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Email Transmittal

Central Platte Natural Resource District  
Board of Directors  
215 N. Kaufman Ave.  
Grand Island, NE 80368

Subject: COHYST

Dear Directors:

I was pleased to be able to attend the June 26, 2003 meeting of the Water Resources Committee. As a landowner of surface and irrigated Platte Valley farmland, I am extremely interested in the COHYST project. If this is done incorrectly, it will have an economically devastating effect on individual landowners, farmers, the entire Platte Valley, and in fact the entire state of Nebraska.

I have been very concerned about the sense of Asecrecy@ regarding this project, and the lack of publicly disclosed (or even willingness to discuss) plans for confirming the correctness of the COHYST model predictions. My attempts to obtain specific information that would factually confirm that plans are in place to fully, and accurately, confirm the correctness of predictions by this computer model had failed to obtain satisfactory answers.

I have been anxiously searching for factual information which would allow me to conclude that the COHYST project is being executed in a manner which will result in proof of adequate accuracy of the model, at all locations where it will be used, and ways to protect an irrigator against harm due to an incorrect prediction by the computer model. I had hoped that the presentation on June 26, 2003 would provide this kind of information, since the three primary modelers were to be presenting it. That is why I was willing to make a special trip to Grand Island, after being invited to do so, to attend this meeting.

Unfortunately, this meeting has intensified my concerns. Let me give you some of my reasons.

Not all is bad, however. I was pleased to hear Ron Bishop emphasize that the purpose of COHYST is to protect the irrigator/farmer. That should clearly be the goal of this project. And, I was pleased to hear the presenters state that ASponsors said to take more time and make the models even better@

However, after attending this meeting and having some time to interact on issues that surfaced, I am now more concerned than ever about the project status. In fact, I am now completely convinced that this project is seriously flawed and needs a complete re-evaluation and redirection.

Let me summarize the areas I am concerned about. Details will follow later in this letter along with my specific suggestions to address the various problems which I have identified.

1. There are no adequate plans to prove the COHYST Model is correct.
2. Model calibration plan(s) violate the ASTM standard stated to set the calibration criteria.
3. There is not an adequate plan to protect the landowner/farmer/irrigator from harm due an incorrect model prediction.
4. In fact, the approach to problems caused by COHYST model inadequacies incorrectly place the burden of proof on the landowner/irrigator instead of with the CPNRD where it belongs.
5. In general, the presentation was not convincing that the direction that ASponsors said to take more time and make the models even better@is truly ingrained in the project.

### **ISSUE DETAILS:**

#### **1. Inadequate model verification plans.**

There was not any specific explanation of just exactly what is going to be done to perform adequate field tests to confirm the model predictions are correct. All references were to standard ASTM D5981-02. A complete examination of that standard shows that it is of a most general nature. It is comparable to describing the process of successfully growing a corn crop in general terms such as as 1) tilling the soil, 2) planting seed, and 3) applying irrigation water. Certainly, that level of detail would not allow someone to know specifically what to do in order to obtain a good crop. Neither does the ASTM standard provide adequate detail to insure that the model is correct. To know when such a model is complete there needs to be specific quantitative criteria defined to establish success. There is no such level of detail in the ASTM standard, and none was provided by the presenters.

#### **Recommendation:**

A specific and complete test plan needs to be developed. This plan should define the overall criteria for testing, such as what specific tests are going to be performed to confirm which specific portions of the model. It should define the iterative process required to adjust the model to match actual physical results and establish the exact criteria for determining when the model results are within an acceptable range of the physical results. It should also specifically define the size of the geographical areas (cells) which will be used to verify the model against actual field tests. It should specifically identify the locations of physical testing planned to confirm the model's correctness. It should define the nature of instrumentation and test processes required to perform all verifications.

This plan should go through more than just a peer review. There need to be outside audits by independent parties who are skilled at the standard engineering process of confirming the performance of systems. These people do not necessarily have to be hydrologists or modelers. In fact, it is best to have some people who are neither. This brings independent thought into the process and will identify problems overlooked by a group of people who probably all think alike, which is the biggest risk of peer review by a group of specialists who all do the same kind of work. Deficiencies are often missed. This independent method of confirming predictions is standard operating procedure in the industries I have been associated with and result in reliable outcomes. Without this approach - as seems to be the case with COHYST - flaws will never be noted until it is too late.

Following approval by independent entities of the test plan, a full set of detailed specific test procedures then needs to be developed. A similar independent review process needs to be performed. These procedures should specifically define the exact sites, methods, equipment, instrumentation, and acceptable limits for confirmation of the model predictions compared to the physical tests. These procedures should be unique to each test site where there is any expectation of differences that require unique procedures for those specific sites. And, such procedures must be detailed for each individual step of the process, so that someone not specialized in the technology can perform the tests and still yield accurate and reproducible results.

## **2. Model Calibration philosophy violates ASTM D5981-02.**

Specifically, during Mr. Luckey's presentation (Slide 13), he basically stated that the model would not be modified simply to make the model better fit calibration observations.

Mr. Luckey's answer to my question as to why the model would not be adapted to match calibration observations was basically evasive and did not specifically justify this violation of the basic approach to any modeling which is generally expected in the industries with which I have been associated. It also violates the basic principles as outlined in ASTM D5981-02 which Mr. Lewis basically stated was being used to know when we are done. Specifically, it violates the definition of Paragraph 3.1.3 which is:

**A 3.1.3 calibration (model application) ---** the process of refining the model representation of the hydrogeologic framework, hydraulic properties, and boundary conditions to achieve a desired degree of correspondence between the model simulations and observations of the groundwater flow system.

What this suggests is that if the results of the model do not match known physical results, the model is to be modified so that it does. Otherwise, the model is incorrect, and from my own experience cannot be relied upon for any predictions. This would, of course, require that the physical results are first reconfirmed by the necessary testing, either as full retesting or properly complete regression testing. This is a standard approach to development of any model. Unless it is done this way, the model is basically useless, as it will not properly predict correct outcomes.

**Recommendation**

This kind of situation is clearly an indication of the failure of the Apeer review@process. And, it is an example of the kind of problem which an independent outside technical and management audit of the project should quickly identify. It also generally points to a problem with the overall management of this project.

There must be a change of approach by the modelers regarding this matter of confirmation that the model is correct. This is both a technical and a management problem. It is recommended that a full, complete, and independent technical and management audit of the program be performed to see just how far this type of problem permeates the project. It is my experience that when one such indicator surfaces, it usually is just one indicator of many serious problems like it throughout the program. That is particularly true when such is evident in the work of a lead individual, as is the case here. A project with this kind of problem left uncorrected is inevitably going to be a failure.

COHYST will affect livelihoods and must be treated with appropriate rigor. That does not currently appear to be the case.

**3./4. Failure to protect the landowner/irrigator.**

There was little time left for discussion after the lengthy presentation. However, the brief discussion which I was able to have clearly showed a serious lack of protection for landowners and irrigators against harm from flaws in the COHYST model. Instead of placing the burden of proof on the regulatory entity (CPNRD) to ensure decisions based on COHYST model analysis are absolutely correct, it is apparent that the burden of proof is going to be on the landowner/irrigator to prove the model is wrong. This hardly Aprotects the farmer@! This is inappropriate and must be corrected.

I am specifically referring to my question as to how the farmer is going to be protected against harm from incorrect model predictions. The response by Mr. Lewis was most disturbing. He essentially stated that Athe farmer will have the right to challenge the prediction and ask for an exception.@This clearly implies that the burden of proof will be upon the farmer to prove the model wrong. And, presumably the farmer will have to bear the burden of cost and time to do so.

This is clearly and simply inappropriate.

**Recommendation:**

First of all, as I told the Board at the time, this is incorrect and flawed policy. It clearly should be the responsibility, in fact I believe it to be the inherent obligation, of the CPNRD Board of Directors to be absolutely certain that tools which they use to make regulatory decisions will be correct and not cause harm to the irrigator due to flaws in those tools - such as an incorrect prediction by the COHYST model.

The COHYST development is a very complex and challenging project. Because of that, and how

critical it is to the future of irrigated agriculture in the Platte Valley, it may require some time and a great deal of effort for the CPNRD Board of Directors to fully address the challenges and issues associated with the project.

It would clearly be appropriate for CPNRD to engage a firm with specific expertise in managing projects of complex and diverse technical content with a record of timely and reliable results with assertive management of projects that affect lives and/or livelihood. That project manager needs to be certain that the criticality of this project's correctness be ingrained in every individual and organization involved in it. This is not merely an academic exercise, but one which will effect the lives and livelihood of nearly everyone involved in, or affected by, the irrigated agricultural industry in the Platte Valley.

Today, it appears to be approached as a mere academic exercise. This is unacceptable.

**5. Failure to take the necessary time and effort to Amake the model better@.**

The previous discussion and recommendations relate directly to this item. Without adequate verification/calibration and model iteration, this goal is not being met. And, it must be met.

**SOME ADDITIONAL GENERAL COMMENTS:**

1. COHYST appears to be at a rather early stage of development. It is far from being complete. The COHYST development is a challenging, diverse, and difficult project. Such projects require several stages to complete. The first stage is usually analytical in nature with some limited testing to confirm that the analytical methods being developed are correct. It is apparent to me that this is where COHYST is. It is almost an academic exercise@ at this stage of (im)maturity.
2. At least two additional stages of development are required before COHYST can be used. The final stage is the full and complete set of field tests covering the entire region which must occur to verify the accuracy of the model. It is my personal opinion that the level of granularity should be not larger than 160 acres in size - at least in the vicinity of any wells that are going to be potentially regulated. In fact, each well to be considered for regulation should be fully tested to confirm model correctness for that location. Only after that is confirmed, can there be reasonable expectation to use the COHYST for future decision making in that location.

And, if the regulation is going to be potentially adverse to the farmer, the policy must be to place the burden of proof on CPNRD and extensive field tests, independently verified, must be required before any control actions occur.

3. The purpose of the June 26 meeting would have been better served if the presentation had concentrated more on the specific facts of the COHYST model, the current status, and the steps planned to ensure the correctness, integrity, and reliability of the completed model. Instead, there was a large amount of time spent on presenting the qualifications of the individuals.

While the qualifications of team members are important, once the project team is selected and the project is underway, it is more productive to concentrate on results. As a result, there was very little time for interaction on the project issues. The results of the team's work are what matters. I would suggest that results be the focus for future reports on project status. This is what is required to determine if there is adequate progress on this challenging project so that it might be successful.

4. I am disappointed to conclude that not enough of the right things are getting done on the COHYST project.

**RECOMMENDED CORRECTIVE ACTION:**

In cases such as this, it is commonplace to bring in truly independent entities to assess the actual status of the project in minuscule detail. Then, corrective action plans are developed to get the project back on track to a successful end. This usually involves specific technical changes to the project. And, it often requires changes in personnel and/or the organizations managing and performing the work.

Troubled projects usually get that way because of both technical and management problems. In this case, I believe one of the fundamental problems is that it is being treated as an "academic exercise". There needs to be a more adequate level of practical emphasis to ensure that the resulting model will actually correctly predict the interactions it is designed to predict. There is an apparent failure to treat it with proper seriousness in view of the serious impact it may have on the lives and livelihoods of those who depend on irrigated agriculture in the Platte Valley of Nebraska.

These characteristics are symptomatic of both a management and a technical problem.

I urge the CPNRD Board of Directors to immediately start the process of taking timely and effective action to correct the direction of this project before it continues to an unsuccessful end that will harm the entire State of Nebraska.

I would appreciate receiving your response to these recommendations as soon as possible.

Respectfully,

Ronald D. Klein, P.E.