Columbia Slough – Baseline Concentrations
Documentation of Methodology
November 21, 2002

Background

The Columbia Slough area includes approximately 30 miles of interconnected waterways over an 18-mile stretch from Fairview Lake in the east, to the confluence with the Willamette River at Kelly Point Park in the west. The land use along the Columbia Slough is varied and includes agriculture, commercial, industrial, and residential. The total drainage basin is 34,200 acres, or 53 square miles. The Slough receives discharges from at least 110 storm sewers, and 90 NPDES permitted stormwater and cooling water outfalls. At least 13 Combined Sewer Overflows (CSOs) discharge to the Lower Slough; however, the upgrade of the CSO system that was completed in 2000, reduced the stormwater flow into the Slough in a typical rainfall year by 99.6%.

In 1994, the City of Portland conducted a widespread sampling event in the Slough. Sediments, surface water, and fish tissue were sampled throughout the system. This data, along with some historical data was input into a database. Data for over 400 sediment samples analyzed for a wide range of constituents was tabulated. The screening level risk assessment completed using this data in 1995 concluded that contaminant concentrations throughout the Slough exceeded available sediment screening levels; consequently, sediment was determined to be a potential source of unacceptable risk to fish, birds, mammals, and human receptors in the Slough. The risk pathway of primary concern was identified as ingestion of fish.

DEQ and the City are working together to determine necessary, feasible actions to address the contaminated sediments. Because a primary source of contamination to the Slough is discharge via the many stormwater outfalls, efforts have focused on reducing pollutant loading from this source. DEQ has also put a high priority on identifying point sources of contaminants in the Slough watershed. While these actions should help to limit future contaminant inputs to the Slough, the issue of addressing sediment contamination resulting from historical discharges remains. DEQ is now relooking at the contaminant database for the Slough to assess where active measures may be warranted to address sediment contamination. The assumption at this point is that it will not be feasible to actively remediate the entire 30 miles of waterway, but localized areas of elevated contamination may warrant more active measures while natural processes, along with source reduction actions, result in long-term reduction of the more widespread contamination.

In order to identify which concentrations may reflect a localized area of elevated contamination, DEQ has evaluated the existing sediment concentration database to determine “baseline” concentrations for the Slough. The documentation of the methodology followed to come up with these levels, which should reflect concentrations that are pervasive throughout the Slough, is provided in the attached tables and figures. A simple description of the process follows.

Methodology

Two methods were used to calculate contaminant baseline levels for the Slough and the results were compared. In the first method, originally described by Levinson (1974) [1], and commonly used by the USGS (e.g., A Synoptic Survey of Trace Metals in Bottom Sediments of the Willamette River, Oregon, Geological Survey Circular 715-F) data is evaluated after plotting on normal probability plotting paper. The second method involves evaluation of simple linear plots of data ordered from lowest to highest detected concentration. The steps involved, and pertinent factors related to the evaluation are presented below:

1. The data was sorted by contaminant and organized from lowest to highest detected concentration. Where a contaminant was not detected, a value of ½ the analytical detection limit was used. If a detection limit was not reported by the laboratory, 0.167 times the analytical reporting limit was used, as the analytical reporting limit was typically about 3 times the analytical detection limit.

2. For the normal probability plots, percentile rankings were determined for each set of contaminant concentrations. These levels are provided in Attachment A.

3. The percentile rankings were then plotted on normal probability plotting paper. These plots are provided in Attachment B. Note that these plots do not always include the highest concentrations (concentrations generally greater than about the 95^{th} percentile and above) as they could not reasonably be fit onto the graph.

4. Asymptotic lines were drawn by hand on each of these graphs along apparent linearities in the plotted percentiles, and the intersection of two asymptotes was interpreted as the maximum baseline concentration. Note that it was often impossible to fit a true asymptotic line through the higher percentile concentrations as they could not be included while producing a meaningful plot. In these cases, a calculated slope reflecting an average slope between the 99.9^{th} and 95^{th} percentile values was used as the upper asymptote. Note that in a few instances, nearly uniform curvature along the lower portion of the normal probability plot made it difficult to define the location of the plot's lower asymptote. In those specific instances, results from the linear ordered data plots were used as an aid in resolving the actual location of the asymptote.

5. The data, ordered from lowest to highest concentration, was also plotted on a linear graph. These graphs are provided in Attachment C. The intersection of the asymptote to the lower part of the curve with the y axis on the right side of the plot was identified as the maximum baseline concentration.

Some details to note in this analysis:

1. The highest detection of arsenic was not considered in plotting the asymptote for the upper portion of the normal probability curve as it created a "plateau" at the upper portion of the curve, the asymptote to which did not generate a useful intersection with the lower asymptote.

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[1] Levinson, A.A., 1974, Introduction to exploration geochemistry: Calgary, Canada, Applied Publ. Co., Ltd., 612 p.

2. As previously stated, in some cases, more than one interpretation was possible for the lower asymptote to the normal probability curve. Results of the linear ordered data plots were used to aid in the interpretation of this slope. Generally, these are illustrated in the attached figures with an indication as to which line appeared to be most representative. Consideration was given to the number of values that reflected detection limits in making this determination.

3. Since the normal probability plot's lower (probability) axis is nonlinear, the curve's lower asymptote is drawn through the segment of the curve which includes the largest portion of data, rather than simply drawing it through the longest straight segment of the curve (which most commonly lies in the 0.1- to 5.0-percentile region of the curve).

Summary

The results of the two data evaluations described above are summarized in the following table. As can be seen, the maximum baseline values determined from both methods are comparable. DEQ is proposing to consider the baseline value calculated using the more documented normal probability plotting method as representative of maximum baseline concentrations in the Columbia Slough.