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Hydrogeology • Mineral Resources • Waste Management • Geological Engineering • Mine Hydrology

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August 18, 1986

Contract No. NRC-02-85-008

Fin No. D-1020

Communication No. 140

Mr. Jeff Pohle
Division of Waste Management
Mail Stop 623-SS
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

WM-RES
WM Record File
D1020
W+H

WM Project 10, 11, 16
Docket No.

PDR ✓
X LPDR ✓ (B, N, S)

Distribution:

Pohle Joan-ticket

RE: Annual Summary of Products Produced
Under Contract No. NRC-02-85-008

(Return to WM, 623-SS)

Dear Jeff:

This document constitutes a summary of work conducted under Contract No. NRC-02-85-008 by Williams and Associates, Inc. The summary covers the period of time from September 1, 1986, to August 1, 1987. This summary is presented as a continuation of the summary of the preceding years work outlined in Communication #80. Details pertaining to our efforts on this contract are outlined based on Task and Subtask numbers.

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WM Project: WM-10, 11, 16

PDR yes

(Return to WM, 623-SS)

WM Record File: D1020

LPDR yes

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TASK 1

The following work was conducted under Task 1.

Subtask 1.1

This subtask was completed (see Communication No. 11). Communication No. 11 included a list of pertinent issues for the Nevada Test Site and comments on those issues. Communication No. 11 also included a list of documents that we had assembled at that time. We also reviewed the DOE NNWSI issue hierarchy and the DOE Mission Plan that has been developed for NNWSI; these comments were forwarded as Communication No. 25.

Subtask 1.2

Williams and Associates, Inc. completed written reviews of the following documents:

1. Daniels, W.R., and others, 1982, Summary Report on the Geochemistry of Yucca Mountain and Environs. Los Alamos National Laboratory, Los Alamos, NM, LA-9328-MS.
2. Hodson, J.N., and Hoover, D.L., 1978, Geology and Lithologic Log for Drill Hole UE17a, Nevada Test Site. USGS-1543-1, 14 p.
3. Hodson, J.N., and Hoover, D.L., 1979, Geology of the UE17e Drill Hole, Area 17, Nevada Test Site. USGS-1543-2, 33 p.
4. Trimmer, D., 1982, Laboratory Measurements of Ultralow Permeability of Geologic Materials. American Institute of Physics, REV. SCI. INSTRUM. 53 (b), p. 1246-1254.
5. Carr, W.J., and Parrish, L.D., 1985, Geology of Drill Hole USW VH-2 and Structure of Crater Flat, Southwestern Nevada. USGS Open File Report 85-475, 41 p.
6. Sinnock, Scott, Lin, Y.T., Tierney, M.S., and others, 1986, Preliminary Estimates of Groundwater Travel Time and Radionuclide Transport at the Yucca Mountain Repository Site. Sandia National Laboratory, Albuquerque, NM, SAND85-2701.
7. Anderson, L.A., 1981, Rock Property Analysis of Core Samples from Calico Hills UE25a-3 Borehole, Nevada Test Site, Nevada. U.S. Geological Survey Open-file Report 81-1337, Denver, 29 p.

8. Anderson, L.A., 1981, Rock Property Analysis of Core Samples from the Yucca Mountain UE25a-1 Borehole, Nevada Test Site, Nevada. U.S. Geological Survey Open-file Report 81-1338, Denver, 36 p.
9. Klavetter, E.A., and Peters, R.R., July 1986, Estimation of Hydrologic Properties of An Unsaturated, Fractured Rock Mass. Nevada Nuclear Waste Storage Investigations Project, Sandia National Laboratories, Albuquerque, NM, SAND84-2642.
10. Christensen, R.C., and Spahr, N.B., 1980, Flood Potential of Topopah Wash and Tributaries, Eastern Part of Jackass Flats, Nevada Test Site, Southern Nevada. USGS Water Resources Investigations, Open-file Report 80-963, Lakewood, CO.
11. Lachenbruch, A.H., 1981, Temperature Effects of Varying Phase Composition During the Steady Vertical Flow of Moisture in Unsaturated Stratified Sediments. USGS Open-file Report 81-1220, 11 p.
12. Perkins, B., Travis, B., and DePoorter, G., 1985, Validation of the TRACR3D Code for Soil Water Flow Under Saturated/Unsaturated Conditions in Three Experiments. Los Alamos National Laboratory, Los Alamos, NM, LA-10263-MS, 33 p.
13. Spengler, R.W., Chornack, M.P., Muller, D.C., and Kibler, J.E., 1984, Stratigraphic and Structural Characteristics of Volcanic Rocks in Core Hole USW G-4, Yucca Mountain, Nye County, Nevada. USGS Open-file Report 84-789, Denver, 77 p.
14. Squires, R.R., and Young, R.L., 1984, Flood Potential of Forty-Mile Wash and Its Principal Southwestern Tributaries, Nevada Test Site, Southern Nevada. USGS Water Resources Investigations Report 83-4001, Carson City, Nevada, 32 p.
15. Wang, J.S.Y., and Narasimhan, T.N., 1984, Hydrologic Mechanisms Governing Fluid Flow in Partially Saturated, Fractured, Porous Tuff at Yucca Mountain, Lawrence Berkeley Laboratory, Berkeley, CA, 47 p.
16. Lin, W., and Daily, W., 1984, Transport Properties of Topopah Spring Tuff. Lawrence Livermore National Laboratory, Livermore, CA, UCRL-53602, 20 p.
17. Muller, D.C., and Kibler, J.E., 1983, Commercial Geophysical Well Logs of the USW G-1 Drill Hole, Nevada Test Site, Nevada. USGS Open-file Report 83-321.
18. Spaulding, W.G., Robinson, S.W., and Paillet, F.L., 1984, Preliminary Assessment of Climate Change During Late Wisconsin Time, Southern Great Basin and Vicinity, Arizona, California, and Nevada: USGS Water Resources Investigations Report 84-4328.

19. Whitfield, M.S., Eshom, E.P., Thordarson, William, and Schaefer, D.H., 1985, Geohydrology of Rocks Penetrated By Test Well USW H-4, Yucca Mountain, Nye County, Nevada. USGS Water Resources Investigations Report 85-4030, Denver, Colorado.
20. Smith, D.M., Updegraff, C.D., Bonano, E.J., and Randall, J.D., November 1986, Assessment of Radionuclide Vapor-Phase Transport in Unsaturated Tuff. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND86-1598, NUREG/CR-4693, 42 p.
21. Winograd, I.J., and Doty, G.C., 1980, Paleohydrology of the Southern Great Basin, With Special Reference to Water Table Fluctuations Beneath the Nevada Test Site During the Late(?) Pleistocene. USGS Open File Report 80-569, Reston, VA.
22. Pawloski, G.A., May 1981, Water Contents of Samples from the Nevada Test Site: Total, Free (Natural State to 105°C). Lawrence Livermore National Laboratory, UCRL-53130.

In addition to the written document reviews, Williams and Associates, Inc. reviewed mini-reports 1, 2, 4, 5, and 6 by Water, Waste and Land.

In addition, we have begun an informal review of the DRAFT SCP for NNWSI.

In preparation for a trip to Tucson to meet with Dr. Dan Evans of the University of Arizona, Williams and Associates, Inc. conducted a review of the following document:

Rasmussen, T.C., and Evans, D.D., 1986, Unsaturated Flow and Transport Through Fractured Rock--Related to High-Level Waste Repositories--Phase II, Vols. 1 and 2 (Draft), prepared for Division of Radiation Programs and Earth Sciences, U.S.N.R.C., Washington, D.C.

In addition, Williams and Associates, Inc. has conducted a literature review pertaining to the evaluation of "Ground Water Testing Methodologies Applicable to Unsaturated Fractured Rock."

Roy E. Williams, George Bloomsburg and James L. Osiensky participated in the "University of Arizona Technology Transfer Meeting on Unsaturated Zone Research" in Tucson on June 22-24, 1987. The trip report was forwarded as Communication No. 135.

Williams and Associates, Inc. is continuing to evaluate "Groundwater Testing Methodologies Applicable to Unsaturated Fractured Rock." Several different methodologies are being evaluated with respect to their potential applicability to Yucca Mountain. A report written jointly by Williams and Associates, Inc. and Water, Waste, and Land, Inc. will be forwarded to the NRC during August, 1987.

Williams and Associates, Inc. has initiated work on a proposed task entitled "Mathematical Simulation of Unsaturated Flow in Yucca Mountain."

Subtask 1.3

Williams and Associates, Inc. is continuing to review the literature pertaining to potential conceptual models for NNWSI.

Williams and Associates, Inc. completed a letter report containing a semiannual update of conceptual models for NNWSI as required by the SOW for Contract No. NRC-02-85-008. This letter report was forwarded as Communication No. 114.

Subtask 1.4

Williams and Associates, Inc. examined Chapter 4 (Geochemistry) of the Draft Site Characterization Plan for Yucca Mountain, Nevada.

TASK 2

The following work was conducted under Task 2.

Subtask 2.1

This subtask was completed (see Communication No. 17). Communication No. 17 included a list of pertinent issues for BWIP and comments on those issues. Communication No. 17 also included a list of documents that we had assembled at that time. We also reviewed the DOE NNWSI issue hierarchy and the DOE Mission Plan that has been developed for NNWSI; these comments were forwarded as Communication No. 25.

Subtask 2.2

Williams and Associates, Inc. has continued a two-dimensional cross-sectional model study of the hydraulic gradients indicated by the cluster piezometer sites (DC-19, -20, and -22). The finite element program UNSAT2 is being used in conjunction with a preprocessor (MBUILD) and a post processor (FEDIT). The purpose of this effort is to investigate the relationship of vertical hydraulic conductivity to horizontal hydraulic conductivity. We will be submitting a letter report to the NRC on this modeling effort at a later date.

Williams and Associates, Inc. examined the U.S. Geological Survey's hydrochemical data base for the Columbia River basalts in the vicinity of the Hanford Site. We submitted a proposal (Communication #86) to the NRC outlining a hypothesis on the groundwater flow system(s) in the vicinity of the site and a method of examining this hypothesis. We acquired off-site data from the U.S. Geological Survey and obtained additional maps that cover the area of investigation in the Pasco Basin. We evaluated the U.S. Geological Survey data base and created subsets of the data base. The township and range, well designation, and geologic formations were input to the data set; a subset of the data was created that includes only those wells in the study area. A preliminary univariate analysis was completed; the analysis was checked for outliers. A second univariate analysis was completed after producing log values for all variables except pH. A data set of log base ten of each variable except pH has been created; this data set was standardized to a mean of zero and a variance of one. A distance matrix was calculated using the log-standard multivariate data base. Preliminary cluster analysis was performed using the off-site data set. The preliminary analysis was reviewed prior to initiating further analyses. The on-site data set used in previous analyses was retrieved and edited.

Williams and Associates, Inc. attended a data review in Richland, Washington, December 1-5, 1986. Representatives from the NRC attended an underground mine tour to observe fracture controlled groundwater flow at the Bunker Hill Mine, Idaho, on December 1, 1986. A brief description of the research activities being conducted at the Bunker Hill Mine was forwarded as Communication No. 104. Other members of the NRC data review team visited the site of the NRC fracture flow research contract near Creston, Washington. A trip report was forwarded as Communication No. 98.

Williams and Associates, Inc. reviewed the Sandia National Laboratories report entitled "Numerical Modeling of Ground-Water Flow Systems in the Vicinity of the Reference Repository Location, Hanford Site, Washington." A detailed review was not authorized by the NRC.

Williams and Associates, Inc. reviewed Nuclear Waste Consultants' mini-reports 1-9. Written reviews were not prepared.

The following document reviews were completed on the BWIP:

1. Brown, W.R., and Jones, R.L., August 1985, Drilling and Completion Specifications for Wanapum (Type W) and Grande Ronde (Type GR) Multi-Level Piezometer Nest Boreholes. Rockwell-Hanford Operations, Richland, WA, SD-BWI-TC-026.
2. Loo, W.W., and Arnett, R.C., December 1984, Effective Porosity of Basalt: A Technical Basis for Values and Probability Distributions Used in Preliminary Performance Assessments. Rockwell Hanford Operations, Richland, WA, ST-BWI-TI-254.
3. Jackson, R.L., Swanson, L.C., Diediker, L.D., Jones, R.L., and Ledgerwood, R.K., June 1986, Design, Drilling and Construction of Well RRL-2B and Piezometer Nest RRL-2C. Rockwell Hanford Operations, Richland, WA, SD-BWI-TI-329.
4. LeGore, T., and Arnett, R.C., February 1986, Ground Water Drawdown As a Factor in Long-Term Repository Performance Assessment. Rockwell Hanford Operations, Richland, WA, BWI-TA-202, 22 p.

Williams and Associates, Inc. reviewed several documents while preparing for the DOE-NRC meeting (April 5-9, 1987) on the hydrogeologic testing program. The principle documents include STP 1.1, the original test plan (SD-BWI-TP-040), a newer version of the same test plan, the Williams and Associates, Inc. trip report (Communication #15) from the previous meeting on hydrogeology testing, the NRC letter of April 10, 1986, and the letter addressed to Mr. John Linehan from DOE (no date). Williams and Associates, Inc. prepared presentations on the cone of depression that will result when the Grande Ronde #5 flow top (Birket) is pump tested. We also prepared a presentation on the hydrogeologic response to the use of a sucker rod pump; a sucker rod pump has been installed in well RRL-2B. Dr. Williams and

Mr. Winter attended the DOE-NRC meeting; a trip report was forwarded as Communication #121.

Draft chapter 3 of the Site Characterization Plan (SCP) was received. We have reviewed this draft chapter for our information. Formal comments have not been requested. We are preparing to have an internal meeting on the most significant aspects of this draft chapter.

Subtask 2.3

Williams and Associates, Inc. submitted a letter (Communication No. 84) to the NRC on the conceptual models for the BWIP site. The letter satisfied our semiannual requirement to re-examine the conceptual models. We again re-evaluated and updated our letter report on conceptual models as Communication #117.

Williams and Associates, Inc. continues to review the literature pertaining to potential conceptual models for the BWIP site. We will continue to evaluate and update existing conceptual models as new data become available.

TASK 3

The following work was conducted under Task 3.

Subtask 3.1

This subtask was completed (see Communication No. 22). Communication No. 22 included a list of pertinent issues for the SALT site and comments on those issues. Communication No. 22 also included a list of documents that we had assembled at that time. We also reviewed the DOE NNWSI issue hierarchy and the DOE Mission Plan that has been developed for NNWSI; these comments were forwarded as Communication No. 25.

Subtask 3.2

Written reviews for the following documents were forwarded to the NRC:

1. Atwood, H.M., O'Brien, K.M., and Shiau, J.C., April 1985, A Preliminary Simulation Model to Determine Ground-Water Flow and Ages Within the Palo Duro Basin Hydrogeologic Province. Prepared by Stone and Webster Engineering Corporation for Battelle Memorial Institute, Topical Report, ONWI/SUB/85/E512-05000-T35.
3. Senger, R.K., Smith, D.A., and Conti, R.D., 1984, Preliminary Results of Porosity and Permeability of Cores from DOE Wells in the Palo Duro Basin, Texas Panhandle. Texas Bureau of Economic Geology, Austin, TX, OF-WTWI-1984-27.
4. Siminitz, P.C., June 1985, Hydrogeologic Subdivision of the Wolfcamp Series and Pennsylvanian System of Eastern New Mexico. Prepared by Stone and Webster Engineering Corporation for Battelle Northwest Institute, Topical Report, ONWI/SUB/85/E512-05000-T41.
5. Smith, P.G., Page, G.W., and Downing, J.K., December 1984, Regional Permeability Determinations from Limited Drill-Stem Test Data. Prepared by Stone and Webster Engineering Corporation for Battelle Memorial Institute, Topical Report, ONWI/SUB/84/E512-05000-T32, 126 p.
6. Dutton, A.R. and Simpkins, W.W., 1985, Hydrogeology and Water Resources of the Lower Dockum Group (Triassic) in the Texas Panhandle and Eastern New Mexico. Prepared for the U.S. Department of Energy by the Bureau of Economic Geology, University of Texas, Austin, TX, OF-WTWI-1985-32.

7. Smith, D.A., 1984, Evaluation of the J. Friemel #1 Vertical Well Tests, Deaf Smith County, Palo Duro Basin, Texas Panhandle. Texas Bureau of Economic Geology, Austin, TX, OF-WTWI-1984-28, 12 p.
8. Kreittler, C.W., Fisher, R.S., Senger, R.K., Hovorka, S.D., and Dutton, A.R., 1984, Hydrology of An Evaporite Aquitard: Permian Evaporite. Texas Bureau of Economic Geology, Austin, TX, OF-WTWI-1984-52.
9. Bush, Daniel D., and Piele, Susan, May 1986, A Full-Scale Borehole Sealing Test in Salt Under Simulated Downhole Conditions, Volume 1. Terra Tek, Inc., BMI/ONWI-573 (1).
10. Stone and Webster Engineering Corp., September 1985, Pumping Test and Fluid Sampling Report, J. Friemel No. 1 Well (PD-9), Palo Duro Basin, Volume I. Prepared for Battelle Memorial Institute, Columbus, OH, ONWI/SUB/85/E512-05000-T31.

Williams and Associates, Inc. reviewed several documents that describe hydrogeologic testing at the WIPP site. We anticipate receiving additional documents that describe hydrogeologic testing conducted at the WIPP site; these additional documents will be reviewed. Written reviews will not be prepared for each document. A topical report will be prepared that covers the hydrogeologic testing described in all the reports. The following documents describing testing at the WIPP site have been reviewed:

1. Basler, J.A., 1983, Instrumentation Used for Hydraulic Testing of Potential Water-Bearing Formations at the Waste Isolation Pilot Plant Site in Southeastern New Mexico. U.S. Geological Survey, Open File Report 83-144, 29 p.
2. Beauheim, R.L., November 1986, Hydraulic-Test Interpretations for Well DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND86-1364, 89 p.
3. Beauheim, R.L., March 1987, Analysis of Pumping Tests of the Culebra Dolomite Conducted at the H-3 Hydropad at the Waste Isolation Pilot Plant (WIPP) Site. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND86-2311, 154 p.
4. Chapman, J.B., October 1986, Stable Isotopes in Southeastern New Mexico Groundwater: Implications for Dating Recharge in the WIPP Area. Health and Environment Department, New Mexico, EEG-35, 76 p.
5. Chaturvedi, Lokesh. March 1984. Occurrence of Gases in the Salado Formation. Environmental Evaluation Group, Environmental Improvement Division, Health and Environment Department, State of New Mexico, EEG-25, 67 p.

6. Chaturvedi, L. and Channell, J.K., December 1985, The Rustler Formation as a Transport Medium for Contaminated Groundwater. Health and Environment Department, State of New Mexico, Santa Fe, EEG-32.
7. Dennehy, K.F., January 1982, Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-6A, H-6B, and H-6C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico. U.S. Geological Survey, Water Resources Investigations 82-8, 68 p.
8. Dennehy, K.F., and Davis, P.A., 1981, Hydrologic Testing of Tight Zones in Southeastern New Mexico. Ground Water, vol. 19, no. 5, p. 482-489.
9. Dennehy, K.F., and Mercer, J.W., February 1982. Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-5A, H-5B, and H-5C, at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico. U. S. Geological Survey, Water-Resources Investigation 82-19, 83 p.
10. Gonzalez, D.D., March 1983, Hydrogeochemical Parameters of Fluid-Bearing Zones in the Rustler and Bell Canyon Formations: Waste Isolation Pilot Plant (WIPP), Southeast New Mexico (SENM). Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND83-0210, 37 p.
11. Gonzalez, D.D., March 1983, Groundwater Flow in the Rustler Formation, Waste Isolation Pilot Plant (WIPP), Southeast New Mexico (SENM): Interim Report. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND82-1012, 39 p.
12. Haug, A., Kelley, V.A., LaVenue, A.M. and Pickens, J.F., March 1987, Modeling of Ground-Water Flow in the Culebra Dolomite at the Waste Isolation Pilot Plant (WIPP) Site: Interim Report. Prepared by INTERA Technologies, Inc., for Sandia National Labs, Albuquerque, NM, SAND86-7167
13. Hydro Geo Chem, Inc., September 1985, WIPP Hydrology Program Waste Isolation Pilot Plant,, SENM, Hydrologic Data Report #1. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND85-7206, 710 p.
14. Hydro Geo Chem, Inc., October 1986, Two-Well Recirculation Tracer Tests at the H-2 Hydropad, Waste Isolation Pilot Plant (WIPP), Southeastern New Mexico. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND86-7092, 33 p.
15. INTERA Technologies, Inc., June 1986, WIPP Hydrology Program, Waste Isolation Pilot Plant, Southeastern New Mexico: Hydrologic Data Report #3. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND86-7109.

16. INTERA Technologies, Inc. and Hydro Geo Chem, Inc., December 1985, WIPP Hydrology Program Waste Isolation Pilot Plant, Southeastern New Mexico: Hydrologic Data Report #2. Sandia National Laboratories, Albuquerque, NM and Livermore, CA, SAND85-7263.
17. Kelley, V.A., and Pickens, J.F., December 1986, Interpretation of the convergent-Flow Tracer Tests Conducted in the Culebra Dolomite at the H-3 and H-4 Hydropads at the Waste Isolation Pilot Plant (WIPP) Site. INTERA Technologies, Inc. for Sandia National Laboratories, Albuquerque, NM, SAND86-7161.
18. Mercer, J.W., 1983, Geohydrology of the Proposed Waste Isolation Pilot Plant Site, Los Medanos Area, Southeastern New Mexico. U.S. Geological Survey, Water Resources Investigations Report 83-4016, 112 p.
19. Mercer, J.W., January 1987, Compilation of Hydrologic Data From Drilling the Salado and Castile Formations Near the Waste Isolation Pilot Plant (WIPP) Site in Southeastern New Mexico. Sandia National Laboratory, Albuquerque, NM and Livermore, CA, SAND86-0954, 39 p.
20. Mercer, J.W., Beauheim, R.L., Snyder, R.P., and Fairer, G.M., April 1987, Basic Data Report for Drilling and Hydrologic Testing of Drillhole DOE-2 at the Waste Isolation Pilot Plant (WIPP) Site. Sandia National Laboratory, Albuquerque, NM and Livermore, CA, SAND86-0611, 317 p.
21. Mercer, J.W., Davis, P., Dennehy, K.F., and Goetz, C.L., May 1981, Results of Hydrologic Tests and Water-Chemistry Analyses, Wells H-4A, H-4B, and H-4C at the Proposed Waste Isolation Pilot Plant Site, Southeastern New Mexico. U.S. Geological Survey, Water Resources Investigations Report 81-36, 92 p.
22. Mercer, J.W., and Orr, B.R., February 1977, Review and Analysis of Hydrogeologic Conditions Near the Site of a Potential Nuclear-Waste Repository, Eddy and Lea Counties, New Mexico. U.S. Geological Survey, Open File Report 77-123, 35 p.
23. Pearson, F.J., Jr., Kelley, V.A., and Pickens, J.F., February 1987, Preliminary Design for a Sorbing Tracer Test in the Culebra Dolomite at the H-3 Hydropad at the Waste Isolation Pilot Plant (WIPP) Site. INTERA Technologies, Inc. for Sandia National Laboratory, Albuquerque, NM and Livermore, CA, SAND86-7177.
23. Peterson, E., Lagus, P., Brown, J., Lie, K., January 1985, WIPP Horizon In Situ Permeability Measurements, Final Report. S-Cubed for Sandia National Laboratory, NM and Livermore, CA, SAND85-7166.
24. Rehfeldt, K., September 1984, Sensitivity Analysis of Solute Transport in Fractures and Determination of Anisotropy within Culebra Dolomite. Health and Environment Department, New Mexico, EEG-27, 46 p.

25. Saulnier, G.J. Jr., Freeze, G.A., and Stensrud, W.A., February 1987, WIPP Hydrology Program Waste Isolation Pilot Plant, Southeastern New Mexico, Hydrologic Data Report #4. INTERA Technologies Inc. for Sandia National Laboratories, Albuquerque, NM, SAND86-7166.
26. Snyder, R.P. and Gard, L.M., Jr. 1982. Evaluation of Breccia Types in Southeastern Mexico and Their Relation to the Waste Isolation Pilot Plant (WIPP) Site with a Section on Drill-Stem Tests. U. S. Geological Survey, Open File Report 82-968, 73 p.
27. Stevens, Ken, and Beyeler, Walt, 1985, Determination of Diffusivities in the Rustler Formation from Exploratory-Shaft Construction at the Waste Isolation Pilot Plant in Southeastern New Mexico. U.S. Geological Survey, Albuquerque, NM, Water-Resources Investigations Report 85-4020, 32 p.
28. Winstanley, D.J., and Carrasco, R.C., October 1986, Annual Hydrogeologic Data report: 1985/1987. IT Corporation for Waste Isolation Pilot Plant, Department of Energy, Carlsbad, NM, DOE-WIPP 86-004.

Subtask 3.3

Williams and Associates, Inc. completed the initial requirement under this subtask with the submission of our conceptual model letter report. Williams and Associates, Inc. is continuing to review the literature pertaining to potential conceptual models for the Palo Duro Basin. We continue to evaluate and update existing conceptual models as new data become available. We updated our evaluation of existing conceptual models as Communication #120.

TASK 4

This task has not been initiated. We are accumulating relevant documents during the course of our other activities under Tasks 1, 2, and 3.

TASK 5

Williams and Associates, Inc. completed (in August) the drafts of two papers for the NRC. The first paper defines "uncertainty" with respect to hydrogeologic considerations and prediction of groundwater travel times. The second paper presents our views on the relationship of scale, hydrogeologic coefficient quantification, and prediction of groundwater travel time. We reviewed the comments received from Dr. Codell on the travel time paper.

Williams and Associates, Inc. prepared for the NRC meeting held the first week of November in Rockville, Maryland. Our trip report was forwarded as Communication #93. The subjects of five proposed Topical Reports were discussed. The forthcoming BWIP data review was discussed during this trip to Rockville and Silver Spring.

Williams and Associates, Inc. met with Nuclear Waste Consultants in Denver, Colorado, on November 24 and 25, 1986. The subject of this meeting was Topical Report #2. The trip report for this meeting was forwarded to the NRC as Communication #96.

Williams and Associates, Inc. forwarded the outline for Topical Report #1 to the NRC as Communication #95. Williams and Associates, Inc. prepared a draft of Topical Report #1 on the categories of uncertainties; the draft was forwarded as Communication #129. Williams and Associates, Inc. prepared a draft of the outline for Topical Report #2 on reducing and quantifying uncertainty. The outline was forwarded as Communication #134. The preparation of this draft outline involved extensive work sessions among the associates of the firm; the draft outline is the product of numerous iterations of the outline. Nuclear Waste Consultants has received a copy of the outline.

We have modified, as requested by the NRC, a previous Communication (#74) entitled "Procedures for Predicting Groundwater Travel Time." The modified version of this paper is entitled "Information Needs for Quantifying Uncertainty When Predicting Groundwater Travel Time." The modified version was forwarded as Communication #130.

Williams and Associates, Inc. prepared a list of potential topics of investigation for the meeting scheduled for the week of January 26, 1987. Several discussions were held among the team members for all the sites during the preparation of this list. The meeting was rescheduled for the week of March 16, 1987. Dr. Williams attended this meeting. These topics and scheduling problems were discussed. Williams and Associates, Inc. completed drafts of several proposed Tasks. These proposed Tasks were forwarded to the NRC in May as Communications #126 and #132.

Our Quality Assurance Plan was completed during the month of January. It was forwarded to the NRC as Communication No. 108.

Williams and Associates, Inc. reviewed and discussed the topics of discussion selected for the July meeting in Silver Spring. Dr. Williams and Dr. Sharp attended this meeting held July 14 and 15. The meeting was held to discuss definitions of pre-waste-emplacement, path of likely radionuclide travel, and groundwater velocity.

Williams and Associates, Inc. reviewed two documents on the subject of treatment of uncertainty. These documents are:

1. Massman, Joel, and Freeze, R. Alan, 1987, Groundwater Contamination from Waste Management Sites: The Interaction Between Risk-Based Engineering Design and Regulatory Policy, 1. Methodology, 2. Results. Water Resources Research, vol. 23, no. 2, p. 351-67.
2. Hofer, E. and Hoffman, F.O., 1987, Selected Examples of Practical Approaches for the Assessment of Model Reliability - Parameter Uncertainty Analysis. OECD/NEA Workshop on Uncertainty Analysis for Systems Performance Assessments, Seattle, Feb.

Sincerely,

Roy Williams pl

Roy E. Williams

REW:s1