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MEMORANDUM

TO: **Tom Moe, U. S. Steel**
FROM: **Mike Johnson/Mat Knutson, Liesch Associates**
DATE: **January 26, 2010**
RE: **January 2010 Minntac Tailings Basin Seep Estimate**

The following memo has been prepared to document the methods used to develop an estimated seepage rate from the Minntac Tailings Basin. The information in this memo is based upon information shared during a January 22, 2010 conference call between U. S. Steel (USS), Hatch, CRA, Barr, and Liesch.

The seep rate through the dikes was calculated by both Liesch and Barr using similar but slightly different methods.

Liesch utilized chloride as a tie element and downstream flow information to back-calculate an estimated seep flow rate. Chloride concentrations were measured at Seep 030 and Seep 020. During a corresponding period, chloride concentrations and flow rates were measured downstream at location 701 on the Sandy River and location D-1 on the Dark River. Data used for the calculation was collected in 2003, 2007, and 2009 (the 2009 data was incorporated following the Jan 22, 2010 conference call). It was assumed all chloride observed at the downstream locations originated from the tailings basin. Based on this information, an average seepage flow rate of 2,896 gpm was estimated.

Barr conducted a slightly more complex yet similar analysis utilizing sulfur as the tie element. See attached Barr memorandum for greater detail on the methodology used by Barr. The Barr estimated seep flow rate was 3,049 gpm.

CRA was requested by USS to estimate the loss of water from the tailings basin into the groundwater through the bottom of the tailings basin. CRA reported that their estimate from the clear pool area (cell 1 and cell 2) ranged from 6 to 154 gpm with a mean of 43 gpm. This estimate was based on 25, 000 linear feet of wetted perimeter on the east side of Cell 1 and the north/east

side of Cell 2. See attached CRA memorandum for greater detail on the methodology used by CRA. It was acknowledged on the conference call that the CRA value did not represent all the water potentially leaving the tailings basin bottom. Due to the fairly small estimated rate (compared to the estimated seep flow rates), the mean average was effectively doubled and rounded up to 100 gpm to represent a reasonable estimate of total tailings basin loss to the groundwater.

It was agreed during the conference call that the Liesch and Barr methods would be averaged with the rounded-up CRA groundwater seep estimate then added to that result. **This results in a total estimated seep flow rate from the tailings basin of 3,070 gpm**. USS has indicated that this value should be used in future modeling of the tailings basin for treatment system sizing.

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