# Georgia Department of Natural Resources

Environmental Protection Division, Watershed Protection Branch
4220 International Parkway, Suite 101, Atlanta, Georgia 30354
Linda MacGregor, Branch Chief
404/675-6232
FAX: 404/675-6247


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MEMORANDUM

TO: Linda MacGregor

THROUGH: Jeff Larson

FROM: Elizabeth Booth
Jeremy Smith

RE: Laurel View River Field Study and Modeling Results

In response to the local interest about the proposed permitted discharge to the Laurel View River (LVR), GA EPD staff conducted an intensive field study in order to calibrate the model used to develop the wasteload allocation. The field study was composed of two phases. A reconnaissance was completed in August 2009 and the field study was completed in September 2009.

The reconnaissance of the Laurel View River took place August 21-24, 2009, and coincided with the largest tidal range that month (8.2-9.0 ft). During this time, field work included: tidal amplitude measurements (yard sticks), bathymetry measurement, high and low slack tide depth profiles, collection of water samples for long term BOD analysis, a dye tracer study, and a drogue study.

The field study took place from September 15-18, 2009. This timeframe was also chosen to coincide with the highest tidal range of the month (8.0-9.2 ft). This study consisted of deploying continuous monitors, conducting tidal velocity measurements (drogue), and high and low slack tide runs. During the slack tide runs, depth profiles were measured at every other river mile and water chemistry samples were collected at designated locations.

The field data was analyzed and the results are presented in the attached powerpoint:

> A sinusoidal curve was used to fit the data from the yard stick surveys. This information was used to adjust the bathymetry data to mid-tide based on the time the bathymetry measurements were recorded.
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> The bathymetry data was used to determine the cross sectional area of each river mile taking the top width of the channel from Delorme topographic maps.
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> The DO, pH, temperature and conductivity depth profile data were plotted, and at each cross section these parameters tended to be uniform from top to bottom, indicating the system was vertically well mixed.
>
> The high and low slack tide center run data was plotted and a best-fit trend line was fit through the data. These trend lines were averaged to derive the mid-tide curve. It should be noted that the highest temperature occurred in August and these data were used to determine the mid-tide curve.

An example of the first order long-term BOD curve fit analysis for NBOD, CBOD-fast, and CBOD-slow are provided along with a summary of the results for all the samples. The k rates used in the model are bolded along with the associated f-ratios.

The dye was continuously released at RM 10.5 for approximately 2.5 hours beginning approximately 1.5 hours after low slack tide. The analysis of the leading edge of the dye data indicated that the aerial extent of the incoming dye cloud was approximately 4.5 miles and the aerial extent of the outgoing dye cloud was approximately 5.5 miles. The seaward movement of the dye was approximately seven miles.

The drogue study provided information on the velocity of the tidal cycle and this data has been graphed to show the maximum velocity occurs at mid-tide. It should be noted that the maximum outgoing velocities are higher than the maximum incoming velocities.

The rainfall data was used to estimate the ungaged freshwater flow into the system using the rational formula, Q=CiA. Where Q is flow (cfs), C is a runoff coefficient, i is the rainfall intensity (in/hour), and A is the drainage area (acres). The average rainfall intensity is calculated as the total rainfall over the flow averaging period divided by the total duration of the averaging period, including both dry and wet periods. The total freshwater in the system was calculated by determining the fraction of freshwater in each segment, by comparing the salinity of the river segment to the salinity of seawater, and multiplying it by the segment volumes. The total freshwater in the system was divided by the estimated freshwater flow to determine the retention time of the system. An iterative approach was used to match the system's retention time to the total duration of the averaging period. The data indicated that the retention time of the system is approximately 21 days and the freshwater flow is approximately 400 cfs.

The continuous monitoring data was used to determine the model boundary conditions. The data were graphed and mid-tide DO and conductivity values were determined. The plots show the influence of the tidal cycle on DO, pH, and conductivity and support the data collected during the slack tide runs.

A summary table of the water chemistry data collected during the high and low slack tide runs is provided. These data were used to calibrate the one-dimensional mid-tide water quality model GA ESTUARY.

The calibration curves for salinity, NBODu, CBODu, and dissolved oxygen are provided. Dispersion was used to adjust the model salinity to match the mid-tide salinity that was calculated based on the field measurements. As previously mentioned, the NBOD and CBOD k rates and CBOD f-ratios were determined from the long-term BOD tests. The marsh loads were adjusted to calibrate the model NBODu and CBODu data to the mid-tide data that was calculated based on the field data. The DO calibration was performed by setting the SOD and reaeration rates to 1 gm/cm/day and 1/day, respectively, and adjusting the marsh DO deficit.

Once the model was calibrated, the model was used to predict the effects of a 3 MGD reuse discharge (5 mg/L BOD5, 2 mg/L NH3-N, 5 mg/L DO) into the Laurel View River at RM 10.5. The results of this model run were plotted against a "natural" model run without a point source discharge. As seen on the graphs the predicted effects of the discharge are de minimis.