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AN ASSESSMENT OF GROUNDWATER MANAGEMENT AT HANFORD

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MASTER

DISCLAIMER

PURPOSE AND SCOPE

This report has been prepared at the request of Mr. Robert W. Hamilton, Chairman, Environmental Hearing Board on Hanford Waste Management Operations. It is a response to his request on January 23, 1975, for the author's assessment of the Hanford groundwater management and environmental surveillance operations.

This report represents only the opinion of the author as a professional consultant in the fields of groundwater management and environmental surveillance and is not intended as necessarily being the views of the Energy Research and Development Administration or its contractors.

INTRODUCTION

A comprehensive review of the groundwater management and environmental monitoring programs at the Hanford reservation was initiated in 1973, and is being managed by the responsible onsite contractor (Atlantic Richfield Hanford Company). The results obtained from this review are represented in several documents.[1, 2, 3, 4] The review was under my direction. A large number of recommendations have been made as a result of this review which will improve the Hanford Hydrology Program.

The purpose of the Hanford Hydrology Program is to maintain a groundwater surveillance network to assess contamination of the natural water system. Potential groundwater contamination is primarily a function of waste management decisions. The review conducted by the author revealed that although the hydrology program would greatly benefit from additional improvements, it is adequate to predict levels of contaminants present in the groundwater system. Studies are presently underway to refine advanced mathematical models to use results of the hydrologic investigation in forecasting the response of the system to different long-term management decisions.

No information has been found by the reviewers which indicates that a hazard through the groundwater pathway presently exists as a

result of Energy Research and Development Administration waste operations at Hanford.

As a result of the review, improvements have been initiated in the groundwater management program. If the recommendations, changes and improvements are completely implemented, it should be possible within a few years to achieve a better and more comprehensive understanding of the migration of groundwater and radionuclides at the Hanford reservation. Special emphasis should be placed on improving existing monitoring structures as well as enhancing the data base to be used in the predictive models. The recommendations to accomplish the improvements needed are identified in the following sections under management and technical recommendations.

MANAGEMENT RECOMMENDATIONS

To accomplish the groundwater management effort in an efficient manner, and to be able to respond to program needs as effectively as possible, I have made a series of recommendations to allow for centralization of the groundwater management effort and delineation of functional areas. By grouping the work into six functional areas under one manager, the responsibility for each task is clearly established and overall coordination becomes easier. The work that should be included in each functional area is as follows:

1. Soil Studies (3 persons)

   Purpose: To accurately characterize the properties of Hanford soils. To examine the nature and properties of soil materials through which waste may percolate. To examine the geochemical reactions between soil and waste.

   Includes: Tank Farm Geology, Actinide Trench Characterization, and Soil Geochemistry.

2. Field Programs (3 persons)

   Purpose: To plan and conduct field tests to characterize the hydrologic properties of the Hanford reservation. To conduct water budgets and other field measurements. To coordinate jointly with Battelle-Northwest the groundwater monitoring program. To maintain a working lysimeter site. To maintain a working seismic network.

   Includes: Measurement of hydrologic properties and water budgets. Moisture transport in the vadose zone, seismic program evaluation.

3. Predictive Models (2 persons)

   Purpose: To enhance the capability to analyze the impact of the irrigation and other stresses on the Hanford reservation. To enhance the predictive capability in regards to accidents and allow proper contingency planning. To examine the system's response to long-term stresses.

   Includes: Predictive Need Analysis, Mathematical Modeling.

4. Regional Studies (1 person)

   Purpose: To conduct regional geologic, geophysical, and hydrological studies to allow proper definition of regional features that affect groundwater flow; i.e., channeling, position of the confined and unconfined aquifer, etc. To examine the need for and methodology regarding offsite migration studies.

   Includes: Regional Studies, Offsite Migration.

5. Drilling (1 person)

   Purpose: To set up an office responsible for coordination of any drilling activity being conducted by any contractor on the reservation. To issue permits to conduct such drilling.

   Includes: Drilling technology.

6. Special Studies (1 person)

   Purpose: To conduct any special studies that may be needed from time to time related to groundwater management.

   Includes: Environmental Impact Statement response.

To accomplish these objectives, a reorganization of priorities and a delineation of new budget categories will be required.

TECHNICAL RECOMMENDATIONS

The technical recommendations that I have made are contained in the final report of "A Comprehensive Review of Mathematical Models Constructed to Describe the Hydrology of the Hanford Reservation," (September 1974), pp. 62-64, and in the final report entitled "A Preliminary Review of the Regional Hydrology of the Hanford Reservation," (November 1974), pp. 51-53. The recommendations are listed by areas of endeavor and some overlapping occurs between some of these areas. For the sake of clarity, all recommendations are summarized in the Appendix. In the Appendix I have also noted the action taken or contemplated as indicated to me in each instance by the responsible contractor. Obviously, in some cases the decision as to what course of action should be taken will not be made until current work clearly indicates the best path to take.

During the last six months, technical progress in the field of groundwater management has been speeded up. Technical changes and improvements that have been completed are listed below:

1. An inventory of well structures used for radionuclide monitoring has been made. Structures have been selected on the basis of definite criteria that are clearly spelled out.

2. A preliminary gravity survey of the basin conducted using a 600-station gravity network has been completed. A bedrock map based on this survey is being prepared.

3. A comprehensive review of all the data available regarding transmissivity and hydraulic conductivity as of 1975 and the generation of various hydrologic maps have been completed.

The additional data acquired after completion of the Draft Environmental Statement generally supports the basic conclusions contained in the hydrology section of the draft statement.

APPENDIX

MASTER PLAN FOR HYDROLOGIC MANAGEMENT

	Initiated	To be Initiated Shortly	Future Work	Not Planned	No Decision Yet
Regional Hydrogeology					
a. Understanding of the regional hydrogeology of the Hanford reservation - evaluation of the validity of model assumptions	X				
b. A study of the confined aquifers in the basalt and a study of the Ringold aquifer		X			
c. Conduct the needed hydrologic tests in the confined aquifers to establish whether or not a model of contamination must be applied to this aquifer.			X		
Vadose Flow Model					
a. Theoretical Work					
1. complete formulation of the mathematical flow regime	X				
2. solution of the numerical algorithm	X				
b. Experimental Work					
1. determination of water potential vs. depth and time in the lysimeters	X				
2. determination of barometric pressure changes vs. depth and time in the lysimeters		X			
3. determination of the extent of moisture removal by barometric pressure pumping		X			
4. conduct a hydrologic inventory at the lysimeter site		X			
5. correlation of extent of precipitation and infiltration		X			
6. determination of the effect of temperature changes on water potential and water transport		X			

	Initiated	To be Initiated Shortly	Future Work	Not Planned	No Decision Yet
PERCOL Model					
a. Begin to apply the model directly to as many useful purposes as possible			X		
b. Extend the model to the case of acid discharges			X		
PST Model					
a. Improve the efficiency of the numerical algorithm being used	X				
b. Conduct a thorough check of numerical dispersion					X
c. Re-examine the problem of tank rupture as discussed in the text of this report		X			
d. Verify that the assumptions required by the present model are satisfied in the Hanford environment	X				
e. Expand the cooperation with Mr. Nelson	X				
f. Test the model with field and experimental data		X			
Transmissivity Iterative Routine					
a. Theoretical Work					
1. improve the efficiency of the computer program	X				
2. develop a storage coefficient calculation to be performed simultaneously with the transmissivity calculation			X		
3. extend the model to account for transient boundary conditions and disposal flow rate variations					X

	Initiated	To be Initiated Shortly	Future Work	Not Planned	No Decision Yet
4. improve the model in the transmissivity determinations					
a) near the mounds underlying the waste disposal sites		X			
b) in areas where small radii of curvature in the streamtube occur, and			X		
c) near impermeable boundaries			X		
5. verify the model		X			
b. Experimental work					
Implement a field program involving geologic, geophysical, and hydrologic work to accurately establish:					
a) the position of the bottom surface of the unconfined aquifer	X				
b) the amount of infiltration, and location of infiltration sites, and	X				
c) the value of transmissivity and storage at various points in the reservation	X				
VTT Model					
a. Improve the efficiency of the computer program	X				
b. Check for numerical dispersion especially when the flow velocity is high		X			
c. Check for the validity of the model assumptions to the Hanford environment	X				
d. Results of the model must be compared to observed field water table measurements and where disagreement is noted a careful scrutiny must be made to establish the reasons for the discrepancy		X			

	Initiated	To be Initiated Shortly	Future Work	Not Planned	No Decision Yet
Transport Model					
a. Theoretical Work					
1. streamline the numerical algorithm and check the instabilities			X		
2. improve the modeling capability for the tank leak case			X		
b. Experimental Work					
Conduct an experimental and field program to expand our knowledge of dispersion components and the Sr sorption coefficient in the Hanford reservation					X
Data Bank					
a. Conduct a complete literature survey of Hanford hydrogeologic publications and related matters	X				
b. Develop a comprehensive data system covering all wells in the basin to be implemented in the Battelle computer		X			
c. Establish a comprehensive data cataloging system		X			
d. Develop the necessary software for the data bank			X		
Permanent Data Monitoring Program					
Implement a hydrologically sound data monitoring program	X				

	Initiated	To be Initiated Shortly	Future Work	Not Planned	No Decision Yet
Establishment of an Interim Contingency Plan					
Using sound water management practices and the data and models presently available, examine various potentially hazardous situations and determine ways to correct the situation. The interim contingency plan should be updated periodically as model and data improvements warrant it.	X				
Definition of the Hydrologic Impact of Waste Disposal					
a. Precise definition of input and output		X			
b. Groundwater chemistry analysis of the flow system			X		
Water Level Monitoring					
a. All wells with open intervals of 40 feet or more should be plugged	X				
b. Piezometers should be used to monitor future episodic events					X
c. The present retrieval system is awkward, time consuming, and expensive. All head data should be published routinely.			X		
Radionuclide Monitoring					
a. Wells constructed for the radionuclide monitoring program should have identical open intervals. A program should be initiated to determine the optimum well design and the optimum sampling procedures for obtaining comparable samples.	X				

	Initiated	To be Initiated Shortly	Future Work	Not Planned	No Decision Yet
b. The possibility of sample aging should be examined in detail			X		
c. Complete chemical analyses should be obtained as well as radionuclide content					X
d. The data should be reported in its entirety in a systematic fashion					X
e. The collector, analyst, and interpreter should be separate individuals					X
f. A mass balance should be achieved					X

REFERENCES

1. R. A. Deju, "Review of the Hydrology Program and Overall Water Management at Hanford Project," November 1973.

2. R. A. Deju, "A Comprehensive Review of Mathematical Models Constructed to Describe the Hydrology of the Hanford Reservation," April 1974.

3. R. A. Deju, "The Hanford Field Testing Program," May 1974.

4. W. K. Summers and R. A. Deju, "A Preliminary Review of the Regional Hydrology of the Hanford Reservation," June 1974.

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