U.S NUCLEAR REGULATORY COMMISSION
DIVISION OF WASTE MANAGEMENT

DEVELOPMENT OF GROUNDWATER CONCEPTUAL FLOW MODELS FOR THE BWIP SITE

SUBTASK 2.4
UPDATE

TECHNICAL ASSISTANCE IN HYDROGEOLOGY
PROJECT B - ANALYSIS
RS-NMS-85-009

OCTOBER 31, 1986

1.0 INTRODUCTION

A report on the "Development of Groundwater Conceptual Flow Models for the BWIP Site" was submitted by Terra Therma, Inc. (TTI) on April 30, 1986 as the contractual product for Subtask 2.4. This document serves as an update to that original 2.4 report, as part of TTI's ongoing work on the BWIP site.

The original report incorporated all hydrogeologic data available at the time and described the BWIP hydrogeologic system in terms of five categories: 1) Framework, 2) Parametric data, 3) Boundary conditions, 4) Stimuli, and 5) Responses. The "conceptual model" was thought to include only framework, parametric data, and boundary conditions; the remaining two categories providing feedback to test the model. In describing and reviewing the available data within the context of the five categories, the level of certainty regarding numerous key issues was identified. As a result, issues which were identified as being unresolved provided a basis for listing data needs. In turn, the data needs provided a basis for establishing work plans to be performed under the 2.5 subtask.

The guiding approach of the work plans and all subsequent 2.5 analyses was not to simply itemize where data are lacking, but rather to determine which data are specifically required by the NRC to reach decisions on licensing. Analyses for a particular parameter involved a two-phase process:

1. Sensitivity studies to determine what value range of the parameter is of significant concern in evaluating NRC's performance criteria.

2. Analyses to determine the current degree of uncertainty of the parameter, based on existing field or generic data.

As a follow-up to this approach, 10 mini-reports have been prepared under Subtask 2.5, five of which are in draft stage (Refer to the Mini-Report list at the end of this document, Section 8.0). These have, in turn, spawned additional analyses which are underway. As an update to the original conceptual model report, the remainder of this document will summarize the results of the various mini-reports where they either support or modify the discussions in the original Conceptual Model report. In general, there have been no substantive changes in the conceptual model framework or parametric categories, which is due in part to the lack of new data from the BWIP site. In the categories of stimuli and responses, however, various analyses suggest that phenomenon such as thermal effects can not be ignored.

2.0 FRAMEWORK

No new information has been provided since the last report from which to suggest any modifications or refinement to the established framework.

3.0 PARAMETRIC DATA

The results of analyses performed in Mini-Reports #5 and #8 suggest that a large-scale hydraulic test, as represented by the drilling and testing effects which were measured in various piezometers, might confirm the results of the small-scale tests performed at BWIP. Using the methods described in those mini-reports, an analysis of responses in the Rocky Coulee flow top resulted in transmissivities of 1.3, 7, and 80 ft^2/day. The first two values fall within the range of the geometric mean (2.6 ft^2/day) calculated by DOE (DOE/NRC LHS Pre-Test Consultation Meeting - Dec. 9-10, 1985, Richland, WA). The third value, which falls outside this range, is from the response of DC-20C (both the Rocky Coulee and Cohassett piezometers) due to activities at RRL-17. However, because of the identical responses in both the Rocky Coulee and Cohassett, it is unclear as to whether or not the results are valid. If vertical leakage had been significant during this response, less drawdown would have been detected, which in a standard Theis analysis would have been attributed to a higher transmissivity.

All of the analyses of the various drilling responses yielded a range of storativity values which is nearly the same as the range of values that either have been measured or assumed for BWIP.

Depending upon how the NRC interprets the Individual Protection Standard (IPS), a "new" parametric data need may be required. Dispersivity was not considered in the Conceptual Model report, but should the NRC decide they must

have an explicit evaluation of the IPS, then a three-dimensional understanding of dispersion may be necessary (Refer to Mini-Report #4 for a detailed explanation). An NRC position on this matter has not yet been received.

4.0 BOUNDARY CONDITIONS

Aside from the drilling effects, no new information has been made available regarding boundaries identified in the Conceptual Model report. To date, responses measured at various piezometers resulting from drilling and testing have not defined any boundaries within or near the RRL. However, with additional data from the remainder of 1986 (May to December), a more detailed analysis of possible boundaries will be performed.

5.0 RESPONSES

5.1 GRADIENTS

The relatively low hydraulic gradients and measurement difficulties at BWIP continue to be issues regarding establishment of baseline. Whether or not these difficulties are significant is the subject of ongoing uncertainty analyses. Analyses performed in Mini-Reports #6 and #9, however, do provide additional support to previous interpretations presented in the Conceptual Model report.

Mini-Report #6 analyzes the uncertainty in head determination due to density differences in the piezometer-column. Although considerable uncertainty exists, the mini-report concludes that due to the nature of the salinity effects on the head determination, that established vertical gradients are erroneously low, but it is unlikely that the direction of flow is in error. The actual vertical gradients are likely to be, therefore, greater than previously indicated, but still generally upward. Because of the high probability that the piezometer-column chemistries are inconsistent, the direction of the horizontal gradients is still in question.

Mini-Report #9 reviews the response of various piezometers to determine whether baseline conditions have been achieved and, therefore, gradients can be calculated. The conclusion is that despite the hydraulic effects of

various BWIP activities, water-level recovery has been sufficient and that further recovery will only minimally reduce the uncertainty in the baseline water levels. This is particularly true when this uncertainty is compared to the uncertainties of head determination.

5.2 HYDROCHEMISTRY

No new hydrochemistry data has been provided to either support or modify previous observations and conclusions of the Conceptual Model report.

6.0 STIMULI

It is generally agreed that repository placement and waste burial will result in significant heat generation. The duration and extent of the thermal gradients, however, have been debated for some time. Mini-Report #7 attempts to determine the significance of the thermal effects with respect to radionuclide transport.

The primary conclusion of Mini-Report #7 is that heat flux from waste burial can significantly affect upward groundwater flux, and therefore, any conceptual model of the site must consider repository heat as a possible stimulus to total flux.

Additionally, Mini-Report #10 concludes that temperature, as one component of the total energetics of the flow system at BWIP, cannot be ignored in any analysis of flow direction. Heads, as defined by environmental or cold water heads, can lead to incorrect assumptions and conclusions regarding the flow regime.

7.0 CONCLUSIONS

Based on the analyses completed to date, the following conclusions have been made:

FRAMEWORK

1. No new information has been made available to either support or modify previous statements or conclusions regarding the Framework.

PARAMETRIC DATA

1. A large-scale hydraulic stress test will probably confirm the geometric mean of transmissivity values derived from small-scale tests. This conclusion is based on analyses of the effects from drilling and testing.

2. A "new" parametric data set (dispersivity) may be required if the NRC decides to have an explicit evaluation of the Individual Protection Standard.

BOUNDARY CONDITIONS

1. No new information has been made available to either support or modify previous statements or conclusions regarding the Boundary Conditions.

RESPONSE

1. Further recovery of the BWIP water levels will not significantly reduce the uncertainty of the values for calculation of pre-emplacement gradients.

2. Uncertainties, due to density variations in the well columns, in converting water level or pressure measurements to head are on the order of 1 foot. Because of the direction of the error, the magnitude of previously calculated vertical gradients may be erroneously low, but direction of the gradient, that is upward, does not change.

3. No new information has been made available to either support or modify previous statements or conclusions regarding the hydrochemistry.

STIMULI

1. The thermal impacts from waste package emplacement must be considered in all flux and groundwater flow-direction analyses.

8.0 MINI-REPORT LIST

NUMBER	TITLE	AUTHOR	STATUS
1	ANALYSIS OF FLOW INTERIOR HETEROGENEITY: GROUND WATER TRAVEL TIME	Marinelli	Final
2	ANALYSIS OF FLOW INTERIOR HETEROGENITY: CUMULATIVE FLUX	Marinelli	Final
3	EVALUATION OF RESIDUAL THERMAL EFFECTS	Marinelli	Final
4	RELATIONSHIP OF HYDRODYNAMIC DISPERSION TO COMPLIANCE WITH OVERALL EPA RELEASE STANDARDS	Logsdon	Final
5	ANALYSIS OF DRILLING RESPONSE AT THE HANFORD SITE: THEORY	Basse	Final
6	USE OF HYDRAULIC HEAD FOR EVALUATING PRE-EMPLACEMENT HYDROGEOLOGIC CONDITIONS: ONE-DIMENSIONAL ANALYSIS	Marinelli	Draft
7	AFFECT OF REPOSITORY HEAT ON GROUND WATER FLUX: ONE-DIMENSIONAL ANALYSIS	Marinelli	Draft
8	ANALYSIS OF DRILLING RESPONSE AT THE HANFORD SITE: ANALYSIS	Basse	Draft
9	SUITABILITY OF BWIP WATER LEVEL DATA FOR CALCULATION OF PRE-EMPLACEMENT HYDRAULIC GRADIENTS	Galloway	Draft
10	USE OF HYDRAULIC HEAD FOR EVALUATING WATER FLOW IN A VARIABLE DENSITY SYSTEM: SIMPLE ANALYTICAL EVALUATION	Marinelli	Draft