

**Minutes of Meeting**  
**North Bosque River TMDL Refinement Project Advisory Group**  
May 11, 2006  
10:00 am -2:30 pm  
J. J. Pickle Research Campus  
MCC Building

**Stakeholders Present:** Jay Bragg (Brazos River Authority, replacing John Ellis); Jerry Golden (City of Clifton); Tony Provin (Texas Cooperative Extension); David Villarreal (Texas Department of Agriculture, substituting for Richard Eyster); Pat Radloff (Texas Parks and Wildlife Department);

**Stakeholders Absent:** John Cowan (Texas Association of Dairymen and Dairy Farmers of America); Allan Jones (Texas A&M University System); Ned Meister (Texas Farm Bureau); Joseph White (Baylor University); Norman Johns (National Wildlife Federation); Justin Taylor (Sierra Club); Mark Kaiser (City of Stephenville); Norman Bade (Natural Resources Conservation Service); John Foster (Texas State Soil & Water Conservation Board); Anjna O'Connor (U.S. Army Corp of Engineers); Shawneille Cambell (U.S. Environmental Protection Agency); Richard Kiesling (U.S. Geological Survey); Ricky Garrett (City of Waco)

**Support Team Present:** Larry Hauck (TIAER); Anne McFarland (TIAER); James Houser (TIAER); George Ward (UT-CRWR)

**Others Present:** Tim Foster (Mobile Process Technology); Larry Koenig (TCEQ); James Miertschin (JMA, Inc.); Lial Tischler (Tischler & Kocurek); Bruce Wiland (Wiland Consulting)

**Materials Distributed:**

The following was provided at the meeting: Draft minutes from the last meeting; handouts on the presentation; and the document titled *Modeling Assumptions for Model Validation Refinement and Application of the North Bosque River TMDL Modeling System*.

**Welcome & Introduction**

The fifth meeting of the North Bosque River TMDL Model Refinement Project Advisory Group was held on Thursday, May 11, 2006 from 10:00 AM until 2:30 PM in Room Room 1.108 of the MCC Building, J.J. Pickle Research Center, The University of Texas at Austin. Larry Hauck (TIAER) introduced the meeting and self-introductions were made.

**Old Business**

The group approved the minutes from the last meeting

## Meeting Overview

Dr. Larry Hauck presented the project schedule showing the progress to date and the tasks that will occur over the remainder of the project. Dr. Hauck explained that overall both the data collection and modeling portions of the project were behind schedule perhaps as much as six months, which is due to various unforeseen complexities. It was emphasized that the focus of the current meeting was on assumptions for the validation/calibration period (1993-2000) and that assumptions may vary for application of the model for future scenarios. A separate meeting will be held to deal specifically with modeling assumptions for application of the model. It was stated that the City of Waco consultant and the dairy industry's consultant had separately requested consideration of a subcommittee meeting to discuss in detail model assumptions and application. A decision on this need was "tabled" until the end of the meeting. In addition, a request was made to have a meeting that would present validation results to the advisory group.

The meeting focused on five broad categories of assumptions as outlined in the assumptions paper distributed in early April 2006. The assumption categories dealt with the following:

1. Management and land use
2. Unauthorized municipal discharges
3. Modeling lagoon discharges
4. Sediment and nutrient removal efficiencies for PL-566 reservoirs
5. Use of soluble soil phosphorus in SWAT-TCEQ to represent soil test phosphorus

All of the following presentation and discussion centered on material provided in the document *Modeling Assumptions for Model Validation Refinement and Application of the North Bosque River TMDL Modeling System* made available to participants before the meeting.

### 1. Management and Land Use Assumptions

Dr. Jim Houser presented the first section on management and land use assumptions. The first items discussed pertained to dairy cow and other livestock quantities in the watershed. The assumptions concerning dairy cow numbers (which drive the manure quantities and characteristics for the model) focused on quantifying collectable manure from the confinement area for land application. Assumptions defining and quantifying the types of dairy cows in confinement were presented. Estimation of confined dairy cows based on inspected cow numbers assumed that most heifers and dry cows are grazed. Manure from heifers and dry cows will be handled in SWAT as part of the grazing function. The inspected cow numbers do not include calves, but were used as a basis for estimating calf numbers.

- a) A question was raised as to whether inspected cow numbers only include dry cows in confinement and not the dry cows that are grazed. Dr. Houser stated that TIAER will check with TCEQ dairy inspectors to see if this is an appropriate assumption.
- b) A question was raised over that possibility that, even though the cow numbers of the entire watershed do not differ much over the validation time period, cow

- numbers may vary within individual subbasins and, if they do, how would this be handled in the calibration? It was explained that calibration for subbasins will be performed for subbasins with “minimal” change in cow numbers, and that a method will be presented to the committee that will quantify the acceptable maximum level of change.
- c) Prompted by a question from the stakeholders, it was pointed out that grazing is assumed to occur only on pasture and rangeland not designated as dairy waste application fields.
  - d) Dr. Provin indicated that the application rate for turkey litter was probably higher than the nitrogen (N) rate during the mid 90s, perhaps as high as 10 to 20 tons/ac. Based on his experience, Dr. Provin suggested a minimum application rate of 5-6 tons per acre. TIAER will look into applying the turkey litter at a higher rate.

Next Dr. Houser presented the characteristics of land applied solid and liquid manure. General assumptions and methodologies of determining manure nutrient content were presented, as well as expected nutrient losses from solid and liquid manure before and during land application.

- e) Concerns about changes in the diet and bedding that may lead to additional phosphorus (P) amounts in the calibration/validation period were raised. Dr. Houser explained that the algorithms used for calculating manure P content take into account the P content of the diet and that dietary P content for the calibration period and more currently have been obtained from the dairy industry and extension dairy specialists.
- f) Concerns that the level of total solids (TS) in the liquid manure seemed too high were expressed. It was explained that TS does not actually play a role in the biophysical simulations within SWAT.
- g) Dr. Provin pointed out that settled lagoon solids are often too saline to land apply. He wanted to know if a survey could be conducted to determine how often dairies clean out solids and indicated that some lagoons are covered and abandoned once they fill with solids. It was suggested that Dr. Tamilee Nennich (Erath County Extension Dairy Specialist), Dr. Saqib Mukhtar (Associate Professor & Extension Specialist in the Department of Biological & Agricultural Engineering at Texas A&M University (TAMU)), and representatives from the dairy industry be contacted for their opinion.
- h) Questions were also raised about whether lagoons are often abandoned once they fill with solids rather than having solids cleaned out, and, as lagoons fill with solids, could this lead to more lagoon spills due to a decrease in capacity? Bruce Wiland pointed out that agitation is often used to mix solids rather than dredging because there are concerns with disturbing the integrity of the clay liners.
- i) Dr. Lial Tischler suggested that the amount of P that settles in lagoons could be part of the sensitivity analysis. Dr. Houser added that in the simulation settling of solids in the lagoon removes 17.3% of P from the lagoon influent which only accounts for 1.32 lb P/cow/yr of the total 59.5 lb P/cow/yr (2.2%).

Dr. Houser next presented assumptions on crop agronomic rates and the amount of manure required to meet the crops N requirements based on anticipated manure N availability and N losses upon application.

- j) Mr. Wiland requested that the terms *crop requirement* and *crop removal rates* be used rather than agronomic rates. Also, he noted that the presented crop agronomic rates do not seem to correspond with Natural Resources Conservation Service (NRCS) values used in the NRCS spreadsheet associated with dairy permits. Dr. Houser replied that these were rates recommended by TAMU but he will follow this up and look at the spreadsheet Bruce Wiland was referring to.
- k) Dr. Provin cautioned about the differences in yield potential between grazing and hay fields, and questioned if the crop listed as sudan was actually sudan sorghum.
- l) Mr. Wiland wondered if the N is accounted for in the second year after application. Dr. Provin answered that there is no “banking” of N; the available N not used in the first year is assumed to be lost prior to the second year.
- m) The group agreed with the assumptions regarding manure N availability and loss, but Dr. Provin suggested that even the fields where solid manure is incorporated upon application would show some N losses due to volatilization because the common practice is not to immediately incorporate the manure. TIAER had the volatilization loss for incorporated manure set at zero, but agreed to set the loss at 10 %.
- n) Mr. Wiland asked if crop removal rates are considered? Dr. Hauck responded that the model grows the plant so there is the additional need to double-check that the results for yields and nutrient removal make sense. Dr Provin added that the TAMU web site for crop nutrient requirements will soon be updated to include better information on yield potential.
- o) Dr. Provin also mentioned that plants grown on high soil test P soils will take up more P than plants grown on lower soil test P, which is mainly a factor in high soil test P hay fields. He wondered if the model could be altered to address this plant response. Dr. Hauck responded that it may be possible and that TIAER will look into this.

## 2. Unauthorized Municipal Discharges

The next section of the meeting dealing with the modeling of unauthorized municipal wastewater discharges was presented by Dr. Hauck. He explained how the frequency and concentration of discharges for each wastewater treatment plant (WWTP) in the watershed was determined. These discharges will be added as a point source to SWAT on a daily basis on the day of the discharge.

- a) Jerry Golden asked if actual WWTP effluent data were used and where were the measurements taken and when? Dr. Hauck explained that for the calibration/validation period, effluent measurements taken directly from the WWTP discharge for each plant will be used as an indication of what came out of the plant. These data were collected by TIAER in the mid to late 90s for about three years.

## 3. Modeling Lagoon Discharges

Dr. Anne McFarland presented the next section on modeling lagoon discharges. She explained how the present lagoon discharge model performs a water balance for the lagoon system of each dairy, assigns one of three different lagoon management strategies to each dairy, and predicts the size and number of lagoon discharges based on rainfall

data. The output of this model becomes a point source input to SWAT at the subbasin level.

- a) Dr. Tischler pointed out that defining a rainy day at 0.05 in. appears to be a bit low. James Miertschin suggested using 0.10 in. based on values used in similar situations.
- b) Several people suggested that the three lagoon management scenarios be labeled A, B and C rather than average, above average and below average.
- c) There was discussion as to whether or not a minimum cut-off volume should be considered for a discharge event. The conclusion reached was that a minimum cut-off volume should not be used to restrict the occurrence of a simulated discharge event.
- d) Dr Provin thought that the discharge nutrient concentrations being considered looked too high and that lower concentrations would be more appropriate because of dilution from rainwater associated with the timing of most lagoon discharges. He wondered if actual discharge values were available. Dr McFarland responded that very few actual discharge values are available. Based on his experience, Dr. Provin thought a concentration of 20 mg/L P would be an approximate average during a lagoon discharge event. Dr. McFarland suggested truncating the self-reporting data set to provide a more reasonable average concentration. Dr. Tischler warned that the truncation should be done statistically not subjectively.
- e) Dr. Provin thought the inorganic/organic ratio in the lagoon effluent should be reversed from what TIAER is using. He also indicated that typically the soluble P in a lagoon is about 8-12 mg/L regardless of the concentration of particulates present. Dr. McFarland explained that TIAER values are based on values from the literature, however, if Dr. Provin could provide sufficient documentation the ratio could be altered. Dr. Tischler agreed that unless we have literature values or something else, the ratio should not be changed.
- f) The group thought it would be useful to provide the size distribution of discharge events as part of the calibration. Also sensitivity analysis on the in-stream impact at a variety of spatial levels (subbasin and full watershed) would be desirable in defining how important lagoon discharges are to stream water quality. Mr. Wiland indicated that modeling efforts by Baylor University for the City of Waco indicated that lagoon discharges only had a minor impact on overall water quality to Lake Waco.
- g) No feedback was received at the meeting, but TIAER requested any feedback the committee would have on TIAER's proposed method to handle double-accounting of lagoon discharge nutrients and the land application of liquid waste nutrients.

#### 4. Sediment and Nutrient Removal Efficiencies for PL-566 Reservoirs

Dr. McFarland presented the next section of the improved modeling of the PL-566 reservoirs which entailed developing annual average nutrient removal efficiencies for the reservoirs based on the sampling of two reservoirs — one that drained an area with many WAFs and one that did not.

- a) Discussion ensued over applying the average of the removal efficiencies for the two reservoirs to all PL-566 reservoirs in the watershed. It was decided that these

efficiencies represent the best information available and to move forward with this assumption.

- b) The committee requested that it would be useful to know the distribution of land use above each PL-566 reservoir and also the size of the watershed and storage capacity of each to help determine how typical the two reservoirs studied are to the other reservoirs.
- c) It was suggested that a sensitivity analysis could reveal the significance of these removal efficiency differences.

#### 5. Use of Soluble Soil Phosphorus in SWAT-TCEQ to Represent Soil Test Phosphorus

Dr. McFarland and Dr. Hauck presented the last section on the use of soluble soil P in SWAT to represent soil test P, with assistance from Dr. Houser on determining a proper starting date for SWAT. They discussed the need to convert or translate the soluble soil P concentration predicted by SWAT into soil test P as part of a method to determine starting date of the validation simulations and for future applications where different manure application rates would be based on soil test P concentrations. Dr. McFarland introduced the algorithms in the literature she used to derive equations that convert values of soluble soil P from one soil test method to another.

- a) Dr. Provin indicated that he was not fond of the conversions presented and indicated that slightly different laboratory methods were used for determining Mehlich-3 in the paper by Ketterling and Flock (2005) than are normally used. He also indicated that he had a dataset and equations from the High Plains that he would provide that should help develop more localized relationships for translating between soil test P laboratory methods and the soil soluble P used in SWAT.
- b) Dr. Tishler indicated that in lieu of additional information forthcoming, what Dr. McFarland had developed would be sufficient, but he suggested sensitivity analysis to determine the potential significance of different methods.
- c) There was some discussion on the method for determining the initiation date for SWAT validation simulations. It was generally decided that the approach presented will suffice.
- d) It was explained that the model needs a start-up period of a couple of years to equilibrate soil moisture and other variables.
- e) Dr. Provin expressed some doubt about the SWAT soluble soil P output, indicating it would take several years to go from low soil test P concentrations to a notable amount of P in the soil ( $> 35$  ppm). Dr. Houser pointed out that SWAT does not mechanistically mimic all of the P functions.
- f) While SWAT is capable of simulating soil test P concentrations at the 0-2 inch and 0-6 inch levels, Dr. Provin warned that the physically collected 0-2 inch soil test P results may be suspect and that the 0-6 inch soil test P results should be used exclusively for calibration purposes.

In conclusion, Dr. Hauck indicated (as he had earlier in the meeting) that the City of Waco and the dairy industry had expressed interest in having a more technical meeting about the modeling assumptions. It was decided that a more detailed technical meeting was not necessary at this time and that if questions/comments arose from either the dairy

industry or the City of Waco, the questions/comments and responses would be shared with both groups.

The meeting adjourned at 2:30 PM.

Action items (refer to the item identification, e.g., 1.a, in the meeting minutes above):

- 1.a. TIAER will check with TCEQ inspectors to determine what their inspected dairy cow numbers include.
- 1.b. For the three inspection periods averaged for the SWAT validation period, TIAER will assess the cow numbers in the different subbasins and quantify the degree of change in those subbasins during the three periods.
- 1.e. TIAER will consult with dairy specialists and the dairy industry to determine the degree of contribution of bedding and feed wastage to waste disposal nutrient during the validation period.
- 1.g-i TIAER will consult with dairy experts to determine the most likely lagoon clean-out methodology and different lagoon solids application scenarios will be added to the sensitivity analysis.
- 1.j TIAER will investigate the crop requirement rates indicated in the NRCS spreadsheet referred to by Mr. Wiland, but TIAER intends to use the fertilizer rates recommended by TAMU and watershed specific information gathered from County Extension agents.
- 1.k. Management files will be checked to ensure that fertilizer recommendations are correct for the grazed pastures.
- 1.o. TIAER will look at the possibility of adjusting SWAT crop growth parameters to affect this change; however, any changes will need to be supported by the literature and/or agreed upon by the advisory committee. It is suspected that such model changes and adjustments are beyond the scope of this current project.
- 3.a. For the lagoon discharge program, a rain day will be defined as 0.10 in. as per recommendation.
- 3.b. The management scenarios will be referred to as A, B, and C as recommended.
- 3.d. The self-reporting lagoon nutrient data set will be truncated using statistical procedures.
- 3.e. Further investigation of the literature will be conducted to assess the inorganic to organic ratio of P in lagoon discharges.
- 3.f. The impact of different lagoon discharge scenarios will be added to the sensitivity analysis.
- 4.a. To determine how representative are the two studied PL-566 reservoirs land use, drainage area, and volume associated with each PL-566 reservoir in the North Bosque River watershed will be characterized.
- 4.c. The effect of different PL-566 reservoir nutrient removal efficiencies will be added to the sensitivity analysis.
- 5.a. The soil test P relationships to be provided by Dr. Provin will be analyzed and changes may be made to the conversion function based on this new information.
- 5.f. The soil test P concentration in the 0-6 inch layer will be used for purposes of SWAT calibration.