood); deployment should be done during average tidal conditions and must be of sufficient duration (up to the estimated residence time of water based on the tidal prism) so as to make the connectivity time scales around the inlet clear.

Based on the drogue study, a connectivity map should be established, namely a map of the time it took for a drogue to reach a particular location in the inlet, which, with suitable filling-in and averaging, should be extended to cover the inlet. This would show how quickly something originating at the raft would spread to the rest of the inlet. This will be a useful reference tool for assessing the spatial extent of impact of various processes, originating at the raft site, with the knowledge of the timescale associated with each process.