A GEOHYDROLOGIC RECONNAISSANCE
OF THE DEAD CANYON AREA,
Klickitat County, Washington

by

Paul A. Eddy and Chuck Cline

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Purpose of the Investigation

This study was initiated in June, 1972, in response to a memo dated May 15, 1972, requesting an evaluation of the general geohydrologic characteristics of the area along with possible effects that additional withdrawals would have on existing production wells. This information is needed to properly evaluate pending applications and to manage the water resource of the area.

Location and Topography

The area of interest lies about 30 miles south of Prosser in the northeast corner of Klickitat County and is an area of about 150 square miles. The area is flanked by Alder Creek and Tule Canyon with a projected line to Glade Creek on the west, the Columbia River to the south and Glade Creek to the north and east. The northern part of the area is approximately four miles wide and slopes from an elevation of 1300 feet to an elevation of 600 feet. The stream pattern is trellis and consists primarily of intermittent streams flowing in a southeasterly direction to the Columbia River (Figure 1).

Geology and Hydrology

The area has one major lithologic unit which is very significant to the occurrence of ground water. This unit consists primarily of basalt flows which have interfingered lake and river sediments consisting of shales, sandstone and clays or claystones.

The area lies on a south limb of a primary anticlinal structure with an east-west tending axis. The dip on this south limb is very gently inclined.

It appears that a secondary synclinal structure is also present in the study area. The trellis stream drainage pattern of Alder Creek indicates a gentle southeastward dip and the drainage of Glade Creek shows a southwestward control. The results of these dips place the axis of the secondary syncline very close to the center of the area under study (Figure 2).

As a result of this secondary geologic feature the heads in wells close to the axis of the syncline are high and heads eastward and westward are significantly lower.

The artesian conditions in the study area appear to be associated with one or two aquifer zones which are 600 feet or more below land surface. Stratigraphic work done by Crosby et al shows a relationship in geophysical logs which indicates gross similarity between the geology of the well logs. The logs show clearly that flows and interrelated sediments on the southern flank of the anticline are only gently inclined and that the productive aquifers are similar in nature.

A total of 8 wells which provided varying amounts of data and detail, were used in the study. Table 3 contains well data for all wells shown on Figure 1. Of the 7 wells canvassed in the area, 6 are used for irrigation, domestic supply, or stock water and 1 is not in use, the water level being too deep for economic pumping. Most of the wells are large production wells and are suitable for irrigation purposes. Pump tests conducted on well 7/25-36N1 which is a test-observation well drilled for the Department of Ecology, indicate high yield aquifers with small drawdowns. This well is not in the area under investigation, but is in the same geologic rock units and is, therefore, indicative of the characteristics of wells in the study area. Data from the tests on this well are available for evaluation and the results of the tests are indicated below.

The test-observation well drilled by Jannsen Drilling Co. of Oregon, was drilled to a depth of 861 feet. It encountered basalt of various difficulty in drilling and interbeds of lake and river sediments. The well was cased from land surface to 730 feet and open hole to 861 feet. This is an artesian well with a water level of about 370 feet below land surface. The time recovery data from the pump tests conducted on this well are as follows:

August 3-4, 1972: Running time, 24 hours; depth of well, 735 feet; All measurements by airline, static water level, 371 feet below land surface, pumping level stabilized at 383 feet below land surface; the average discharge of the water from the well was 692 gallons per minute with a water temperature of 21.8^{o} Celsius.

Based on the above data the specific capacity was calculated to be:

specific yield ÷ drawdown = specific capacity

692 gpm ÷ 12 feet = 58 gpm/ft of drawdown

October 4-5, 1972: Running time, 20 hours; depth of well, 861 feet; All measurements made by electric tape, static water level 375.8 feet below measuring point, pumping level stabilized at 380.2 feet below measuring point; the average discharge of water from the well was 650 gallons per minute with a water temperature of 21.6^{o} Celsius.

Based on the above data the specific capacity was calculated to be:

specific yield ÷ drawdown = specific capacity

650 gpm ÷ 4.4 ft = 148 gpm/ft of drawdown

This data indicates that wells in the study area are capable of yielding large quantities of water.

Ground-water gradients, hydrologic factors, and stratigraphy suggest that recharge occurs via numerous intermittent streams which originate in the high country in the western region of the Horse Heaven Hills. Vadose waters migrate downward and eastward along the dip of the west limb of the broad secondary synclinal fold. Ground water percolates to the major regional potentiometric surface by movement through jointing and vertical fractures in the basalt. The very low vertical hydraulic conductivity, which is estimated to be 2.7×10^{-5} cfd/sq. ft. requires that broken zones or piping areas between the basalt flows must exist in order to obtain the artesian heads found in the area.

The mean annual precipitation for a weather station in Bickleton indicates a precipitation of 12 inches/year over a 29 year period. Of this amount a large quantity is lost to evapotranspiration. For a 2" soil moisture the loss is about 7.5 inches and for a 6" soil moisture the loss is in excess of 11 inches. This allows a maximum of 4.5 inches and a minimum of less than 1 inch of water for recharge. Assuming an average of about 3 inches of rainfall annually for recharge of which 40% is for runoff, a specific retention of 10% and an area of approximately 135 square miles, there is about 11,000 AF of recharge into the area annually (0.25 feet $\times 8.64 \times 10^4$ AC $\times (0.40 + 0.10) = 10{,}800$ AF/yr.). Of this amount 6933 AF is presently under permit and certificates with the Department of Ecology. This leaves 3,867 AF of recharge unappropriated.

It must be understood that estimates of water surplus and water deficiency based only on normals of temperature and precipitation are both underestimated. In using the Palmer-Haven diagram for the Thornthwaite method of determining evapotranspiration, daily data for a period of years are necessary in order to arrive at good quantitive estimates of surplus or deficiency of water. Therefore, the above calculation is in all probability on the low side.

Conclusions

It is felt by the authors and others that the present production rates are near the area recharge at the present time and that increased production in excess of the calculated amount of recharge may cause decreases in the artesian head in the area.

It is therefore recommended that:

1. Water Rights not be granted in extreme excess of the calculated recharge quantity of 11,000 AF annually.
2. New wells be drilled on a "one at a time" basis in order to examine the results of each well on the aquifer system.
3. Pressure meters be installed on all wells in the area having a flowing artesian condition.
4. Wells which have a water level below land surface be equipped with an airline or other means for obtaining water level measurements.
5. If, over an extended period of time, the maximum discharge of 11,000 AF does not cause reductions in pressures or lowering of the piezometric surface, a review of the underestimations of the Palmer-Haven diagram should be reevaluated and possibly additional withdrawals allowed in the area.

References Cited

Crosby, J. W., II, Anderson, J. V., and Kiesler, J. P., 1972, Geophysical Investigation of Wells in the Horse Heaven Hills Area; Washington State University; Pages 14-20.

-----, Normals of Precipitation and Evapotranspiration (Inches); State of Washington; Pages 1 and 10.

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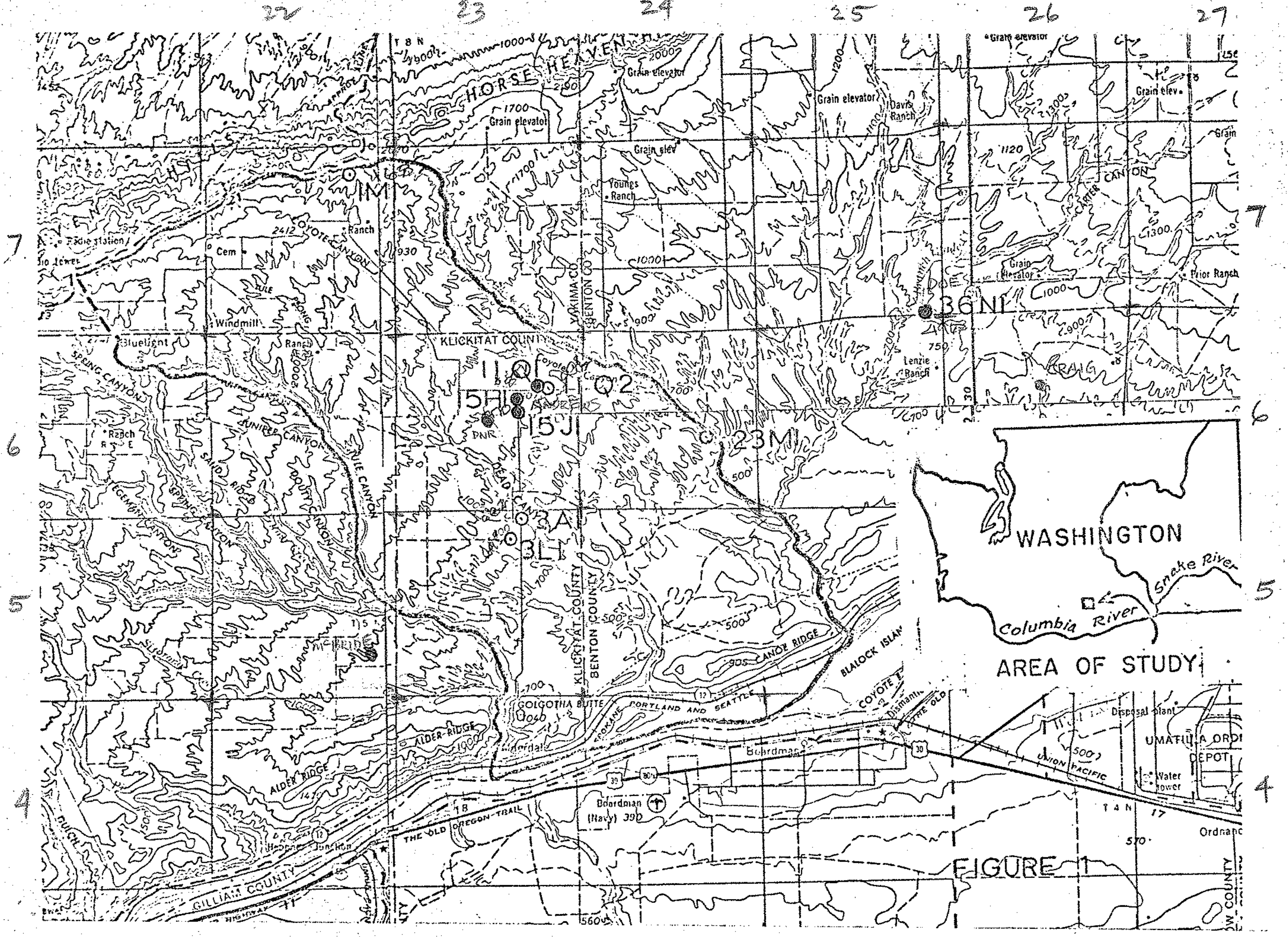

WASHINGTON
Columbia River
Snake River
AREA OF STUDY
HORSE HEAVEN
KLICKITAT COUNTY
BENTON COUNTY
YAKIMA CO
BENTON CO
GILLIAM COUNTY
THE OLD OREGON TRAIL
ALDER RIDGE
GOLGOTHA BUTTE
CANOE RIDGE
BLALOCK ISLAND
COYOTE CANYON
JUNIPER CANYON
SPRING CANYON
SAND RIDGE
EGEMON CANYON
CARTER CANYON
SPOKANE PORTLAND AND SEATTLE
UNION PACIFIC
UMATILLA ORD
DEPOT
Boardman
Boardman (Navy) 390
Bluelight
Windmill
Cem
Ranch
Youngs Ranch
Davis Ranch
Lenzie Ranch
Prior Ranch
Grain elevator
Grain elev
Disposal plant
Water tower
Ordnance
CRAIG
T 8 N
T 4 N
1M
11Q1
11Q2
5H1
15J
3A1
3L1
23M1
36N1
PNR
22
23
24
25
26
27
4
5
6
7

FIGURE 1

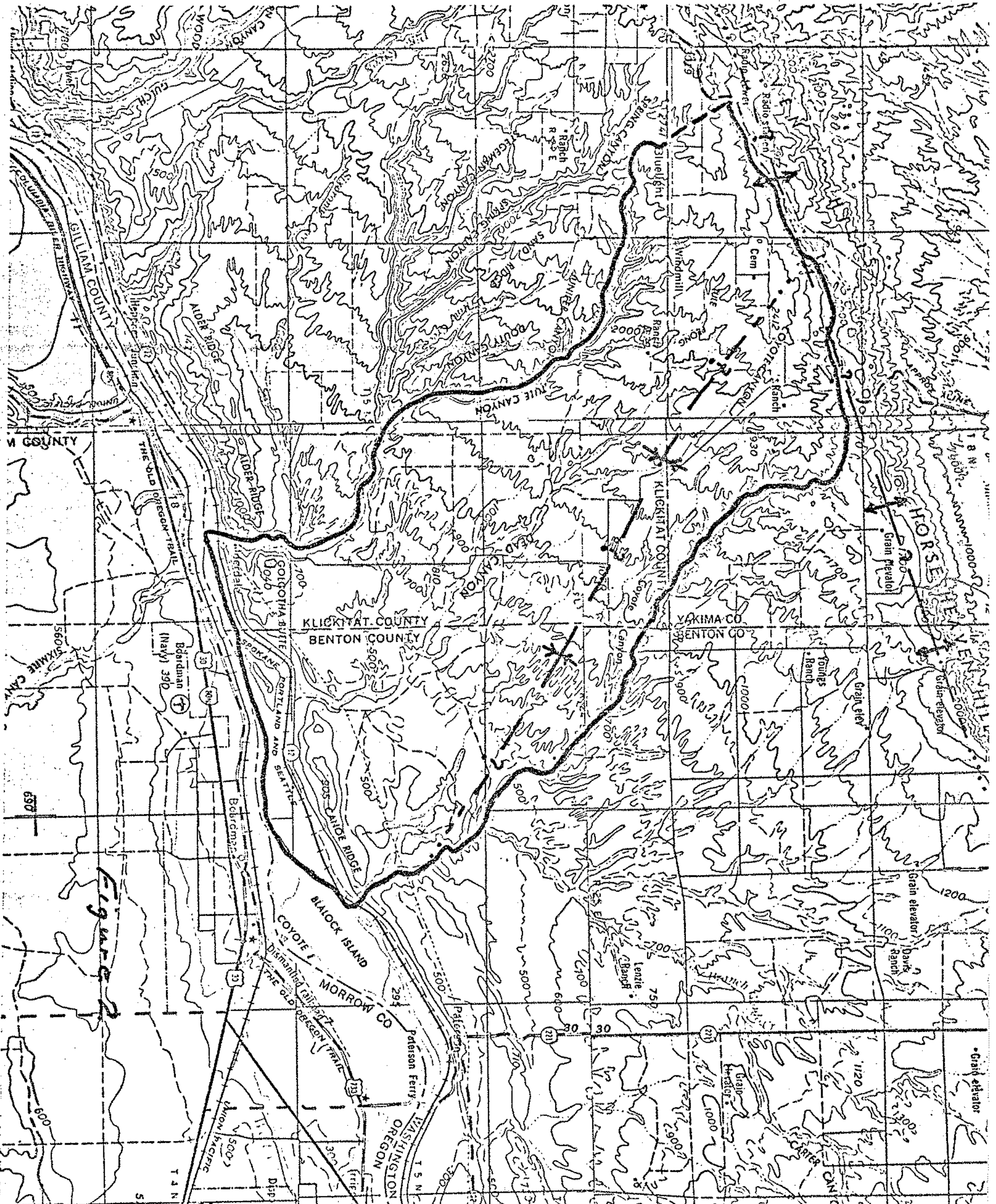
GILLIAM COUNTY
M COUNTY
ALDER RIDGE
THE OLD OREGON TRAIL
KLICKITAT COUNTY
BENTON COUNTY
GOLGOTHA BUTTE
KLICKITAT COUNTY
YAKIMA CO.
BENTON CO.
SPOKANE PORTLAND AND SEATTLE
CANOE RIDGE
BLALOCK ISLAND
COYOTE I
MORROW CO
Boardman
Dismantled railroad
THE OLD OREGON TRAIL
Peterson Ferry
WASHINGTON
OREGON
UNION PACIFIC
Disposal plant
Water tower
UMATI
PIE CANYON
DEAD CANYON
Coyote Canyon
HORSE HEAVEN HILLS
Grain elevator
Younges Ranch
Davis Ranch
CARTER CANYON
Radio station
Cem
Windmill
Ranch

Figure 2

Table 3 - Records of wells

Well No.	Owner or tenant	Well: Alt. (feet)	Well: Type	Well: Diam. (inches)	Well: Depth (feet)	Well: Casing depth (feet)	Water-bearing zone(s): Material	Water-bearing zone(s): Depth interval (feet)	Water level: Below land surface (feet)	Water level: Date	Pump: Type	Pump: H.P.	Use of Water	Remarks
T 5N	R 23E													
3A1	Robert Peterson	735		12 10 8	575	0-58 0-79 226-321	Basalt	27-79 225-240 278-321	53 (682)	12- -65				
3L1	Robert Peterson	820		8	150	0-132	Basalt		125 (695)	11-21-66	Turb	7.5	Irr.	Crooked Hole
T 6N	R 23E													
11Q1	George Smith	1010		8	208	150	Basalt	154-208	138 (872)	9-26-57		7.5	Irr. & Domest	No drawdown at 200 gpm Cert. 3956
11Q2	George Smith	1010		12 8	670	0-154 485-560	Basalt	152-252 278-287 326-480 654-670	15 (995)	4-22-59	Turb	30	Irr.	300 gpm & 125' drawdown Cert. 3957
15H1	George Smith	1052		12 10 8	950	0-128 268-323 440-560	Basalt	377-405 490-537 675-938	80.8+ (970)	2-10-71			Irr.	Flows at 2200 gpm Cert. 6281
T 6N	R 25E													
36N1	Dept. of Ecology	730		10 8 6	860	0-740 456-716 740-860	Basalt	105-185 200-290 720-755 770-860	370 (490)	11- 1-72				Test-observation well
T 7N	R 22E													
1M1	Roy Sharpe	1690		6	270	0-20	Basalt	260-270	4 (1685)	3- 5-70				50 gpm & 256 drawdown