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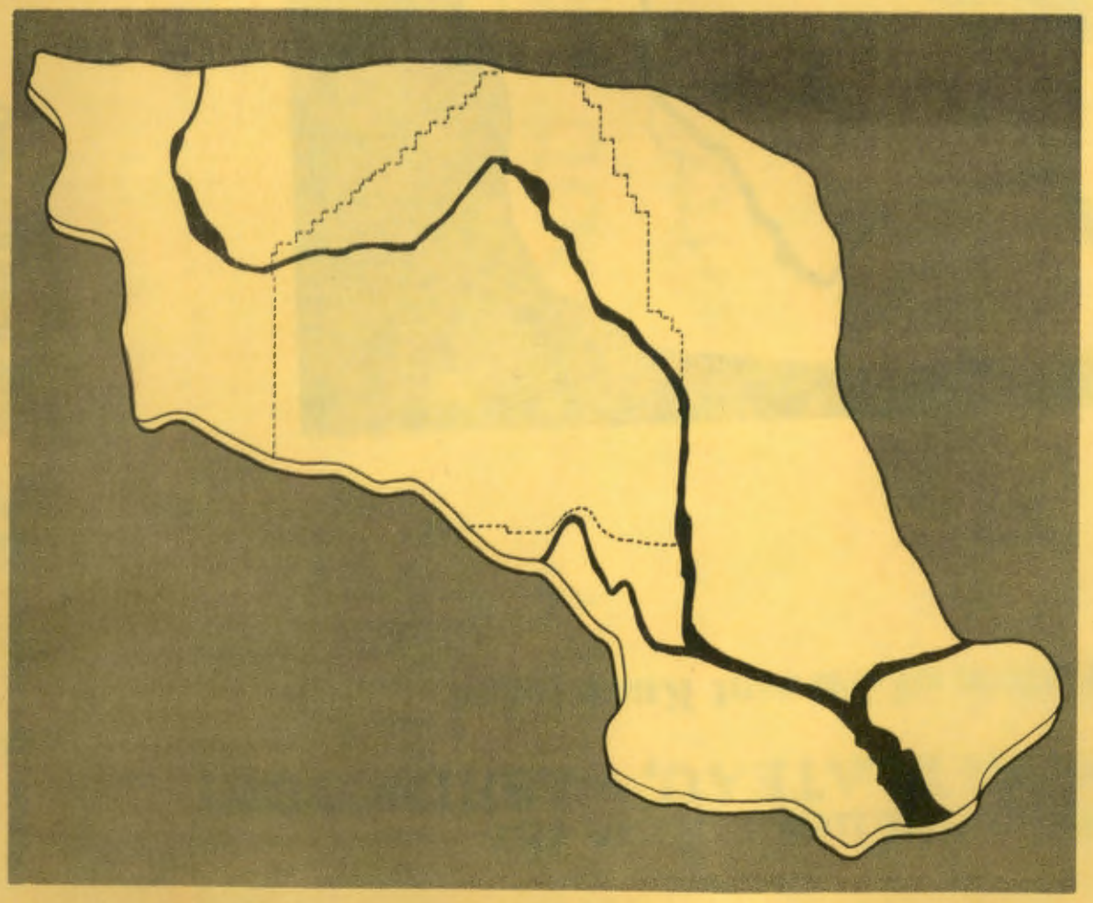
Hydrologic Studies within the COLUMBIA PLATEAU, WASHINGTON:

An Integration of Current Knowledge



Plates III-1 through III-6 Pasco Basin Hydrology

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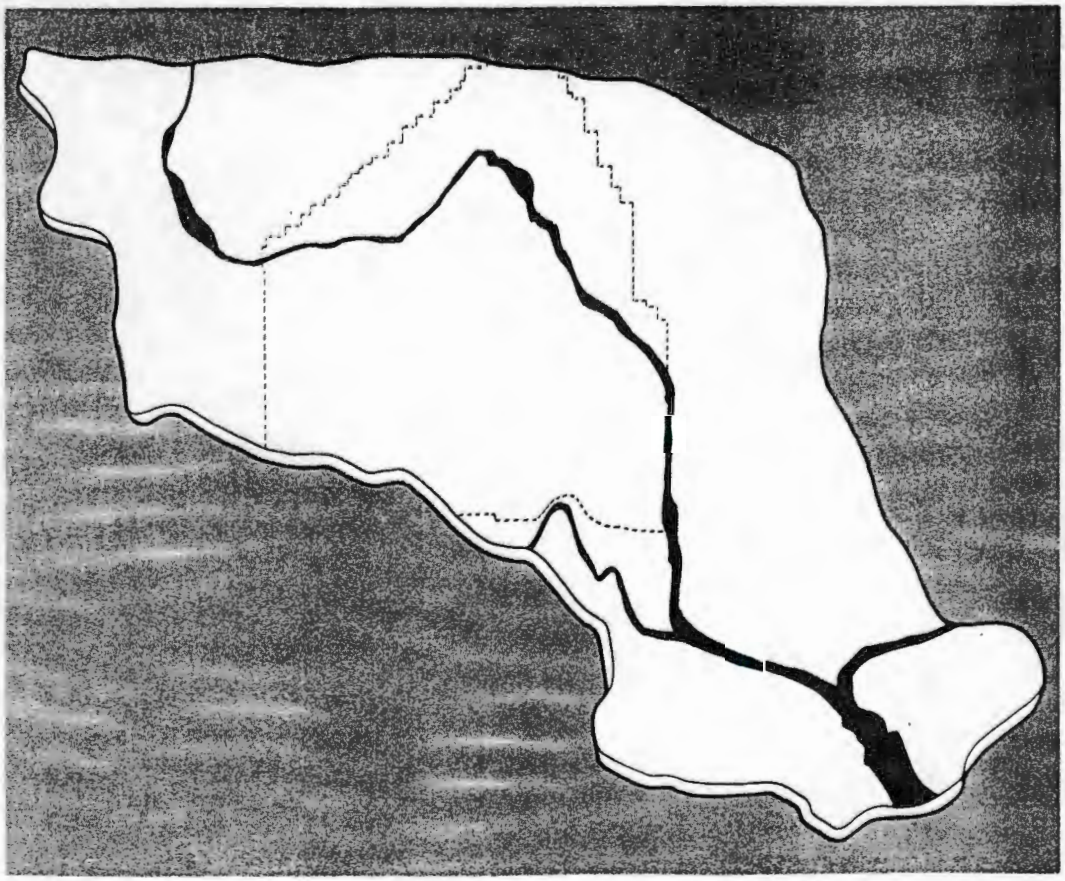
Hydrologic Studies within the COLUMBIA PLATEAU, WASHINGTON:

An Integration of Current Knowledge



Plates III-1 through III-6 Pasco Basin Hydrology

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Base from U.S. Geological Survey
State base map, 1962

PLATE III-1

DESIGNATED "FLOOD ZONES" WITHIN WASHINGTON STATE

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OCTOBER 1979

0 1 2 3 4 5

MILES

PLATE III-2

THICKNESS OF THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

THE UNCONFINED
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INTERVAL LIES PA
THE GLACIOFLUVI
AQUIFER WAS CON
(PLATE III-4) FROM
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RHO-BWI-ST-5

OCTOBER 1979

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PLATE III-3

ELEVATION OF THE BOTTOM OF THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

THE LOWER SURFA
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PLATE WAS CONSTF
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OF LOWEST ELEVAT
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0 1 2 3 4 5

MILES

PLATE III-4

WATER TABLE MAP WITHIN THE PASCO BASIN

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AND INTO THE
WASHINGTON,
GROUNDWATE
OF THE HANFO
THE EARLY 194
ABOVE THE WA

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MILES

PLATE III-5

AREAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY IN THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

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THE AREAL DISTR
THE UNCONFINED
THIS PLATE. THES
(BIERSCHENK, 195
THE HANFORD SIT
CORRESPONDING
COLUMBIA RIVER
A LARGE GROUND
HANFORD SITE DU
HYDRAULIC COND
VALUE IS RELATIV
MILES TO THE EAS
DISPOSAL OPERAT

REFERENCES CITE

BIERSCHENK, W. H
HW-60601, GENERA

KIPP, K. L. AND MU
TRANSMISSIVITY
RICHLAND, WASHI

DEJU, R. A., 1974,
HANFORD COMPAN

NITRATE CONCENTRATIONS >150 milligrams

NITRATE CONCENTRATIONS >10 milligrams/
< 150 milligrams

PLATE III-6
NITRATE CONCENTRATION WITHIN THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

THIS PLATE IS
AQUIFER BENE
WELLS SAMPLE
U.S. GEOLOGIC

THE LARGE NI
RECHARGE TO
200 WEST AREA
GROUNDWATE
COLUMBIA RIV
ATTRIBUTABLI
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REFERENCES C

EDDY, P.A., 197
JANUARY-DEC
RICHLAND, WA

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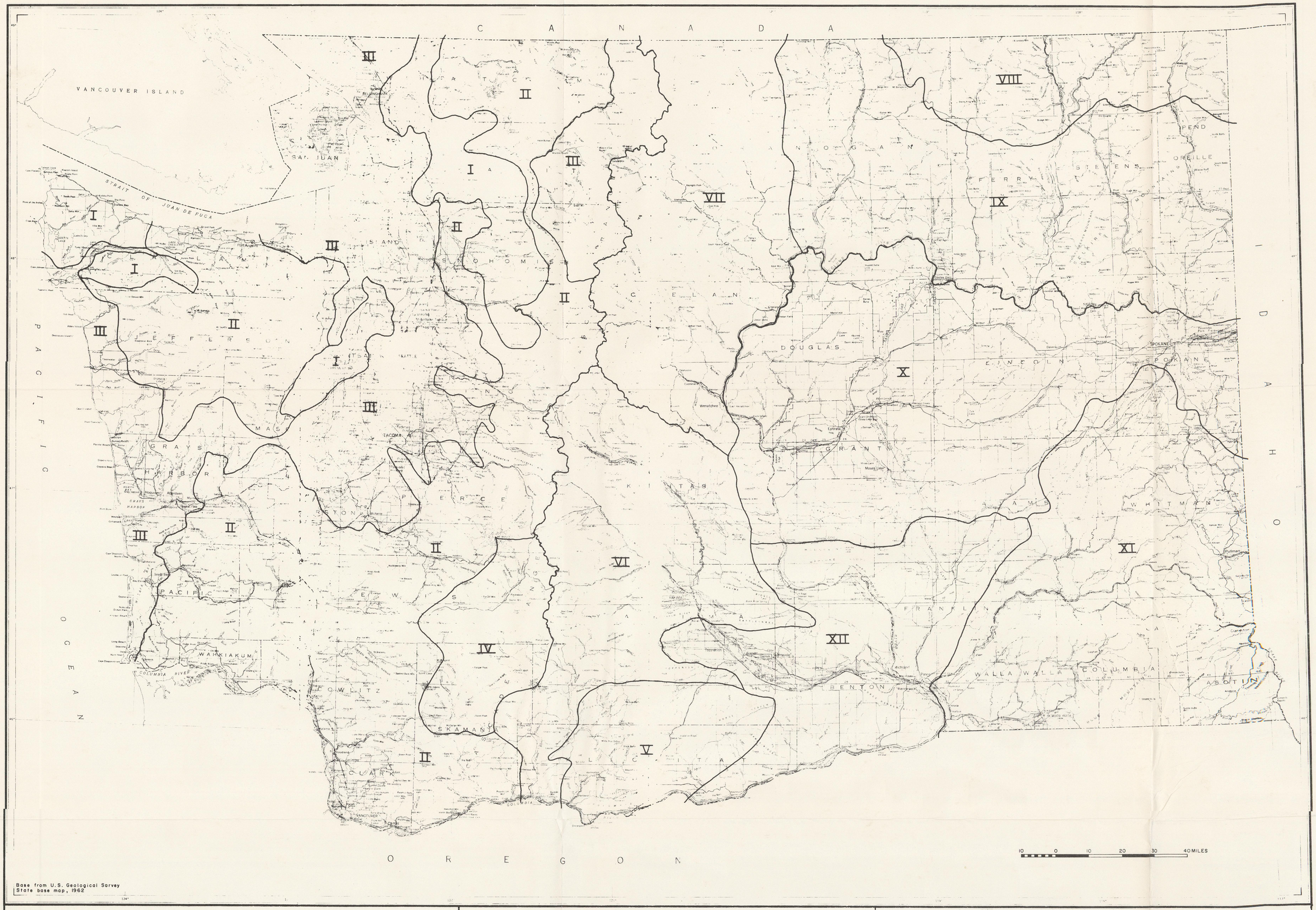
OCTOBER 1979



Base from U.S. Geological Survey
State base map, 1962

PLATE III-1

DESIGNATED "FLOOD ZONES" WITHIN WASHINGTON STATE

RHO-BWI-ST-5

OCTOBER 1979

LEGEND

XII "FLOOD ZONE" DESIGNED BY CUMMANS AND OTHERS (1975)

N

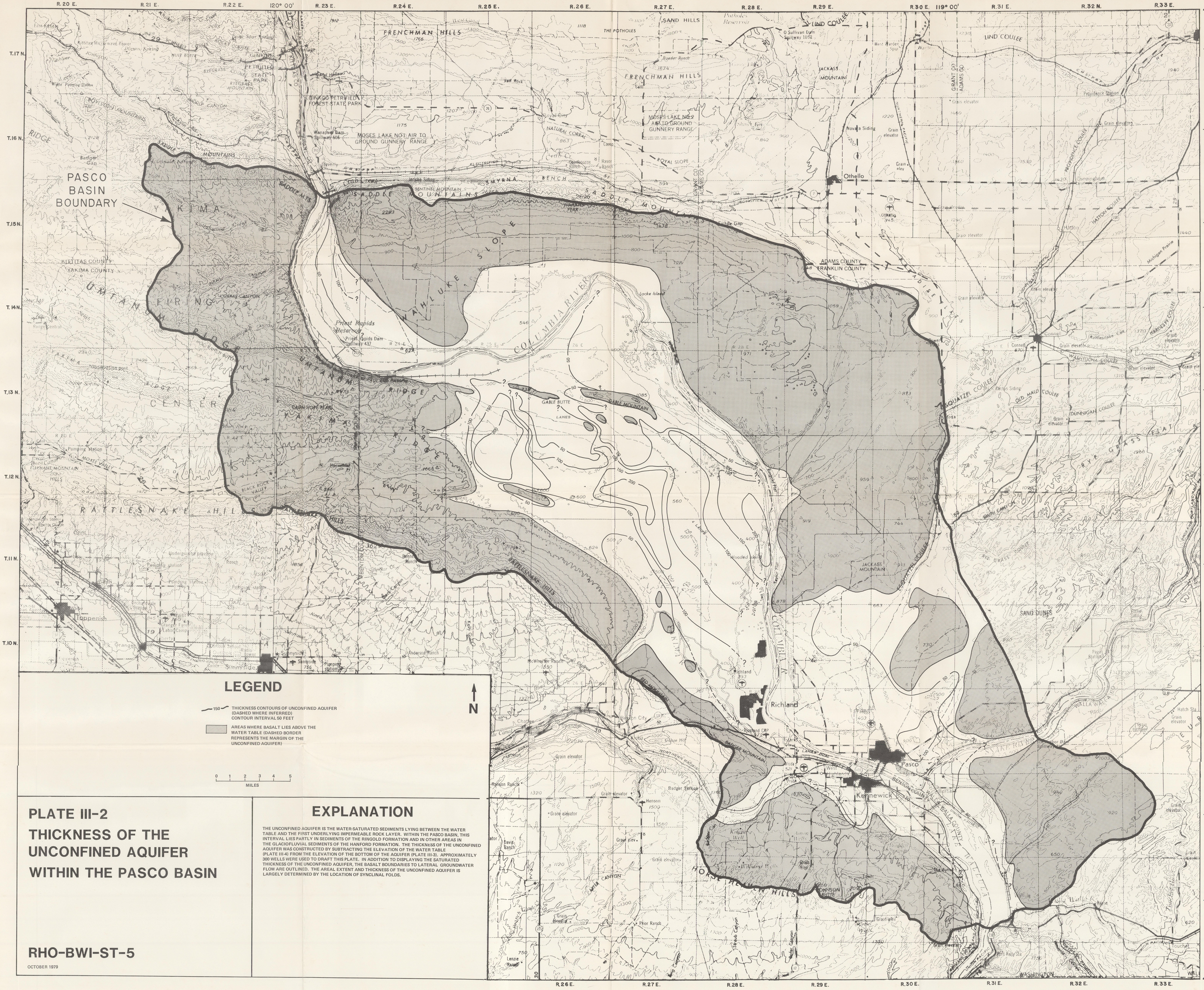
0 10 20 30 40
MILES

EXPLANATION

THE STATE OF WASHINGTON HAS BEEN DIVIDED INTO 12 REGIONS OR "FLOOD ZONES" IN WHICH THE ANNUAL FLOODS OF SMALL STREAMS EXHIBIT SIMILAR FLOOD CHARACTERISTICS (CUMMANS AND OTHERS, 1975). EACH AREA IS REPRESENTED BY UNIQUE COEFFICIENTS AND PARAMETER VALUES TO BE USED IN THE REGRESSION EQUATION AS DISCUSSED WITHIN THE TEXT.

REFERENCES CITED:

CUMMANS, J.E., COLLINGS, M.R., AND NASSAR, E.G., 1975, MAGNITUDE AND FREQUENCY OF FLOODS IN WASHINGTON: OPEN FILE REPORT 74-336, U.S. GEOLOGICAL SURVEY, TACOMA, WASHINGTON.



LEGEND

150 THICKNESS CONTOURS OF UNCONFINED AQUIFER (DASHED WHERE INFERRED) CONTOUR INTERVAL 50 FEET

AREAS WHERE BASALT LIES ABOVE THE WATER TABLE (DASHED BORDER REPRESENTS THE MARGIN OF THE UNCONFINED AQUIFER)

0 1 2 3 4 5
MILES

PLATE III-2

THICKNESS OF THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

EXPLANATION

THE UNCONFINED AQUIFER IS THE WATER-SATURATED SEDIMENTS LYING BETWEEN THE WATER TABLE AND THE FIRST UNDERLYING IMPERMEABLE ROCK LAYER. WITHIN THE PASCO BASIN, THIS INTERVAL LIES PARTLY IN SEDIMENTS OF THE RINGOLD FORMATION AND IN OTHER AREAS IN THE GLACIOFLUVIAL SEDIMENTS OF THE HANFORD FORMATION. THE THICKNESS OF THE UNCONFINED AQUIFER WAS CONSTRUCTED BY SUBTRACTING THE ELEVATION OF THE WATER TABLE (PLATE III-4) FROM THE ELEVATION OF THE BOTTOM OF THE AQUIFER (PLATE III-3). APPROXIMATELY 300 WELLS WERE USED TO DRAFT THIS PLATE. IN ADDITION TO DISPLAYING THE SATURATED THICKNESS OF THE UNCONFINED AQUIFER, THE BASALT BOUNDARIES TO LATERAL GROUNDWATER FLOW ARE OUTLINED. THE AREAL EXTENT AND THICKNESS OF THE UNCONFINED AQUIFER IS LARGELY DETERMINED BY THE LOCATION OF SYNCLINAL FOLDS.

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OCTOBER 1979

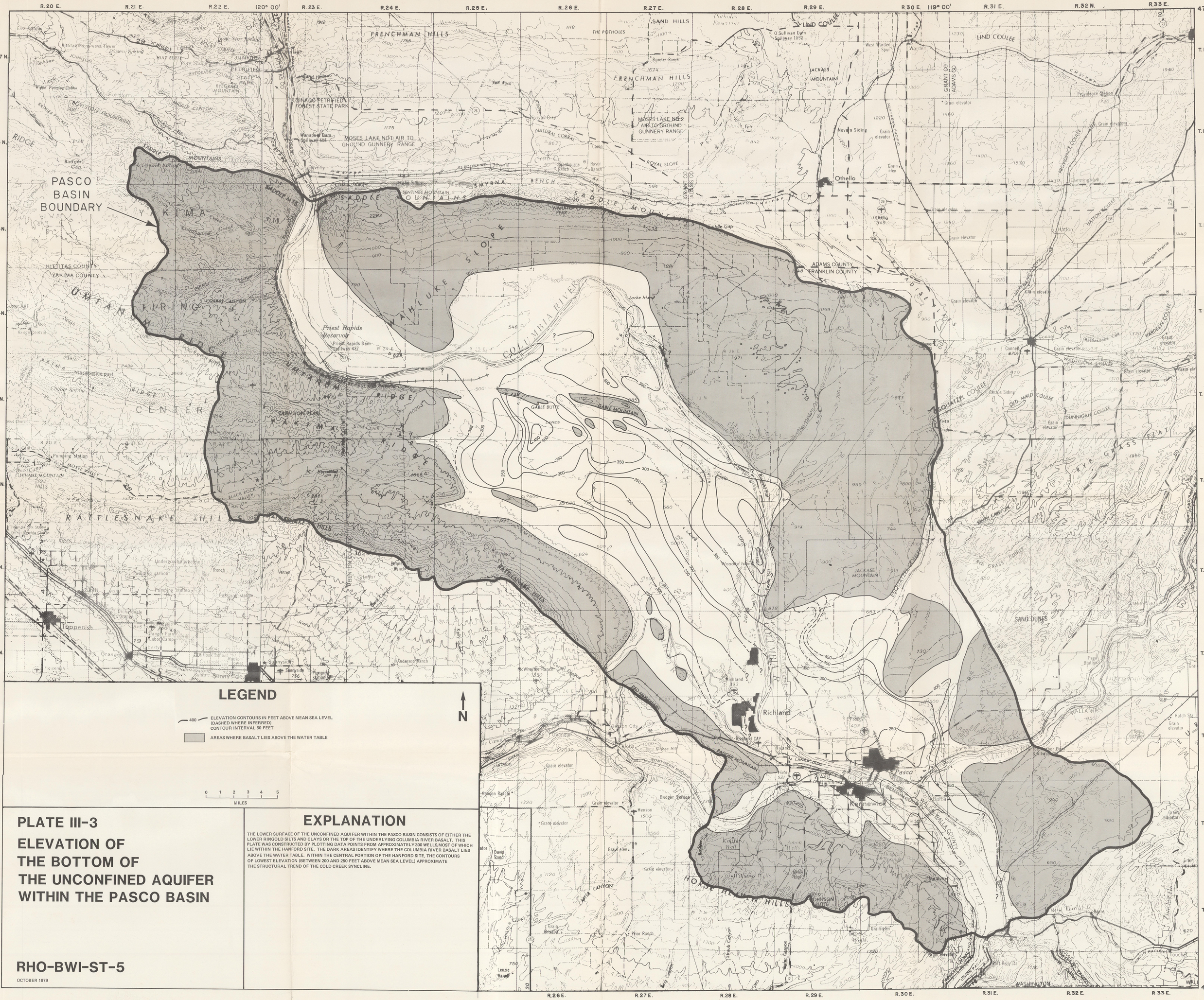

PLATE III-3

ELEVATION OF THE BOTTOM OF THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

EXPLANATION

THE LOWER SURFACE OF THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN CONSISTS OF EITHER THE LOWER RINGOLD SILTS AND CLAYS OR THE TOP OF THE UNDERLYING COLUMBIA RIVER BASALT. THIS PLATE WAS CONSTRUCTED BY PLOTTING DATA POINTS FROM APPROXIMATELY 300 WELLS, MOST OF WHICH LIE WITHIN THE HANFORD SITE. THE DARK AREAS IDENTIFY WHERE THE COLUMBIA RIVER BASALT LIES ABOVE THE WATER TABLE. WITHIN THE CENTRAL PORTION OF THE HANFORD SITE, THE CONTOURS OF LOWEST ELEVATION (BETWEEN 200 AND 250 FEET ABOVE MEAN SEA LEVEL) APPROXIMATE THE STRUCTURAL TREND OF THE COLD CREEK SYNCLINE.

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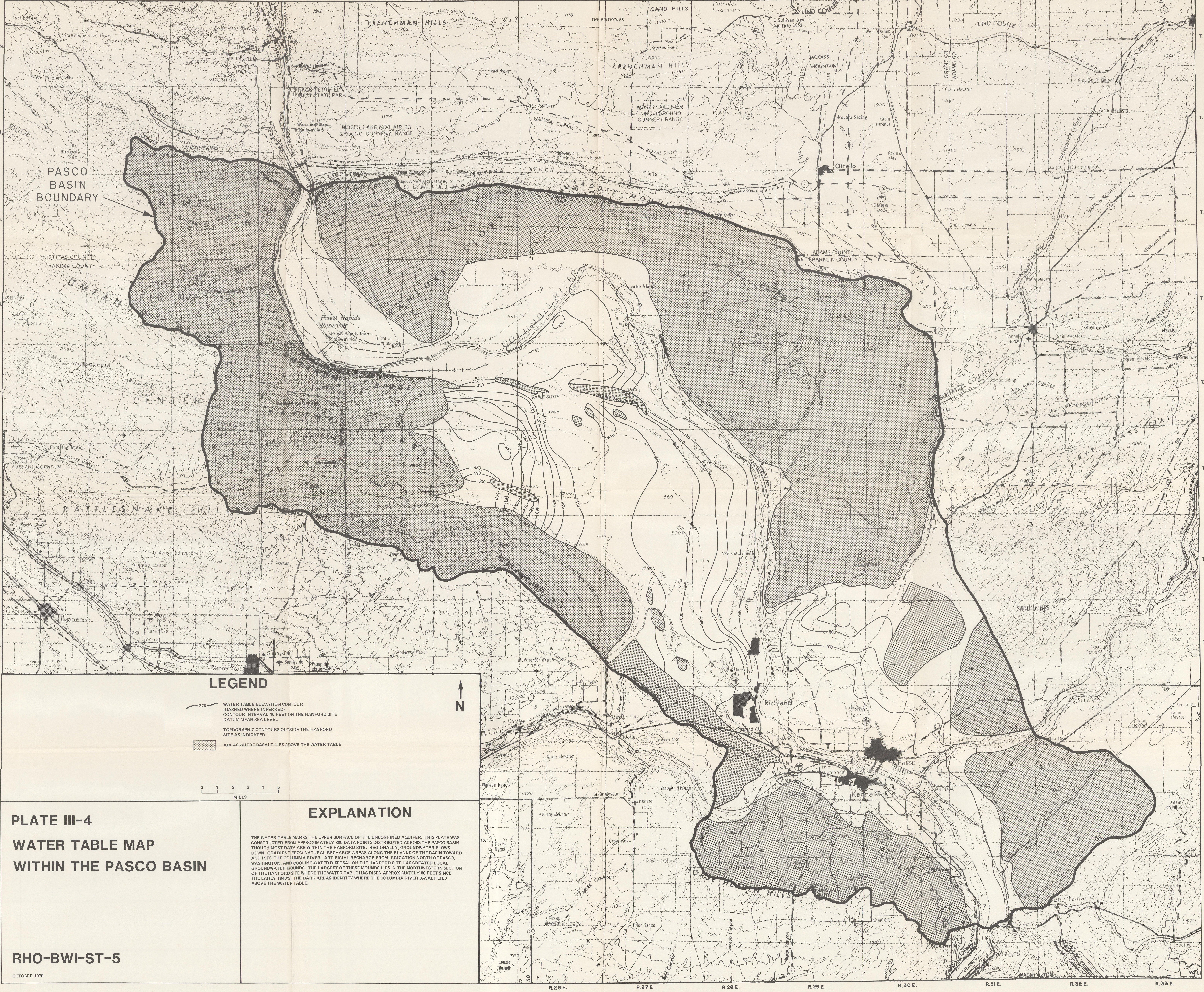
OCTOBER 1979



LEGEND

370 — WATER TABLE ELEVATION CONTOUR (DASHED WHERE INFERRED) CONTOUR INTERVAL 10 FEET ON THE HANFORD SITE DATUM MEAN SEA LEVEL

TOPOGRAPHIC CONTOURS OUTSIDE THE HANFORD SITE AS INDICATED

AREAS WHERE BASALT LIES ABOVE THE WATER TABLE

N

0 1 2 3 4 5 MILES

PLATE III-4

WATER TABLE MAP WITHIN THE PASCO BASIN

EXPLANATION

THE WATER TABLE MARKS THE UPPER SURFACE OF THE UNCONFINED AQUIFER. THIS PLATE WAS CONSTRUCTED FROM APPROXIMATELY 300 DATA POINTS DISTRIBUTED ACROSS THE PASCO BASIN THOUGH MOST DATA ARE WITHIN THE HANFORD SITE. REGIONALLY, GROUNDWATER FLOWS DOWN GRADIENT FROM NATURAL RECHARGE AREAS ALONG THE FLANKS OF THE BASIN TOWARD AND INTO THE COLUMBIA RIVER. ARTIFICIAL RECHARGE FROM IRRIGATION NORTH OF PASCO, WASHINGTON, AND COOLING-WATER DISPOSAL ON THE HANFORD SITE HAS CREATED LOCAL GROUNDWATER MOUNDS. THE LARGEST OF THESE MOUNDS LIES IN THE NORTHWESTERN SECTION OF THE HANFORD SITE WHERE THE WATER TABLE HAS RISEN APPROXIMATELY 80 FEET SINCE THE EARLY 1940'S. THE DARK AREAS IDENTIFY WHERE THE COLUMBIA RIVER BASALT LIES ABOVE THE WATER TABLE.

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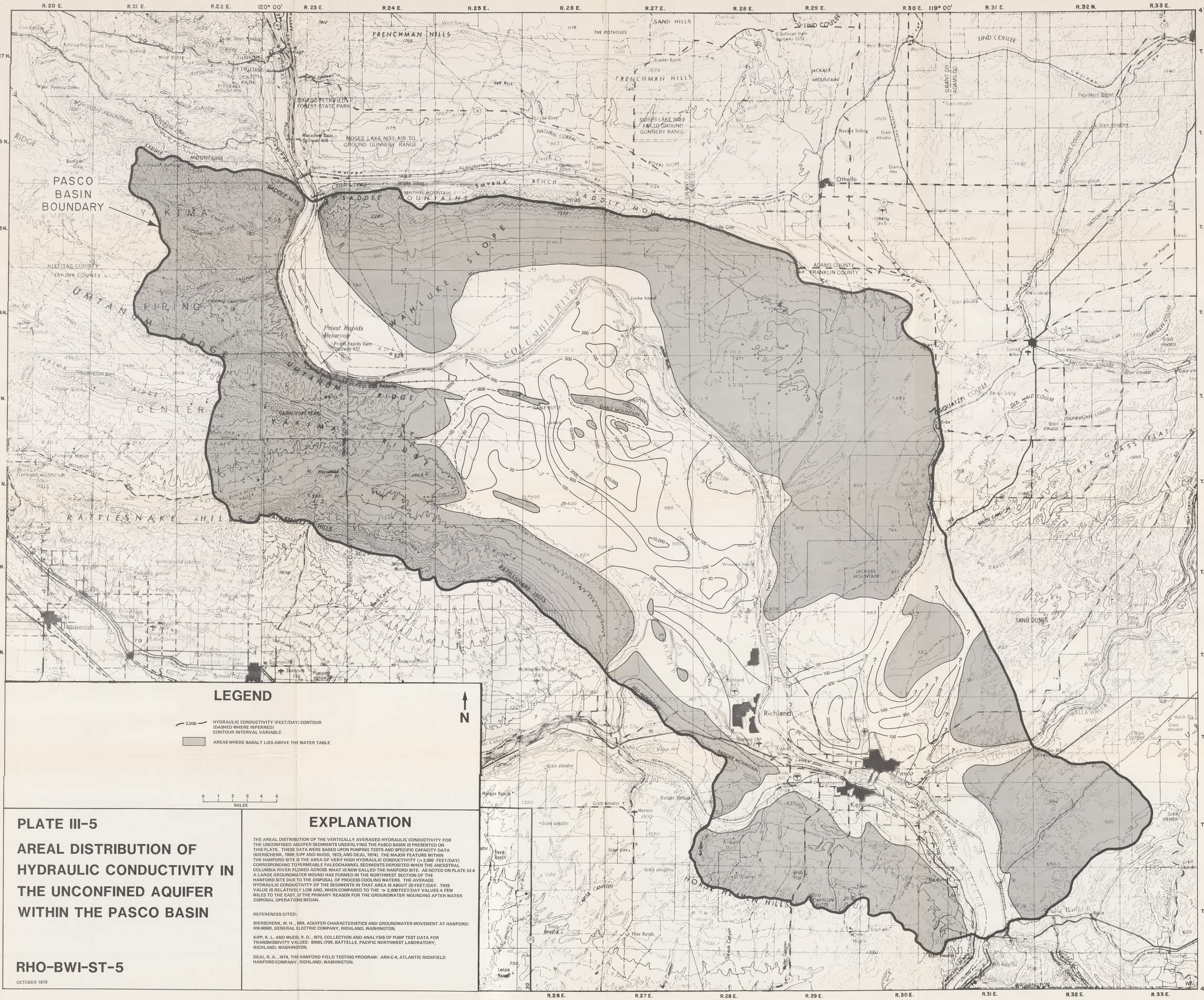

PLATE III-5

AREAL DISTRIBUTION OF HYDRAULIC CONDUCTIVITY IN THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

EXPLANATION

THE AREAL DISTRIBUTION OF THE VERTICALLY AVERAGED HYDRAULIC CONDUCTIVITY FOR THE UNCONFINED AQUIFER SEDIMENTS UNDERLYING THE PASCO BASIN IS PRESENTED ON THIS PLATE. THESE DATA WERE BASED UPON PUMPING TESTS AND SPECIFIC CAPACITY DATA (BIERSCHENK, 1959; KIPP AND MUDD, 1973; AND DEJU, 1974). THE MAJOR FEATURE WITHIN THE HANFORD SITE IS THE AREA OF VERY HIGH HYDRAULIC CONDUCTIVITY (> 2,000 FEET/DAY) CORRESPONDING TO PERMEABLE PALEOCHANNEL SEDIMENTS DEPOSITED WHEN THE ANCESTRAL COLUMBIA RIVER FLOWED ACROSS WHAT IS NOW CALLED THE HANFORD SITE. AS NOTED ON PLATE III-4 A LARGE GROUNDWATER MOUND HAS FORMED IN THE NORTHWEST SECTION OF THE HANFORD SITE DUE TO THE DISPOSAL OF PROCESS COOLING WATERS. THE AVERAGE HYDRAULIC CONDUCTIVITY OF THE SEDIMENTS IN THAT AREA IS ABOUT 20 FEET/DAY. THIS VALUE IS RELATIVELY LOW AND, WHEN COMPARED TO THE > 2,000 FEET/DAY VALUES A FEW MILES TO THE EAST, IS THE PRIMARY REASON FOR THE GROUNDWATER MOUNDING AFTER WATER DISPOSAL OPERATIONS BEGAN.

REFERENCES CITED:

BIERSCHENK, W. H., 1959, AQUIFER CHARACTERISTICS AND GROUNDWATER MOVEMENT AT HANFORD: HW-60601, GENERAL ELECTRIC COMPANY, RICHLAND, WASHINGTON.

KIPP, K. L. AND MUDD, R. D., 1973, COLLECTION AND ANALYSIS OF PUMP TEST DATA FOR TRANSMISSIVITY VALUES: BNWL-1709, BATTELLE, PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.

DEJU, R. A., 1974, THE HANFORD FIELD TESTING PROGRAM: ARH-C-4, ATLANTIC RICHFIELD HANFORD COMPANY, RICHLAND, WASHINGTON.

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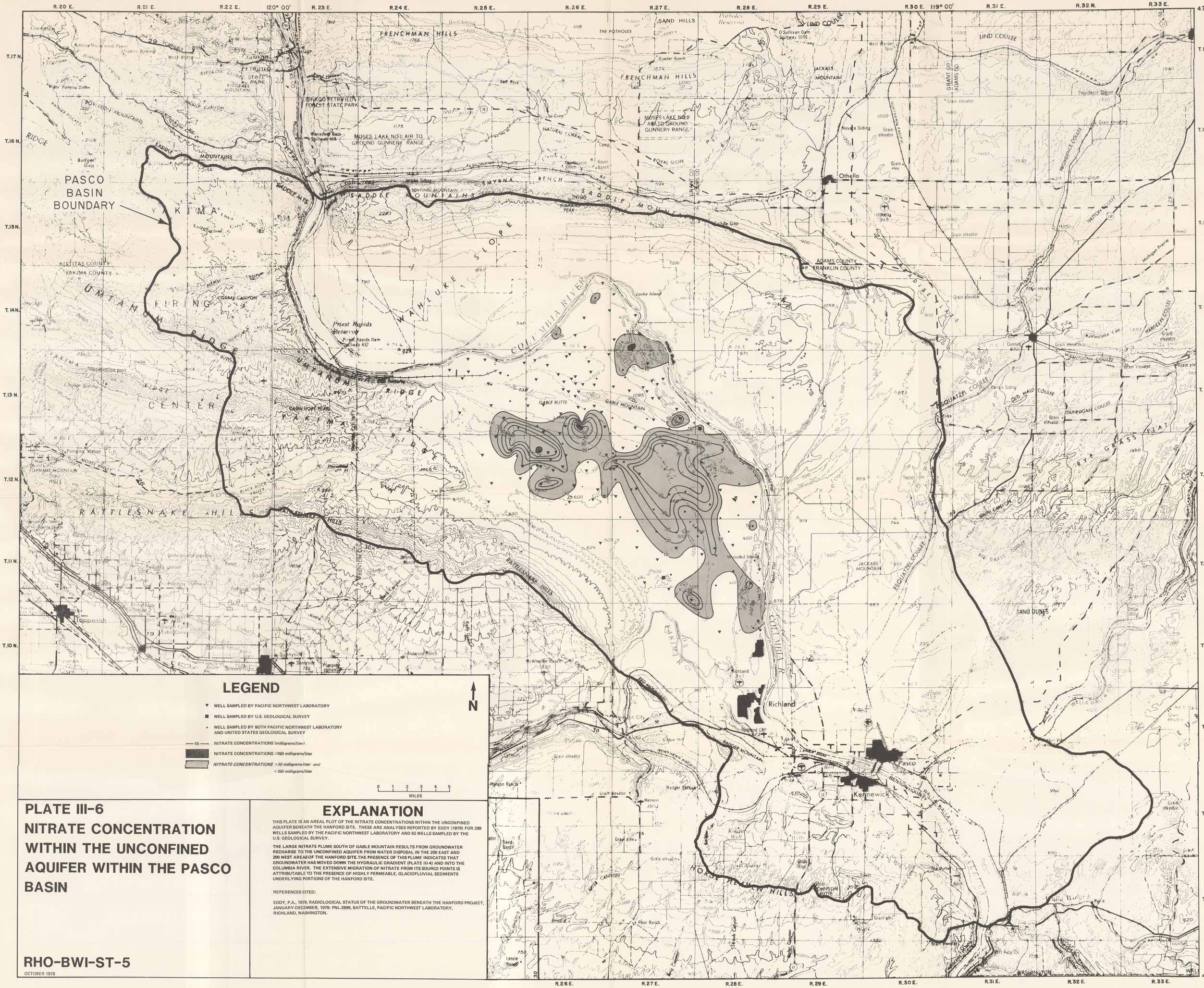

PLATE III-6
NITRATE CONCENTRATION WITHIN THE UNCONFINED AQUIFER WITHIN THE PASCO BASIN

RHO-BWI-ST-5

OCTOBER 1979

EXPLANATION

THIS PLATE IS AN AREAL PLOT OF THE NITRATE CONCENTRATIONS WITHIN THE UNCONFINED AQUIFER BENEATH THE HANFORD SITE. THESE ARE ANALYSES REPORTED BY EDDY (1979) FOR 289 WELLS SAMPLED BY THE PACIFIC NORTHWEST LABORATORY AND 62 WELLS SAMPLED BY THE U.S. GEOLOGICAL SURVEY.

THE LARGE NITRATE PLUME SOUTH OF GABLE MOUNTAIN RESULTS FROM GROUNDWATER RECHARGE TO THE UNCONFINED AQUIFER FROM WATER DISPOSAL IN THE 200 EAST AND 200 WEST AREAS OF THE HANFORD SITE. THE PRESENCE OF THIS PLUME INDICATES THAT GROUNDWATER HAS MOVED DOWN THE HYDRAULIC GRADIENT (PLATE III-4) AND INTO THE COLUMBIA RIVER. THE EXTENSIVE MIGRATION OF NITRATE FROM ITS SOURCE POINTS IS ATTRIBUTABLE TO THE PRESENCE OF HIGHLY PERMEABLE, GLACIOFLUVIAL SEDIMENTS UNDERLYING PORTIONS OF THE HANFORD SITE.

REFERENCES CITED:

EDDY, P.A., 1979, RADIOLOGICAL STATUS OF THE GROUNDWATER BENEATH THE HANFORD PROJECT, JANUARY-DECEMBER, 1978: PNL-2899, BATTELLE, PACIFIC NORTHWEST LABORATORY, RICHLAND, WASHINGTON.