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MEMORANDUM FOR: Myron Fliegel, Section Leader
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John Linehan, Acting Project Manager
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FROM: Neil M. Coleman
Hydrology Section
Geotechnical Branch

SUBJECT: STATUS REPORT ON THE COLD CREEK HYDROLOGIC ANOMALY

In support of NRC's consultation with BWIP on the proposed program of large-scale hydraulic stress (LHS) testing, I have recently reviewed available information about the Cold Creek Hydrologic Anomaly. The geologic structure that causes this anomaly appears to represent a significant hydrologic boundary within the Cold Creek Syncline that could influence the results of the LHS testing, as well as long-term repository performance. This memorandum reviews our current knowledge of the anomaly and recommends joint evaluation of it by the Geology and Hydrology Sections of WMGT in preparation for future meetings with BWIP.

The hydrologic anomaly consists of a zone of contrasting hydraulic head differences located less than 2 km northwest of the Reference Repository Location (RRL) (see Figure 1). The anomaly and associated geophysical signatures have been variously referred to as the Cold Creek Barrier, the Nancy Linear, the Cold Creek Impediment, the N 96 to N 84 "Linear", and, more recently, as the Cold Creek Syncline Hydrologic Barrier (CCSHB). In this memorandum the term "Hydrologic Anomaly" is used because the nature and physical characteristics of the geologic structure that causes the anomaly have not been characterized. This anomaly is one of a number of subsurface phenomena that have been targeted by the Basalt Waste Isolation Project (BWIP) for hydrologic characterization.

DOE's currently preferred conceptual model of the geologic structure that causes the anomaly invokes the presence of a fault to account for observed stratigraphic displacements and hydraulic head differences. An evaluation of hydrologic conditions within this structural zone and its proximity is needed to obtain a better understanding of boundary conditions within the Cold Creek Syncline. An evaluation of groundwater flow conditions both within this syncline and on its margins is needed to support performance assessment studies

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of long-term repository performance with respect to groundwater travel time.

The existence of groundwater barriers within the Columbia Plateau was first discussed by Newcomb (1961). The presence of such a barrier within the Cold Creek Syncline has been known for at least 12 yr. Newcomb et al. (1972) described the presence of a structural barrier in the eastern portion of the Cold Creek Syncline that seemed to terminate a local basin characterized by flowing artesian wells. They noted that the barrier seemed to align with a local monoclinal flexure and that fault displacements or tight folds may be responsible for the barrier conditions. Ledgerwood and Deju (1976) also referred to restricted flow conditions and flowing artesian wells on the eastern side of the Cold Creek Valley. They speculated that a tight monoclinal downfold in this area was responsible for these conditions.

In the BWIP Site Characterization Report (USDOE, 1982), the following comments were presented on page 5.1-61 regarding a possible hydrologic barrier: "Hydraulic heads within the Mabton interbed decrease nearly 80 meters between borehole DB-11 (head of 204.2 meters above mean sea level), which lies west of the Cold Creek structural barrier, compared to boreholes near the reference repository location. In comparison, the hydraulic head of the Priest Rapids Member of the Wanapum Basalt at DB-11 is 280 meters above mean sea level. This is 76 meters greater than that in the overlying Mabton interbed at that same borehole and some 160 meters larger than the Priest Rapids heads east of the structural barrier. Therefore, the confining nature of this barrier might increase with depth. Future drilling and testing will determine whether or not these head differences across the barrier continue into the lower Wanapum and Grande Ronde Basalts." Well locations are shown in Figure 1 (attached).

Information presented during the DOE/NRC Hydrology Workshop of December 12-13, 1984 revealed that hydraulic head differences across the "barrier" zone do persist downward into the Grande Ronde basalts. Head data from the McGee well (Wood et al., 1984) and the DC-22 well cluster (Jackson et al., 1984) indicate that a head difference across the "barrier" of about 60 m exists in the Rocky Coulee flow top.

Additional information was provided by DOE/BWIP in a telephone conference on November 20, 1985. It was reported that the hydrologic anomaly appears to coincide closely with the location of known geophysical anomalies (gravity and ground-based magnetics) that strike almost due north-south in the vicinity of boreholes DH-27 and DH-28. However, the DOE staff noted that the geologic structure(s) that causes the hydrologic anomaly may not be the cause of the geophysical anomalies. The geophysical anomalies have a discernable length of only a few miles. Stratigraphically, a 400-ft offset of the top of the Pomona

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Basalt was reported on the basis of data from wells DH-27 and DH-28. However, Middle Ringold and later sediments appear not to be deformed. If verified, this would imply that deformation occurred prior to deposition of the Middle Ringold sediments of Pliocene age and sometime after the emplacement of the Pomona Member basalts (12 m.y.b.p. during Miocene). DOE's currently preferred conceptual model of the Cold Creek "Barrier" invokes the presence of a subvertical fault to account for observed stratigraphic displacements and hydraulic head differences.

Hydraulic heads for the Priest Rapids, as measured in the McGee, Enyart, Ford, and O'Brian wells, are about 150 m higher than those measured in the Priest Rapids near the RRL. All four of these wells were reported to be flowing artesian wells when first drilled (Myers et al., 1979). The results of shut-in tests performed in the McGee well demonstrated that the flowing artesian conditions originated in the Wanapum Basalts (Wood et al., 1984). Apparently these flowing wells occur in part of a localized groundwater flow system that exists in the highlands west and northwest of the RRL. This localized flow system seems to be characterized by 1) recharge of hydrostratigraphic units where they are areally or subareally exposed along the crest and southern flank of Umtanum Ridge; 2) flow downdip from recharge areas under variably confining conditions through a region of flowing artesian wells toward the RRL and the axis of the Cold Creek Syncline; and 3) subsequent infiltration and migration through and around an apparent zone of structural deformation of unknown depth and length that restricts lateral groundwater flow and produces the observed hydraulic head differences.

The BWIP Site Characterization Plan (SCP), to be reviewed by NRC during FY86, should contain testing plans that are designed to address the following questions with regard to the Cold Creek Hydrologic Anomaly and other likely or presently unknown hydrologic boundaries:

- What kind of geologic feature is causing the observed hydraulic head anomaly? (fault, dike, fold, etc.)
- What are the relative orientations of this geologic structure and its subparts? (dips and strikes)
- What is the overall magnitude of the geologic structure? (subsurface length, continuity, and depth)
- What are the hydraulic characteristics of related subsurface structures?
- Are continuous vertical flow paths likely to exist within or adjacent to the geologic structure that causes the hydrologic anomaly?
- Within key hydrostratigraphic units, what are the corresponding changes in hydraulic potential across the structural boundary?
- What are the vertical hydraulic head profiles on both sides of the

structural boundary?

° Does the apparent hydrologic boundary appear to correlate with independent sources of data, such as that obtained from surface geophysics, borehole geophysics, and photolineament studies?

The BWIP hydrology and geology review teams should evaluate the degree to which these questions are addressed in upcoming DOE/NRC meetings and in the BWIP Draft SCP. The SCP should be examined closely to determine the adequacy of plans to characterize the Cold Creek Hydrologic Anomaly and other structural zones likely to influence the results of hydrologic testing within the Cold Creek Syncline.

/S/

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Attachment:
As Stated

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REFERENCES

Jackson, R. L., L. D. Diediker, R. K. Ledgerwood, and M. D. Veatch, 1984. Piezometer Completion Report for Borehole Cluster Sites DC-19, DC-20 and DC-22, SD-BWI-TI-226, REV 1, Rockwell Hanford Operations, Richland, Washington.

Ledgerwood, R. K. and R. A. Deju, 1976. Hydrogeology of the Uppermost Confined Aquifers Underlying the Hanford Reservation, ARH-SA-253, Atlantic Richfield Hanford Company, Richland, Washington.

Myers, C. W. , S. M. Price, and others, 1979. Geologic Studies of the Columbia Plateau: A Status Report, RHO-BWI-ST-4, Rockwell Hanford Operations, Richland, Washington.

Newcomb, R. C., 1961. Storage of Groundwater Behind Subsurface Dams in Columbia River Basalt, Washington, Oregon and Idaho, Professional Paper 383-A, U. S. Geological Survey, Washington, D.C.

Newcomb, R. C., Strand, J. R., and Frank, F. J., 1972. Geology and Groundwater Characteristics of the Hanford Reservation of the U. S. Atomic Energy Commission, Washington, Professional Paper 717, U. S. Geological Survey, Washington, D.C.

USDOE, 1982. Site Characterization Report for the Basalt Waste Isolation Project, DOE/RL 82-3, Vol I, U. S. Dept. of Energy, Washington, D.C.

Wood, T. J., G. S. Mack, and W. W. Pidcoe, 1984. McGee Well Report, SD-BWI-TI-227, Rockwell Hanford Operations, Richland, Washington.

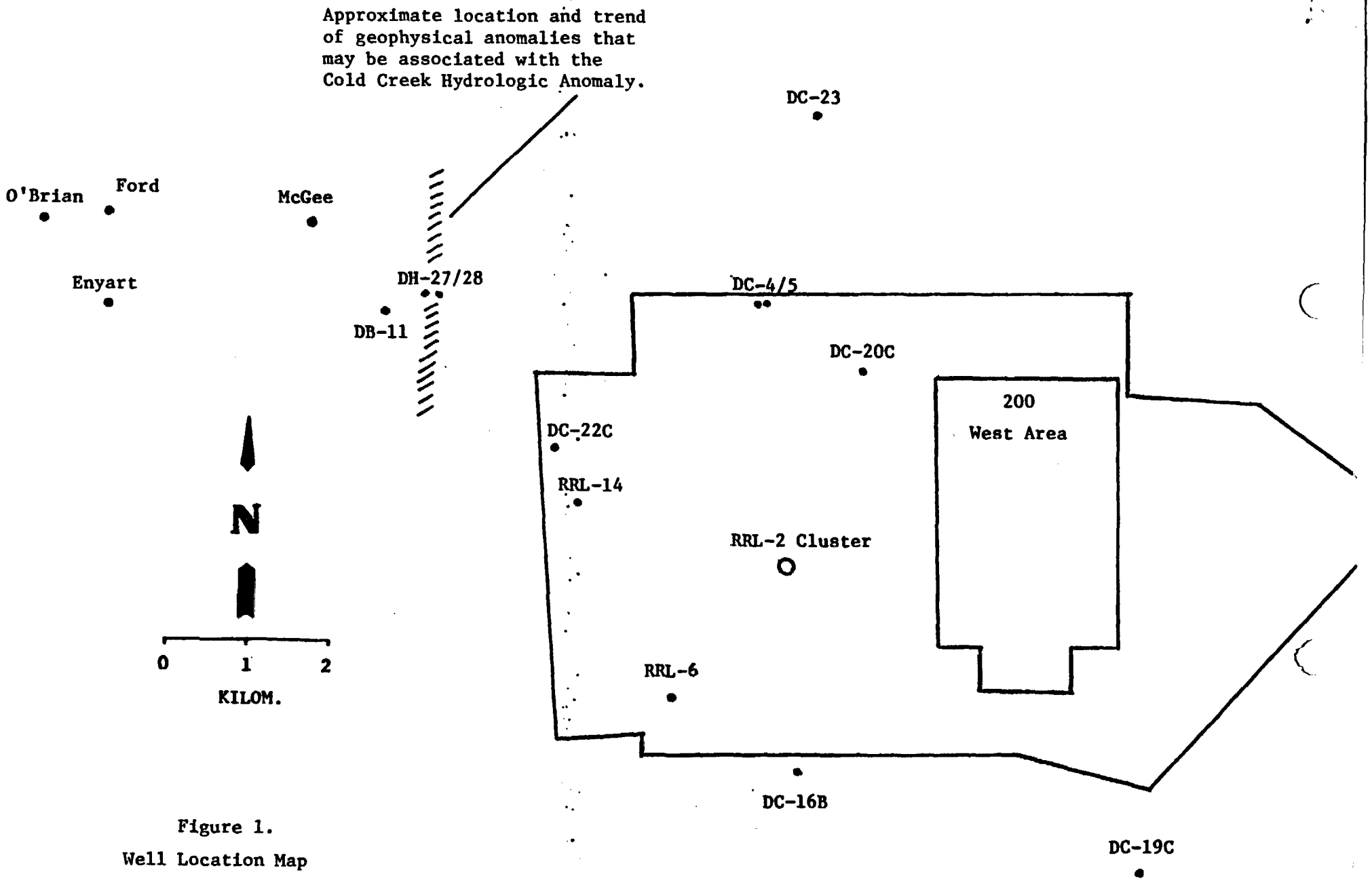

Figure 1.

Well Location Map

(based on a draft DOE base map, 1984)