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

WM-RES

WM Record File B-7372 W+A

WM Project 10

Docket No.

PDR Y

LPDR B

Distribution: GORDON

(Return to WM, 623-SS) 23

July 9, 1985
Contract NRC-02-82-044
FIN # B7372-3
Communication #133

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

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WM DOCKET CONTROL CENTER

Dear Matt:

Two copies of our reviews of SD-BWI-DP-059 and SD-BWI-TC-023 are enclosed. Our review of SD-BWI-TP-039 is in second draft; we have completed a first draft of our review of the letter from Mr. Rowe (Golder Assoc.) to Mr. Luttrell (Rockwell Hanford Operations). Our review of the Lu and Yeh report on inverse modeling is in progress. Please call if you have any questions concerning our reviews.

Sincerely,

Gerry

Gerry Winter

2207

WMGT DOCUMENT REVIEW SHEET

FILE #:

ROCKWELL HANFORD OPERATIONS #: SD-BWI-TC-023

DOCUMENT: Drilling and Completion Specifications for Boreholes RRL-2B (Test Well) and RRL-2C (Multi-Level Piezometer Nest)

REVIEWER: Williams and Associates, Inc.

DATE REVIEW COMPLETED: June 1985

BRIEF SUMMARY OF DOCUMENT: DATE APPROVED:

The document reviewed herein constitutes the drilling and completion specifications for boreholes RRL-2B and RRL-2C. The document discusses the rationale for testing at the RRL-2 location. "The general objectives of the multiple-well hydraulic testings at test well RRL-2B are:

- Facilitation of design of future multiple well hydraulic tests planned at other locations on the Hanford site (e.g., DC-16, DC-20, and DC-22 sites).
- Identification and classification of hydrogeologic boundaries. These boundaries may be correlated later to rock inhomogeneities that may influence groundwater flow in the RRL.
- Characterization of dissolved substances in groundwater removed from the Grande Ronde Basalt through test well RRL-2B.
- Assessment of areal representativeness of hydraulic values obtained by previous single-well testing (e.g., RRL-2).
- Assessment of the degree of vertical leakage into the test flow tops through adjacent flow interiors.
- Evaluation of the hydraulic continuity of selected flow tops (and flow "bottoms") in the Grande Ronde Basalt in the RRL."

The report under review also states specific requirements for testing the units in the Grande Ronde in terms of specific test objectives. These specific test objectives are:

"1. Evaluation of horizontal hydraulic conductivity, storativity, effective porosity, and longitudinal dispersivity of flow tops.

2. Evaluation of vertical hydraulic conductivity of flow interiors using parameter variation and analytical techniques.

3. Collection and chemical analyses of groundwater from selected flow tops."

The report under review also describes the organizational and functional responsibilities inherent with testing at the BWIP site. A discussion is also presented regarding site preparation, environment, and security measures employed at the site.

Subsurface conditions are described for the proposed site. This discussion includes both the known and anticipated geologic and hydrogeologic conditions anticipated during the drilling of RRL-2B and RRL-2C.

The essence of the report consists of the borehole specifications for test well RRL-2B and the multi-level piezometer nest for RRL-2C.

Test well RRL-2B will be installed by using multiple stages of drilling, casing, and grouting. The hole will be drilled to an approximate depth of 2,800 ft which is above the flow top of the Rocky Coulee flow. This portion of the well will be drilled with cable tool and mud rotary drilling rigs. A casing string (13.375 inch O.D.) will be installed and the annulus grouted with portland cement. The borehole will then be deepened through the Rocky Coulee flow top using a 12.25 inch bit. Clear water will be used as the drilling fluid for this portion of the drilling operation. The flow top will be tested prior to initiating further drilling activities in the hole.

The Rocky Coulee flow top will be sealed with portland cement, after testing, and the borehole will be deepened with a 12.25 inch bit to just above the Cohassett flow top. The grouted portion of the borehole will be cased and grouted. The borehole then will be deepened through the Cohassett flow top; the flow top then will be tested.

This sequence of testing, grouting, drilling, casing, grouting, and drilling will be continued for the Grande Ronde #5 flow top

and the Umtanum flow top. However, the Umtanum flow top, which is the lowermost interval to be tested, will not be cased or grouted upon completion of testing. This portion of the borehole will remain open and available for future testing. The total depth proposed for the well is 3,755 ft. The planned final diameter of the borehole in the Umtanum flow top will be 5.875 inches. The drilling and casing schedule allows for the placement of a large capacity submersible pump to a depth of at least 2,400 ft. The casing size planned for this depth is at least 10 inch I.D. The final, minimum hole diameter allowed in the Umtanum flow top is 3.5 inches.

The multi-level piezometer nest (RRL-2C) will consist of six piezometers installed in a single borehole over a depth range of approximately 2,830 ft to 3,350 ft. Three of the six piezometers will monitor the Rocky Coulee, Cohassett, and Grande Ronde #5 flow tops. The Cohassett flow bottom is coincident with the Grande Ronde #5 flow top. The remaining three piezometers will be completed in the Rocky Coulee, Cohassett and Grande Ronde #5 flow interiors. Each piezometer string will be isolated within the specified unit. High density portland cement will be used to isolate the piezometers. The borehole will be drilled by cable tool and mud rotary to an approximate depth of 2,800 ft. This depth is just above the flow top of the Rocky Coulee flow. A 13.375 inch O.D. steel casing will be installed from the ground surface to this depth. The annulus will be grouted with portland cement. The hole then will be rotary drilled using either water or an aerated water rotary system to a final depth of approximately 3,400 ft. The piezometer strings will consist of 1.75 inch I.D. by 2.06 inch O.D. tubing with one or more screened sections placed in the monitoring horizon. A multiple gradation filter pack will be used around the screened section. The screened section will be isolated from adjacent units by a cement seal. The location of the screens, cement seals, and filter packs will be based on interpretation of borehole geophysical logs. These logs include caliper, neutron-epithermal neutron, and resistivity. The screens on the piezometers will be continuous slot wire wound screen over a perforated pipe base. Slot size will be 40. The screened sections will be between 2 and 20 ft in length.

A section of the report under review is devoted to the acquisition of data during drilling. This section describes the types of data that will be obtained during the drilling of boreholes RRL-2B and RRL-2C. Fluid gain and loss are included in the list of variables to be monitored . This information may be valuable for a qualitative evaluation of hydraulic conductivity. The report also describes equipment calibration and the applicable BWIP procedures; the applicable BWIP procedures are referenced by Rockwell Hanford document numbers. The principal

document is RHO-BWI-MA-4.

A section of the report under review describes the borehole geophysical logging anticipated for these two boreholes. The logs that will be run include natural gamma, gamma-gamma, neutron-epithermal-neutron, caliper, fluid temperature, resistivity, televiewer, spontaneous potential, borehole survey, and borehole television. A cement bond tool (sonic log) will be run after each casing has been cemented to verify the bonding of the cement to the casing and formation. Rockwell notes that additional logs may be obtained where a specific need has been identified and approved. Equipment calibration for the logging tools is described in the report under review. Reference to applicable BWIP procedures is noted.

A section of the report under review is devoted to describing the ground water monitoring that will occur during the borehole completion activities. The ground water monitoring activities include observing heads and pressures, collecting pumping or discharge rates, and collecting ground water samples. This information will be used to assess whether the borehole and subsequent piezometers are "cleaned-up". This phrase refers to whether or not the piezometers in the borehole have been developed properly. Applicable BWIP procedures are described and documents referenced.

Sections of the report under review also are devoted to the expected results of the activity, quality assurance, acceptance and change control procedures, safety, schedule, and references.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This document is important to the Waste Management Program because this document describes the drilling and completion of two very important boreholes at the RRL site. These boreholes, RRL-2B and RRL-2C, are important because they are required for the initial large-scale test at the BWIP site. Inadequate design or implementation of design could seriously affect the outcome of the large-scale test. It is very important that the initial testing be conducted in an appropriate manner in order to measure, over a large area, the hydraulic conductivity of the basalt flow tops. The test also is designed to attempt to measure the vertical hydraulic conductivity of some flow interiors. This test, if appropriately conducted, will also provide valuable information regarding hydraulic continuity across the site. Hydraulic continuity will be demonstrated by the areal extent of the cone of depression as monitored in the numerous observation wells available for the pump test. This forerunner of the large-scale test plans will be used as a standard by which subsequent tests will be designed and/or

modified.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

The subsequent discussion of items of concern are presented in the chronological order in which they appear in the report under review. The first item of concern appears on page 11 regarding Item 2 under Test Objectives. This section states that vertical hydraulic conductivity of the flow interiors will be evaluated using "parameter variation and analytical techniques." We interpret the phrase "parameter variation" to mean inverse modeling. A document prepared by Lu and Yeh (no date) entitled "Basalt System Characterization: Inverse Technique" apparently describes the "parameter variation" technique noted in the document under review. The Lu and Yeh document describes an inverse technique based on application of the Trescott model. The Trescott model is a finite difference method for simulation of three-dimensional ground water flow (1975). The three-dimensional model has the option of accounting for storativity in the confining units which increases the number of nodes and blocks required in the simulation. The methodology described by Lu and Yeh does not take into account the storativity of the confining units. Their methodology appears to account only for the contribution of flow through the confining unit and not the storativity of the confining unit. This limitation could prove to be a serious handicap in the evaluation of the data from the pump test.

It was noted in the July 1983 workshop that the placement of the pumping well and observation wells for the large-scale test should be based on an evaluation of the probable stress changes which will occur due to the pumping test. Justification for the placement of test well RRL-2B and the multi-level piezometer nest RRL-2C is not included in the report under review. The locations of the wells are not distant from the existing borehole RRL-2A. Justification for the well locations should be provided in the document under review or in a companion document. As noted in the workshop of July 1983, the placement of these wells is critical to the detection of leakage through the basalt flow interiors. This justification is not provided. This omission constitutes a limitation of the design presented in the report under review.

The report under review states that "no pressures beyond hydrostatic are expected." This quote appears on page 19 of the report under review. The review of the long-term (baseline) water level and pressure data from clusters DC-19, -20, and -22 refutes this statement. The data indicate a general potential for upward flow at the Hanford site, especially around the RRL. This statement should be revised based on data currently

available.

A comment was prepared by the NRC on the BWIP EA concerning the use of the phrase "effective thickness". The phrase appears in Table 2 (pages 20 and 22). The use of "effective thickness" in this table conflicts with the use of the phrase in the EA. The phrase in this context appears to be consistent with the definition used prior to the EA. That is, the phrase refers to that portion of the borehole which is contributing flow for testing procedures. "Effective thickness" in the EA refers to the product of effective porosity and the thickness of the interval in question. The two uses of the phrase are not compatible.

The section on drilling requirements for borehole RRL-2B begins on page 22. It is stated that hydrologic testing will begin after the bit and drilling tools have been pulled from the borehole. This statement is misleading because it implies that there will be no well development procedures employed prior to hydrologic testing. This implication is contradictory to statements made on page 25. It is stated on page 25 of the document under review that the borehole and hydrogeologic unit will be initially flushed with Hanford system water until the discharge water is essentially free of cuttings. It is stated further that the clean-up of the borehole will be completed during the step drawdown and/or pumping phases of the large-scale hydraulic stress test. We believe that the well should be developed properly prior to the initiation of large-scale stress testing. It is not clear in the document under review that the well will be properly developed. The same general statement regarding the completion of the borehole with bit and tool removal followed by hydrologic testing is presented for each of the flow tops under discussion in the document under review.

The document under review states on page 28 that one or more screened sections may be used in the monitoring horizon. The document under review does not state why more than one screen section would be used in a monitoring horizon. It is possible that multiple screen sections are required if the flow top is thicker than the length of a single available screen section.

The document under review states that the piezometer strings will consist of several components. One of these components is a "seating nipple". It is not stated whether the seating nipple will be perforated for the piezometer completions in the flow tops or the flow interiors. It was noted in the May 1985 public meeting that the transducers would be seated in an unperforated nipple so that the transducers will monitor water pressures only in a small interval below the nipple. It is our understanding that the current seating nipples are perforated so that water

level measurements can be conducted from land surface in conjunction with the transducer readings in the vicinity of the seating nipple. The document under review should state clearly the type of seating nipple that will be used. It should indicate clearly whether these nipples are perforated to allow movement of fluid into the tubing above the transducer.

The Gulick and Buck (1980) reference on page 31 apparently is incorrect. Checking this reference against the reference list in the back of the document under review indicates that a second author should have been included. This second author is Boa. If this assumption is incorrect then the proper reference should be included in the reference list.

The multi-piezometer borehole will be pumped in order to develop the well. The document under review states that such pumping will continue until the borehole is "relatively free of particulate matter." This development procedure deviates from that described for RRL-2B which is the pumping well. Apparently clean water will not be added to the borehole to facilitate the clean-up. Standard potable water supply development procedures include some kind of jetting or surging action to facilitate the removal of particulate matter. The methodology noted in the document under review probably is adequate for the purposes intended especially considering the small diameter of the piezometer tubing.

The document under review on page 35 states that "Preliminary indication of the integrity of the installation" will be based on pressure responses. It is not clear what the final indication of integrity of the installation will be. Apparently, the installation will be placed in operation with only a "preliminary indication of the integrity of the installation." This point should be clarified by stating what the final method of integrity testing will be.

The schedule for LHS testing in RRL-2 is on page 49 of the document under review. The schedule indicates that only a short period of time in November of fiscal year 1986 is allowed for the pre-test period and the injection test in the Cohassett flow top in borehole RRL-2B. The time frame is much shorter than that designated for the Rocky Coulee, Cohassett flow bottom, and Umtanum flow tops. The short period of time designated for testing the Cohassett flow top apparently is based on the low hydraulic conductivity apparent from testing in borehole RRL-2A. It should be noted somewhere in the document under review that this short period of testing is based on the supposition that large quantities of water cannot be pumped from the Cohassett flow top in RRL-2B. This restricts the test of the Cohassett flow top to a short term, injection test. The document under

review does not appear to allow for the possibility that RRL-2B may in fact intersect a higher hydraulic conductivity zone that was encountered in RRL-2A. The ability to pump test the Cohassett flow top would push the schedule for testing back and would approach the point in time at which the exploratory shaft penetrates the Grande Ronde Basalt. This potential schedule conflict should be addressed with respect to potential test changes for the Cohassett flow top.

SUGGESTED FOLLOW-UP ACTIVITY:

DOE should be notified of the deficiencies noted in the document under review.

REFERENCES CITED:

Lu, A.H., and Yeh, W.W.G. no date. Basalt System Characterization: Inverse Technique. Paper prepared under the auspices of Rockwell Hanford Operations.

WMGT DOCUMENT REVIEW SHEET

FILE #:

ROCKWELL HANFORD OPERATIONS #: SD-BWI-DP-059

DOCUMENT: Water-Level, Downhole Pressure and Atmospheric Pressure Measurements from Piezometer Clusters DC-19, DC-20 and DC-22, December 1 through December 31, 1984

REVIEWER: Williams & Associates, Inc.

DATE REVIEW COMPLETED: June 1985

BRIEF SUMMARY OF DOCUMENT: DATE APPROVED:

The document reviewed herein is a data package report that includes water level measurements, downhole pressure measurements, and atmospheric pressure measurements for the piezometer sets at locations DC-19, DC-20, and DC-22. The data included in the document are for the period December 1 through December 31, 1984. The report discusses limitations associated with the data. The report also includes information concerning the location of the piezometers and the elevation and depth of the piezometers at the cluster sites. Steel tape water level data and downhole pressure data are presented in tabulated form.

SIGNIFICANCE TO NRC WASTE MANAGEMENT PROGRAM:

This document is important to the overall licensing process because the information contained therein constitutes a part of the baseline data being obtained at the BWIP site. This baseline information constitutes the long-term water level data being collected to establish ground water flow directions and gradients at the site.

PROBLEMS, DEFICIENCIES OR LIMITATIONS OF REPORT:

We have calculated the mean values for the depth to water level measurements below a control datum. These mean values were calculated for the Mabton interbed (DC-19D, DC-20D, and DC-22D), the Priest Rapids interflow zone, the Sentinel Gap flow top, the Ginkgo flow top, the Rocky Coulee flow top, the Cohassett flow

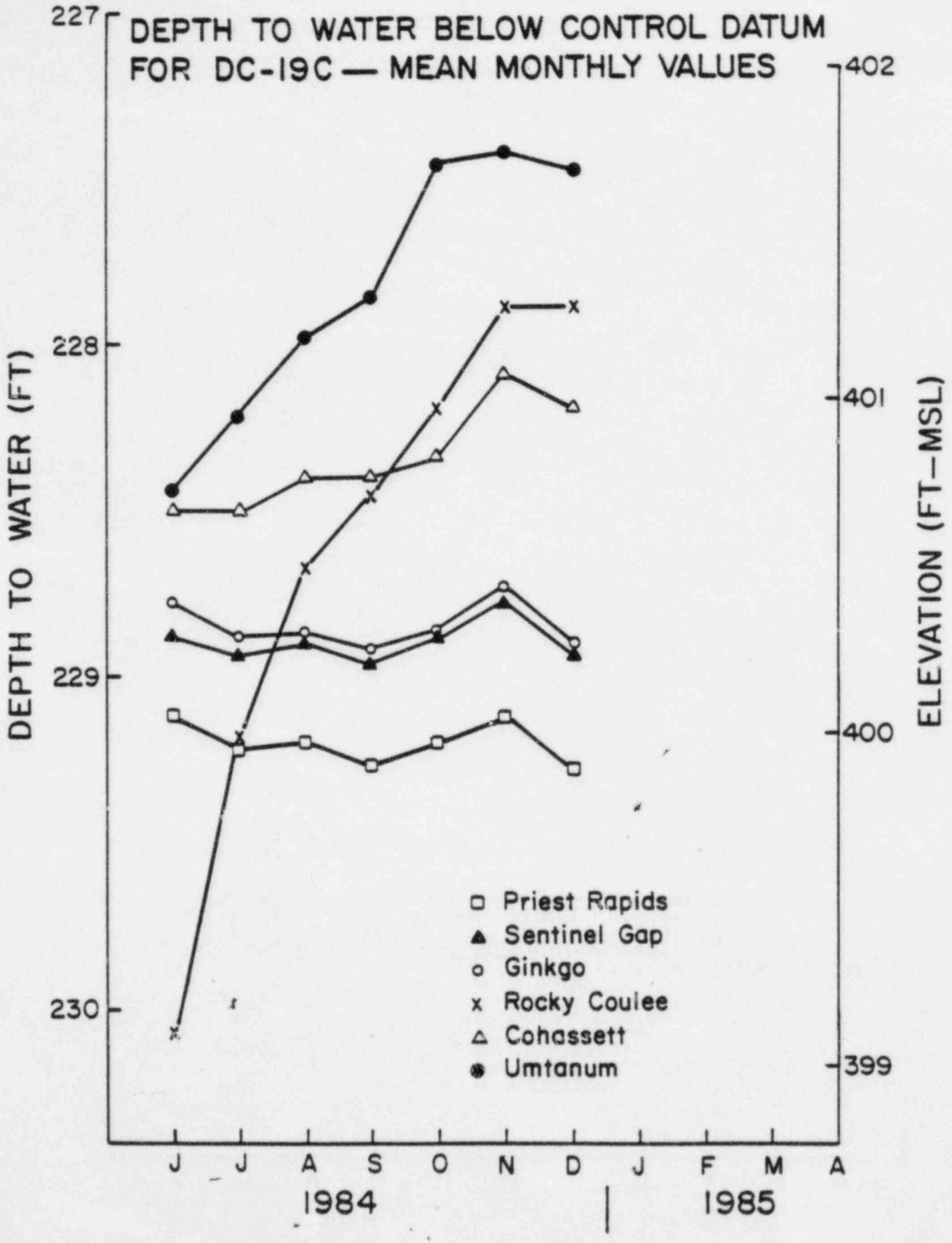
top, and the Umtanum flow top (DC-19C, DC-20C, and DC-22C). We calculated the mean values of daily water levels for the month of record in the appropriate piezometers to minimize the effects of barometric and earth tide influences on the water levels. These summarized data have been plotted on the attached figures.

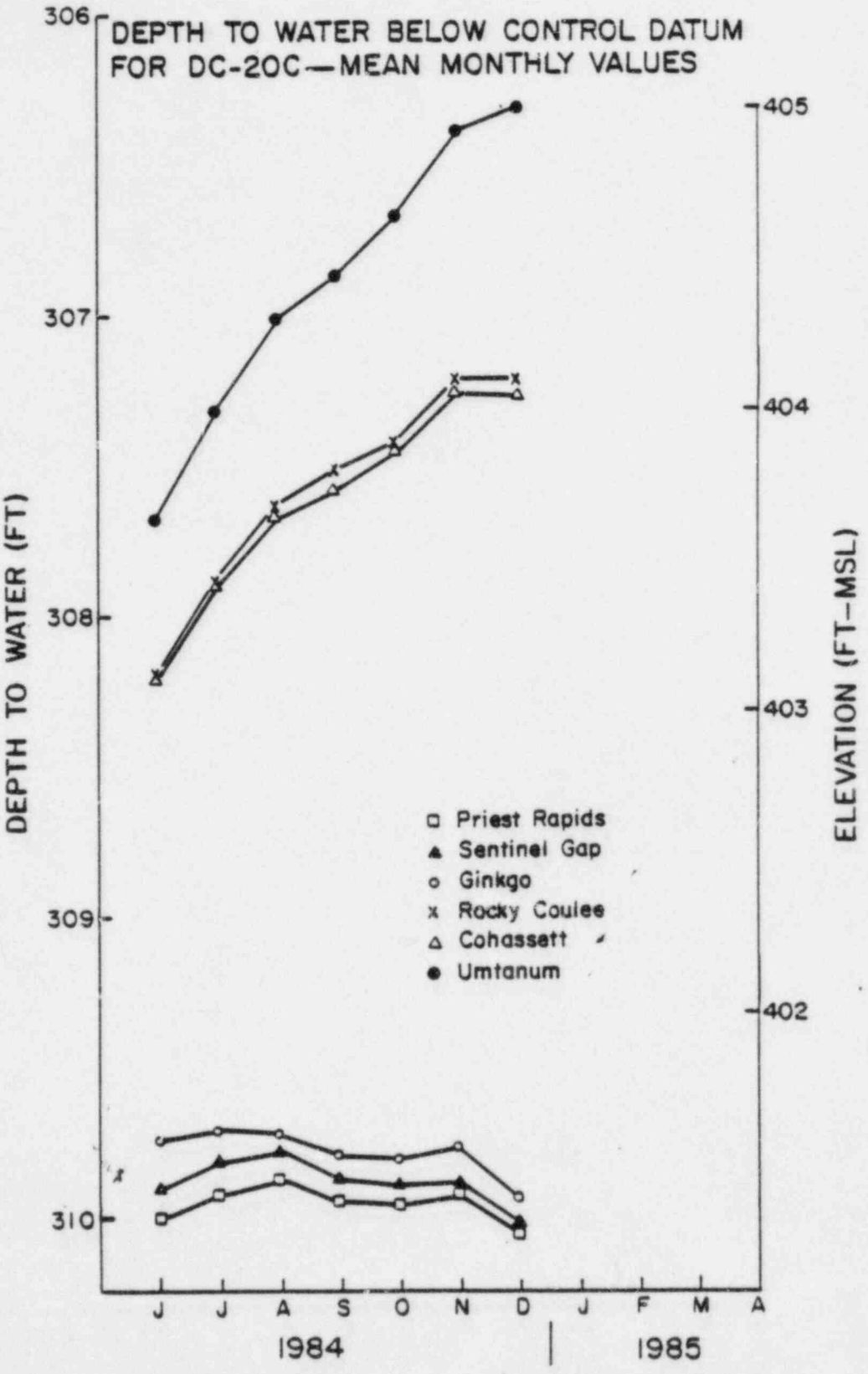
Water levels generally are recovering in the Grande Ronde Formation. Water levels in the Mabton Interbed and the Wanapum Formation basically have stabilized although some unexplained fluctuations are occurring in the water level data.

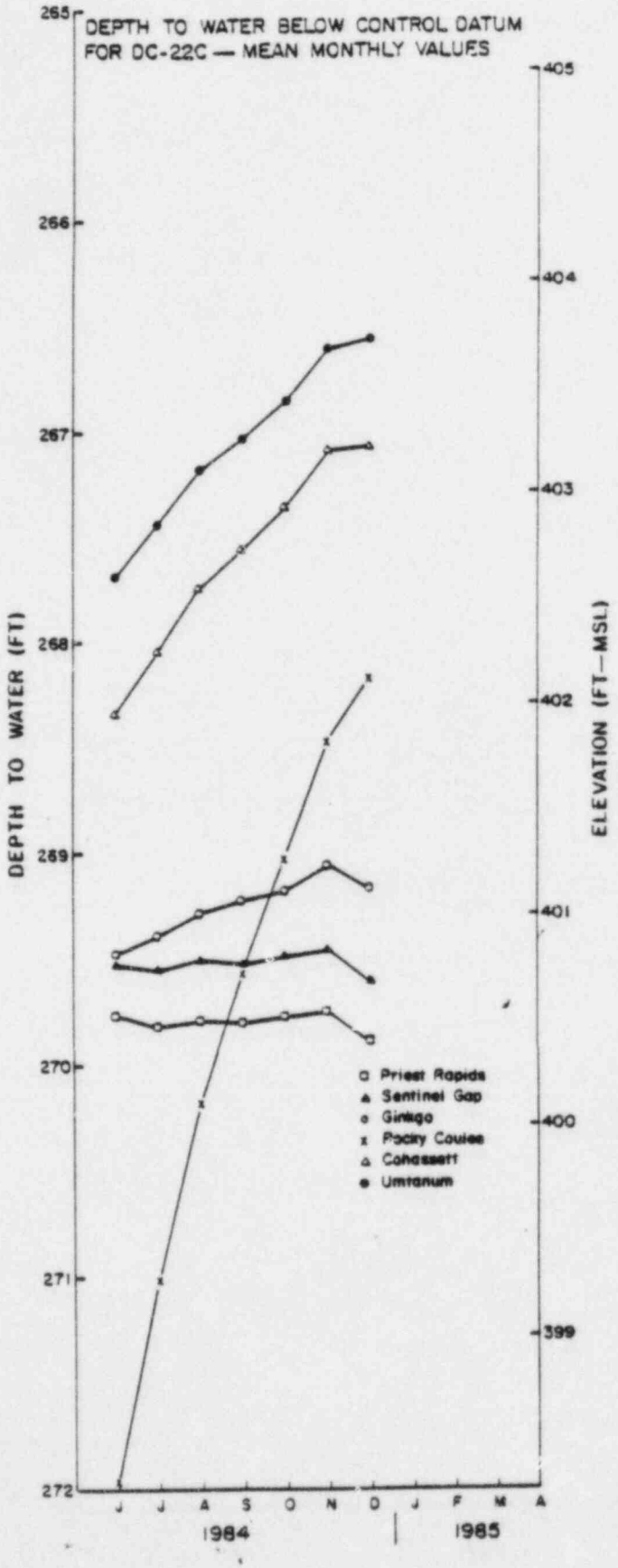
The downhole pressure data were not evaluated in our review. The report under review notes that there is a definite drift associated with data obtained from the downhole pressure transducers. This drift is being investigated but no conclusions have been reached at this time. We believe that the depth to water level measurements are the most useful information for current analyses.

SUGGESTED FOLLOW-UP ACTIVITY:

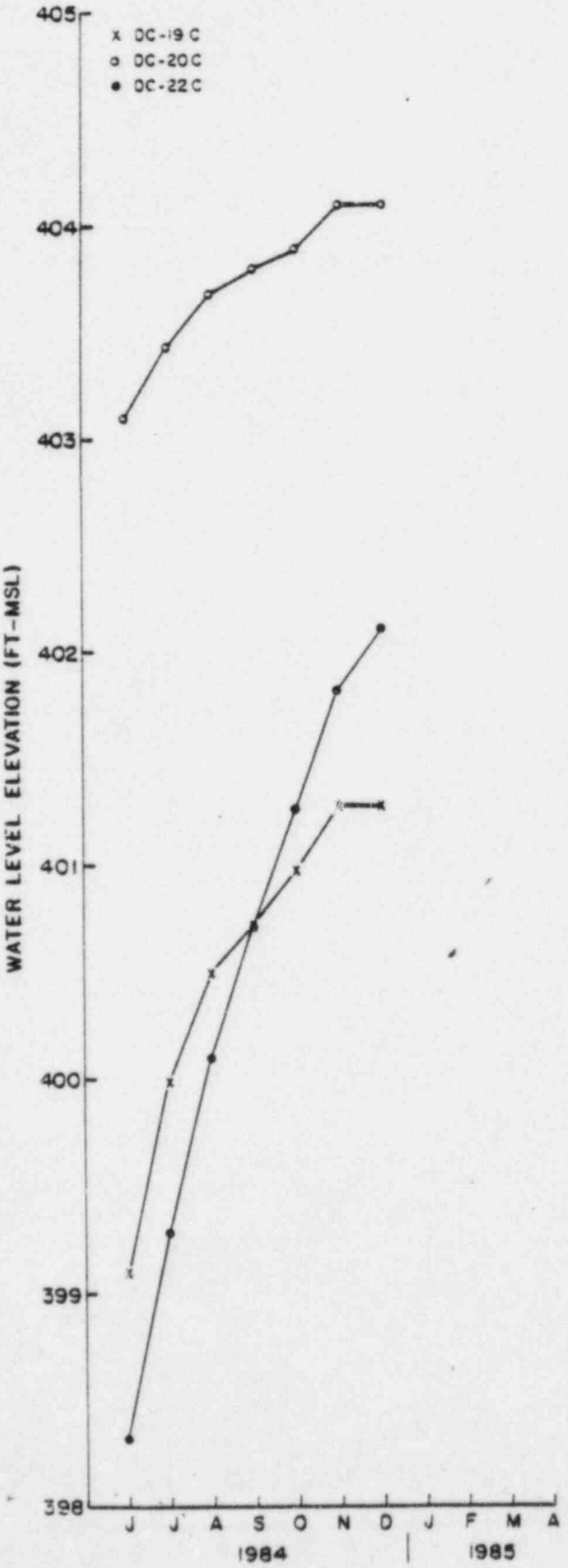
We suggest that subsequent data reports be supplied to Williams and Associates, Inc. The data will be evaluated in the same manner as the data in the report under review. The use of mean values will minimize if not eliminate the effects of barometric and earth tide influences on the water level measurements. The data presented in the attached figures is at a more appropriate scale for ascertaining the long-term water level recovery from drilling activities.


DEPTH TO WATER BELOW CONTROL DATUM
FOR DC-19C — MEAN MONTHLY VALUES
DEPTH TO WATER (FT)
227
228
229
230
ELEVATION (FT—MSL)
402
401
400
399
Priest Rapids
Sentinel Gap
Ginkgo
Rocky Coulee
Cohassett
Umtanum
J J A S O N D J F M A
1984
1985

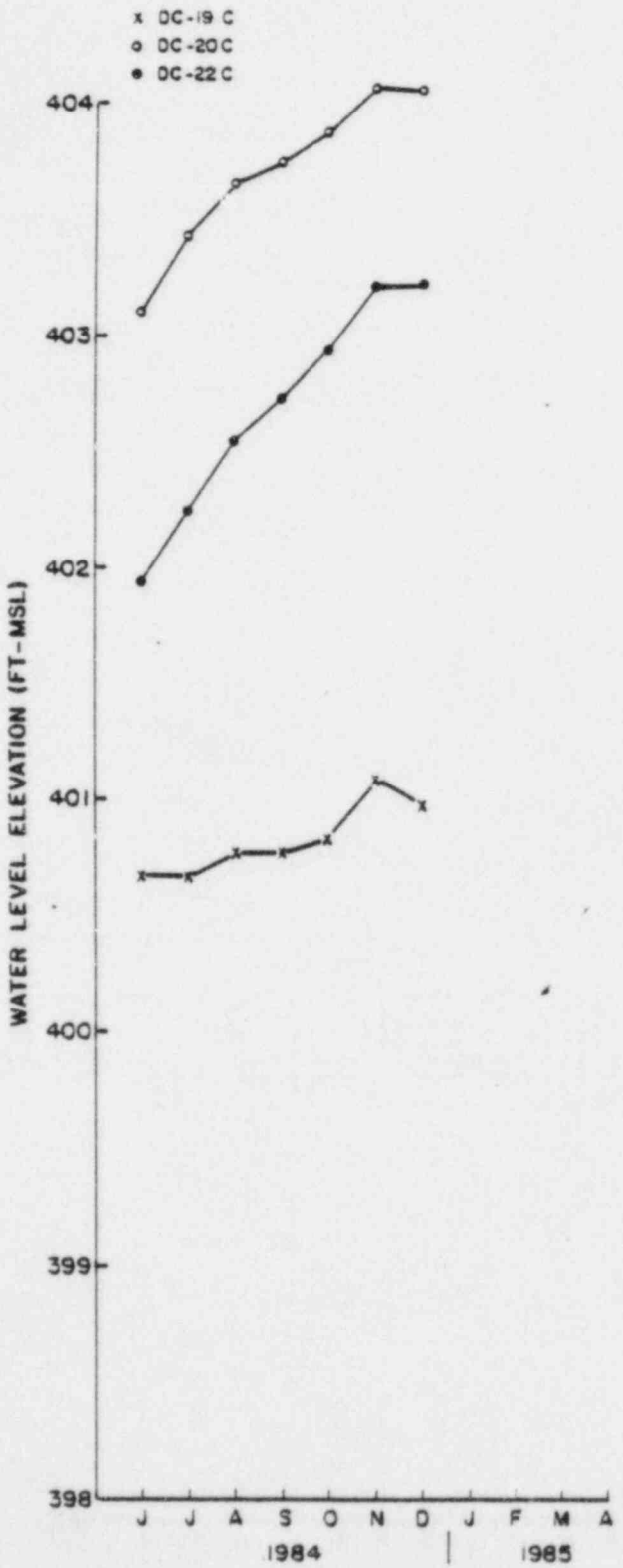

DEPTH TO WATER BELOW CONTROL DATUM
FOR DC-20C—MEAN MONTHLY VALUES
306
307
308
309
310
405
404
403
402
DEPTH TO WATER (FT)
ELEVATION (FT-MSL)
Priest Rapids
Sentinel Gap
Ginkgo
Rocky Coulee
Cohassett
Umtanum
J J A S O N D J F M A
1984
1985


DEPTH TO WATER BELOW CONTROL DATUM
FOR DC-22C — MEAN MONTHLY VALUES
DEPTH TO WATER (FT)
ELEVATION (FT—MSL)
265
266
267
268
269
270
271
272
405
404
403
402
401
400
399
Priest Rapids
Sentinel Gap
Ginkgo
Pasco Coulee
Cohassett
Umtanum
J J A S O N D J F M A
1984
1985

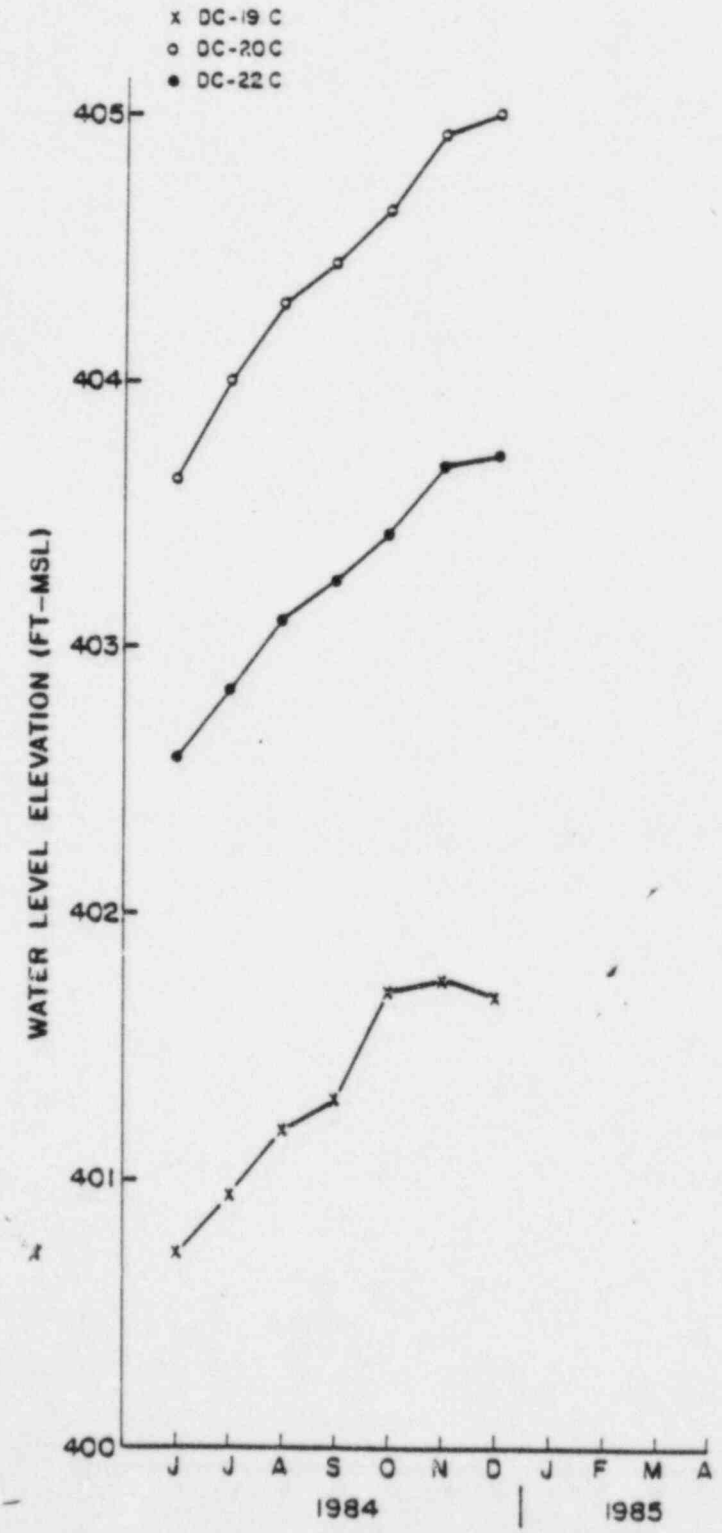
WATER LEVEL ELEVATION-ROCKY COULEE
FLOW TOP; DC-19C, DC-20C, & DC-22C



WATER LEVEL ELEVATION – COHASSETT
FLOW TOP; DC-19C, DC-20C, & DC-22C

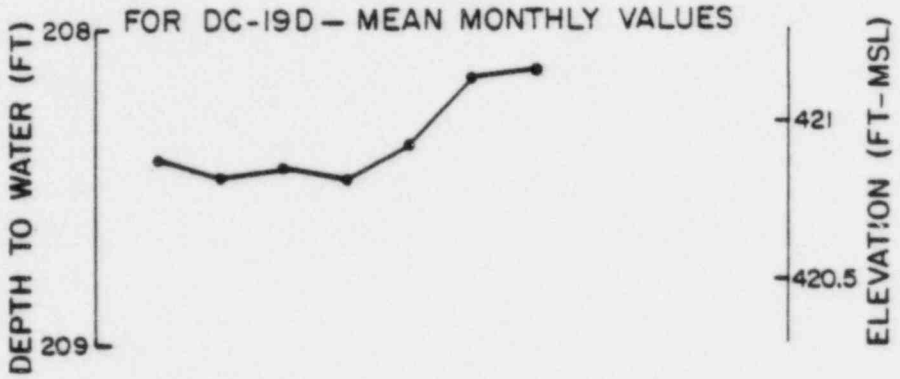


WATER LEVEL ELEVATION - UMTANUM
FLOW TOP; DC-19C, DC-20C, & DC-22C

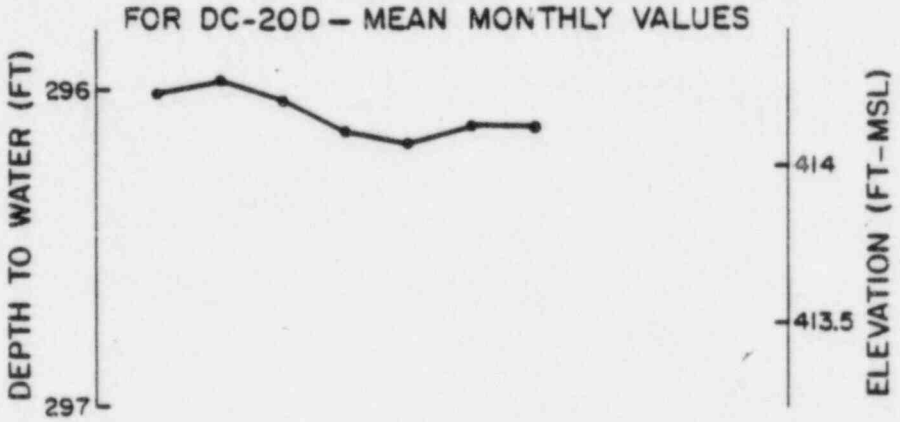


MABTON INTERBED

DEPTH TO WATER BELOW CONTROL DATUM
FOR DC-19D – MEAN MONTHLY VALUES



DEPTH TO WATER BELOW CONTROL DATUM
FOR DC-20D – MEAN MONTHLY VALUES



DEPTH TO WATER BELOW CONTROL DATUM
FOR DC-22D – MEAN MONTHLY VALUES