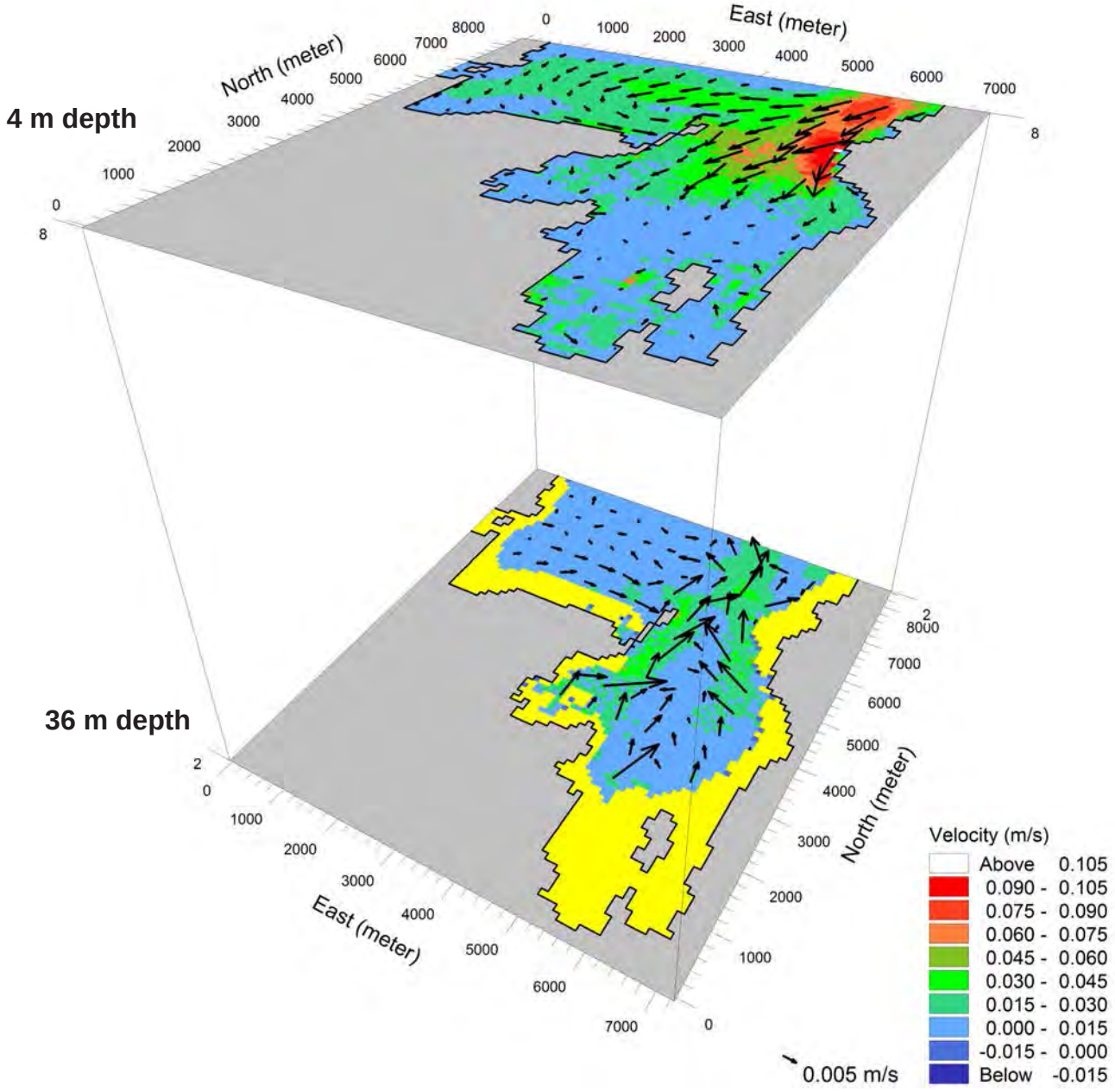

NEWMONT NORTH AMERICA

Mean Model Current Velocities and Directions at 4 and 36 m Depths, August 5 – August 8, 2011

Figure 3.1-7

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Table 3.2-1. Flushing Rates of Roberts Bay (in days) at the Melville Sound Exchange Location for Different Water Column Sections and Modelling Scenarios

Model Scenarios	All Depths	10 m Depth to Bottom	20 m to Bottom	30 m to Bottom
2011 Baseline	6.71	8.58	15.00	17.58
2009 Winds	6.92	8.54	18.38	25.13
2007 Winds	8.83	11.54	19.04	26.33
2005 Winds	7.75	10.04	18.75	27.71
Double Outflow	6.95	10.08	16.67	21.08
Quadruple Outflow	7.33	12.38	22.33	28.50
North Winds	6.29	7.05	14.83	23.54
South Winds	5.25	6.63	7.92	9.96
East Winds	6.49	8.42	17.63	24.25
West Winds	6.79	8.71	17.67	25.50

The flushing rate considered in Table 3.2-1 only takes account of northern flowing waters; thus, there is the possibility that some of the water exchange is simply the result of back and forth circulation at the Melville Sound boundary, and not Roberts Bay entirely flushing into Melville Sound. An important question is whether or not waters at the southern part of the bay actually reach Melville Sound. While tracking all discrete water parcels at every time step in the model could easily solve this issue, such calculations are numerically intensive and well beyond the scope of this report. Instead, parcels at three specific depths (4, 20 and 36 m) were recorded using a Lagrangian description during the simulation, starting at the 38 m station (i.e., the potential TIA discharge point). For this experiment, the parcels were assumed to be uniformly affected by the currents at each grid and followed their depth isoclines during the model run (i.e., no vertical mixing). While this latter assumption is sometimes unrealistic, particularly during episodes of large upwelling/downwelling (e.g., storms, boundary regions, collapsing fronts), generally it is reasonable given that the horizontal currents are more than an order of magnitude larger than vertical currents.

The results of the tracking experiment for each layer are plotted in Figure 3.2-1. In general, parcels at all three depths followed a clockwise pattern around Roberts Bay before reaching Melville Sound, as had been observed in the 2011 Roberts Bay Physical Oceanography Baseline Report (Rescan 2012b). The shallowest parcel at 4 m depth traveled a much greater distance than the others within Roberts Bay, as it was subjected to stronger, more variable currents. This is clearly apparent around the dates of July 5-6, where the parcels suddenly shifted eastward and then northward, skirting the coast and nearly exiting the bay, before moving back towards the middle of the Bay around July 12. Afterwards, wind/wave interactions subjected the parcel to a couple of cyclonic motions before being ejected out of the bay at the western end of the Melville Sound boundary shortly before July 18. The deeper parcels underwent comparatively more straightforward trajectories: at 20 m depth, the waters went through a small clockwise eddy before exiting the bay around July 15, while at 36 m depth, the parcel simply circulated anticyclonically before entering Melville Sound on July 12.

Given that each tracked parcel flushes out of Roberts Bay within two to three weeks of circulation, the flushing rates displayed in Table 3.2-1 are surmised to affect the complete regional volume of the bay within a few weeks of open water circulation.