pt 43

MENOMINEE INDIAN TRIBE OF WISCONSIN
P.O. Box 910
Keshena, WI 54135-0910

715
799-5113

August 26, 1997

Apesanahkwat, Chairman
Menominee Nation

Dear Wisconsin Legislator,

According to an August 15 letter from Wisconsin Department of Natural Resources to Crandon Mining Company that I recently reviewed with the Menominee Nation's expert in groundwater flow modeling, the groundwater flow model data supplied by Crandon Mining Company (CMC) for its proposed Wolf River mine is inaccurate and unacceptable. In fact, the data supplied by CMC is of such poor quality that it calls into question the reliability of the company's groundwater flow model and its usefulness as a predictive tool for evaluating mining impacts (see enclosed letter from Wisconsin Department of Natural Resources to Crandon Mining Company).

Although the Wisconsin Department of Natural Resources (WDNR) has requested that CMC revise its groundwater flow model, I believe that CMC has demonstrated that it cannot be trusted to supply appropriate data for a critical study of groundwater which is the basis for other important studies of surface waters. I think stronger measures than a revision are required to make sure that CMC provides accurate data in order to be able to protect the quality of the Wolf River for future generations.

I realize the Army Corps of Engineers (ACE) also has a responsibility to evaluate the groundwater aspects of Crandon Mining Company's Environmental Impact Statement (EIS), but the Menominee believe the ACE and WDNR have not, as yet, exerted sufficient regulatory authority to ensure that an adequate evaluation of CMC's groundwater flow model data for their EIS is being made.

The permitting process for the proposed Crandon mine, which has been going on since 1994, was supposed to be in the Master Hearing by the end of this year or early next year. Wisconsin

Indian tribes and citizens have had to invest large amounts of time and dollars to protect themselves from the negative impacts of sulfide mining on their environmental and economic resources during this time. Now with the recent extension of the permitting process into 1999, your constituents will continue to suffer economic and emotional hardship for a huge sulfide mine project that will use unproven technology. I do not believe your constituents should have to be an experiment for Exxon.

Therefore, as Chairman and representative of the people of the Menominee Nation I am writing to request that you use the full authority of your office to initiate and/or conduct a complete investigation of the groundwater flow model data produced by Crandon Mining Company for their proposed Wolf River mine. I am also requesting that, until Crandon Mining Company can produce a scientifically reliable groundwater flow model, that the permitting process for CMC's proposed mine near Crandon be put on hold.

Sincerely,

Apesanahkwat, Chairman
Menominee Nation

Cc:
Arlyn Ackley, Chairman, Mole Lake Sokaogon Chippewa
Phil Shopodock, Chairman, Forest County Potowatomi
George Meyer, Secretary, WDNR
Colonel John Wonsik, ACE
Dan Cozza, EPA Region V
Representative Spencer Black
Representative Marc Duff, Chairman, Assembly Environment Committee
Wisconsin environmental groups

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NEWS RELEASE NEWS RELEASE NEWS RELEASE NEWS RELEASE

August 26, 1997

For Immediate Release

Exxon's CMC Groundwater Data Highly Questionable

(*Keshena, WI*) "A million dollar public relations campaign can't buy quality science. The entire permit process for Crandon Mining Company should be put on hold until they provide a scientifically valid groundwater flow model," stated Apesanahkwat, Chairman of the Menominee Nation.

The Menominee Chairman asked Wisconsin's members of Congress and the Bureau of Indian Affairs today for state and federal investigations of groundwater flow model data supplied by Exxon's Crandon Mining Company (CMC) and requested that the permit process for CMC's proposed Wolf River mine be put on hold until CMC provides an accurate groundwater flow model.

Apesanahkwat became outraged after receiving a report from the Menominee Nation's groundwater expert about an August 15 letter from Wisconsin Department of Natural Resources (DNR) to Crandon Mining Company. The DNR letter indicates CMC used inaccurate and inappropriate data to create its groundwater flow model. In the letter titled "Review Comments on the Crandon Mining Company Groundwater Flow Model, Dated August 1996: Model Input - Unconsolidated Glacial Geology," Chris Carlson, Hydrogeologist for WDNR stated that the DNR and U.S. Geological Survey (USGS) staff who reviewed CMC's groundwater flow model:

> "found several areas where we have comments or concerns. Several of these appear to be errors which may affect the model results. Several others are inconsistencies which may not directly affect model results, but do make the review extremely difficult and time consuming and call into question other parts of the model input."

-- more --

Carlson concluded his letter by stating the DNR believes "the model and model narrative should be revised."

"The groundwater flow model is supposed to provide baseline data to develop other equally important studies of surface waters, but CMC appears to have manipulated their groundwater flow model to predict minimal impact by using critical values which are unreasonable and physically impossible." stated Apesanahkwat.

"CMC's data is inconsistent. The groundwater data reported in their EIR does not match the data used in their groundwater flow model." stated Apesanahkwat. "That's the science Crandon Mining Company expects the citizens of Wisconsin to trust. Crandon Mining Company has repeatedly stated the public can trust it to use reliable science and proven technology, but CMC's groundwater data is so poor that it calls into question all of the company's studies for their proposed mine."

"The DNR is being extremely polite to Crandon Mining Company when what the Department should be doing is putting the entire permit process on hold," stated Apesanahkwat. "The erroneous, inconsistent data supplied by CMC only substantiates what people opposing this mine have said for over twenty years: the area where CMC's mine would be located has so many ground and surface water bodies that it is too complex to ever be modeled successfully. CMC's data certainly shows we can't rely on them to create a workable groundwater flow model."

Apesanahkwat believes CMC's groundwater data should be a wake up call. "The public trusts elected officials and the DNR to protect their resources, but if CMC's groundwater data is that company's example of consultation and cooperation with the public and agency officials, the public needs to get concerned and get involved. CMC's groundwater data reveals the big lie behind their glossy public relations campaign."

"The Menominee Nation, other tribes and other Wisconsin organizations have hired experts to oversee the permitting project. We are not going to stand by and let our clean water, clean air, and healthy economy be destroyed by a sulfide mine. I'm calling on people in Wisconsin and around the world who are concerned about sulfide mining to demand that the Wisconsin DNR halt the permitting process for Exxon's proposed Wolf River mine until state and Federal investigations are conducted of CMC's groundwater data input and CMC provides a scientifically valid groundwater flow model."

The August 15 letter from the DNR to CMC may be viewed on the Menominee Nation Treaty Rights & Mining Impacts web site: http://www.menominee.com/nomining/dnr815a.html

-- end --

Treaty Right

WISCONSIN
DEPT. OF NATURAL RESOURCES

State of Wisconsin \ DEPARTMENT OF NATURAL RESOURCES

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George E. Meyer, Secretary

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CHAIRPERSON'S OFFICE

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AUG 20 1997
MINING IMPACTS

August 15, 1997

Mr. Don Moe
Crandon Mining Company
7 North Brown Street, 3rd Floor
Rhinelander, WI 54501

SUBJECT: Review Comments on the Crandon Mining Company Groundwater Flow Model, Dated August 1996: Model Input - Unconsolidated Glacial Geology

Dear Mr. Moe:

The Department and its consultants are continuing with the review of the groundwater flow model submitted by the Crandon Mining Company (CMC) in support of its permit applications and environmental impact report for the proposed Crandon Mine. This letter provides comments on the model input for the unconsolidated glacial geology. The attached memo provides a more detailed review.

A meeting has been tentatively scheduled for Tuesday, September 16 at 10am in Rhinelander to discuss the Department's series of regional flow model review/comment letters and the company's responses. The Department letters and CMC responses consist of this review letter on model inputs; the January 9, 1997, letter with initial review comments; the March 3, 1997, CMC response to the January letter; the May 16, 1997, review letter on the bedrock interface representation; the July 1, 1997, comment letter on the CMC March response; and the July 3, 1997, review letter on the geologic interpretation. Please contact me as soon as possible to finalize the meeting time and agenda.

We have found several areas in the model input where we have comments or concerns. Several of these appear to be errors which may affect the model results. Several others are inconsistencies which may not directly affect model results, but do make the review extremely difficult and time consuming and call into question other parts of the model input which we have not reviewed in detail. It is important that the model be set up as indicated in the model narrative and that inputs be consistent throughout the model domain - including areas where cells are inactive in the final simulations.

Please revise the model input and the narrative to account for our comments and concerns as detailed in the attached memo. In particular, please include the following:

- A complete, detailed narrative explaining the process used to convert the manually-defined hydrostratigraphic layers on the cross sections in the site area to model hydrostratigraphy and model input. Include details on the algorithm used to define the model input in the areas between cross sections.
- Revisions to the model and the model narrative to accurately and appropriately represent the lakes in the Lake Stage Package and model Layer 1. Include appropriate details and figures to clarify the model structure and the estimation of the inputs.

- Revisions to the model to eliminate negative values of VCONT or revisions to the model narrative to explain the use of negative VCONT values (provide documentation as to the appropriateness and prior use of negative VCONT in MODFLOW).

- Revisions to the model to eliminate ACALCed hydraulic conductivity values which are lower or higher than reasonably possible.

Since, based on our work presented here, we believe the model and model narrative should be revised, we suggest that you include responses to the comments and questions we raised in the last three flow model review letters and the comment letter on your response to the first review letter in those revisions. In addition, we suggest that you consider using the precipitation and evaporation information developed by the Army Corps of Engineers and its contractor in your model revisions.

Please feel free to contact me at 608/267-0856 if you wish to discuss this further.

Sincerely,

Christopher P. Carlson, P.G., Hydrogeologist
Bureau of Waste Management

attachment

cc: Bill Tans - SS/6
Stan Druckenmiller - AD/5
Dennis Mack - WA/3
Larry Lynch - WA/3
Dave Johnson - DG/2
Edwina Kavanaugh - Public Intervenor - LS/5
Archie Wilson/Ken Markart - NR-Rhinelander
Chuck Fitzgerald - NR-Rhinelander
Dave Kunelius - NR-Rhinelander
Ken Bradbury - WGNHS
Jim Krohelski/Randy Hunt/Chuck Dunning - USGS-Madison
Daniel Feinstein - USGS-Milwaukee
Dave Blowes - University of Waterloo
Jerry Sevick - Foth & Van Dyke
Peter Andersen - HSI GeoTrans
Dave Ballman - US Army COE
Mark Myers - US Army COE
Earl Edris - US Army COE - WES
Dan Cozza - US EPA Region V
Margaret Thielke - US EPA Region V
Robert Jaeger - BIA
Janet Smith - USFWS
John Coleman - UW-Madison (GLIFWC)
Mark Nelson/Benjamin Gresser - Horsley & Witten
Doug Cherkauer - UW-Milwaukee
Arlyn Ackley - Mole Lake Sokaogon Chippewa
Apesanahkwat - Menominee Nation
Phil Shopodock - Forest County Potawatomi
Dave Blouin - Sierra Club

MARCH 3, 1849

United States Department of the Interior

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RECEIVED
AUG 2
CHAIRPERSON

To: Chris Carlson, WDNR

From: Chuck Dunning, USGS CPE
Dave Johnson, WDNR DAJ

Date: August 15, 1997

Re: Verification of Model Input Data Representing Unconsolidated Glacial Deposits in the Crandon Mining Company's Ground-Water Flow Model.

The attached document is the product of a review of the model input values for model layers 1 through 4 as presented by Crandon Mining Company in the Environmental Impact Report and related documents and files. The review was requested by the Wisconsin Department of Natural Resources as part of its evaluation of Crandon Mining Company's ground-water flow model presented in the Environmental Impact Report.

Please feel free to contact either author with questions concerning the review.

Verification of Model Input Data Representing Unconsolidated Glacial Deposits in the Crandon Mining Company's Ground-Water Flow Model

Charles Dunning and David Johnson
August 1, 1997

In order to assist in the review of documents submitted by the Crandon Mining Company (CMC), the Wisconsin Department of Natural Resources (WDNR) has requested a review of the model input data to CMC's ground-water flow model. The review of model input data representing unconsolidated glacial deposits in CMC's ground-water flow model as presented in the Environmental Impact Report (EIR) (August 28th, 1996 report titled **Final Report on the Numeric Simulation of the Effect on Groundwater and Surface Water of the Proposed Zinc and Copper Mine Near Crandon, Wisconsin**) is the subject of this letter.

An evaluation of the glacial stratigraphy presented by CMC in the EIR has been provided to the WDNR in a previous document (Dunning, Johnson, and Batten, June 30, 1997). This review of model input data will not refer to any differences in interpretation of glacial stratigraphy that were presented in the document by Dunning and others, but will focus on how CMC has represented their interpretation of glacial stratigraphy in the flow model. This is not a review of the appropriateness of model input values, but rather a verification of conformance between model input and the presentation of the geologic layers in the EIR narrative and on cross sections.

It was impractical to verify model input values for every cell and layer, so this review began by looking at model input data for approximately 175 model cells which contain approximately 285 boreholes and wells found on CMC's cross sections A through S (Appendix 4.2-3 of the EIR). This review is organized into three topics: 1) comparison of model layer boundaries to lithology as presented on cross sections A through S, 2) comparison of model layers thickness to model input values, and 3) comparison of model layer aquifer properties to model input values. Model input values for layer thickness and aquifer properties were compared to the glacial geology and model layers at the position of each well on the cross sections. Areas of concern were further investigated by looking at model input arrays from the Best Engineering Judgment model run (model run 68a).

It is important to keep in mind that even though our discussion focuses on a small number of model cells, the problems identified are potentially present in an additional number of other model cells.

As a result of this review, a number of concerns have been identified. These include:

- The steps taken to convert the 3 manually defined hydrostratigraphic units on cross sections to values used in model cells on and between cross sections are still unclear. As a result, it has been difficult during this review to determine whether questionable model input data represents a choice made by those constructing the model or is an artifact of the steps taken between the geology cross sections and the cell input values.
- The Lake Stage Package (LSP) input uses ¾ of the lake sediment thickness for calculating vertical conductance rather than ½ of the thickness as presented in the EIR flow model narrative.

- Under the internal lakes - Little Sand, Deep Hole, Duck and Skunk Lakes - VCONT (vertical leakance) between Layers 1 and 2 is calculated using the saturated thickness of Layer 1 as stated in the EIR model narrative. However, the saturated thickness of Layer 1 is much greater than either ¼ the lake sediment thickness (consistent with the LSP input) or ½ the lake sediment thickness (consistent with EIR). As a result, the VCONT calculated for model input is roughly one order of magnitude lower than VCONT calculated using ¼ of the lake sediment thickness, and will proportionally influence the movement of water across the boundary between Layer 1 and Layer 2 in the model.

- Negative values for VCONT (which are not possible given the equation for VCONT) are present in approximately 850 active cells in Layers 1 and 2. Many of these cells are in the model grid interior and go dry on the first iteration of a model run. As a result, these cells appear to behave essentially as inactive cells.

- In the north-central portion of the model (near and north of Swamp Creek), Layer 4 is found to be extremely thick in places and Layer 2 is found to be absent in places. This does not conform to the relative percentage thicknesses of layers described in the EIR to be applied outside the area defined by the cross sections, and could influence water movement in the model.

- Some model input thickness values are not consistent with descriptions in the EIR model narrative and/or their depiction on model layer cross sections. As a result, the glacial sediments may not be represented as well as possible in these parts of the model.

- Some model input hydraulic conductivity values are not consistent with descriptions in the EIR model narrative or estimates made from model layer cross sections. As a result, the glacial sediments may not be represented as well as possible in these parts of the model.

The numerous inconsistencies present in the model input made review difficult. In particular the input was not internally consistent throughout the model, and, in places, it was not consistent with the flow model narrative. Resolving these identified inconsistencies between model input data and the EIR could have an effect on model results and predictions. These inconsistencies and concerns are presented in detail in the following sections.

Comparison of Model Layers 1, 2, 3 and 4 to Geologic Cross Sections

Excerpts from EIR model narrative

Section 3.2.3.1.1 Definition of Hydrostratigraphic Units from Geologic Cross Sections

"The first step in the development of the glacial model layering entailed manually defining boundaries of the three basic hydrostratigraphic units, namely the upper till (or Late Wisconsinan till), outwash (fine and coarse), and lower till (or Pre- to Early Wisconsin till), from the geologic cross sections. Generally, the cross sections exhibit simple hydrostratigraphic layering enabling straight-forward vertical definition. In these cases, the following rules applied. Land surface is the uppermost boundary of the glacial system. In most cases, land surface is the top of the Late Wisconsinan till. The bottom of the Late Wisconsinan till is the first occurrence of continuous outwash (fine or coarse). In some cases, no Late Wisconsinan till is present and the top of the outwash is at land surface. Bottom of the outwash is defined as the first occurrence of continuous Pre- to Early Wisconsinan till. The bottom of the massive saprolite is considered to be the bottom of the glacial system for purposes of assigning model layers."

Section 3.2.3.1.2 Conversion of Hydrostratigraphic Units to Model Layer Top and Bottom Elevations

"Boundaries of the three manually defined basic hydrostratigraphic units (upper till, outwash, and lower till) along cross sections were converted to hydrostratigraphic top and bottom elevations in three-dimensional space using Arc/Info's dynamic segmentation functions using lateral data density of 100 to 500 feet along the cross sections."

"The three hydrostratigraphic layers were then converted to four model layers as the outwash unit was divided into two halves to enhance the vertical resolution in the outwash."

"The total thickness of glacial overburden outside the area defined by the cross sections is the difference between land surface elevations from USGS quadrangle maps and top of bedrock elevations from seismic geophysics and borings (Golder, 1982: Foth & Van Dyke, 1995b). Individual model layers thicknesses were computed by multiplying the relative thickness of each layer as a percent of total overburden thickness, by the total thickness of overburden at each grid cell. Model layers one through four outside the area of the cross sections were assigned a relative thickness of 7, 35, 35 and 23 percent, respectively."

Creation of Model Layers - General Review Comments

- It would be helpful for this and subsequent reviews to have cross sections showing the 3 manually defined basic hydrostratigraphic units. These hydrostratigraphic units represent the intermediate step between geologic cross sections and model layers.

- The steps taken to convert the 3 manually defined hydrostratigraphic units on cross sections to values used in model cells on and between cross sections are still unclear. For example, what numerical procedures were used to extrapolate model input values between cross sections?

- Within the area defined by the cross sections, the intersection of the model layers and the geological cross sections (figures 3.8 through 3.26) show generally good agreement between layer boundaries and lithologic boundaries. However, it would have been preferable to compare model layer boundaries directly with the hydrostratigraphic unit boundaries. Examples of exceptions to good model layer and lithologic boundary agreement are presented in Table 1. These exceptions include instances where layer boundaries are higher or lower than the associated lithologic boundaries, thicknesses are questionable, or odd elevation changes occur in layer boundary position.

- The EIR narrative states that the thickness of Layers 2 and 3 are to be equal. Examples of cells where the thickness of Layer 2 does not equal the thickness of Layer 3 are listed in Table 2, and Figures 1,2,3 and 11.

- Outside the area defined by the cross sections, model Layers 1 through 4 were to be assigned a relative thickness of 7, 35, 35 and 23 percent, respectively. Seven percent seems to be a low relative percentage for Layer 1, and it is not clear how CMC supports this value.

- Outside the area defined by the cross sections, model Layers 1 through 4 do not consistently show relative thicknesses of 7, 35, 35 and 23 percent. Examples of significant deviations from these percentages are presented in Figures 1, 2 and 3. Layer thicknesses outside the area defined by the cross sections may have an effect on the base flow to Swamp Creek.

- Layer 2 is absent in an area along Swamp Creek in the north-central portion of the model. As a result, these cells go dry on the first iteration of a model run and appear to behave as inactive cells.

- Layer 4 is extremely thick in the north-central portion of the model. This thick zone trends from just north of Swamp Creek to an area between Lakes Metonga and Lucerne. This thick zone does not conform to the relative thicknesses of layers described in the EIR to be applied outside the area defined by the cross sections, and could influence water movement in the model.

Model Layer Thicknesses Used As Model Input Data

Excerpts from EIR model narrative

Section 3.2.3.3 Recent Lacustrine Deposits

"The recent lacustrine deposits under the lakes, creeks, and wetlands are incorporated in the model using the conductance term in the River, Streamflow Routing, or Drain package ... However, for Little Sand, Deep Hole, Duck, and Skunk Lakes the Lake Stage package was used. For these lakes, the upper half of the lake bed is represented in the conductance term of the Lake Stage package and the lower half of the lake bed comprises model layer one. This method of explicitly modeling the lower half of the lake bed as an active model layer was done to increase the vertical resolution of head under the lakes that are most likely to be affected by mining activities."

"The process of incorporating the lake beds as a model layer consisted of several steps and utilized the best available site data. The information available includes lake stage (from direct measurement), lake bathymetry (from the Inman Foltz survey, 1976), muck thickness (from borings), and lake bed thickness (from borings and surface geophysics). The general procedure was to "hang" or subtract surfaces from the lake stage. Specifically, the lake bathymetric surface was subtracted from lake stage to calculate lake bottom elevation. The average muck thickness for each lake was subtracted from the lake bottom elevation to calculate the lake bed top elevation. Muck thicknesses of 9.1 feet for Little Sand Lake, 9.5 feet for Deep Hole Lake, 14.0 feet for Duck Lake and 4.25 feet for Skunk Lake were used. These values were applied uniformly across each lake. The muck layer is assumed to offer no resistance to flow and is not incorporated as a model layer. However, the thickness of the muck is used to more accurately establish the vertical position of the lake bed. Inclusion of the muck layer thickness lowers the lake bottom elevation below where it would be, had it not been included."

"The lake bed thickness was subtracted from the lake bed top elevation to calculate the lake bed bottom elevation. The top of model layer one was assigned as the middle of the lake bed. The bottom of model layer one was assigned the bottom of the lake bed and replaced the previously defined bottom of layer one based on the geologic gross sections. Using this convention, layer one beneath the lakes will be composed of only lake bed deposits."

Model Layer Thickness - General Review Comments

- There are a number of instances in which the model layer thickness shown on a cross section is significantly different than the model input layer thickness. Table 3 provides examples of these differences in thickness.

- There are a few instances where it is unclear whether the saturated thicknesses or total thickness of geologic units are used for calculating Kh for Layers 1 and 2.

Model Layer Thickness - Under Internal Lakes

Layer 1 - Both the Lake Stage Package and model Layer 1 incorporate part of the lake sediment under Little Sand, Duck, Deep Hole and Skunk Lakes. However, it appears that the method of dividing the total lake sediment thickness between the LSP and model Layer 1 does not follow the method presented in the EIR narration.

- Layer 1 on the cross sections appears to be roughly half the total thickness of lake sediments. This is in conformance with the EIR model narrative which states that the lake sediment thickness is to be divided equally between the LSP and the flow model.

- The LSP input uses ¾ of the total thickness of lake sediments for calculating vertical conductance rather than ½ the thickness as described in the EIR. As a result, only ¼ of lake sediment thickness remains to be incorporated into model Layer 1. This is not consistent with either the EIR model narrative or what is generally presented on model cross sections.

- Model input for Layer 1 thickness appears to be calculated from the top of the muck to the bottom of the lake sediment. This thickness is much greater than the ½ lake sediment thickness (consistent with EIR) or ¼ lake sediment thickness (consistent with LSP). As a result, the calculation of horizontal flow in Layer 1 could be affected.

- VCONT between Layers 1 and 2 is calculated using a saturated thickness of Layer 1 which is measured from the lake-water surface to the bottom of the lake sediments. This thickness is much greater than ½ (consistent with EIR) or ¼ (consistent with LSP input) of the lake sediment. As a result, the VCONT calculated for model input is roughly one order of magnitude lower than VCONT calculated using ¼ of the lake sediment thickness.

- The various thicknesses used to represent Layer 1 under the interior lakes are presented in Figures 4 through 10.

Layers 2 and 3 - The thickness of Layer 2 does not equal the thickness of Layer 3 under the internal lakes - particularly under Deep Hole and Duck Lakes.

- It appears that the position of the Layer 2/Layer 3 boundary was not adjusted following the assignment of the bottom of Layer 1 to the bottom of the lake deposit. It may be CMC's intention to handle layers under the lake this way, but this treatment of the layers was not described in the EIR model narrative, nor were the possible effects on the flow model in the vicinity of the lakes discussed.

- Examples of cells under lakes where the thickness of Layer 2 does not equal the thickness of Layer 3 are listed in Table 2, as well as cross sections from GWVistas presented on Figure 11.

Layer 4 - Model input thickness values for Layer 4 under the internal lakes generally conform to the thickness of model layer cross sections.

Model Layer Aquifer Properties Used As Model Input Data

Excerpts from EIR model narrative

Section 3.2.4 Heterogeneity

"The model layering isolates unique hydrostratigraphic and geologic units reasonably well (e.g., layer one is predominantly Late Wisconsinan till, etc.). However, to further improve the representation of heterogeneity of geologic units within a given model layer, the vertical and horizontal hydraulic conductivity for each of the model layers at a given model cell is based on a weighted average of potentially six different hydrogeologic units encountered within a model cell. These six units include, 1) Late Wisconsin till, 2) coarse outwash, 3) fine outwash, 4) Pre- to Early Wisconsinan till, 5) ice margin contact deposits, and 6) ancient lacustrine deposits. The recent lacustrine deposits were excluded from the averaging procedure because they were either always representative of layer one or were included in the conductance term of the River or Lake Stage package for lakes. An arithmetic average was used for the horizontal flow direction and a harmonic mean was used for the vertical flow direction."

"The process of developing hydraulic conductivity for individual model cells was accomplished with a computer program called ACALC."
Section 3.2.3.1.3 Saturated Thicknesses

"The saturated thickness of the units was used in the calculation of vertical leakance (VCONT). The saturated thickness is the difference between the water table elevation and the bottom of each model layer."

Kh - General Review Comments

- There are instances where the model input values for horizontal conductivity do not conform well with estimates based on the percentage and thicknesses of lithologies presented on a model layer cross sections. As a result, the glacial sediments may not be represented as well as possible in these parts of the model. Examples are presented in Table 4.

Layer 1

- Most cells in Layer 1 have values consistent with the assigned Late Wisconsin till value (0.8 feet/day). However, several broad (non-lake) areas in the interior portion of the model have values less than 0.8 feet/day. Table 5 contains examples of Kh values in Layer 1 that are less that 0.8 feet per day. Figure 12 shows Layer 1 Kh values in the interior portion of the model. In Figure 12 a different shade of gray represents each Kh value assigned to an input parameter (0.8 feet/day for Late Wisconsin till, 7.3 feet/day for coarse outwash, etc.). Model input values which fall in between two set parameter values were assigned a median value and an intermediate shade of gray (4.05 feet/day assigned to all values between 0.8 and 7.3 feet/day). Even though most of the lower Kh values occur in inactive cells, a significant number do occur in active cells. Kh values less than 0.8 feet/day can perhaps be explained for cells immediately adjacent to lakes with Kh values of 0.008 feet/day, but cannot be explained for other cells which are located away from the lakes. Layer 1 Kh values significantly lower than 0.8 feet/day may affect horizontal flow in those areas of the model.

  If inactive cells have input values, those values should be reasonable and consistent with the rest of the model.

Layers 2 and 3

- Kh values for Layers 2 and 3 fall within a range consistent with assigned values for fine and coarse outwash with additions of till. The zonation under the TMA is clearly evident. However, there are two areas north of Swamp Creek where Layers 2 and 3 have significantly lower values than expected (Figures 13 and 14). These low conductivity zones may have an effect on horizontal flow in the vicinity of Swamp Creek.

Layer 4

- Layer 4 includes some areas of Kh which are significantly higher or lower than expected for Early Wisconsin till (0.8 feet/day). Areas are found with Kh values as low as 0.071 feet/day, and as high as

43 feet/day. These areas are concentrated around the interior lakes and under the TMA (Figures 15 and 16). The input value for Layer 4 conductivity is significant because of its influence on the movement of water between the glacial sediments and the bedrock in the model.

Kh - Under Internal Lakes

Layer 1

- Model input values for Kh under Little Sand, Deep Hole and Duck Lakes are consistently 0.008 feet/day. Kh values under Skunk Lake are consistently 0.07 feet/day. This distribution is in conformance with the EIR model narrative.

Layers 2 and 3

- Model input values for Kh of Layers 2 and 3 under the internal lakes fall within a range consistent with values assigned to fine and coarse outwash with additions of till. This distribution is in conformance with the EIR model narrative.

Layer 4

- Model input values for Kh for Layer 4 fall within a range consistent with values assigned to Pre- to Early Wisconsin till with additions of outwash. This distribution is in conformance with the EIR model narrative.

Kv - General Review Comments

- Kv was evaluated by verifying that ratios of input values for Kh/Kv for specific layers are consistent with the ratios calculated using Kh and Kv values presented in the EIR model narrative. The model input values are in conformance with values in the EIR model narrative and tables.

Vertical Leakance - General

- Negative values for VCONT (which are not possible given the equation for VCONT) are present in approximately 850 active model cells. These cells are primarily in Layer 1, but a few also appear in Layers 2 (in addition, a few negative VCONT values are found in inactive Layer 3 cells). Cells with negative values for VCONT go dry in the first iteration of a model run. As a result, these cells behave essentially as inactive cells. (The only other cells to go dry in the first iteration are the Layer 2 cells with zero thickness discussed previously.) Examples of negative VCONT values found in Layer 1 are listed in Table 6, and their distribution is shown in Figure 17. Table 7 presents the iteration log for a model run showing the active model cells which go dry as a result of negative VCONT input values.

Vertical Leakance - Under Internal Lakes

Lake Stage Package/Layer 1

- The Lake Stage Package (LSP) input uses ¾ of the lake sediment thickness for calculating vertical conductance rather than ½ of the thickness as presented in the EIR flow model narrative.

Layer 1/Layer 2

- Vertical leakance (VCONT) is calculated using saturated thicknesses of model layers. The CMC model uses a saturated thickness for Layer 1 measured from approximately the surface of the lake to the bottom of lake sediment. This thickness is too great and is not consistent with using ¾ of the lake sediment thickness for vertical leakance in the Lake Stage Package. Refer again to Figures 4 through 10 which illustrate this situation. As a result, the VCONT calculated for model input is roughly one order of magnitude lower than VCONT calculated using ¼ of the lake sediment thickness.

Recharge

- Checked in database and in GW Vistas. Distribution of cells having active recharge appears to be in conformance with the EIR model narrative and figures.

Distribution of Active and Inactive Cells

- Checked in database. Distribution appears to be in conformance with the EIR model narrative and figures.

Conclusion

This review was intended to provide verification of conformance between model input values (BEJ) and the presentation of the geologic layers in the EIR narrative and on cross sections. Only those model input parameters presented specifically in this document were a part of this review. This review did not address the appropriateness of model input values, nor was it a discussion of the appropriateness of the presentation of the geologic layers in the EIR narrative and on cross sections.

As a result of this review, a number of concerns and inconsistencies which may affect model results have been identified.

Table 1
Examples of exceptions to good agreement between model layer and lithologic boundary

Cross section	Location	Comment
A - A'	Near G40-H27	Top of Layer 1 is below land surface
A - A'	Near G40-H28	Bottom of Layer 4 is below cross section
A - A'	Around G40 - G24	Top of Layer 1 is below land surface
A - A'	Near G40-E22	Top of Layer 1 is above land surface
A - A'	Near DMB - 18	Top of Layer 1 is above land surface
A - A'	Near DMB - 23	Top of Layer 1 is above land surface
A - A'	Near G40-G7	Top of Layer 2 is below land surface
B - B'	Oak Lake	Top of Layer 1 is lake surface
B - B'	Between G40 - P10 and G40 - Q7	Very blocky expression of Layer 1 surface
D - D'	At G40 - T30	Top of Layer 1 is above land surface
D - D'	Little Sand Lake	Layer 1 is less than one-half the lake sediment thickness
E - E'	Near G41 - C32	Top of Layer 1 is above land surface
E - E'	Near G41 - B12 and under Swamp Creek	Bottom of Layer 4 is below cross section
G - G'	Between G41 - K21A and CMC - TMA - 110	Questionable position of Layer 1 and Layer 2 contact
J -J'	Near DMB - 10 and EX - 6	Top of Layer 1 is below land surface
	Near EX - 6	Top of Layer 1 is above land surface
L - L'	Near G40 - H13	Top of Layer 1 is above land surface
L - L'	Near G40 - H14	Top of Layer 1 is below land surface
L - L'	Oak Lake	Top of Layer 1 is lake surface
M - M'	Near G40 - E16	Top of Layer 1 is above land surface
N -N'	Near EX - 3	Top of Layer 1 is above land surface
O - O'	Skunk Lake	Layer 1 is thin and then thick under Skunk Lake
O - O'	Between CMC - BO - 101 and G41 - H9	Bottom of Layers 3 and 4 are below cross section
R - R'	Skunk Lake	Odd thick cell in Layer 1
	Several places	Bottom of Layer 4 is below cross section

Table 2
Examples of cells where thickness of layer 2 does not equal thickness of Layer 3
BEJ model run (68a) input

Well ID	Row	Column	Layer	Layer Top Elevation in feet	Layer Bottom Elevation in feet	Layer Thickness feet
DMB-24	158	10	2	1,535.00	1,493.59	41.41
DMB-24	158	10	3	1,493.59	1,428.61	64.98
DMP-3	87	31	2	1,586.19	1,507.91	78.28
DMP-3	87	31	3	1,507.91	1,426.86	81.05
G40-Y21	116	55	2	1,573.60	1,518.23	55.37
G40-Y21	116	55	3	1,518.23	1,444.33	73.90
G41-B12	4	62	2	1,599.00	1,556.04	42.96
G41-B12	4	62	3	1,556.04	1,498.80	57.24
STS-LSL-6	114	41	2	1,562.89	1,503.67	59.22
STS-LSL-6	114	41	3	1,503.67	1,447.08	56.59
CMC-LSL-102	75	59	2	1,565.14	1,516.19	48.95
CMC-LSL-102	75	59	3	1,516.19	1,477.89	38.30
CMC-LSL-103	85	42	2	1,564.77	1,485.79	78.98
CMC-LSL-103	85	42	3	1,485.79	1,419.51	66.28
CMC-LSL-105	121	40	2	1,574.40	1,506.87	67.53
CMC-LSL-105	121	40	3	1,506.87	1,435.01	71.86
STS-DHL-1	134	89	2	1,575.12	1,486.00	89.120
STS-DHL-1	134	89	3	1,486.00	1,418.73	67.270
STS-DL-1	98	92	2	1,574.31	1,479.92	94.390
STS-DL-1	98	92	3	1,479.92	1,441.50	38.420

Table 3
Examples of differences in thickness between model layer and BEJ model (68a) input value

Well ID	Row	Column	Layer	Layer Thickness feet Calculated from elevation of layer top and bottom - BEJ input values	Layer Thickness feet Estimated from layer cross sections [ ] = sat. thickness
CMC-04	79	110	1	62.12	150 [65]
CMC-04	79	110	2	92.58	30
CMC-04	79	110	3	92.47	30
CMC-04	79	110	4	62.70	75
DMA-12	45	74	1	29.79	20
DMA-48	38	6	1	0.00	20
DMB-18	118	6	1	53.10	28
DMB-23	65	6	1	25.35	0
DMB-24	158	10	1	0.00	30
DMP-3	87	31	2	78.28	62
DMP-3	87	31	3	81.05	65
EX-12AL	92	109	2	43.18	25
EX-12AL	92	109	3	43.19	25
EX-12AL	92	109	4	47.63	80
EX-12AU	92	109	2	43.18	25
EX-12AU	92	109	3	43.19	25
EX-12AU	92	109	4	47.63	80
EX-12BL	92	109	2	43.18	25
EX-12BL	92	109	3	43.19	25
EX-12BL	92	109	4	47.63	80
EX-12BU	92	109	2	43.18	25
EX-12BU	92	109	3	43.19	25
EX-12BU	92	109	4	47.63	80
EX-6AL	31	125	1	32.72	15
EX-6AU	31	125	1	32.72	15
EX-6BL	31	125	1	32.72	15
EX-6BU	31	125	1	32.72	15
EX-9AL	59	109	1	125.99	130 [10]
EX-9AL	59	109	2	67.18	62
EX-9AU	59	109	1	125.99	130
EX-9AU	59	109	2	67.18	62
EX-9BL	59	109	1	125.99	130
EX-9BL	59	109	2	67.18	62
EX-9BU	59	109	1	125.99	130
EX-9BU	59	109	2	67.18	62
G40-H13	71	9	1	0.00	150
G40-H13	71	9	2	77.70	60
G40-Q7	38	23	2	49.15	50 [25]
G40-T30	154	59	1	34.04	5

Table 3
Examples of differences in thickness between model layer and BEJ model (68a) input value

Well ID	Row	Column	Layer	Layer Thickness feet Calculated from elevation of layer top and bottom - BEJ input values	Layer Thickness feet Estimated from layer cross sections [ ] = sat. thickness
G40-Y15	87	66	1	24.15	8
G40-Y15A	87	66	1	24.15	8
G40-Y21	116	55	1	21.40	0
G41-B12	4	62	1	-28.31	70
G41-B12	4	62	2	42.96	15
G41-B12	4	62	3	57.24	10
G41-D18	101	96	1	91.58	125
G41-D18	101	96	2	53.71	75
G41-D18	101	96	3	53.78	75
G41-F13	75	105	1	61.36	50
G41-H13	63	110	1	96.82	50
G41-H13	63	110	2	76.63	110 [40]
G41-P18	107	123	1	48.57	60
CMC-BO-102	94	104	1	149.50	30
CMC-BO-102	94	104	2	49.59	70
CMC-BO-102	94	104	3	49.81	70
STS-LSL-1	81	57	1	27.66	10
STS-LSL-6	114	41	1	19.41	5
CMC-LSL-101	91	59	1	20.52	8
CMC-LSL-102	75	59	1	24.61	2
CMC-LSL-102/	80	64	1	23.10	8
CMC-LSL-102E	81	65	1	22.98	8
CMC-LSL-103	85	42	1	24.31	8
CMC-TMA-110	82	110	1	69.1	90
STS-DHL-1	134	89	1	19.51	5
STS-DL-1	98	92	1	31.00	10
STS-OL-1	79	17	1	47.61	10 ft sed and 37 ft water

Table 4
Comparison of horizontal hydraulic conductivity (Kh) used in BEJ model run (68a) to Kh estimated from model layer cross sections

Well ID	Row	Column	Layer	Horizontal Conductivity feet/day BEJ input values	Horizontal Conductivity feet/day Estimated from lithologic thickness found on layer cross sections and EIR Kh values
BE-211-1	58	38	1	0.562	0.8
BE-211-2	59	40	1	0.546	0.8
BE-211-3	59	38	1	0.554	0.8
CMC-09	61	26	1	0.639	0.8
CMC-09P	61	26	1	0.639	0.8
CMC-BO-101A	50	104	1	0.572	0.008
CMC-BO-101A	50	104	2	5.440	42 sat or 56 total
CMC-BO-101A	50	104	3	5.430	40
CMC-BO-101B	50	104	1	0.572	0.8
CMC-BO-101B	50	104	2	5.440	48 sat or 56 total
CMC-BO-101B	50	104	3	5.430	40
CMC-DL-103A	90	94	4	0.383	0.8
CMC-DL-103B	90	94	4	0.383	0.8
CMC-SL-104	47	83	1	0.070	0.8
CMC-TMA-103	51	113	1	0.798	0.8
CMC-TMA-105	96	114	1	8.290	0.8
CMC-TMA-109	68	105	4	0.249	0.8
CMC-TMA-110	82	110	1	7.110	0.8
CMC-BO-102	94	104	4	0.406	0.8
DMA-12	45	74	1	0.800	20
DMA-16	16	9	1	4.590	0.8
DMA-16	16	9	2	46.200	60.2
DMA-16	16	9	4	2.200	0.8
DMA-17	152	30	1	0.689	0.8
DMA-18	106	7	1	0.769	0.8
DMA-31	32	90	1	0.763	0.8
DMA-6	69	111	4	0.793	0.8
DMA-7	95	125	1	6.110	0.8
DMB-11	124	21	1	0.221	0.8
DMB-12	149	28	1	0.518	0.8
DMB-14	123	9	1	0.589	20
DMB-16	105	19	1	0.437	0.8
DMB-27	137	106	1	0.690	0.8
DMB-4	41	106	1	0.376	0.8
DMP-2	72	61	1	0.780	0.8
DMP-3	87	31	1	0.436	0.8
EX-10AL	72	107	1	12.900	0.8
EX-10AL	72	107	2	0.800	18
EX-10AL	72	107	4	0.713	0.8
EX-10AU	72	107		12.900	0.8
EX-10AU	72	107	2	0.800	18
EX-10AU	72	107	4	0.713	0.8
EX-10BL	72	107	1	12.900	0.8
EX-10BL	72	107	2	0.800	18
EX-10BL	72	107	4	0.713	0.8
EX-10BU	72	107	1	12.900	0.8
EX-10BU	72	107	2	0.800	18
EX-10BU	72	107	4	0.713	0.8

Table 4
Comparison of horizontal hydraulic conductivity (Kh) used in BEJ model run (68a) to Kh estimated from model layer cross sections

Well ID	Row	Column	Layer	Horizontal Conductivity feet/day BEJ input values	Horizontal Conductivity feet/day Estimated from lithologic thickness found on layer cross sections and EIR Kh values
EX-11AU	91	106	4	0.179	0.8
EX-11BL	91	106	4	0.179	0.8
EX-11BU	91	106	4	0.179	0.8
EX-14AL	121	114	1	50.200	0.8
EX-14AL	121	114	4	1.520	0.8
EX-14AU	121	114	1	50.200	0.8
EX-14AU	121	114	4	1.520	0.8
EX-14BL	121	114	1	50.200	0.8
EX-14BL	121	114	4	1.520	0.8
EX-14BU	121	114	1	50.200	0.8
EX-14BU	121	114	4	1.520	0.8
EX-7AL	45	116	1	0.389	0.8
EX-7BL	45	116	1	0.389	0.8
EX-7BU	45	116	1	0.389	0.8
EX-7CL	45	116	1	0.389	0.8
EX-9AL	59	109	1	0.800	0.8
EX-9AL	59	109	2	4.600	40
EX-9AU	59	109	1	0.800	0.8
EX-9AU	59	109	2	4.600	40
EX-9BL	59	109	1	0.800	0.8
EX-9BL	59	109	2	4.600	40
EX-9BU	59	109	1	0.800	0.8
EX-9BU	59	109	2	4.600	40
G40-G7	38	6	3	36.900	42
G40-L19	113	9	1	0.580	0.8
G40-M14	78	11	1	0.714	0.8
G40-P20	113	19	1	0.263	0.8
G40-R23	136	26	1	0.222	0.8
G40-S11	61	28	1	0.612	0.8
G40-S17	101	32	1	0.570	0.8
G40-S17A	100	32	1	0.625	0.8
G40-Y22	135	58	1	0.591	0.8
G40-Q7	38	23	2	16.500	11 sat or 31 total
G41-A23	193	77	1	0.799	0.8
G41-D18	101	96	1	5.410	0.8
G41-D18	101	96	3	46.300	15
G41-D18	101	96	4	0.800	
G41-E11	65	102	4	0.952	10
G41-E19	121	104	3	11.500	8
G41-E19A	121	104	3	11.500	8
G41-E22	124	100	1	0.797	0.8
G41-E22	124	100	4	5.980	0.8
G41-E22A	124	100	1	0.797	0.8
G41-E22A	124	100	4	5.980	0.8
G41-F13	75	105	1	26.400	0.8
G41-F13	75	105	4	2.270	0.8
G41-G11	63	108	3	11.200	4
G41-G13	71	109	2	1.380	0.8
G41-G13	71	109	4	0.423	0.8
G41-G14	83	108	4	5.660	0.8
G41-G14A	83	108	4	5.660	0.8

Table 4
Comparison of horizontal hydraulic conductivity (Kh) used in BEJ model run (68a) to Kh estimated from model layer cross sections

Well ID	Row	Column	Layer	Horizontal Conductivity feet/day BEJ input values	Horizontal Conductivity feet/day Estimated from lithologic thickness found on layer cross sections and EIR Kh values
G41-G14B	83	108	4	5.660	0.8
G41-G14C	83	108	4	5.660	0.8
G41-G14D	85	108	1	8.040	.8 sat or 8 total
G41-G14D	85	108	4	3.520	0.8
G41-G14E	85	108	1	8.040	.8 sat or 8 total
G41-G14E	85	108	4	3.520	0.8
G41-G14F	85	108	1	8.040	.8 sat or 8 total
G41-G14F	85	108	4	3.520	0.8
G41-G15	89	108	4	0.774	0.8
G41-G15A	89	108	4	0.774	0.8
G41-G15B	89	108	4	0.774	0.8
G41-G15C	89	108	4	0.774	0.8
G41-H13	63	110	1	0.800	15
G41-H13	63	110	2	3.370	.8 sat or 15 total
G41-H18	109	110	4	0.607	0.8
G41-H18A	109	110	4	0.607	0.8
G41-H18B	109	110	4	0.607	0.8
G41-H9	50	110	1	3.780	0.8
G41-H9	50	110	4	0.440	0.8
G41-J18	111	111	4	1.140	0.8
G41-K21A	126	113	1	28.400	0.8
G41-K21A	126	113	2	27.300	0.8
G41-L19	113	116	1	27.900	0.8
G41-L19	113	116	4	0.627	0.8
G41-L23	141	115	1	0.319	0.8
G41-M11	61	119	1	0.638	0.8
G41-N21	132	121	1	14.300	0.8
G41-P18	107	123	1	0.441	wetland value?
G41-Q22	139	123	1	0.050	wetland value?
STS-DL-1	98	92	2	42.400	37
G40-S17	101	32	1	0.570	0.8
G40-S17A	100	32	1	0.625	0.8
CMC-04	79	110	1	5.610	30 sat or 20 total
CMC-04	79	110	2	0.800	37

Table 5
Examples of selected sites where BEJ model (68a) input values for Kh are less than 0.8 feet/day

Well ID	Row	Column	Layer	Horizontal Conductivity feet/day
BE-211-1	58	38	1	0.56
BE-211-2	59	40	1	0.55
BE-211-3	59	38	1	0.55
CMC-04	79	111	4	0.53
CMC-09	61	26	1	0.64
CMC-09P	61	26	1	0.64
CMC-BO-101A	50	104	1	0.57
CMC-BO-101B	50	104	1	0.57
CMC-BO-102	94	104	4	0.41
CMC-DL-103A	90	94	4	0.38
CMC-DL-103B	90	94	4	0.38
CMC-SL-104	47	83	1	0.07
CMC-SP-04	76	65	1	0.43
CMC-TMA-103	51	113	1	0.80
CMC-TMA-106	57	106	1	0.73
CMC-TMA-109	68	105	4	0.25
CMC-TMA-110	82	110	4	0.79
Deep Hole Lake			1	0.76
DMA-10	118	29	1	0.02
DMA-17	152	30	1	0.69
DMA-18	106	7	1	0.77
DMA-30	20	85	4	0.79
DMA-31	32	90	1	0.76
DMA-6	69	111	4	0.79
DMB-11	124	21	1	0.22
DMB-12	149	28	1	0.52
DMB-14	123	9	1	0.59
DMB-16	105	19	1	0.44
DMB-27	137	106	1	0.69
DMB-3	55	118	1	0.54
DMB-4	41	106	1	0.38
DMP-2	72	61	1	0.78
DMP-3	87	31	1	0.44
Duck Lake			4	0.77
Duck Lake			4	0.59
Duck Lake			4	0.59
Duck Lake			4	0.40
Duck Lake			4	0.42
Duck Lake			4	0.37
Duck Lake			4	0.40

Table 5
Examples of selected sites where BEJ model (68a) input values for Kh are less than 0.8 feet/day

Well ID	Row	Column	Layer	Horizontal Conductivity feet/day
Duck Lake			4	0.42
Duck Lake			4	0.37
Duck Lake			4	0.41
Duck Lake			4	0.51
Duck Lake			4	0.49
EX-10AL	72	107	4	0.71
EX-10AU	72	107	4	0.71
EX-10BL	72	107	4	0.71
EX-10BU	72	107	4	0.71
EX-11AL	91	106	4	0.18
EX-11AU	91	106	4	0.18
EX-11BL	91	106	4	0.18
EX-11BU	91	106	4	0.18
EX-2AL	120	8	1	0.67
EX-2AU	120	8	1	0.67
EX-2CL	120	8	1	0.67
EX-5AL	34	42	1	0.80
EX-5AU	34	42	1	0.80
EX-5BL	34	42	1	0.80
EX-5BU	34	42	1	0.80
EX-5CL	34	42	1	0.80
EX-7AL	45	116	1	0.39
EX-7BL	45	116	1	0.39
EX-7BU	45	116	1	0.39
EX-7CL	45	116	1	0.39
EX-8AL	60	119	1	0.62
EX-8AU	60	119	1	0.62
EX-8BL	60	119	1	0.62
EX-8BU	60	119	1	0.62
G40-L19	113	9	1	0.58
G40-M14	78	11	1	0.71
G40-P17	96	19	1	0.78
G40-P20	113	19	1	0.26
G40-R23	136	26	1	0.22
G40-S11	61	28	1	0.61
G40-S17	101	32	1	0.57
G40-S17A	100	32	1	0.63
G40-Y22	135	58	1	0.59
G41-A23	193	77	1	0.80
G41-E22	124	100	1	0.80
G41-E22A	124	100	1	0.80
G41-G13	71	109	4	0.42
G41-G15	89	108	4	0.77
G41-G15A	89	108	4	0.77

Table 5
Examples of selected sites where BEJ model (68a) input values for Kh are less than 0.8 feet/day

Well ID	Row	Column	Layer	Horizontal Conductivity feet/day
G41-G15B	89	108	4	0.77
G41-G15C	89	108	4	0.77
G41-H18	109	110	4	0.61
G41-H18A	109	110	4	0.61
G41-H18B	109	110	4	0.61
G41-H9	50	110	4	0.44
G41-L19	113	116	4	0.63
G41-L23	141	115	1	0.32
G41-M11	61	119	1	0.64
G41-P18	107	123	1	0.44
G41-Q22	139	123	1	0.05
Oak Lake			1	0.62
Oak Lake			1	0.60
Oak Lake			1	0.59
Oak Lake			1	0.69
Oak Lake			1	0.59
Oak Lake			1	0.58
Oak Lake			1	0.56
Oak Lake			1	0.68
Oak Lake			1	0.56
Oak Lake			1	0.55
Oak Lake			1	0.54
Oak Lake			1	0.68
Oak Lake			1	0.54
Oak Lake			1	0.52
Oak Lake			1	0.53
Oak Lake			1	0.67
Skunk Lake			1	0.07
Skunk Lake			1	0.07
Skunk Lake			1	0.07
Skunk Lake			1	0.07
Skunk Lake			1	0.07
Skunk Lake			1	0.07
Skunk Lake			1	0.07
Skunk Lake			1	0.07
STS-DL-1	98	92	4	0.37
STS-OL-1	79	17	1	0.62

Table 6
Examples of active Layer 1 cells assigned negative values of VCONT in the BEJ (68a) model run

Well ID	Row	Column	Layer	VCONT
CMC-04	79	110	1	-8.70E-05
CMC-BO-101A	50	104	1	-3.00E-06
CMC-BO-101B	50	104	1	-3.00E-06
CMC-TMA-103	51	113	1	-6.30E-05
CMC-TMA-106	57	106	1	-8.00E-06
CMC-TMA-110	82	110	1	-8.90E-05
DMA-12	45	74	1	-3.30E-05
DMB-2	74	113	1	-8.10E-05
EX-10AL	72	107	1	-9.90E-05
EX-10AU	72	107	1	-9.90E-05
EX-10BL	72	107	1	-9.90E-05
EX-10BU	72	107	1	-9.90E-05
EX-6AL	31	125	1	-8.30E-05
EX-6AU	31	125	1	-8.30E-05
EX-6BL	31	125	1	-8.30E-05
EX-6BU	31	125	1	-8.30E-05
EX-8AL	60	119	1	-3.00E-06
EX-8AU	60	119	1	-3.00E-06
EX-8BL	60	119	1	-3.00E-06
EX-8BU	60	119	1	-3.00E-06
G41-F13	75	105	1	-1.35E-04
G41-G13	71	109	1	-8.10E-05
G41-H13	63	110	1	-8.00E-05
G41-H9	50	110	1	-4.00E-06
G41-M11	61	119	1	-4.00E-06

```
CELL CONVERSIONS FOR ITERATION    1  LAYER= 1  TIME STEP    1  STRESS PERIOD   1        (ROW,COL)

DRY( 11,103)  DRY( 12,104)  DRY( 12,105)  DRY( 12,106)  DRY( 12,107)  DRY( 13,106)  DRY( 13,107)  DRY( 14, 98)
DRY( 14, 99)  DRY( 14,100)  DRY( 14,101)  DRY( 14,102)  DRY( 14,103)  DRY( 14,105)  DRY( 15, 93)  DRY( 15, 94)
DRY( 15, 95)  DRY( 15, 97)  DRY( 15, 98)  DRY( 15, 99)  DRY( 15,100)  DRY( 15,101)  DRY( 15,102)  DRY( 15,106)
DRY( 16, 73)  DRY( 16, 74)  DRY( 16, 75)  DRY( 16, 76)  DRY( 16, 77)  DRY( 16, 78)  DRY( 16, 79)  DRY( 16, 80)
DRY( 16, 81)  DRY( 16, 82)  DRY( 16, 83)  DRY( 16, 84)  DRY( 16, 85)  DRY( 16, 86)  DRY( 16, 87)  DRY( 16, 88)
DRY( 16, 89)  DRY( 16, 90)  DRY( 16, 91)  DRY( 16, 92)  DRY( 16, 93)  DRY( 16, 94)  DRY( 16, 95)  DRY( 16, 96)
DRY( 16, 97)  DRY( 16, 98)  DRY( 16, 99)  DRY( 16,100)  DRY( 16,101)  DRY( 16,102)  DRY( 16,103)  DRY( 16,104)
DRY( 16,105)  DRY( 16,106)  DRY( 17, 71)  DRY( 17, 72)  DRY( 17, 73)  DRY( 17, 74)  DRY( 17, 75)  DRY( 17, 76)
DRY( 17, 77)  DRY( 17, 78)  DRY( 17, 94)  DRY( 17, 95)  DRY( 17, 96)  DRY( 17, 97)  DRY( 17, 98)  DRY( 17,103)
DRY( 17,104)  DRY( 17,105)  DRY( 18, 70)  DRY( 18, 71)  DRY( 18, 72)  DRY( 18, 73)  DRY( 18, 74)  DRY( 18, 75)
DRY( 18, 76)  DRY( 18, 77)  DRY( 19, 71)  DRY( 19, 72)  DRY( 19, 73)  DRY( 19, 74)  DRY( 19, 75)  DRY( 19, 76)
DRY( 19, 77)  DRY( 20,  4)  DRY( 20, 71)  DRY( 20, 72)  DRY( 20, 73)  DRY( 20, 74)  DRY( 20, 75)  DRY( 20, 76)
DRY( 21,  4)  DRY( 21, 71)  DRY( 21, 72)  DRY( 21, 73)  DRY( 21, 74)  DRY( 22,  4)  DRY( 22,  5)  DRY( 22, 73)
DRY( 22, 74)  DRY( 22, 75)  DRY( 22, 76)  DRY( 23,  4)  DRY( 23,  5)  DRY( 23, 76)  DRY( 23, 77)  DRY( 23, 78)
DRY( 23, 79)  DRY( 24,  4)  DRY( 24,  5)  DRY( 24, 78)  DRY( 24, 79)  DRY( 24, 80)  DRY( 24, 81)  DRY( 24, 99)
DRY( 25,  4)  DRY( 25,  5)  DRY( 25, 81)  DRY( 25, 82)  DRY( 25, 95)  DRY( 25, 96)  DRY( 25, 97)  DRY( 25, 98)
DRY( 25, 99)  DRY( 25,100)  DRY( 25,101)  DRY( 25,102)  DRY( 25,103)  DRY( 25,104)  DRY( 26,  4)  DRY( 26,  5)
DRY( 26, 84)  DRY( 26, 91)  DRY( 26, 92)  DRY( 26, 93)  DRY( 26, 94)  DRY( 26,104)  DRY( 27,  4)  DRY( 27,105)
DRY( 27,113)  DRY( 28,  4)  DRY( 28, 27)  DRY( 28,106)  DRY( 28,107)  DRY( 28,112)  DRY( 28,113)  DRY( 29, 26)
DRY( 29,108)  DRY( 29,109)  DRY( 29,112)  DRY( 29,113)  DRY( 29,120)  DRY( 29,121)  DRY( 30, 25)  DRY( 30, 26)
DRY( 30,109)  DRY( 30,112)  DRY( 30,113)  DRY( 30,120)  DRY( 31, 25)  DRY( 31, 26)  DRY( 31,111)  DRY( 31,112)
DRY( 31,113)  DRY( 31,120)  DRY( 31,121)  DRY( 31,125)  DRY( 32, 25)  DRY( 32,111)  DRY( 32,112)  DRY( 32,113)
DRY( 32,120)  DRY( 32,121)  DRY( 32,125)  DRY( 33,111)  DRY( 33,112)  DRY( 33,113)  DRY( 33,114)  DRY( 33,120)
DRY( 33,121)  DRY( 34,111)  DRY( 34,112)  DRY( 34,113)  DRY( 34,114)  DRY( 34,121)  DRY( 35,111)  DRY( 35,112)
DRY( 35,114)  DRY( 36,111)  DRY( 36,112)  DRY( 36,114)  DRY( 37, 32)  DRY( 37,111)  DRY( 37,112)  DRY( 37,114)
DRY( 38, 35)  DRY( 38,111)  DRY( 38,112)  DRY( 38,113)  DRY( 38,114)  DRY( 38,126)  DRY( 39, 76)  DRY( 39, 77)
DRY( 39,111)  DRY( 39,112)  DRY( 39,113)  DRY( 40, 42)  DRY( 40, 73)  DRY( 40, 74)  DRY( 40, 75)  DRY( 40, 76)
DRY( 40,111)  DRY( 40,112)  DRY( 40,113)  DRY( 41, 74)  DRY( 41, 75)  DRY( 41, 76)  DRY( 41,111)  DRY( 41,112)
DRY( 41,113)  DRY( 42, 73)  DRY( 42, 74)  DRY( 42, 75)  DRY( 42, 76)  DRY( 42, 93)  DRY( 42, 94)  DRY( 42, 95)
DRY( 42, 96)  DRY( 42, 97)  DRY( 42, 98)  DRY( 42, 99)  DRY( 42,100)  DRY( 42,101)  DRY( 42,102)  DRY( 42,103)
DRY( 42,104)  DRY( 42,111)  DRY( 42,112)  DRY( 42,113)  DRY( 42,114)  DRY( 43, 73)  DRY( 43, 74)  DRY( 43, 75)
DRY( 43, 92)  DRY( 43, 93)  DRY( 43, 94)  DRY( 43, 95)  DRY( 43, 96)  DRY( 43, 97)  DRY( 43, 98)  DRY( 43, 99)
DRY( 43,100)  DRY( 43,101)  DRY( 43,102)  DRY( 43,103)  DRY( 43,104)  DRY( 43,105)  DRY( 43,111)  DRY( 43,112)
DRY( 43,113)  DRY( 43,114)  DRY( 44, 72)  DRY( 44, 73)  DRY( 44, 74)  DRY( 44, 92)  DRY( 44, 93)  DRY( 44, 94)
DRY( 44, 95)  DRY( 44, 96)  DRY( 44, 97)  DRY( 44, 98)  DRY( 44, 99)  DRY( 44,100)  DRY( 44,101)  DRY( 44,102)
DRY( 44,103)  DRY( 44,104)  DRY( 44,105)  DRY( 44,106)  DRY( 44,107)  DRY( 44,108)  DRY( 44,109)  DRY( 44,110)
DRY( 44,111)  DRY( 44,112)  DRY( 44,113)  DRY( 44,114)  DRY( 44,115)  DRY( 45, 72)  DRY( 45, 73)  DRY( 45, 74)
DRY( 45, 92)  DRY( 45, 93)  DRY( 45, 94)  DRY( 45, 95)  DRY( 45, 96)  DRY( 45, 97)  DRY( 45, 98)  DRY( 45, 99)
DRY( 45,100)  DRY( 45,101)  DRY( 45,102)  DRY( 45,103)  DRY( 45,104)  DRY( 45,105)  DRY( 45,106)  DRY( 45,107)
DRY( 45,108)  DRY( 45,109)  DRY( 45,110)  DRY( 45,111)  DRY( 45,112)  DRY( 45,113)  DRY( 45,114)  DRY( 45,115)
DRY( 46, 72)  DRY( 46, 73)  DRY( 46, 91)  DRY( 46, 92)  DRY( 46, 93)  DRY( 46, 94)  DRY( 46, 95)  DRY( 46, 96)
DRY( 46, 97)  DRY( 46, 98)  DRY( 46, 99)  DRY( 46,100)  DRY( 46,101)  DRY( 46,102)  DRY( 46,103)  DRY( 46,104)
DRY( 46,105)  DRY( 46,106)  DRY( 46,107)  DRY( 46,108)  DRY( 46,109)  DRY( 46,110)  DRY( 46,111)  DRY( 46,112)
DRY( 46,113)  DRY( 46,114)  DRY( 46,115)  DRY( 47, 73)  DRY( 47, 92)  DRY( 47, 93)  DRY( 47, 94)  DRY( 47, 95)
DRY( 47, 96)  DRY( 47, 97)  DRY( 47, 98)  DRY( 47, 99)  DRY( 47,100)  DRY( 47,101)  DRY( 47,102)  DRY( 47,103)
DRY( 47,104)  DRY( 47,105)  DRY( 47,106)  DRY( 47,107)  DRY( 47,108)  DRY( 47,109)  DRY( 47,110)  DRY( 47,111)
DRY( 47,112)  DRY( 47,113)  DRY( 47,114)  DRY( 48, 93)  DRY( 48, 94)  DRY( 48, 95)  DRY( 48, 96)  DRY( 48, 97)
```

VCONT <0

Table 7

Portion of iteration history for MODFLOW output (BEJ (68a) model run) showing cells that went dry on first iteration.
All of these cells had negative values for VCONT.

```
0CELL CONVERSIONS FOR ITERATION=  1  LAYER= 1  TIME STEP=  1  STRESS PERIOD=  1      (ROW,COL)      continued

DRY( 48, 98)   DRY( 48, 99)   DRY( 48,100)   DRY( 48,101)   DRY( 48,102)   DRY( 48,103)   DRY( 48,104)   DRY( 48,105)
DRY( 48,106)   DRY( 48,107)   DRY( 48,108)   DRY( 48,109)   DRY( 48,110)   DRY( 48,111)   DRY( 48,112)   DRY( 48,113)
DRY( 48,114)   DRY( 48,127)   DRY( 49, 94)   DRY( 49, 95)   DRY( 49, 96)   DRY( 49, 97)   DRY( 49, 98)   DRY( 49, 99)
DRY( 49,100)   DRY( 49,101)   DRY( 49,102)   DRY( 49,103)   DRY( 49,104)   DRY( 49,105)   DRY( 49,106)   DRY( 49,107)
DRY( 49,108)   DRY( 49,109)   DRY( 49,110)   DRY( 49,111)   DRY( 49,112)   DRY( 49,113)   DRY( 49,114)   DRY( 49,127)
DRY( 50, 95)   DRY( 50, 96)   DRY( 50, 97)   DRY( 50, 98)   DRY( 50, 99)   DRY( 50,100)   DRY( 50,101)   DRY( 50,102)
DRY( 50,103)   DRY( 50,104)   DRY( 50,105)   DRY( 50,106)   DRY( 50,107)   DRY( 50,108)   DRY( 50,109)   DRY( 50,110)
DRY( 50,111)   DRY( 50,112)   DRY( 50,113)   DRY( 50,114)   DRY( 50,127)   DRY( 51, 97)   DRY( 51, 98)   DRY( 51, 99)
DRY( 51,100)   DRY( 51,101)   DRY( 51,102)   DRY( 51,103)   DRY( 51,104)   DRY( 51,105)   DRY( 51,106)   DRY( 51,107)
DRY( 51,108)   DRY( 51,109)   DRY( 51,110)   DRY( 51,111)   DRY( 51,112)   DRY( 51,113)   DRY( 51,114)   DRY( 52, 99)
DRY( 52,100)   DRY( 52,101)   DRY( 52,102)   DRY( 52,103)   DRY( 52,104)   DRY( 52,105)   DRY( 52,106)   DRY( 52,107)
DRY( 52,108)   DRY( 52,109)   DRY( 52,110)   DRY( 52,111)   DRY( 52,112)   DRY( 52,113)   DRY( 52,114)   DRY( 53,100)
DRY( 53,101)   DRY( 53,102)   DRY( 53,103)   DRY( 53,104)   DRY( 53,105)   DRY( 53,106)   DRY( 53,107)   DRY( 53,108)
DRY( 53,109)   DRY( 53,110)   DRY( 53,111)   DRY( 53,112)   DRY( 53,113)   DRY( 53,114)   DRY( 53,124)   DRY( 53,125)
DRY( 54,100)   DRY( 54,101)   DRY( 54,102)   DRY( 54,103)   DRY( 54,104)   DRY( 54,105)   DRY( 54,106)   DRY( 54,107)
DRY( 54,108)   DRY( 54,109)   DRY( 54,110)   DRY( 54,111)   DRY( 54,112)   DRY( 54,113)   DRY( 54,114)   DRY( 54,124)
DRY( 54,125)   DRY( 55,101)   DRY( 55,102)   DRY( 55,103)   DRY( 55,104)   DRY( 55,105)   DRY( 55,106)   DRY( 55,107)
DRY( 55,108)   DRY( 55,112)   DRY( 55,113)   DRY( 55,114)   DRY( 55,125)   DRY( 56,101)   DRY( 56,102)   DRY( 56,103)
DRY( 56,104)   DRY( 56,105)   DRY( 56,106)   DRY( 56,107)   DRY( 56,108)   DRY( 56,113)   DRY( 56,125)   DRY( 57,101)
DRY( 57,102)   DRY( 57,103)   DRY( 57,104)   DRY( 57,105)   DRY( 57,106)   DRY( 57,107)   DRY( 57,108)   DRY( 57,111)
DRY( 57,113)   DRY( 57,125)   DRY( 58,103)   DRY( 58,104)   DRY( 58,105)   DRY( 58,106)   DRY( 58,107)   DRY( 58,111)
DRY( 58,112)   DRY( 58,113)   DRY( 59,104)   DRY( 59,107)   DRY( 59,111)   DRY( 59,112)   DRY( 60,104)   DRY( 60,110)
DRY( 60,111)   DRY( 60,112)   DRY( 60,119)   DRY( 60,126)   DRY( 60,128)   DRY( 61,110)   DRY( 61,111)   DRY( 61,112)
DRY( 61,119)   DRY( 61,126)   DRY( 61,128)   DRY( 62,109)   DRY( 62,110)   DRY( 62,111)   DRY( 62,112)   DRY( 62,119)
DRY( 62,126)   DRY( 62,128)   DRY( 63,109)   DRY( 63,110)   DRY( 63,111)   DRY( 63,119)   DRY( 64,108)   DRY( 64,109)
DRY( 64,110)   DRY( 64,118)   DRY( 64,119)   DRY( 65,109)   DRY( 65,117)   DRY( 65,118)   DRY( 65,119)   DRY( 66,106)
DRY( 66,117)   DRY( 66,118)   DRY( 66,119)   DRY( 66,129)   DRY( 67,106)   DRY( 67,107)   DRY( 67,116)   DRY( 67,117)
DRY( 67,118)   DRY( 67,119)   DRY( 67,129)   DRY( 68,106)   DRY( 68,107)   DRY( 68,108)   DRY( 68,116)   DRY( 68,117)
DRY( 68,118)   DRY( 68,119)   DRY( 68,129)   DRY( 69,105)   DRY( 69,106)   DRY( 69,107)   DRY( 69,108)   DRY( 69,116)
DRY( 69,117)   DRY( 69,129)   DRY( 70,106)   DRY( 70,107)   DRY( 70,108)   DRY( 70,109)   DRY( 70,115)   DRY( 70,116)
DRY( 70,129)   DRY( 71,106)   DRY( 71,107)   DRY( 71,108)   DRY( 71,109)   DRY( 71,110)   DRY( 71,115)   DRY( 71,116)
DRY( 71,129)   DRY( 72,106)   DRY( 72,107)   DRY( 72,108)   DRY( 72,109)   DRY( 72,110)   DRY( 72,111)   DRY( 72,112)
DRY( 72,114)   DRY( 72,115)   DRY( 72,116)   DRY( 72,129)   DRY( 73,106)   DRY( 73,107)   DRY( 73,108)   DRY( 73,109)
DRY( 73,110)   DRY( 73,111)   DRY( 73,112)   DRY( 73,114)   DRY( 73,115)   DRY( 74,106)   DRY( 74,107)   DRY( 74,108)
DRY( 74,109)   DRY( 74,110)   DRY( 74,111)   DRY( 74,112)   DRY( 74,113)   DRY( 74,114)   DRY( 74,115)   DRY( 75,105)
DRY( 75,106)   DRY( 75,107)   DRY( 75,108)   DRY( 75,109)   DRY( 75,110)   DRY( 75,111)   DRY( 75,112)   DRY( 75,113)
DRY( 75,114)   DRY( 75,115)   DRY( 75,128)   DRY( 76,106)   DRY( 76,107)   DRY( 76,108)   DRY( 76,109)   DRY( 76,110)
DRY( 76,111)   DRY( 76,112)   DRY( 76,114)   DRY( 76,115)   DRY( 76,128)   DRY( 77,107)   DRY( 77,108)   DRY( 77,109)
DRY( 77,110)   DRY( 77,111)   DRY( 77,112)   DRY( 77,114)   DRY( 77,115)   DRY( 77,128)   DRY( 78,107)   DRY( 78,108)
DRY( 78,109)   DRY( 78,110)   DRY( 78,111)   DRY( 78,112)   DRY( 78,114)   DRY( 78,115)   DRY( 78,128)   DRY( 79,108)
DRY( 79,109)   DRY( 79,110)   DRY( 79,111)   DRY( 79,112)   DRY( 79,114)   DRY( 79,115)   DRY( 79,129)   DRY( 80, 45)
DRY( 80,108)   DRY( 80,109)   DRY( 80,110)   DRY( 80,111)   DRY( 80,112)   DRY( 80,114)   DRY( 80,115)   DRY( 80,116)
DRY( 81, 41)   DRY( 81, 76)   DRY( 81,109)   DRY( 81,110)   DRY( 81,111)   DRY( 81,112)   DRY( 81,114)   DRY( 81,115)
DRY( 81,116)   DRY( 82, 38)   DRY( 82,109)   DRY( 82,110)   DRY( 82,111)   DRY( 82,112)   DRY( 82,114)   DRY( 82,115)
DRY( 82,116)   DRY( 83,109)   DRY( 83,110)   DRY( 83,111)   DRY( 83,114)   DRY( 83,115)   DRY( 83,116)   DRY( 84,110)
DRY( 84,111)   DRY( 84,115)   DRY( 84,116)   DRY( 85,110)   DRY( 85,111)   DRY( 85,112)   DRY( 85,116)   DRY( 86,111)
DRY( 86,112)   DRY( 86,117)   DRY( 87,117)   DRY( 97,  2)   DRY( 98,  2)   DRY( 99,  2)   DRY( 99, 28)   DRY( 99, 29)
DRY(100,  2)   DRY(100, 29)   DRY(101, 29)   DRY(102, 28)   DRY(102, 29)   DRY(103, 28)   DRY(103, 29)   DRY(104, 28)
```

VCONT <0

Table 7

Portion of iteration history for MODFLOW output (BEJ (68a) model run) showing cells that went dry on first iteration.
All of these cells had negative values for VCONT.

```
0CELL CONVERSIONS FOR ITERATION=  1  LAYER= 1  TIME STEP=  1  STRESS PERIOD=  1      (ROW,COL)      continued

 DRY(105, 27)    DRY(105, 28)    DRY(106, 27)    DRY(107, 26)    DRY(107, 27)    DRY(108, 26)    DRY(108, 27)    DRY(109, 26)
 DRY(110, 25)    DRY(110, 26)    DRY(111, 25)    DRY(111, 26)    DRY(112, 25)    DRY(115, 56)    DRY(115, 71)    DRY(115, 72)
 DRY(115, 73)    DRY(115, 74)    DRY(115, 75)    DRY(116, 67)    DRY(116, 68)    DRY(116, 69)    DRY(116, 70)    DRY(116, 71)
 DRY(116, 72)    DRY(116, 73)    DRY(116, 74)    DRY(116, 75)    DRY(117, 66)    DRY(117, 67)    DRY(117, 68)    DRY(117, 69)    VCONT < 0
 DRY(117, 70)    DRY(117, 71)    DRY(117, 72)    DRY(117, 73)    DRY(117, 74)    DRY(118, 67)    DRY(118, 68)    DRY(118, 69)
 DRY(118, 70)    DRY(118, 71)    DRY(118, 72)    DRY(118, 73)    DRY(118, 74)    DRY(119, 68)    DRY(119, 69)    DRY(119, 70)
 DRY(119, 71)    DRY(119, 72)    DRY(119, 73)    DRY(120, 69)    DRY(120, 70)    DRY(120, 71)    DRY(120, 72)    DRY(120, 73)
 DRY(121, 69)    DRY(121, 70)    DRY(129, 69)    DRY(132, 68)    DRY(135, 67)    DRY(137, 66)    DRY(148, 94)    DRY(150, 91)
 DRY(154, 12)

0CELL CONVERSIONS FOR ITERATION=  1  LAYER= 2  TIME STEP=  1  STRESS PERIOD=  1      (ROW,COL)

 DRY( 11,112)    DRY( 11,113)    DRY( 11,119)    DRY( 11,120)    DRY( 11,121)    DRY( 11,122)    DRY( 11,123)    DRY( 11,124)
 DRY( 12,114)    DRY( 12,115)    DRY( 12,116)    DRY( 12,117)    DRY( 12,118)    DRY( 12,119)    DRY( 13,118)    DRY( 13,119)    b = 0
 DRY( 13,120)    DRY( 13,121)    DRY( 13,122)    DRY( 13,123)    DRY( 14,116)    DRY( 14,117)    DRY( 14,118)    DRY( 14,119)

 DRY( 18, 97)    DRY( 18, 98)    DRY( 18, 99)    DRY( 18,100)    DRY( 45, 55)    DRY( 46, 57)    DRY( 47, 24)    DRY( 48, 24)
 DRY( 49, 24)    DRY( 49, 63)    DRY( 50, 24)    DRY( 51, 24)    DRY( 51, 66)    DRY( 61, 61)    DRY( 62, 19)    DRY( 63, 21)    VCONT < 0
 DRY( 63, 22)    DRY( 64, 23)    DRY( 64, 57)    DRY( 64, 58)    DRY( 66, 50)    DRY( 68, 32)    DRY( 69, 33)    DRY(156, 67)
 DRY(157, 46)
```

Table 7

Portion of iteration history for MODFLOW output (BEJ (68a) model run) showing cells that went dry on first iteration. All of these cells had negative values for VCONT.

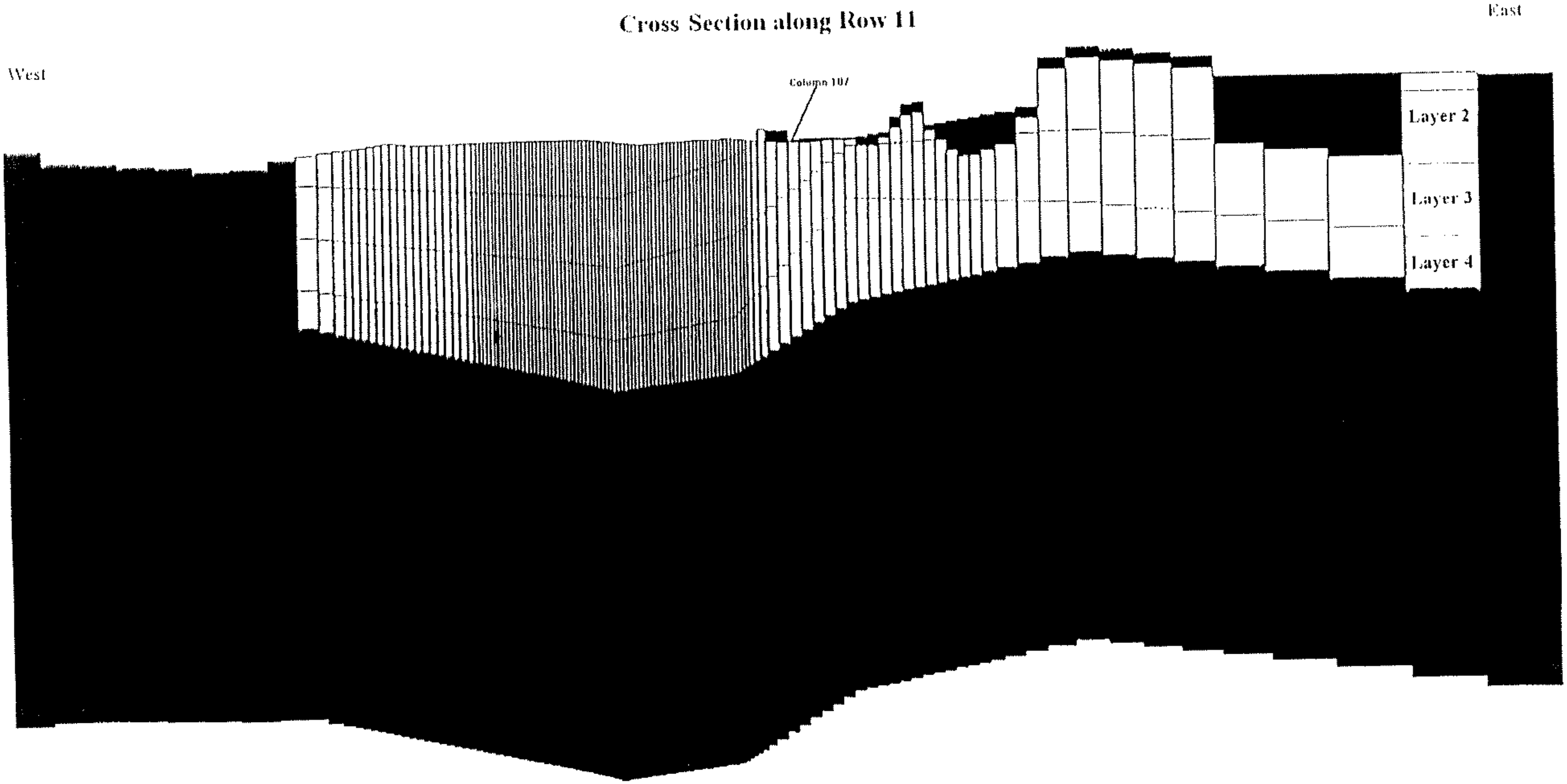
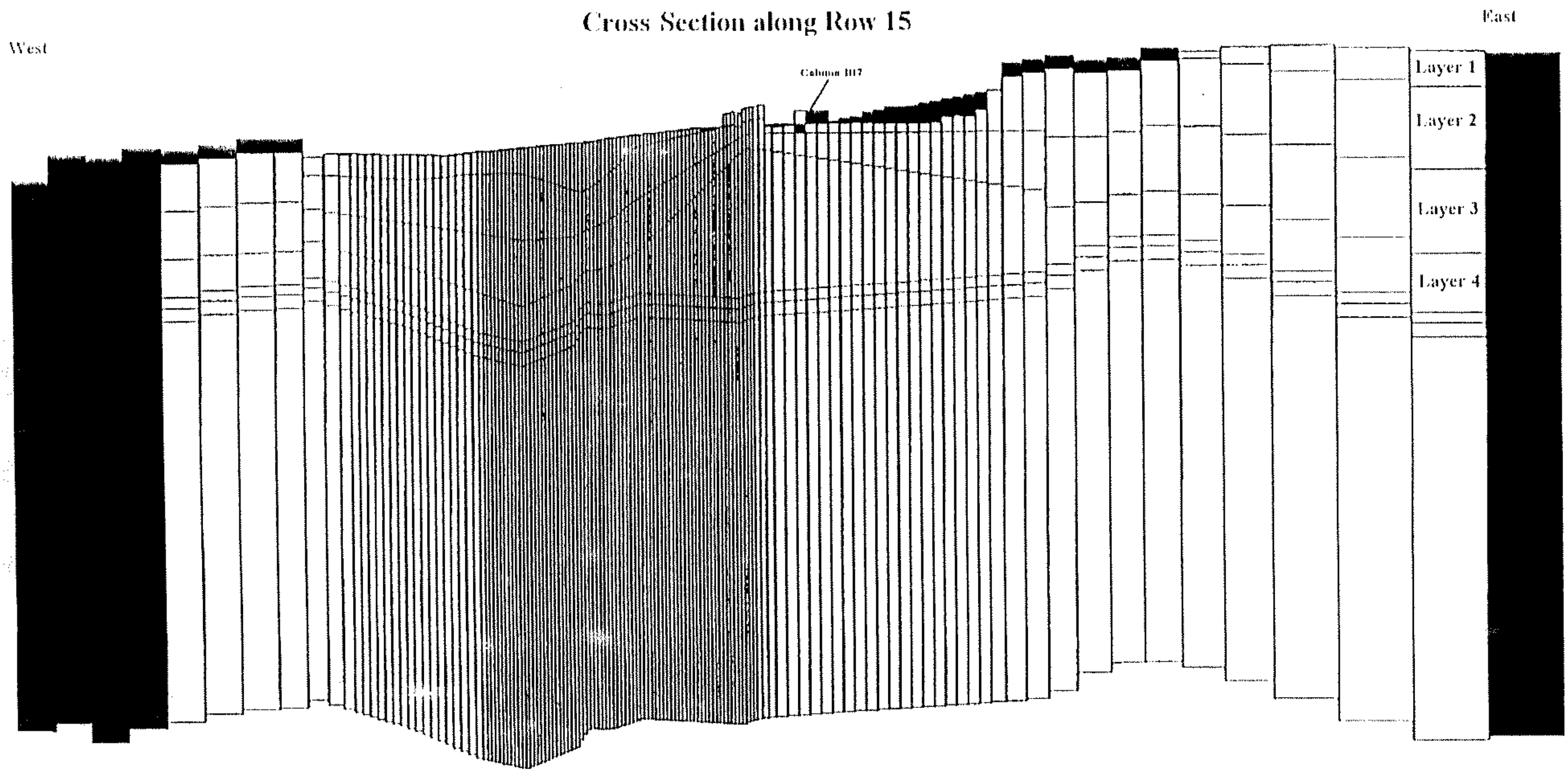


Figure 1 GW Vistas cross section along row 11 showing Layer 2 pinchout and thickness of Layer 4.



Cross Section along Row 15

Figure 2 GW Vistas cross section along row 15 showing relative thicknesses of Layers 2, 3 and 4

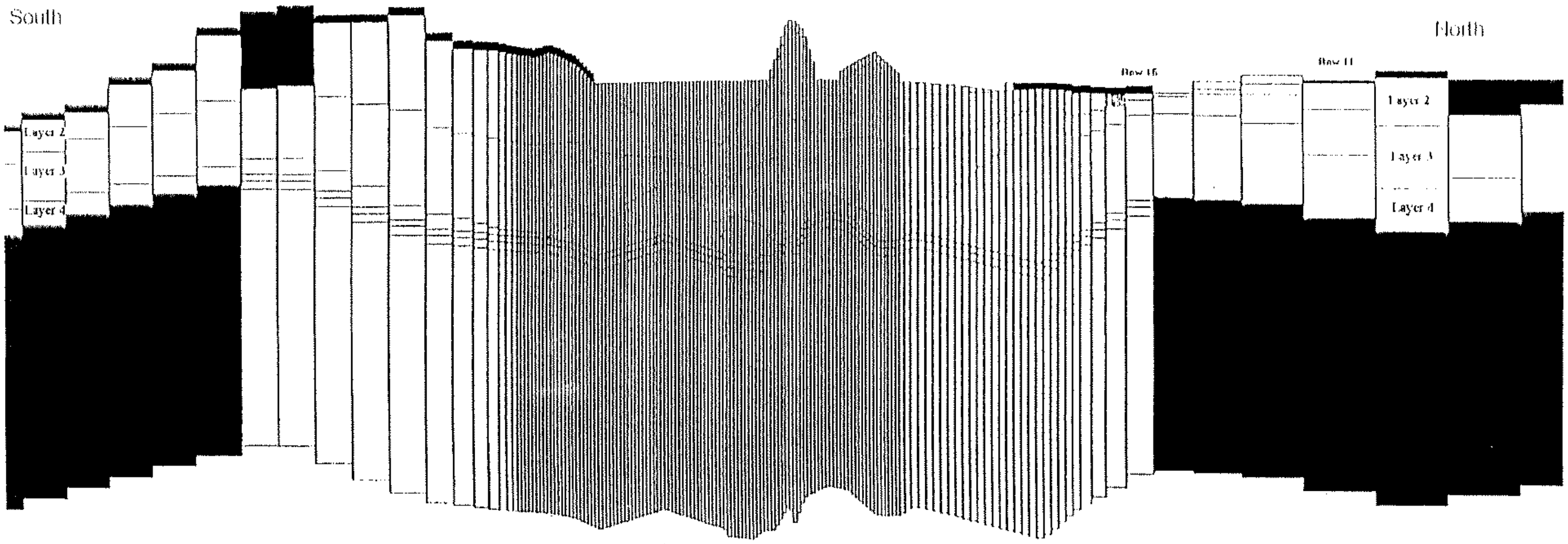
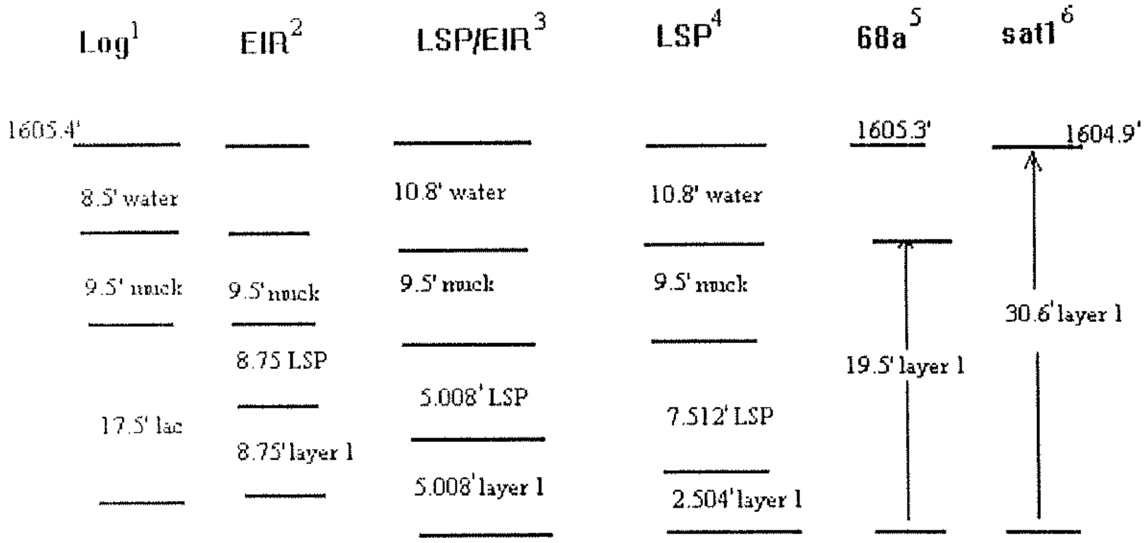

Cross Section along Column 107

Figure 3 GW Vistas cross section along column 107 showing relative thicknesses of Layers 2, 3 and 4.

STS DHL-1

not to scale



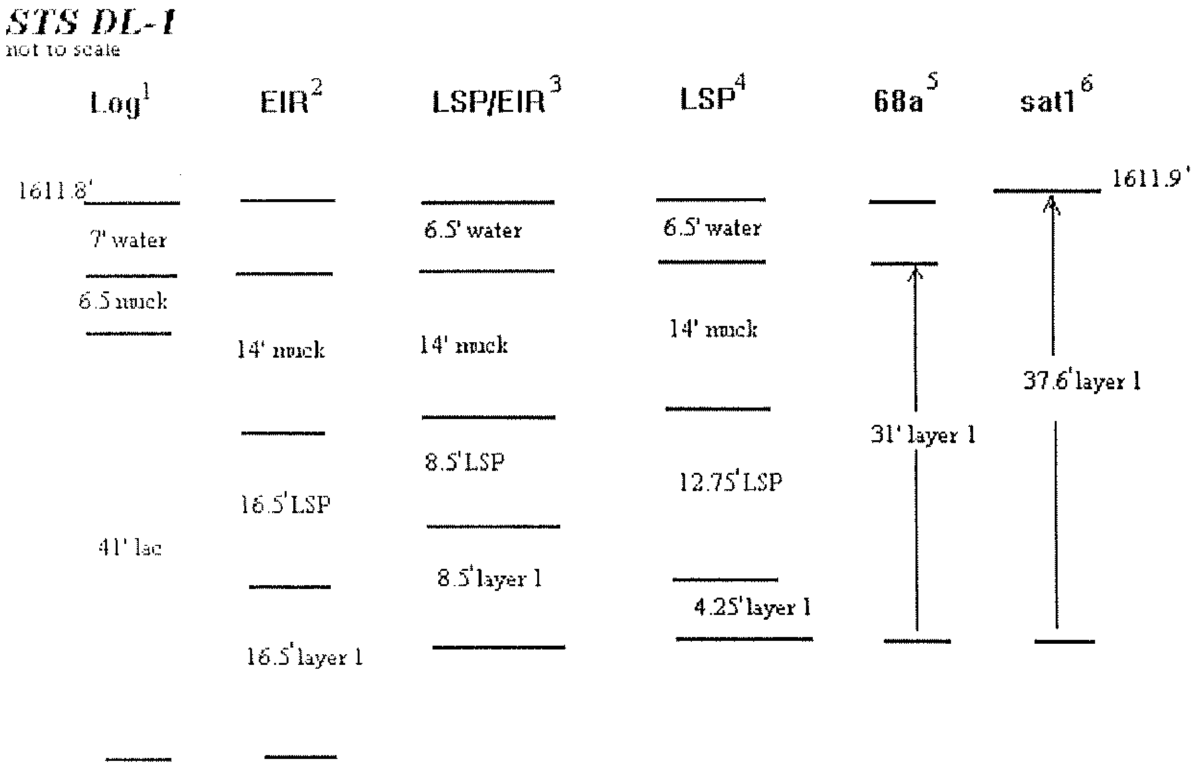
Lake conductance	3.99	2.66*		
Vcont between layers 1 and 2	1.56e-03	3.06e-03	4.08e-04	2.61e-04*

(* Value used in the model.)

		Thicknesses	
		Layer 1	Layer 2
Vcont value consistent with Lake Stage Package (using 1/4 of Lacustrine)	3.06e-03	2.504'	89.12
Vcont value from model input (using saturated thickness)	2.61e-04	30.6'	89.12

1 Geologic information from the soil boring log.
2 The division of the geology based on the EIR narrative and defined average muck thickness.
3 The division using the EIR narrative and the defined thickness of lacustrine deposits from the Lake Stage Package
4 The division of lacustrine deposits as it was done in the Lake Stage Package.
5 Thickness of Layer 1 as input to run 68a.
6 Thickness of Layer 1 from ACALC input file used to calculate Vcont input for run 68a (sat1 47a mod).

Figure 4 Various thicknesses used to represent Layer 1 at well STS DHL-1 (Row 134, Column 89)



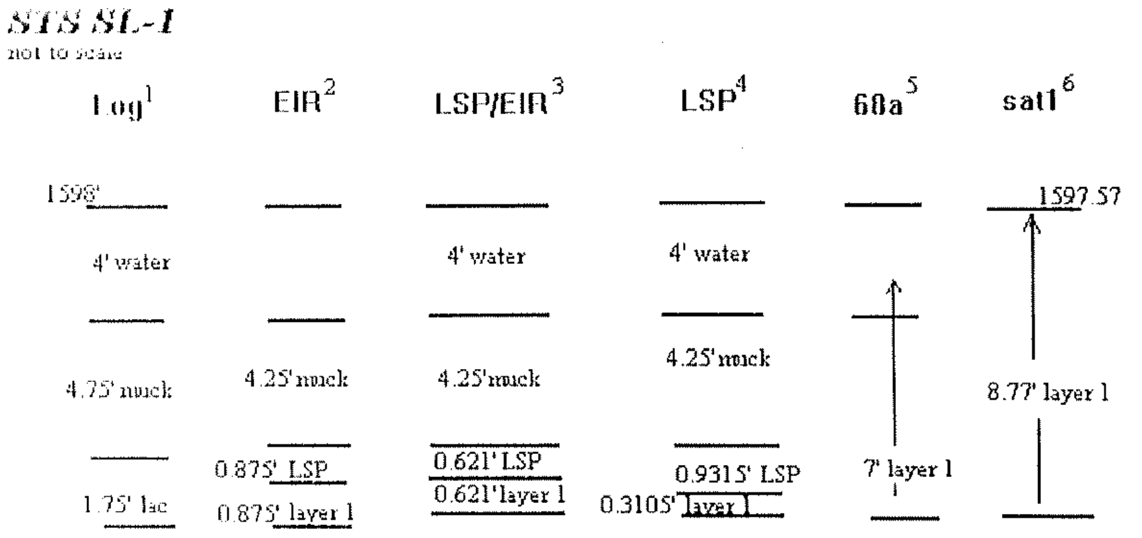
Lake conductance	2.35	1.57*		
Vcont between layers 1 and 2	9.26e-04	1.82e-03	2.56e-04	2.12e-04*

(* Value used in the model.)

		Thicknesses	
		Layer 1	Layer 2
Vcont value consistent with Lake Stage Package (using 1/4 of Lacustrine)	1.82e-03	4.25'	94.39'
Vcont value from model input (using saturated thickness)	2.12e-04	37.6'	94.39'

1 Geologic information from the soil boring log.
2 The division of the geology based on the EIR narrative and defined average muck thickness.
3 The division using the EIR narrative and the defined thickness of lacustrine deposits from the Lake Stage Package
4 The division of lacustrine deposits as it was done in the Lake Stage Package.
5 Thickness of Layer 1 as input to run 68a.
6 Thickness of Layer 1 from ACALC input file used to calculate Vcont input for run 68a (sat1 47a mod).

Figure 5 Various thicknesses used to represent Layer 1 at well STS DL-1
(Row 98, Column 92)



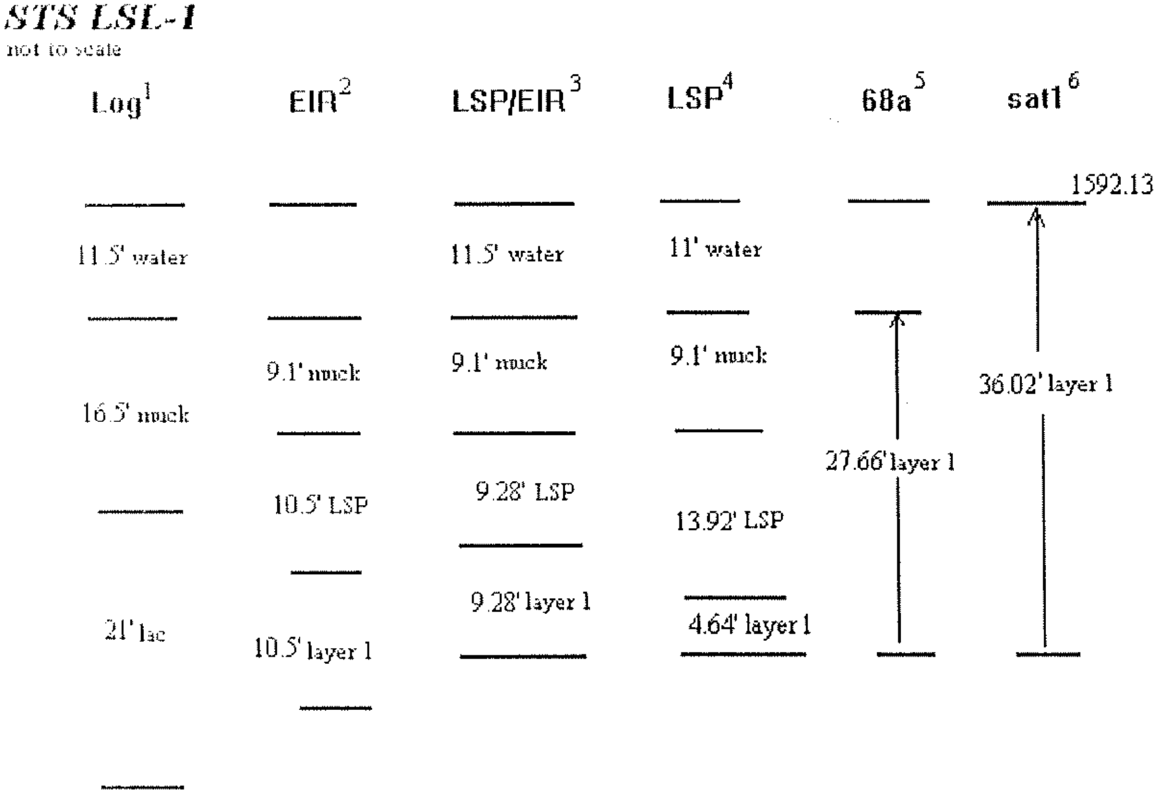
	LSP/EIR	LSP	68a	sat1
Lake conductance	563.61	375.74 *		
Vcont between layers 1 and 2	6.9e-02	1.23e-01	9.46e-03	7.76e-03*

(* Value used in the model.)

		Thicknesses	
		Layer 1	Layer 2
Vcont value consistent with Lake Stage Package (using 1/4 of Lacustrine)	1.23e-01	0.3105'	44'
Vcont value from model input (using saturated thickness)	7.76e-03	8.77'	44'

1 Geologic information from the soil boring log.
2 The division of the geology based on the EIR narrative and defined average muck thickness.
3 The division using the EIR narrative and the defined thickness of lacustrine deposits from the Lake Stage Package
4 The division of lacustrine deposits as it was done in the Lake Stage Package.
5 Thickness of Layer 1 as input to run 68a.
6 Thickness of Layer 1 from ACALC input file used to calculate Vcont input for run 68a (sat1 47a mod).

Figure 6 Various thicknesses used to represent Layer 1 at well STS SL-1 (Row 48, Column 80)



Lake conductance	2.16	1.44*		
Vcont between layers 1 and 2	8.6e-04	1.71e-03	2.9e-04	2.22e-04*

(* Value used in the model.)

		Thicknesses	
		Layer 1	Layer 2
Vcont value consistent with Lake Stage Package (using 1/4 of Lacustrine)	1.71e-03	4.64'	66.55'
Vcont value from model input (using saturated thickness)	2.22e-04	36.02'	66.55'

[1] Geologic information from the soil boring log.

[2] The division of the geology based on the EIR narrative and defined average muck thickness.

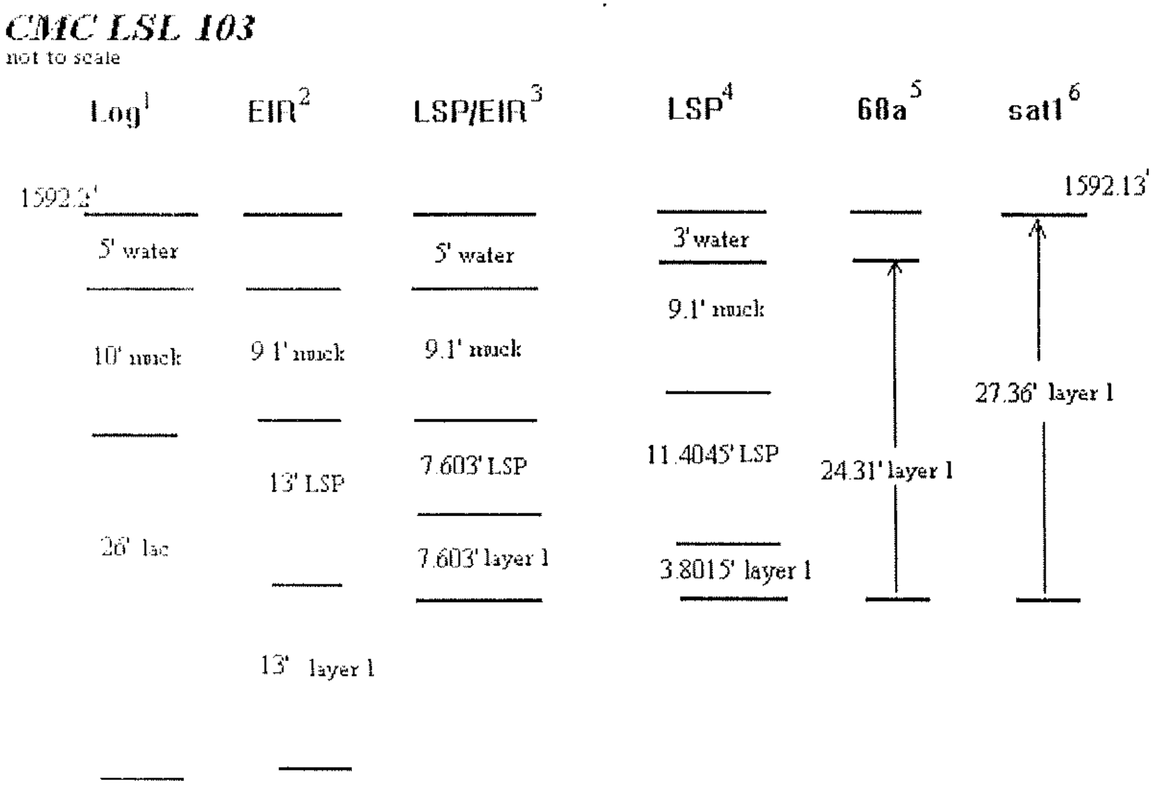
[3] The division using the EIR narrative and the defined thickness of lacustrine deposits from the Lake Stage Package

[4] The division of lacustrine deposits as it was done in the Lake Stage Package.

[5] Thickness of Layer 1 as input to run 68a.

[6] Thickness of Layer 1 from ACALC input file used to calculate Vcont input for run 68a (sat1 47a mod).

Figure 7 Various thicknesses used to represent Layer 1 at well STS LSL-1
(Row 81, Column 57)



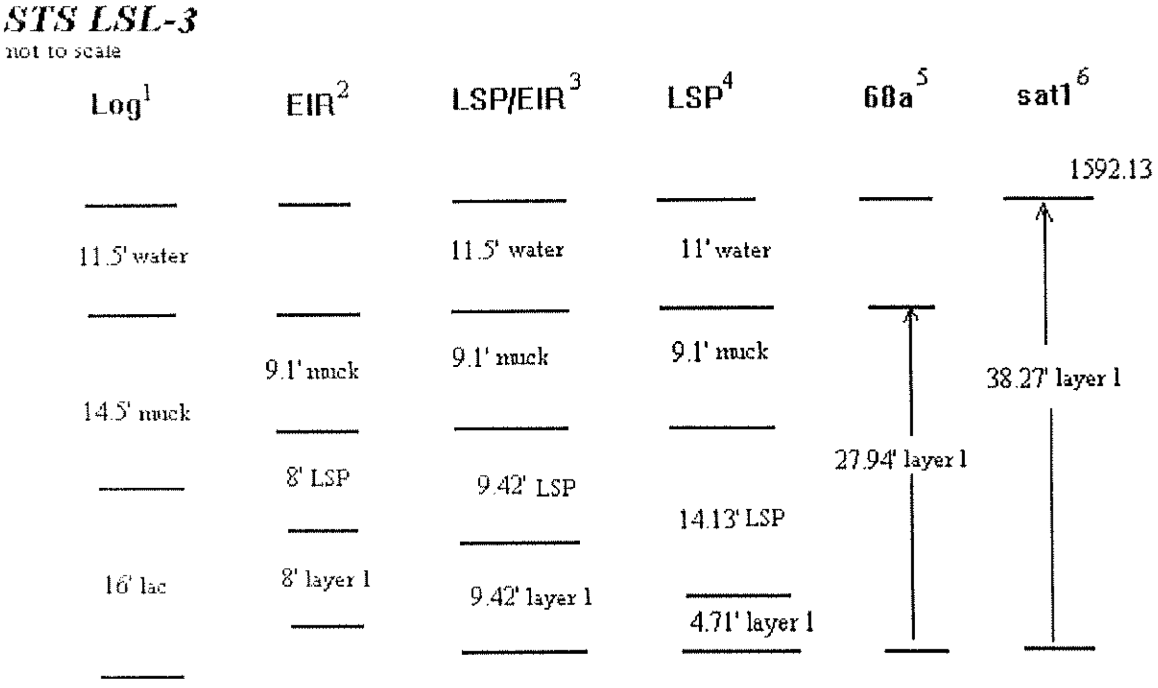
	LSP/EIR	LSP	68a	sat1
Lake conductance	2.625	1.75*		
Vcont between layers 1 and 2	1.75e-03	2.08e-03	3.28e-04	2.92e-04*

(* Value used in the model.)

		Thicknesses Layer 1	Layer 2
Vcont value consistent with Lake Stage Package (using 1/4 of Lacustrine)	2.08e-03	3.8015'	78.98'
Vcont value from model input (using saturated thickness)	2.09e-04	27.36'	78.98'

1 Geologic information from the soil boring log.
2 The division of the geology based on the EIR narrative and defined average muck thickness.
3 The division using the EIR narrative and the defined thickness of lacustrine deposits from the Lake Stage Package
4 The division of lacustrine deposits as it was done in the Lake Stage Package.
5 Thickness of Layer 1 as input to run 68a.
6 Thickness of Layer 1 from ACALC input file used to calculate Vcont input for run 68a (sat1 47a mod).

Figure 8 Various thicknesses used to represent Layer 1 at well CMC LSL 103 (Row 85, Column 42)



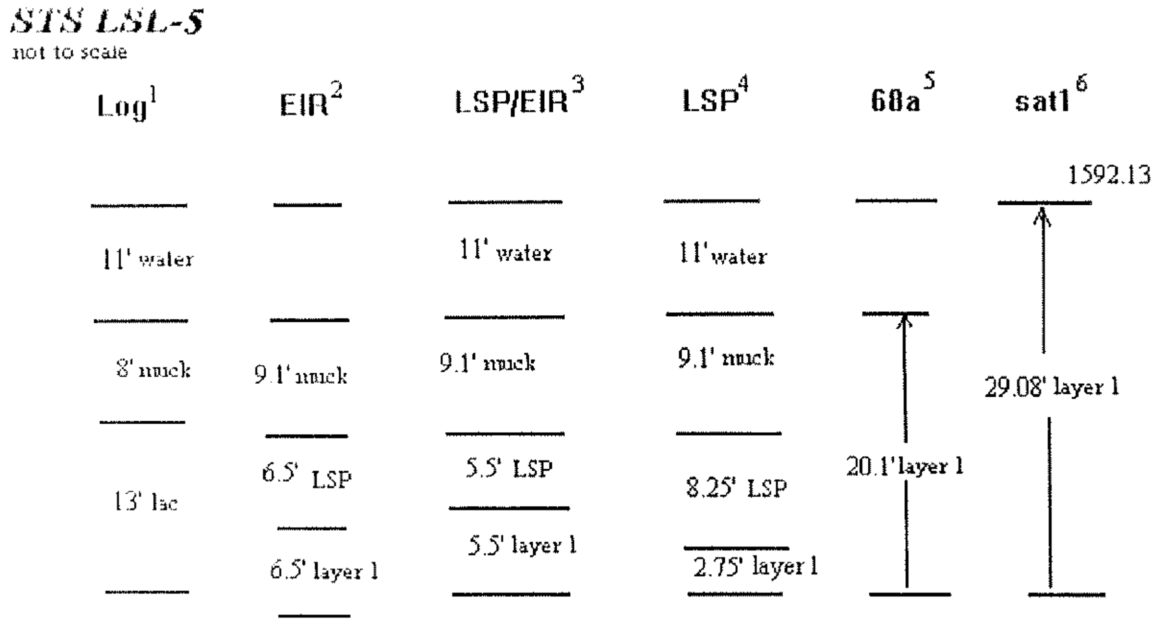
Lake conductance	2.13	1.42*		
Vcont between layers 1 and 2	8.45e-04	1.68e-03	2.86e-04	2.09e-04*

(* Value used in the model.)

		Thicknesses	
		Layer 1	Layer 2
Vcont value consistent with Lake Stage Package (using 1/4 of Lacustrine)	1.68e-03	4.71'	66.51'
Vcont value from model input (using saturated thickness)	2.09e-04	38.27'	66.51'

1 Geologic information from the soil boring log.
2 The division of the geology based on the EIR narrative and defined average muck thickness.
3 The division using the EIR narrative and the defined thickness of lacustrine deposits from the Lake Stage Package
4 The division of lacustrine deposits as it was done in the Lake Stage Package.
5 Thickness of Layer 1 as input to run 68a.
6 Thickness of Layer 1 from ACALC input file used to calculate Vcont input for run 68a (sat1 47a mod).

Figure 9 Various thicknesses used to represent Layer 1 at well STS LSL-3
(Row 88, Column 55)



	Log	EIR	LSP/EIR	LSP	68a	sat1
Lake conductance			3.63	2.42*		
Vcont between layers 1 and 2			1.44e-03	2.87e-03	3.97e-04	2.75e-04*

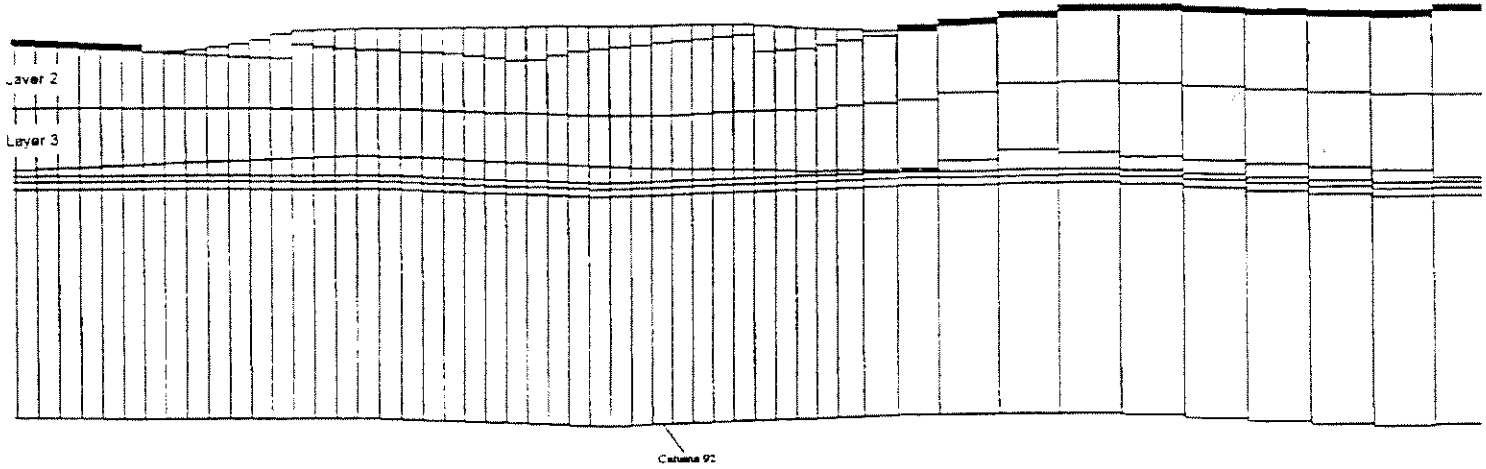
(* Value used in the model.)

		Thicknesses	
		Layer 1	Layer 2
Vcont value consistent with Lake Stage Package (using 1/4 of Lacustrine)	2.87e-03	2.75'	58.63'
Vcont value from model input (using saturated thickness)	2.75e-04	29.08'	58.63'

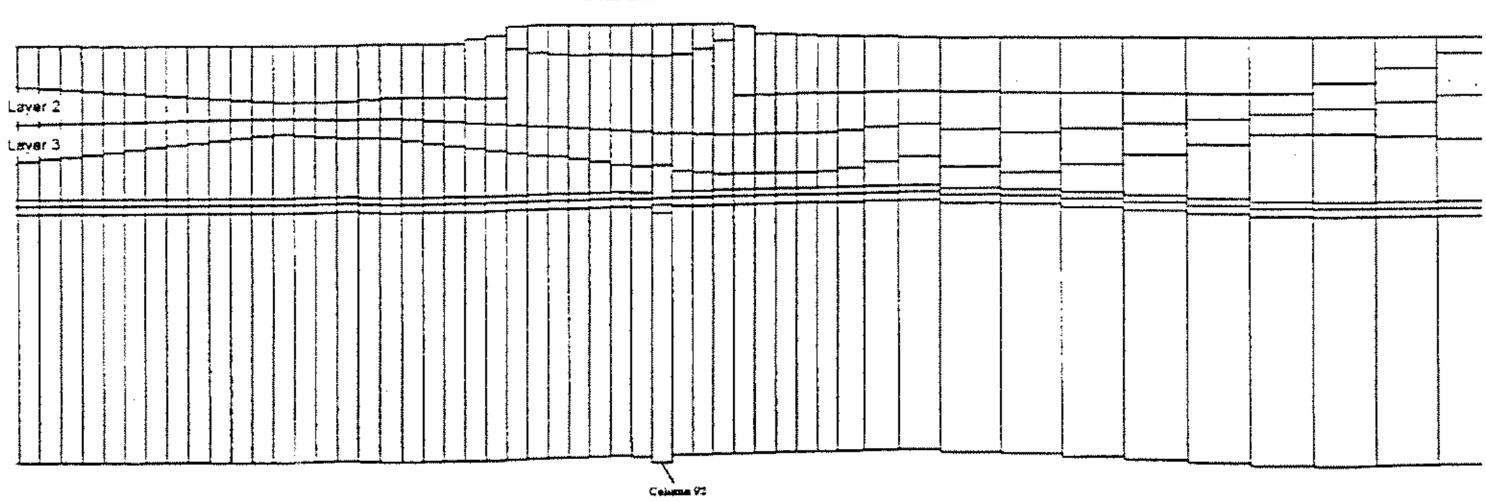
1 Geologic information from the soil boring log.
2 The division of the geology based on the EIR narrative and defined average muck thickness.
3 The division using the EIR narrative and the defined thickness of lacustrine deposits from the Lake Stage Package
4 The division of lacustrine deposits as it was done in the Lake Stage Package.
5 Thickness of Layer 1 as input to run 68a.
6 Thickness of Layer 1 from ACALC input file used to calculate Vcont input for run 68a (sat1 47a mod).

Figure 10 Various thicknesses used to represent Layer 1 at well STS LSL-5 (Row 110, Column 49)

Cross Section along Row 134



Cross Section along Row 98



Cross Section along Column 92

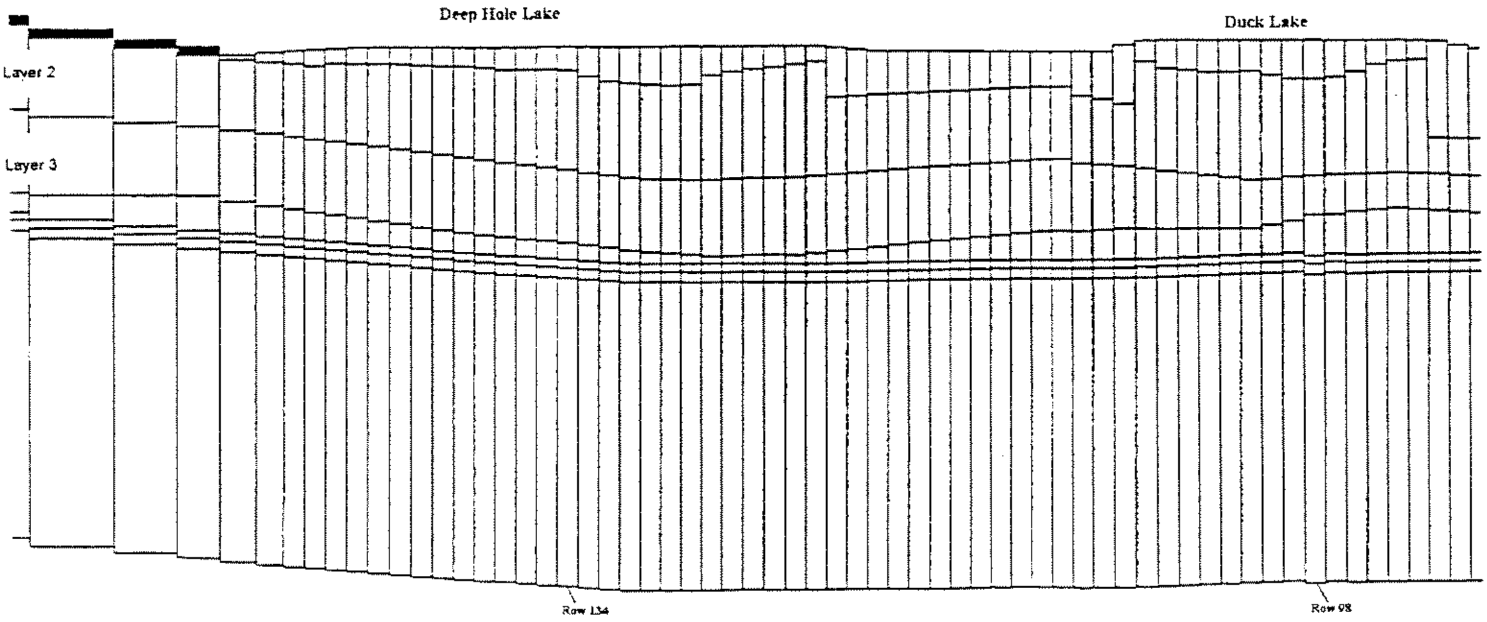


Figure 11 GW Vistas cross sections illustrating thickness differences between Layers 2 and 3 beneath the internal lakes.

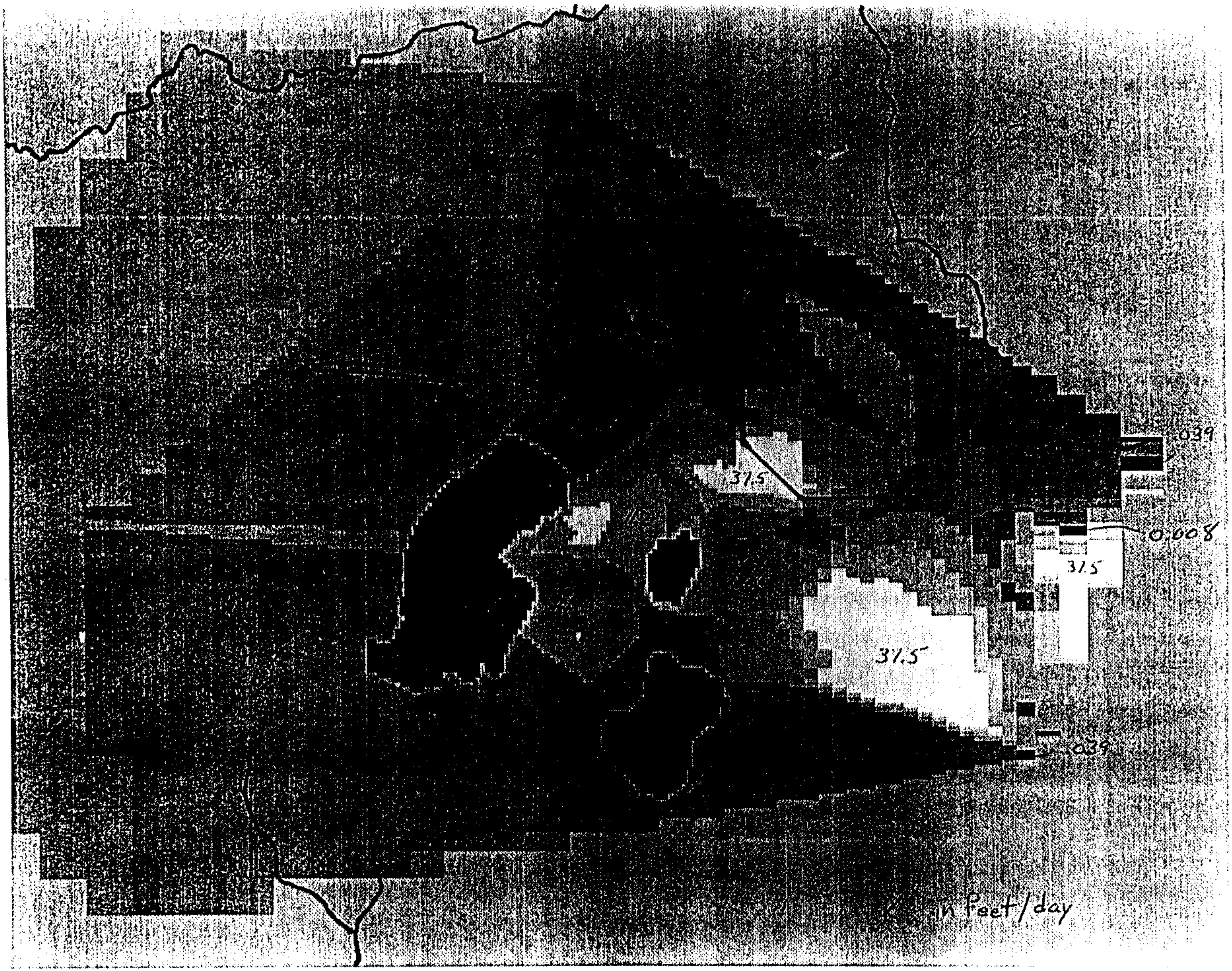


Figure 12
Distribution of model input values for Kh in Layer 1
[illegible]

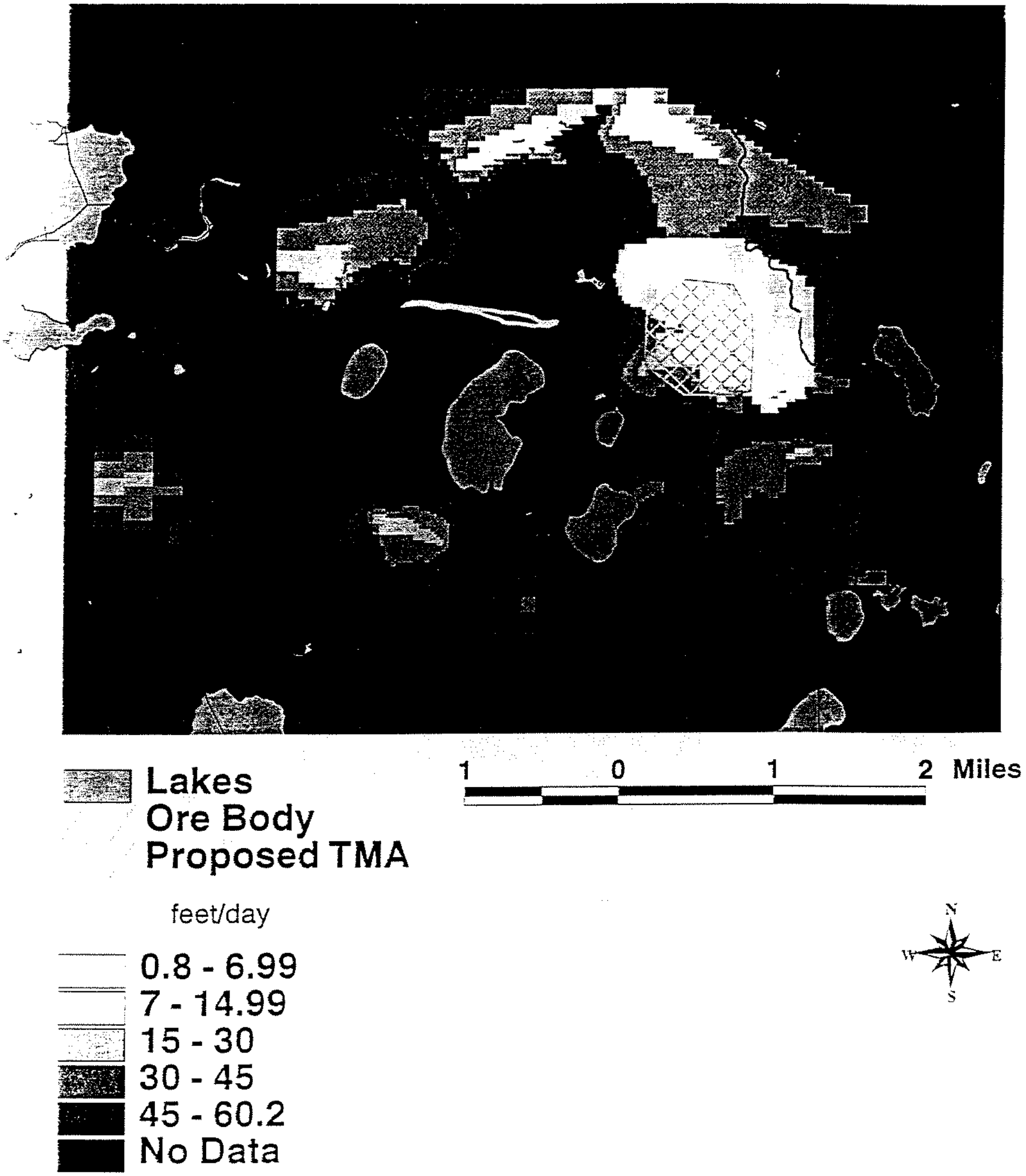


Figure 13 Hydraulic Conductivity Zones for Layer 2

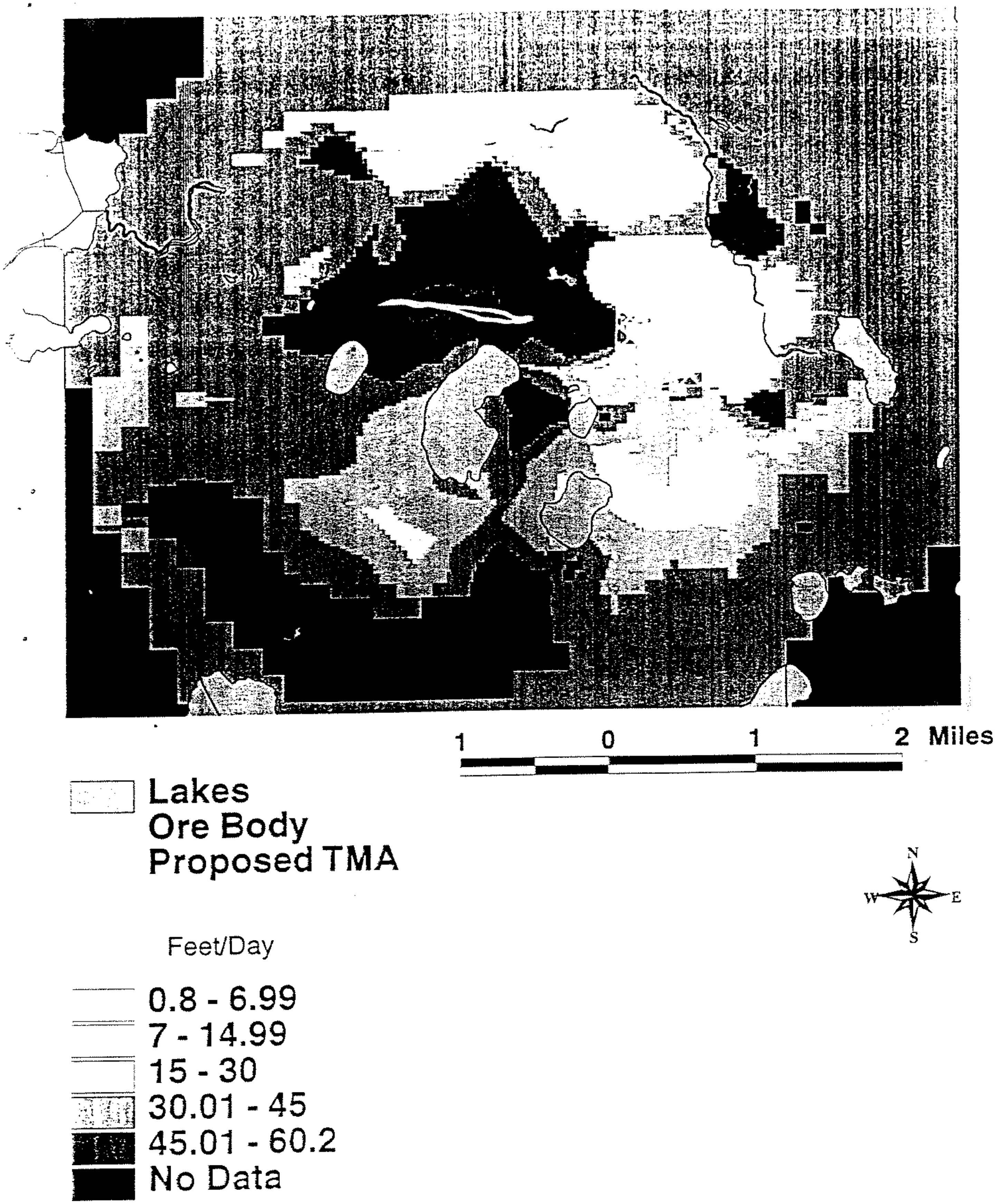


Figure 14 Hydraulic Conductivity Zones for Layer 3

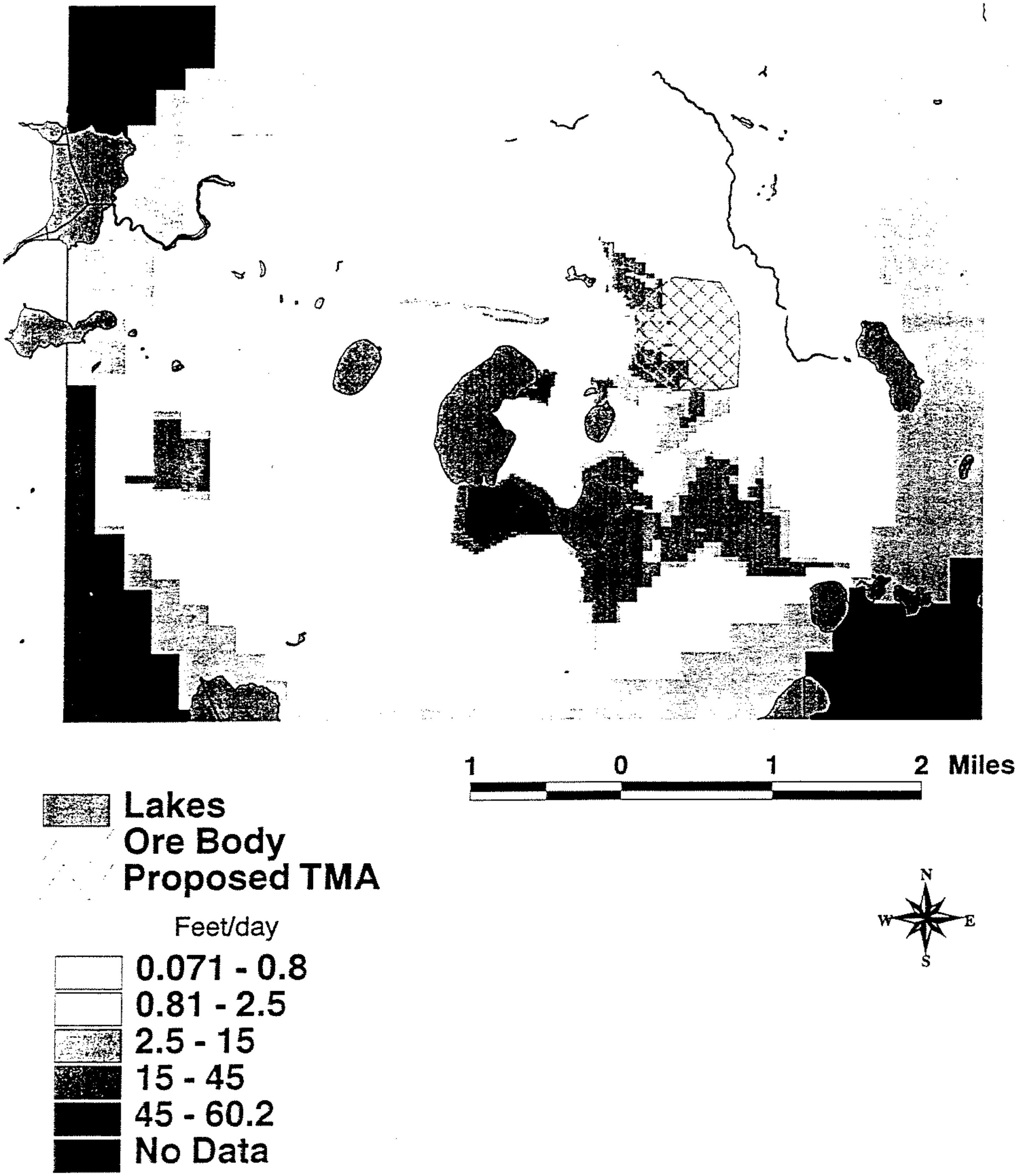


Figure 15 Hydraulic Conductivity Zones for Layer 4

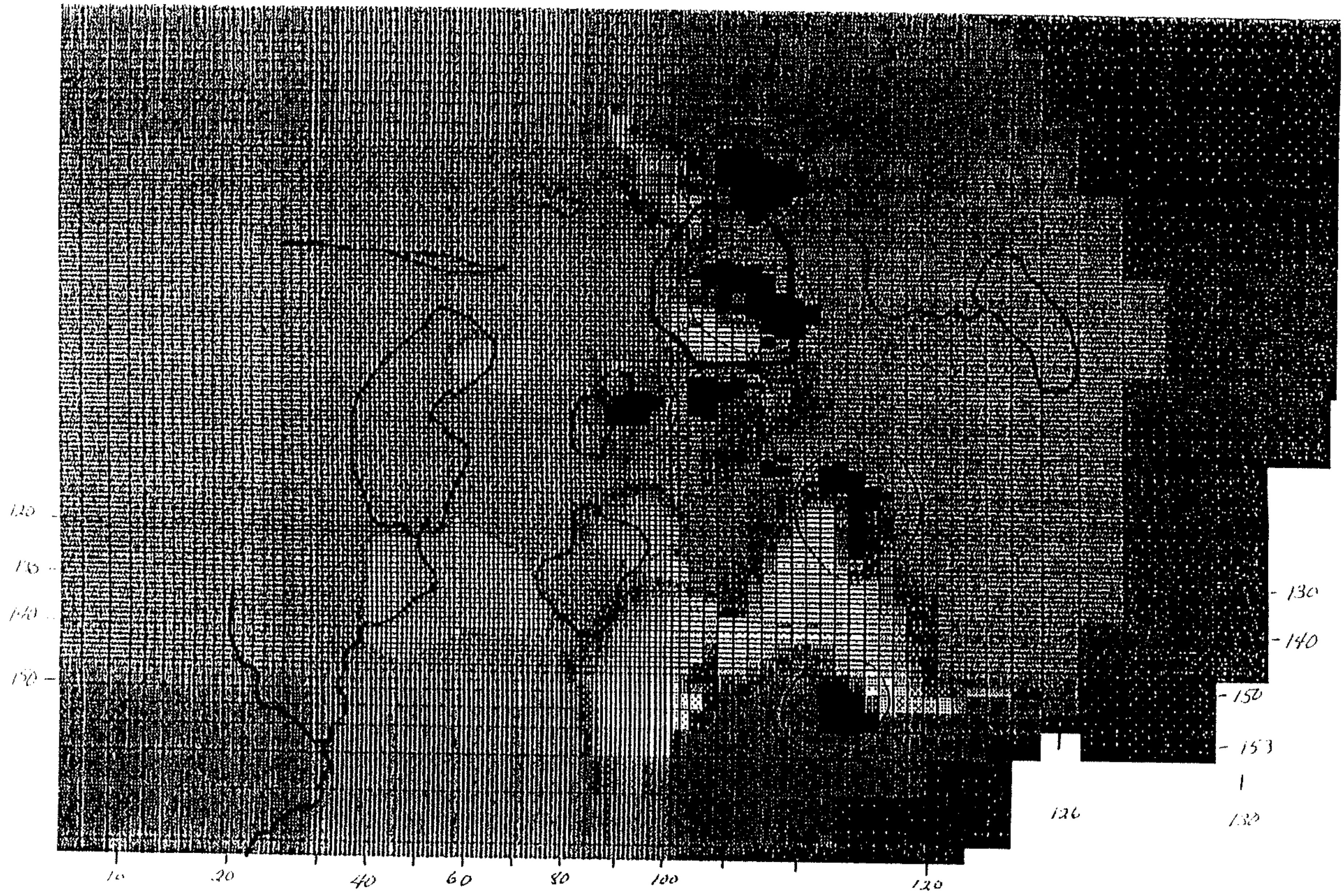


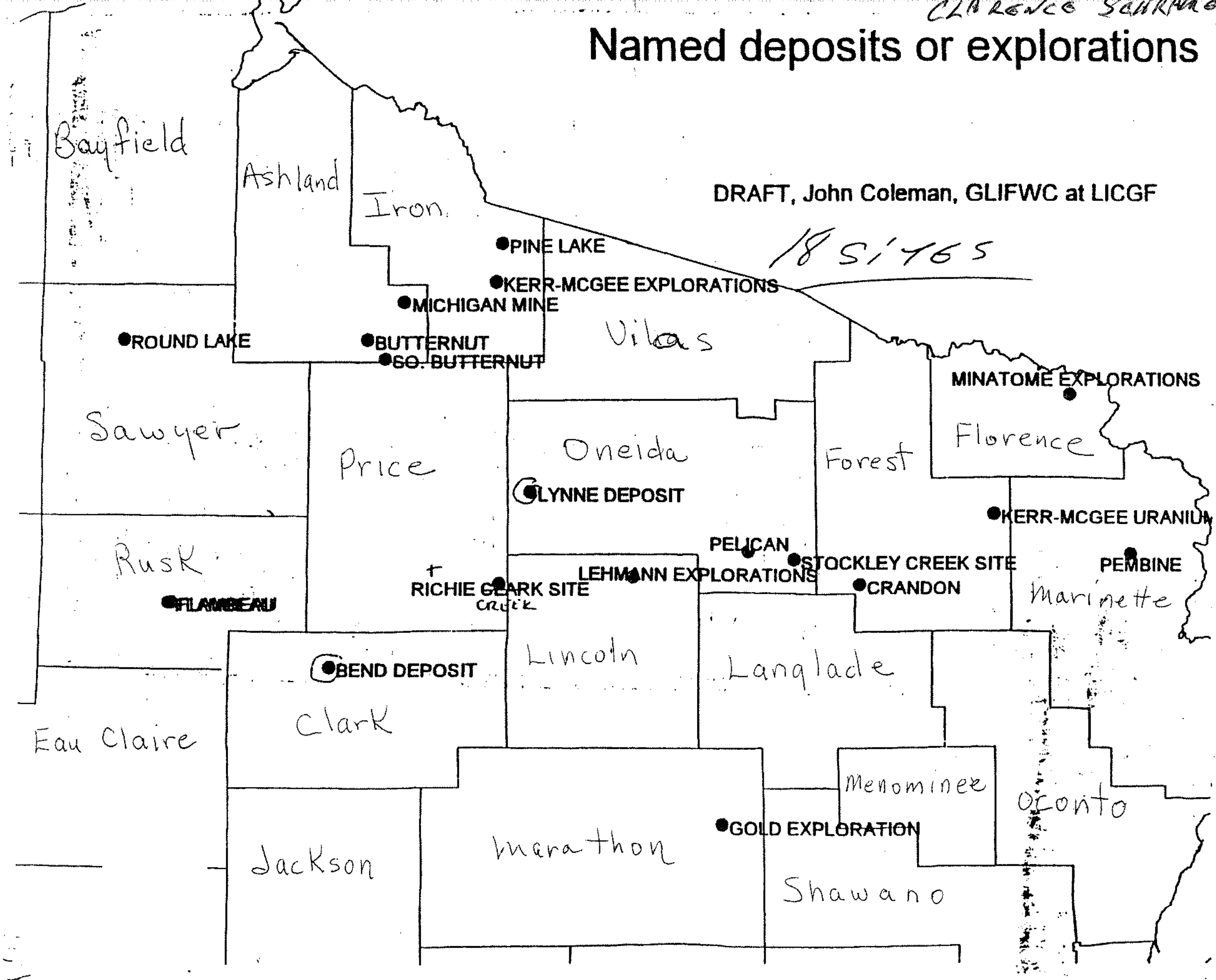
Figure 16
Areas identified in Layer 4 which have model input values for Kh of less than 0.8 feet/day.
Black highlighted areas represent values which range from 0.071feet/day up to 0.8 feet/day
Depiction of base map features is approximate

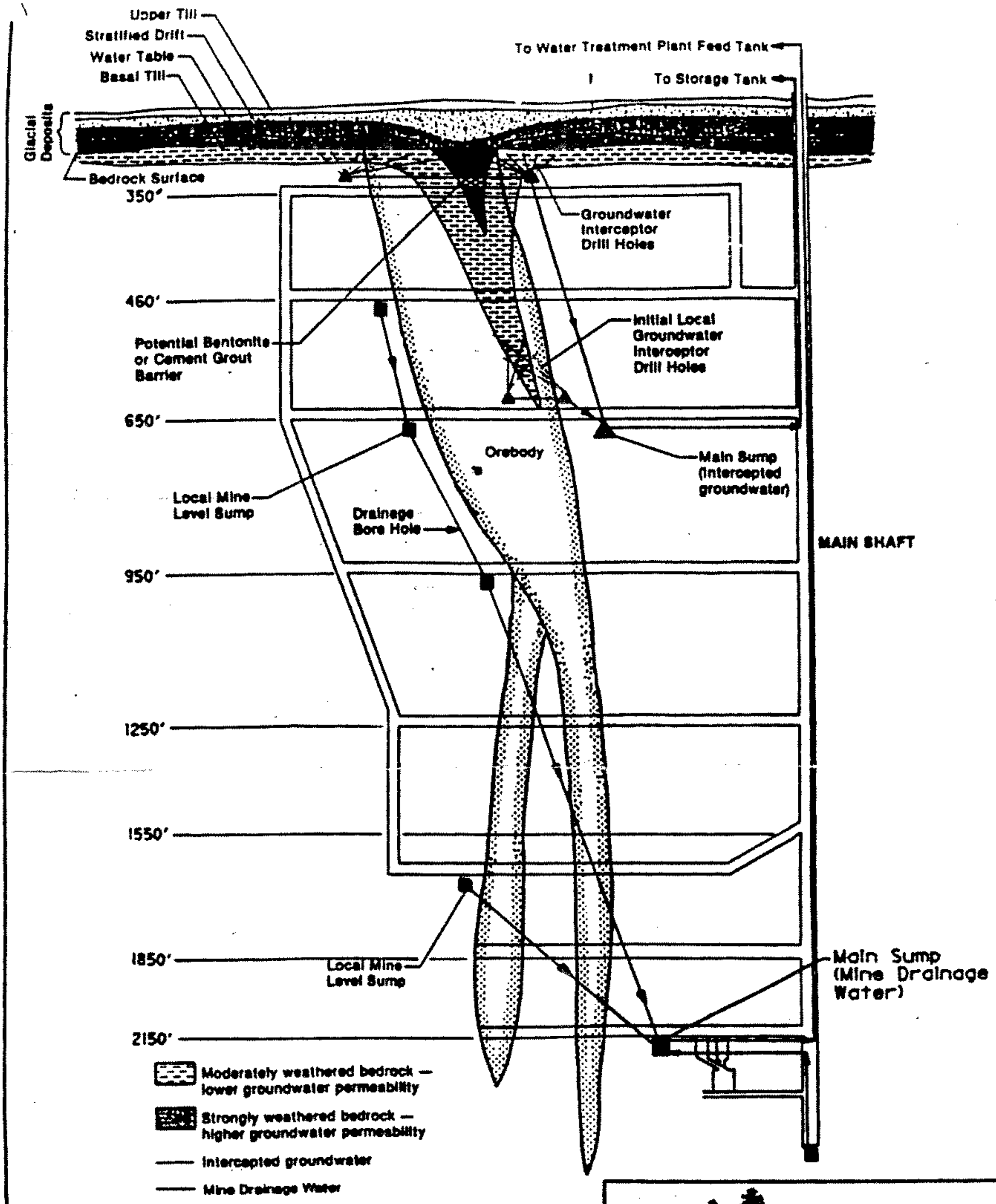
CLARENCE SCHRAMEYER

Named deposits or explorations

DRAFT, John Coleman, GLIFWC at LICGF

18 S/765





Crandon Mining Compan

FIGURE 3 - 7

MINE DRAINAGE SCHEMATIC

Scale: NOT TO SCALE

Date: JANUARY, 19

Prepared By: Foth & Van Dyke

By:

93C

REVISED	DATE	BY	DESCRIPTION

3c49f1.DGN

WISCONSIN LEGISLATIVE COUNCIL STAFF MEMORANDUM

One East Main Street, Suite 401; P.O. Box 2536; Madison, WI 53701–2536
Telephone (608) 266–1304
Fax (608) 266–3830

DATE: December 8, 1997

TO: REPRESENTATIVE MARC DUFF, CHAIRPERSON, ASSEMBLY COMMITTEE ON THE ENVIRONMENT

FROM: William Ford, Senior Staff Attorney

SUBJECT: Applicability of Wisconsin Mining Permit Laws and 1997 Engrossed Senate Bill 3 to Mining of Metallic Minerals Conducted Upon Indian Lands

A. INTRODUCTION

This memorandum is in response to your request for an answer to the following questions:

1. Would s. 293.49 (1), Stats., which requires a person who wishes to mine metallic minerals in this state to obtain a mining permit from the Department of Natural Resources (DNR), apply to mining of metallic minerals conducted upon Indian lands either by the tribe or by a lessee of land from the tribe?

2. Would 1997 Engrossed Senate Bill 3 ("the Engrossed Bill"), if enacted into law, relating to issuance of metallic mining permits for the mining of sulfide ore bodies, apply to mining of metallic minerals conducted upon Indian lands either by the tribe or by a lessee of land from the tribe?

As will be explained in Section D. of this memorandum, the answer to both of these questions appears to be "no." Under legal principles articulated by the U.S. Supreme Court, it appears that the state would be preempted from requiring issuance of a mining permit as a condition of mining metallic minerals upon Indian lands by doctrines of federal preemption and infringement of the tribal right to self government and by federal laws and regulation. In addition, the Engrossed Bill would establish two preconditions for issuance of a mining permit by the DNR in addition to the requirements of current law. Therefore, the Engrossed Bill would not apply to mining activities on Indian lands because the mining permit requirement does not appear to be applicable to mining conducted upon Indian lands.

In 1986, the Wisconsin Attorney General opined that the mining permit process is generally not applicable to mining operations on the Sokaogon Reservation, whether those operations are conducted by the tribe or by a non-Indian lessee. [75 OAG 220, November 7, 1986 (Attachment 1 to this memorandum).] The analysis employed by the Attorney General in this opinion is directly applicable to the questions addressed in this memorandum. In addition, the conclusions reached by the Attorney General in this opinion are not contradicted by subsequent federal statutory or case law. Therefore, Section D. of this memorandum, which explains in more detail why state mining permit laws and the Engrossed Bill do not appear to apply to mining conducted upon Indian lands, relies substantially upon the analysis in the Attorney General's opinion.

In this memorandum, the term "Indian lands" is used to refer to Indian reservations and tribal trust lands. Generally, ***reservations*** are lands that are held in trust by the U.S. government for Indian tribes that were established or confirmed by treaty, statute or executive order. [William C. Canby, *American Indian Law*, West Publishing Co., St. Paul, 1988, p. 264.] Tribal ***trust*** lands are lands held in trust by the U.S. government for Indian tribes that are established under the process described in Attachment 2 to this memorandum. For purposes of federal limits on state regulation (including the requirements for obtaining a state permit to mine metallic minerals), Indian reservation and tribal trust lands purchased or accepted into trust for use of the Indian tribes generally have the ***same*** status. [71 OAG 82.]

The remainder of this memorandum first describes the mining permit requirement under s. 293.49 (1), Stats., next describes the Engrossed Bill and finally explains why it appears that the requirement to obtain a mining permit for the mining of metallic minerals, including the requirements under the Engrossed Bill, would not apply to mining activities conducted upon Indian lands.

B. CONDITIONS FOR ISSUANCE OF A METALLIC MINING PERMIT UNDER CURRENT LAW

Under s. 293.49 (1), Stats., the DNR is directed to issue a metallic mining permit if it finds:

NO MINING PLAN OR RECLAMATION PLAN APPROVED BY STATE

1. The mining plan and reclamation plan are reasonably certain to result in reclamation of the mining site and the DNR has approved the mining plan. "Reclamation" is defined in s. 293.01 (23), Stats., to mean the process by which an area physically or environmentally affected by mining is rehabilitated to either its original state or, if this is shown to be physically or economically impracticable or environmentally or socially undesirable, to a state that provides long-term environmental stability.

2. The proposed operation will comply with all applicable air, groundwater, surface water and solid and hazardous waste management laws and rules of the DNR.

NO UNSUITABILITY DETERMINATION

3. In the case of a surface mine, the site is not unsuitable for mining. "Unsuitability" is defined in s. 293.01 (28), Stats., to mean that the land proposed for surface mining is not suitable for such activity because the surface mining activity itself may reasonably be expected to destroy or irreparably damage either: (a) habitat required for survival of species of vegetation or