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HOWE SOUND

ENVIRONMENTAL EFFECTS MONITORING (EEM) CYCLE FIVE INTERPRETIVE REPORT

FINAL

Prepared for:

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EXECUTIVE SUMMARY

The Environmental Effects Monitoring (EEM) Cycle Five program for Howe Sound Pulp and Paper Limited Partnership (HSLP) ran between April 2007 and April 2010, and included process effluent sublethal toxicological testing, fish tissue survey, and fish population survey components.

Ongoing process changes since the late 1980's have resulted in significant removal of TSS, BOD, AOX, and dioxins/furans in effluent being discharged to Howe Sound. Sublethal toxicity testing during Cycle Five demonstrated no effects of mill effluent on survival or growth of topsmelt (*Atherinops affinis*) larvae, effects on echinoderm fertilization at a mean effluent concentration of 32.8% (IC25), and effects on *Champia parvula* reproduction at a mean effluent concentration of 2.7% (IC25). Based on a 1% effluent concentration zone of 2,000 m from the diffuser, maximum potential zones of sublethal effect from the effluent discharge point were <20 m for fish growth and survival, 61 m for invertebrate fertilization, and 743 m for algal reproduction.

Dioxin and furan concentrations in sediments, crab, and fish near the HSLP mill have dropped considerably following pollution abatement changes in the 1980's and 1990's, including the phase out of elemental chlorine bleaching and introduction of secondary effluent treatment. Since the early 1990's, despite the complete elimination of elemental chlorine in 1997, concentrations of dioxins and furans in sediments have persisted near the diffuser, have not exhibited any recent patterns over time, and appear to be fluctuating at low levels. In 2009 this trend continued, and concentrations of 2,3,7,8-T_4CDD, 2,3,7,8-T_4CDF, and Total Toxic Equivalency (TEQ) were within the lower end of the historical range. In Dungeness crab, total TEQ concentrations at three of the eight sampling stations were above Health Canada's consumption threshold (24.4 pg/g hepatopancreas), while levels at the remaining five stations were below the threshold. The total TEQ concentration in dogfish liver was over 34 times greater than the threshold (30.0 pg/g liver), and the concentration in liver from a single English sole was below the consumption threshold.

An extended 28-day topsmelt sublethal toxicity test was performed for the HSLP EEM Cycle Five fish survey. The effluent dilution series proposed in the design document for Cycle Five was a repeat of the Cycle Three series of 1%, 2.5%, 6.4%, 16%, 40%, and 100% effluent. Unfortunately, the dilution series used by the laboratory for the test was a 0.5-factor dilution series of 6.25%, 12.5%, 25%, 50%, and 100% effluent. Following discussions with Environment Canada, the test was not repeated using the correct dilution series given that the original test failed due to poor survivorship of embryos/larvae in the control treatment and there was no evidence of a dose response among treatments using the 0.5-factor dilution series.

High mortality rates of the control (36%) in exceedance of the maximum allowable rate (35%) were reached by Day 13 of the 28 day test. High mortality rates and inconsistent dose response were also associated with the majority of effluent test concentrations. Due to mortality rates for both the control and effluent test concentrations, the test was terminated after Day 13. The testing laboratory was unable to identify the specific cause of high mortality rates; however, sensitivity of organisms to handling (particularly during

hatch) was identified as a potential reason for the test's failure. The lab was also not able to identify any additional precautions or procedures that could have further minimized mortality rates. In general, marine fish egg tests are sensitive, often perform poorly and unpredictably, and are not routinely used by ecotoxicology labs.

The HSLP Local Monitoring Committee (LMC), on advice from EEM Science Committee members, explored potential alternatives for completing the Cycle Five fish survey following failure of the extended topsmelt sublethal toxicity test. Alternative bioassays proposed by the ecotoxicology lab included a bivalve larval development test, an echinoderm larval development test, and a rainbow trout egg-alevin test. In addition, the EEM Science Committee proposed either repeating the extended topsmelt test or performing an expanded benthic survey as a fish study alternative.

After much deliberation, LMC and EEM Science Committee members agreed that none of the proposed alternatives were suitable or feasible for implementation in Cycle Five. The primary concern with the substitute laboratory bioassays was that they would not adequately answer the EEM fish survey question regarding potential local fish population effects associated with mill effluent. Bivalve and echinoderm tests would have provided similar results to the routine sublethal toxicity program, while the freshwater rainbow trout species test would not have been particularly relevant to the marine environment. The ecotoxicology lab repeating not repeating the extended topsmelt test, given the likelihood that a similar mortality rate would occur.

The extended benthic invertebrate survey, although the most reasonable alternative, was not selected for implementation given the lack of remaining time available in Cycle Five and because a similar study was just completed in Cycle Four. An expanded benthic invertebrate survey will be explored as a possible alternative approach to the fish survey in Cycle Six.