STATE OF OREGON

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STATE ENGINEER

GROUND - WATER LEVELS 1968 - 1972

BY

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STATE-FEDERAL COOPERATIVE PROGRAM

Measurements from selected wells in the United States are published by the Geological Survey at five-year intervals in a series of water-supply papers titled "Water Levels and Artesian Pressures in Observation Wells in the United States: Part 5, Northwestern States".

Under the state cooperative program, funds expended by state personnel in basic data collection and the publication of this report are matched by the federal government and are expended by the Geological Survey for other hydrologic studies in Oregon.

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OREGON GROUND-WATER LEVELS

by

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INTRODUCTION

Ground water is one of Oregon's most valuable resources. Adequate information relating to the source and quantities of ground water now used in Oregon is urgently needed for ground-water management. Studies of divergent geologic, hydrologic, topographic, and climatic factors affecting Oregon's ground-water supply must be accelerated. These studies are needed to better handle the enormous task of managing the ground-water resources in a way that best satisfies the needs of the people of Oregon. Oregon is not a water rich state and we are not as well endowed with areas of large ground-water reserves as some may claim.

Oregon's ground water today satisfies irrigation, industrial, municipal, rural domestic, and stock watering needs. Heating and air conditioning are also important uses of ground water in Oregon's larger cities. These uses are increasing rapidly each year. Therefore, the growing concern over present day water problems is certainly justified.

Today, emphasis on exploration for and development of geothermal power resources offers the prospect of rapidly expanding the use of ground water. Ground water is the vehicle by which heat energy is transported to the earth's surface for power generation. Close supervision, regulation, and controls will be required to prevent overdraft and surface contamination in developing thermal ground-water bodies of the state.

GROUND WATER DIVISION

The State Engineer is charged with the administration of Oregon's Ground Water Laws. The duties of the Ground Water Division include:

(1) answering general public inquiries pertaining to ground water and water wells;
(2) processing water well reports;
(3) collecting basic ground-water data;
(4) licensing water well drillers and contractors;
(5) developing and enforcing water well standards;
(6) outlining ground-water basin resources;

(7) delineating critical ground-water areas;
(8) regularly publishing information, singly or in cooperation with the U. S. Geological Survey, pertaining to ground water in Oregon; and
(9) assisting other governmental agencies in making sound hydrogeological decisions which affect Oregon's water resources.

An increase of more than 25 per cent in the number of public inquiries is expected during the coming biennium. During 1972, this division processed nearly 7,000 water well reports. This is an increase of about 1,000 over the previous year.

Two new critical ground-water areas have been identified in Oregon. They are called the Buttercreek and Cooper Mountain-Bull Mountain areas. In order to make the optimum use of, and properly manage Oregon's ground-water resources, basin wide studies employing computer technology are needed.

The Ground Water Act of 1955 required both administrative and technical services in carrying out the ground water management and regulatory functions prescribed by law. Originally, two hydrogeologists were employed to provide technical assistance in problems of ground water overdraft, well interference, and the regulation of water well construction in Oregon. The ever expanding work load has required the services of four additional hydrogeologists.

Ground-water management is dependent upon the timely collection of adequate and factual water data throughout the state. The need for water level measurements, well data, geologic mapping, and topographic mapping is expanding with every year. It is expected that the demand for ground-water information will double during the next ten years. Today the nation draws 20 per cent of its total water needs from ground-water resources. With limited surface water supplies available, future increases in water consumption must come from stored ground-water resources. It is estimated that Oregon is rapidly approaching the day when 25 to 30 per cent of all water consumed in the state well be ground water. Therefore, increasing efforts must continue to outline the extent of Oregon's ground-water resources. The impact of any developed geothermal power resources will greatly affect the producing ground-water basins involved.

New Personnel

The 1971 legislature authorized two additional hydrogeologists. One geologist works in close cooperation with the State Department of Environmental Quality. His duties are to make local ground water investigations and evaluate proposed sanitary landfill sites, chemical and toxic waste disposal sites, waste discharge permits, and attend to problems related to ground-water quality in the State of Oregon. The second hydrogeologist was authorized to conduct statewide ground-water basin investigations. He is to determine the general areal extent and hydrologic characteristics of each ground water basin. Such data will aid in determining the degree to which ground water may serve as a viable alternative to surface water supplies within a particular water basin. The initial project area is the North Coast Basin extending from Tillamook to Astoria and inland along the Columbia River drainage to St. Helens, Oregon.

Supporting staff have been added to this division. A part time secretary was added in June 1972 and a part time draftsman in December of 1972.

Administrative Duties

A. Public Information

Inquiries from the general public regarding water well report data, local ground-water conditions, ground-water occurrence, standard well construction practices and requirements, and general ground-water geology information have been received daily. A substantial increase in the total and daily number of requests for this information has been noted. A 25 per cent increase in the number of inquiries during the next few years is anticipated. The following graph represents the numbers of requests received during the years 1969 through 1972, see Figure 1.

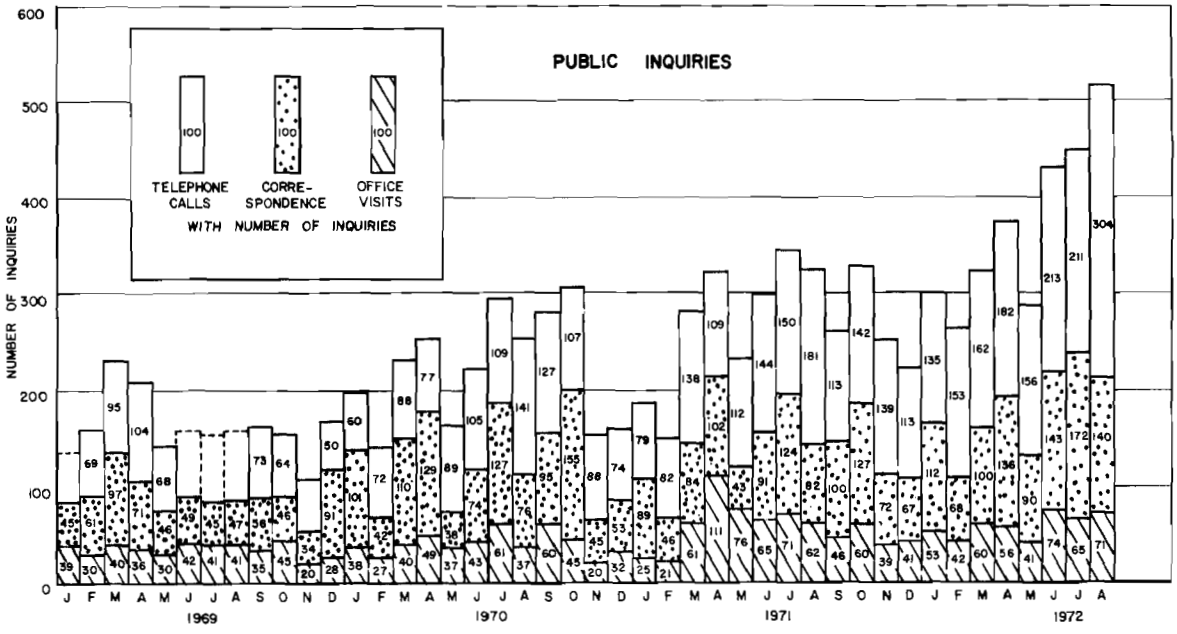


Figure 1

B. Water Well Contractors and Drilling Machine Operators

The Ground Water Act of 1955 provides for the licensing of water well contractors and drilling machine operators. Water well contractors are required to pass a written examination and post a performance type bond in the amount of $2,000 to assure compliance with Oregon's well construction standards. Drilling machine operators must have a minimum of 1 year's experience to be eligible for the qualifying driller's examination. Each examination was given quarterly, on the second Monday of January, April, July, and October. During the last two years a total of 84 water well

contractor's examinations and 123 drilling machine operator's license examinations were given. Because of the increasing number of applicants and in order to make examinations more convenient for the applicants, arrangements have been made to give the examinations on a monthly basis.

C. Water Well Reports

ORS 537.765 requires that a water well report for every water well constructed after August 3, 1955 be filed with the State Engineer within 30 days from the date of well completion. Each water well report provides a description of the geologic formations encountered and the well constructed. Upon receipt of each log, the log is filed and given a location number which identifies the well by township, range, and section.

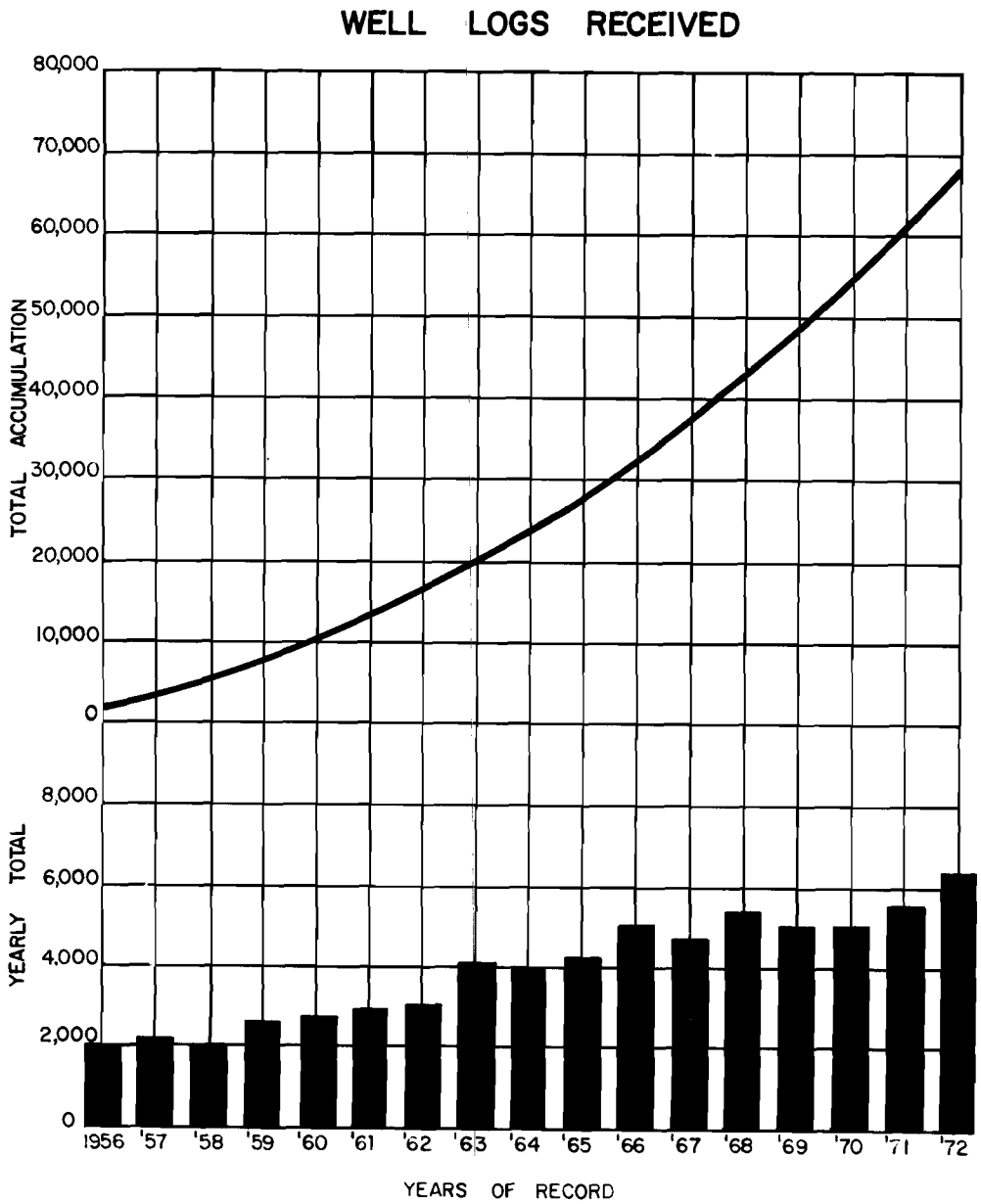


Figure 2

During 1970 through 1972, 12,045 logs were filed with the State Engineer. Well log data is essential in the study of Oregon's ground-water reservoirs. Planners, engineering consultants, well contractors, farmers, and the general public have requested numerous copies of these reports. There has been a marked increase in the demand for this type of well information during the last several years. The well drilling activity in Oregon is most active during periods of July through October. Eight hundred to one thousand logs per month are received during the summer season. In the winter months, well construction declines and the monthly receipt of well logs averages approximately 300 to 400 logs per month.

The increased water needs in areas of limited surface water supply continues the expansion of well construction in many areas. This trend has continued over the past two years. The graph above, Figure 2, indicates the number of water well reports received each year during the period of 1956 through 1972. The total number of well logs reported is over 75,000.

There are many administrative problems dealing with the proper location of wells constructed in Oregon. It has been found that many water well contractors and well owners do not adequately report the location of wells constructed. Usually the new well locations are reported to the nearest square mile, which is not adequate for purposes of ground water management.

D. Well Construction Standards

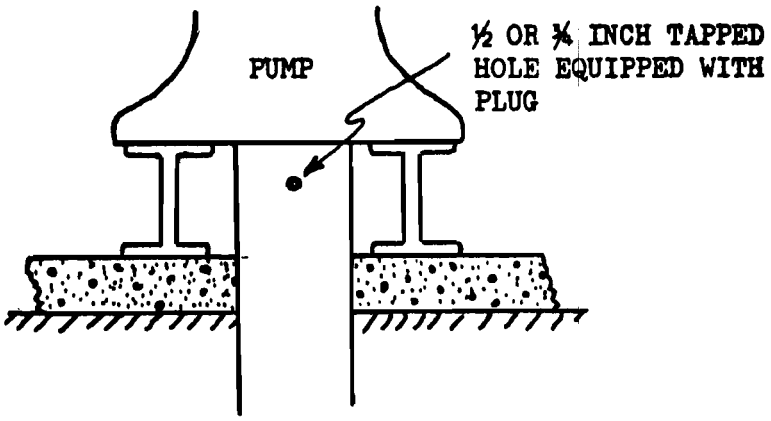
The State Engineer prescribed general standards for the construction and maintenance of water wells on July 11, 1962. These standards have been revised and will be adopted in 1975. The standards set forth the type and minimum amount of well casing to be installed in each well, and specify the particular sealing requirements for various types of wells. Well construction standards are needed to protect the quality of our ground water supply, and are designed to upgrade well construction methods and practices in Oregon. Continued improvement in the enforcement of the well construction standards has been noted over the past several years. The duty of policing the general standards however, continues to be a significant problem and requires substantial amounts of the hydrogeologists field and office time. During the past biennium, 185 wells were inspected. Due to increasing well costs, many private landowners are now drilling wells on their own property. A number of them are filing the required $2,000 landowner's bond in order to comply with state statutes.

Thirty-six administrative hearings regarding the violations of the Ground Water Law or the General Well Construction Standards were heard during the biennium. Under the provisions of ORS 537.747 and 537.756 the State Engineer has issued orders pertaining to the violations of the well construction standards. The penalties prescribed by these orders have varied from public reprimands to the temporary or permanent revocation of a water well contractor's and/or a drilling machine operator's license, depending upon the facts and the circumstances relative to the particular violation.

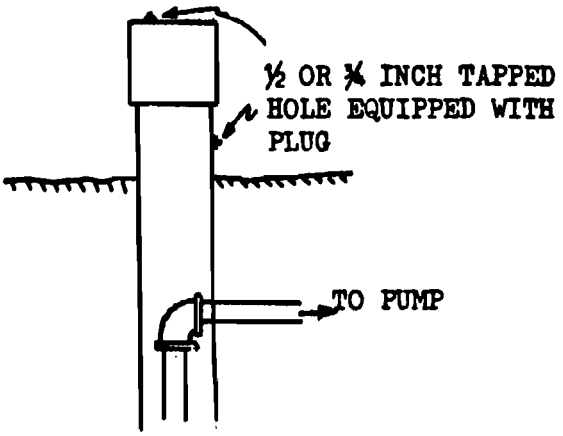
To provide a full-time incentive to drillers and contractors to comply with Oregon state law and the well construction standards, the employment of several well inspectors with drilling experience would be of material advantage in improving the policing of well construction standards in Oregon.

SUGGESTED METHODS OF INSTALLING ACCESS PORTS, PRESSURE GAUGES, AND AIR LINES FOR MEASURING WATER LEVELS IN WELLS

Figure 3



ACCESS PORT FOR MEASURING DEVICE



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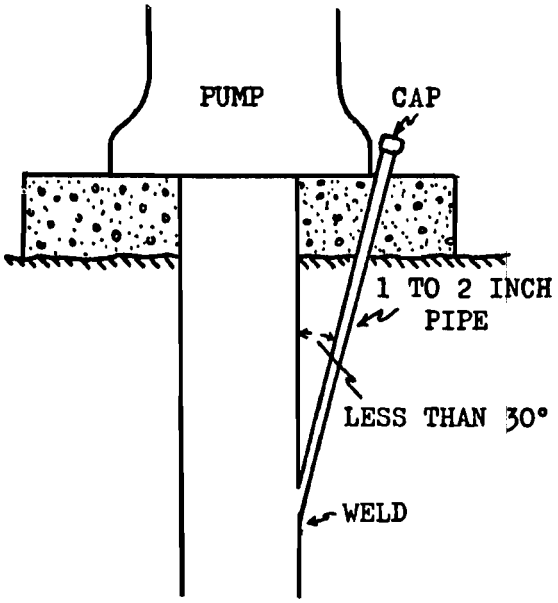

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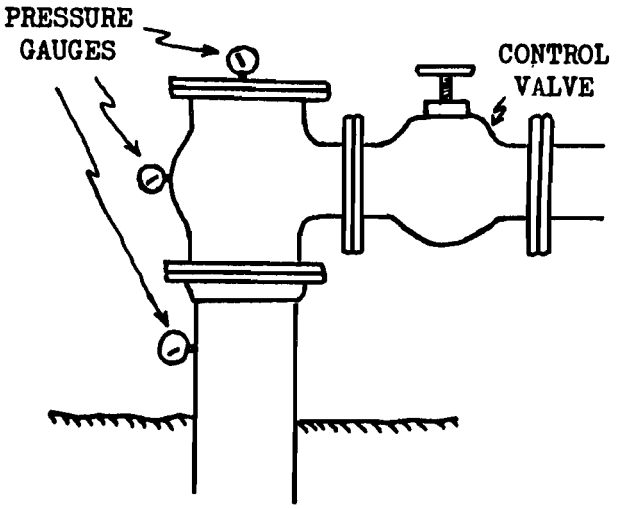
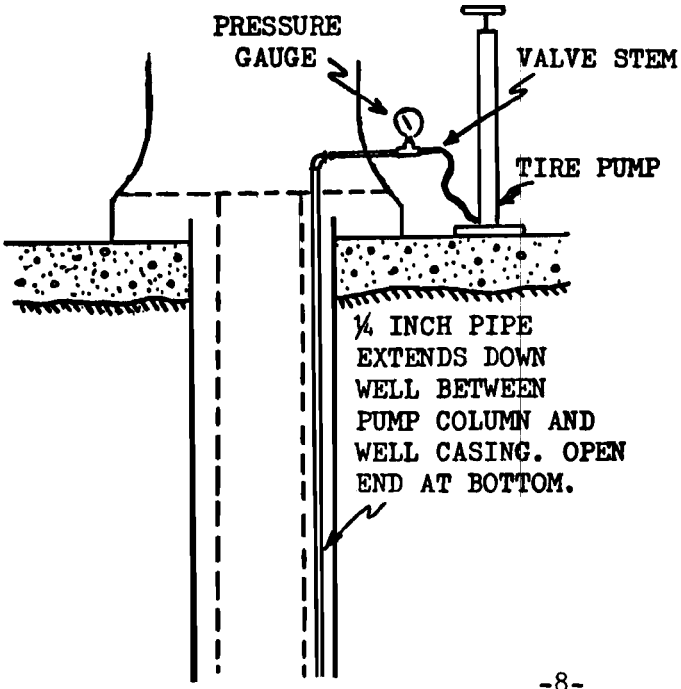


POSSIBLE LOCATION FOR PRESSURE GAUGES ON AN ARTESIAN WELL



AIR LINE INSTALLATION

AN AIR LINE INSTALLATION IS RECOMMENDED WHERE THE WATER LEVEL LIES AT A CONSIDERABLE DEPTH BELOW LAND SURFACE. THE AMOUNT OF AIR PRESSURE THAT CAN BE BUILT UP INSIDE THE AIR LINE WILL BE EQUAL TO THE DEPTH OF WATER STANDING ABOVE THE BOTTOM OF THE AIR LINE. THE EXACT DEPTH TO THE BOTTOM OF THE AIR LINE IS REQUIRED TO OBTAIN AN ACCURATE MEASUREMENT OF THE WATER LEVEL IN THE WELL. ONE POUND PER SQUARE INCH PRESSURE EQUALS 2.31 FEET OF WATER.

Cooperative Ground Water Investigations

The State of Oregon has been engaged in cooperative fund programs with the U. S. Geological Survey since 1905. State funds have been made available to the Geological Survey for matching funds projects on a dollar for dollar basis. Ground-water reports prepared under this cooperative program and released as open file reports or published by the U. S. Geological Survey during the last four years are listed as follows:

(1) Frank, F. J., 1971, Ground Water in the Eugene-Springfield Area, Southern Willamette Valley, Oregon: U. S. Geological Survey, Open File Report.

(2) Hampton, E. R., 1972, Geology and Ground Water of the Molalla-Salem Slope Area, Northern Willamette Valley, Oregon: U. S. Geological Survey, Water Supply Paper 1997, p. 83.

(3) Leonard, A. R., 1972, Geology and Ground Water Resources of Harney Basin: U. S. Geological Survey, Open File Report.

(4) Robison, J. H., 1971, Availability of Ground Water in the Grants Pass Area: U. S. Geological Survey, Open File Report.

(5) Robison, J. H., 1971, Hydrology of Basalt Aquifers in the Hermiston-Ordnance Area, Umatilla and Morrow Counties, Oregon: U. S. Geological Survey, Hydrologic Atlas HA-387.

(6) Robison, J. H., 1971, Availability and Quality of Ground Water in the Medford Area, Jackson County, Oregon: U. S. Geological Survey, Hydrologic Atlas HA-392.

(7) Robison, J. H., 1972, Availability and Quality of Ground Water in the Ashland Quadrangle, Jackson County, Oregon: U. S. Geological Survey, Hydrologic Atlas HA-421.

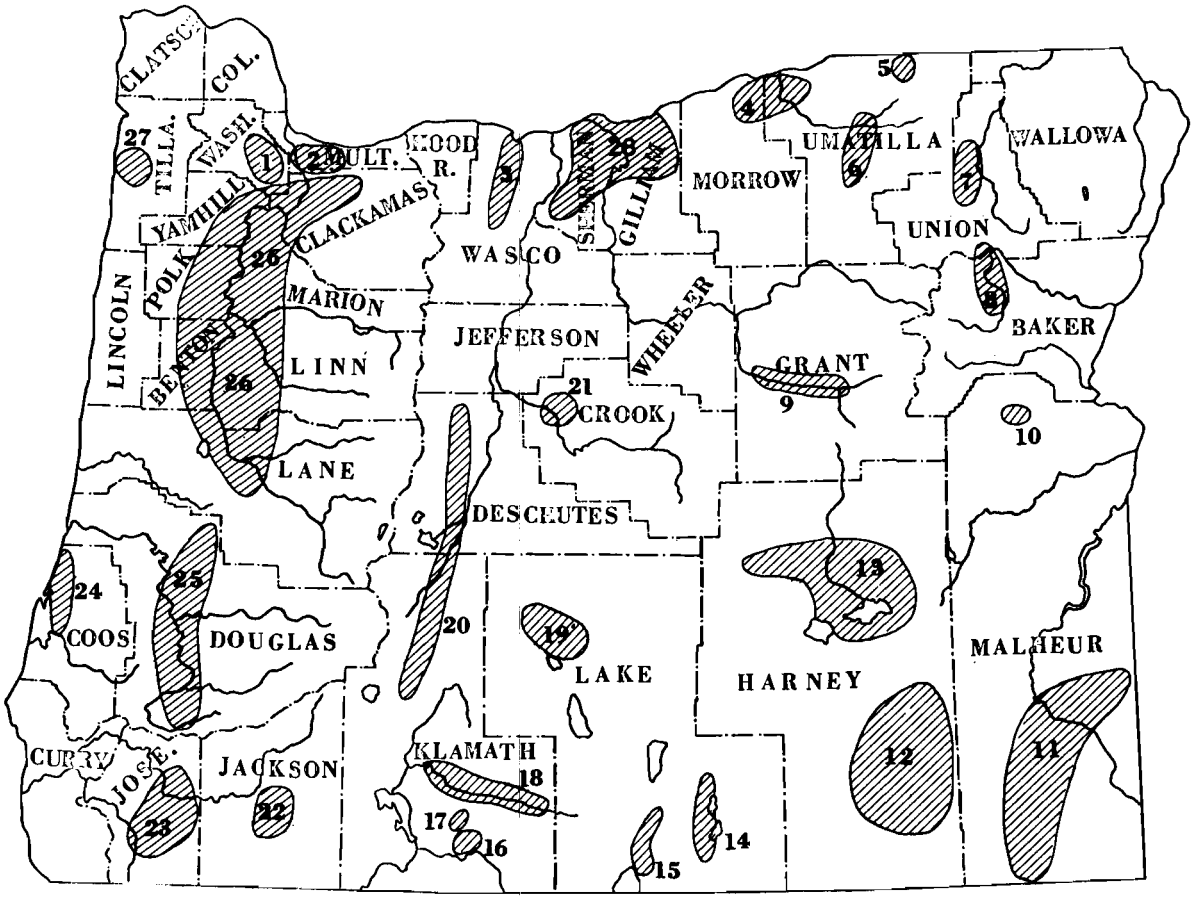
Field work has begun on the geology and ground-water resource report for part of Clackamas County and field work has been initiated on the ground-water resources in the upper Willamette Valley between Albany and Coburg, Oregon.

Observation Well Program

The observation well program consists of the periodic measurement of the depth to water or artesian pressure in water wells located throughout the state. This report contains hydrographs for 192 of these observation wells. For convenience in using this report, the depicted hydrographs have been grouped together by area.

Each area has been assigned a reference number as shown on Figure No. 4 on page 10. The name and reference number is shown at the top of each page of hydrographs. A list of all observation wells is recorded on page 129. Water level records and descriptions of the individual wells measuring point for each well in the observation net can be obtained by contacting the State Engineer's Office.

Figure 4



Ground Water Areas Represented By Hydrographs In This Report

1. Tualatin Valley
2. Portland Metropolitan Area
3. The Dalles Area
4. Columbia Slope Area
5. Milton-Freewater Area
6. Pendleton-Pilot Rock Area
7. Grande Ronde Valley
8. Baker Valley
9. Upper John Day Valley
10. Cow Valley Area
11. Southern Malheur Area
12. Southern Harney Area
13. Harney Basin
14. Warner Valley
15. Goose Lake Basin
16. Yonna Valley
17. Swan Lake Valley
18. Sprague River Valley
19. Fort Rock Area
20. Chemult-Lapine-Sisters Area
21. Prineville Area
22. Medford Area
23. Grants Pass Area
24. Coos Bay Area
25. Umpqua River Valley
26. Willamette Basin
27. Tillamook Area
28. Gilliam-Sherman County

During the past four years, 48 wells were added to the State Observation well net, while 123 wells were discontinued. The total number of observation wells in the net at the present time is 767. Water levels in these wells are measured periodically each year to determine changes in the amount of ground water storage within each ground water reservoir. Results of these water level measurements are published periodically and provide a basis for giving an early warning of any serious depletion of ground water storage. Such data also provides valuable background information for future water resource investigations and computer analysis of hydrologic flow systems.

Frequency of Measurement	Number
Continuously (recording device)	2
Monthly or more often	55
Four to six times per year	710
Total	767

The number of wells being measured within each county is listed as follows:

County	Number of Observation Wells	County	Number of Observation Wells	County	Number of Observation Wells
Baker	14	Harney	50	Morrow	36
Benton	16	Hood River	2	Multnomah	18
Clackamas	36	Jackson	5	Polk	15
Clatsop	2	Jefferson	5	Sherman	5
Columbia	5	Josephine	10	Tillamook	11
Coos	5	Klamath	60	Umatilla	55
Crook	12	Lake	54	Union	13
Curry	4	Lane	29	Wallowa	3
Deschutes	7	Lincoln	5	Wasco	35
Douglas	8	Linn	35	Washington	40
Gilliam	4	Malheur	53	Wheeler	1
Grant	12	Marion	82	Yamhill	24

Designations of wells discussed in this report are based upon official systems for rectangular subdivision of public lands. The numbers indicate the location of the well by township, range, section, and position within the section. A graphic illustration of this method of well location is shown on Figure 5. The first numeral indicates the township south of the Willamette Baseline. The second number separated from the first by a slash (/) indicates the range east of the Willamette Meridian. The third number indicates the section in which the well is located and the letters following the section number locate the well within the section. The first letter

denotes the quarter-section (160 acres); the second, the quarter-quarter section (40 acres); and the third, the quarter-quarter-quarter section (10 acres). If two or more wells are located in the same 10 acre tract, they are distinguished by a sequence number in parentheses. For example, the well designated by 32S/8E-33dcb(2) is the second well located in the northwest quarter of the southwest quarter of the southeast quarter, Section 33, Township 32 South, Range 8 East, of the Willamette Base Line and Meridian.

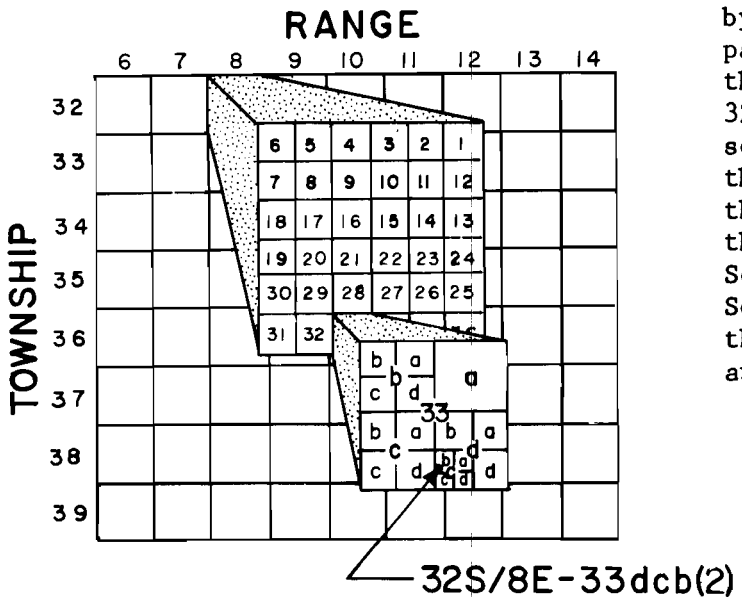


Figure 5

Ground Water Reports

The State Engineer has published five ground-water reports during the last four years. These reports are listed as follows:

(1) Bartholomew, Wm. S. and Robert DeBow, Water Levels 1967-1968, Ground Water Report No. 15, p. 122.

(2) Frank, F. J., 1972, Ground Water in the Eugene-Springfield Area, Southern Willamette Valley, Oregon: Oregon State Engineer, Ground Water Report No. 14, p. 70.

(3) Frank, F. J., and Nyra A. Johnson, 1972, Ground Water Data in the Corvallis-Albany Area, Central Willamette Valley, Oregon: Ground Water Report No. 17, p. 46.

(4) Illian, J. R., 1970, Interim Report on the Ground Water in the Klamath Basin, Oregon: Oregon State Engineer, Interim Report, p. 110.

(5) Leonard, A. R., 1970, Ground Water Resources in Harney Valley, Harney County, Oregon: Oregon State Engineer, Ground Water Report No. 16, p. 85.

Critical Ground Water Areas

Expanding ground-water exploitation and an increasing number of wells in Oregon has resulted in the overdevelopment of some ground-water reservoirs. Five ground-water areas in Oregon have been defined as critical.

Cow Valley in northern Malheur County was Oregon's first critical ground-water area. Notice of hearing for the determination of this critical ground-water area was given February 24, 1956. Final controls and regulations of ground-water use in Cow Valley were set forth in the State Engineer's Order dated November 12, 1959. Controls on the total amount of ground water to be pumped each year limited the annual pumpage to approximately 5,000 acre feet. Totalizing water meters on producing wells in the valley indicate that annual ground-water use has declined from about 5,000 acre feet in 1961 to about 3,400 acre feet in 1971 and 1972. Water levels in wells of the area have stabilized during the past two years. Ground-water withdrawals appear to be balanced with the annual recharge to the Cow Valley aquifers. If water use does not exceed 4,000 acre feet per year, it is expected that the critical ground-water area will remain stabilized and that no further water level declines will occur.

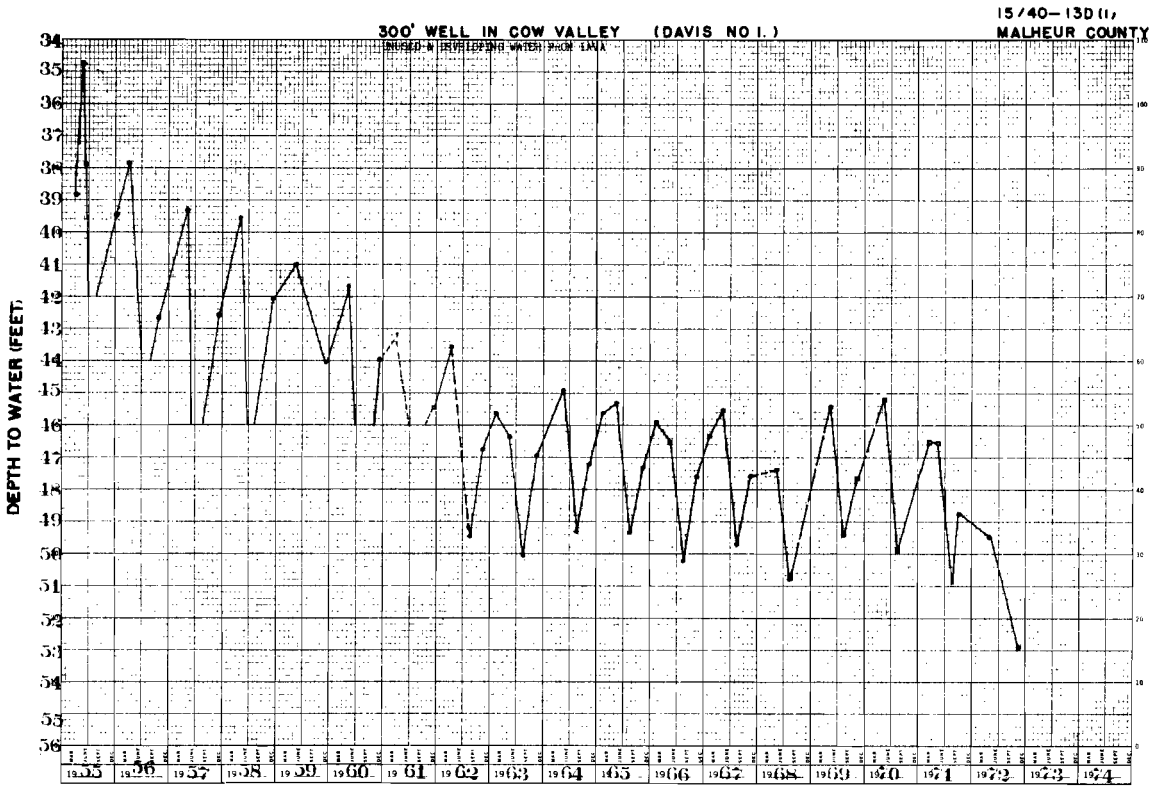


Figure 6 Cow Valley critical ground-water area

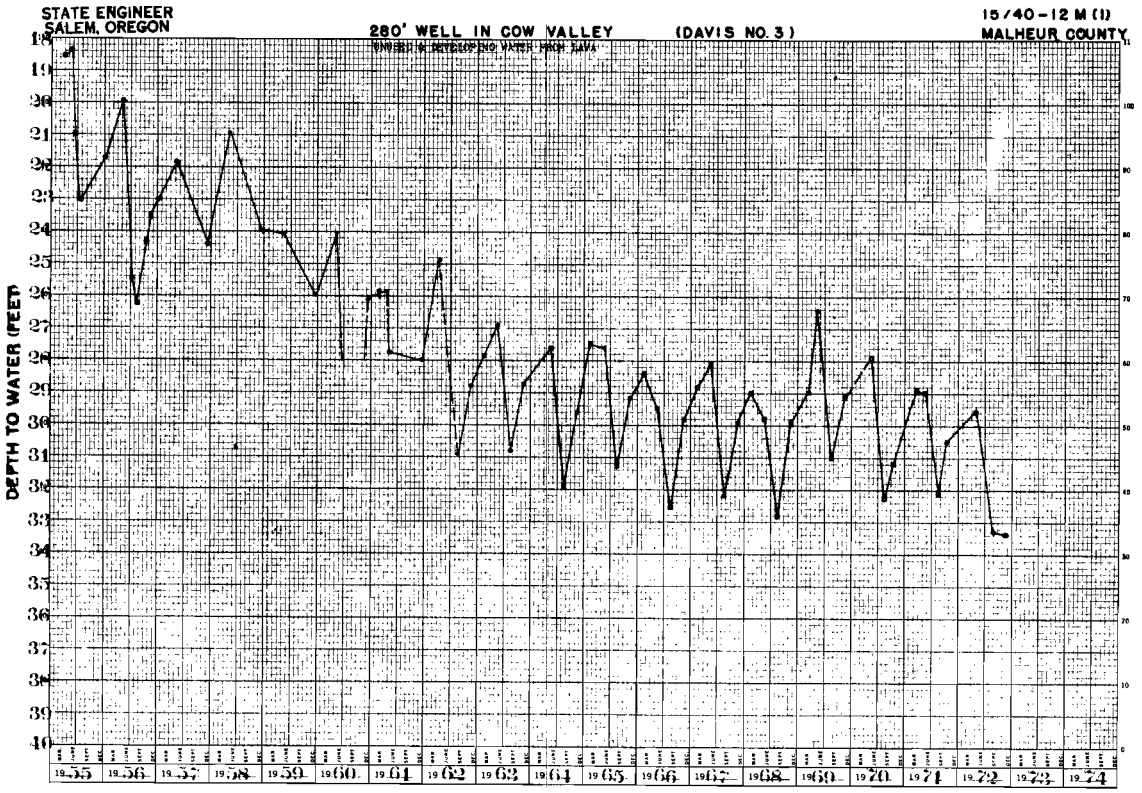


Figure 7 Cow Valley critical ground-water area

Oregon's second critical ground-water area was identified in the vicinity of The Dalles, Oregon. A notice of hearing was issued on January 30, 1959, and the State Engineer's subsequent order controlling ground-water use dated December 11, 1959. On April 25, 1960, the Circuit Court of Wasto County ordered a stay of the enforcement of the State Engineer's Order. The appeal to the State Engineer's Order was dismissed effective December 30, 1966. During the six years of delay, water levels declined at a rate of 5 to 6 feet per year and the annual water level declines continued into 1967. It was at this time that water from the Bureau of Reclamation project became available for irrigation uses within the critical area at The Dalles. Between the years of 1966 through 1968, water level declines within the critical area fell at a rate of 1 to 1½ feet per year. However, by 1970, the water levels began to stabilize and then to recover at a rate of 1 to 3 feet per year. Water levels now stand at approximately the 1967-1968 water level. No further water level declines are expected within the critical area at the present level of development. However, totalizing water meters are needed on all production wells within The Dalles critical area. It is necessary that this office proceed with enforcement of the State Engineer's Order which requires totalizing water meters be placed on all production wells within the critical area.

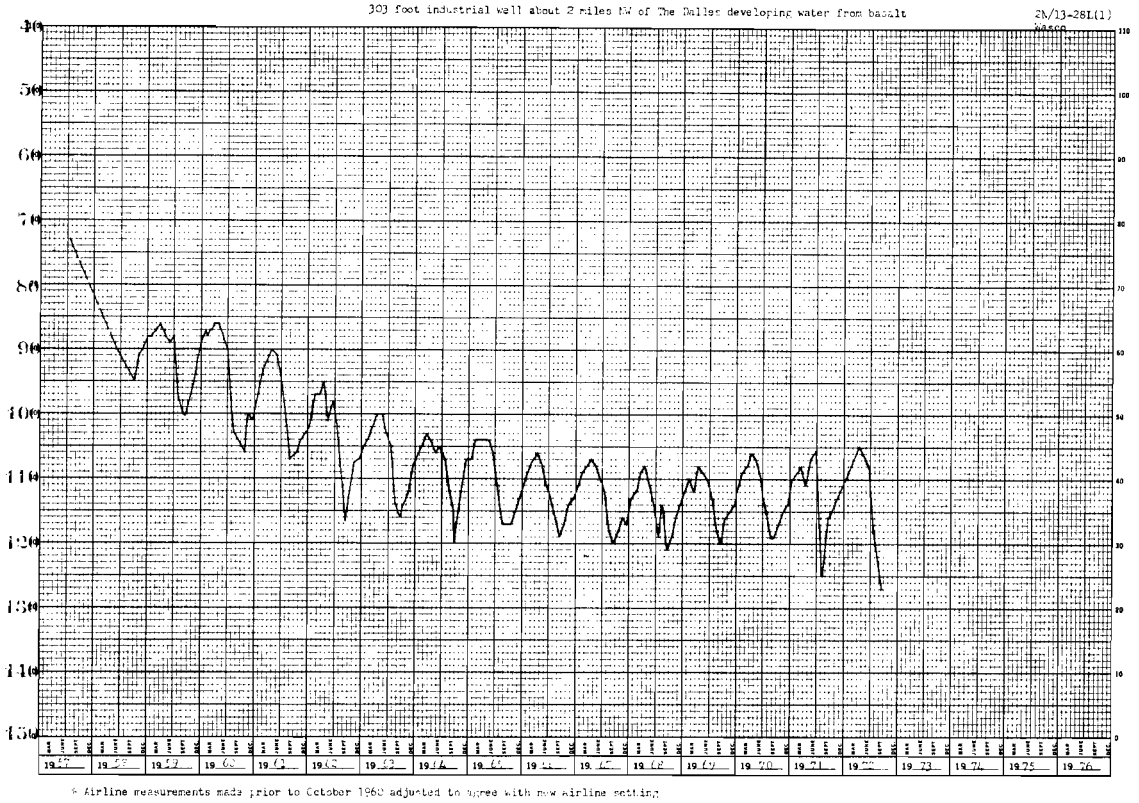


Figure 8 The Dalles critical ground-water area

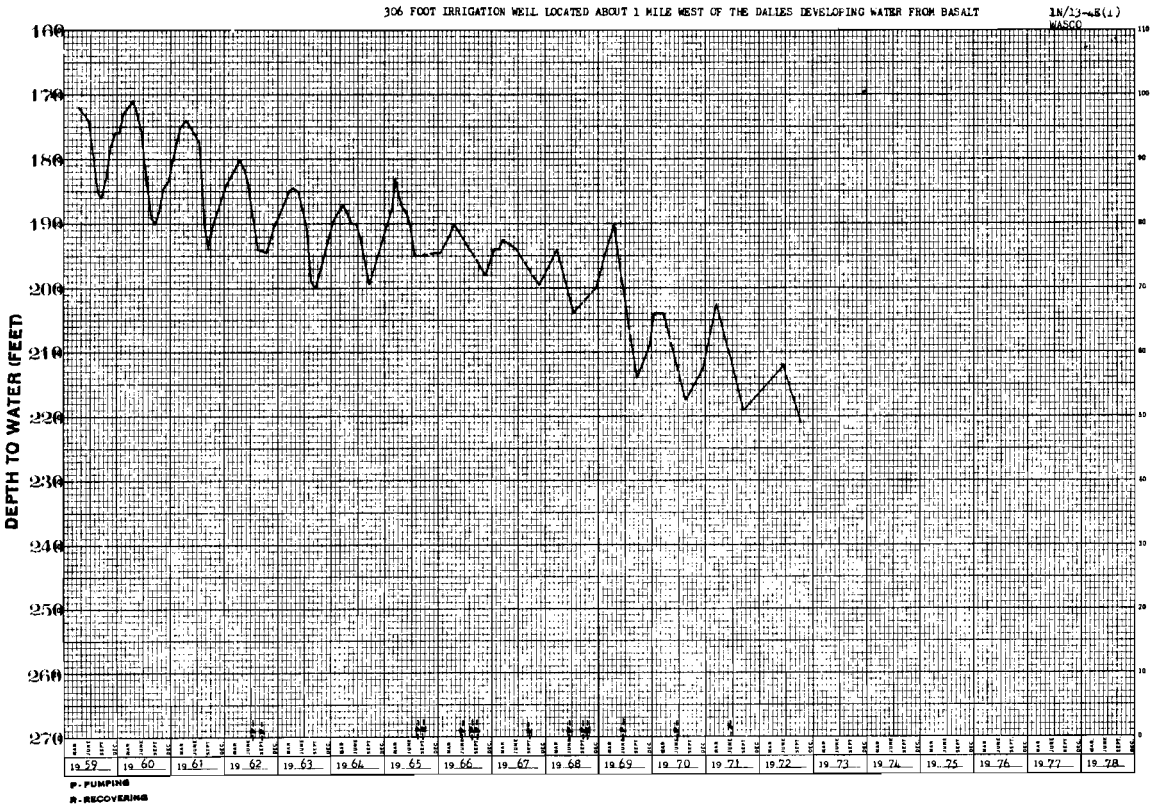


Figure 9 The Dalles critical ground-water area

Oregon's third critical ground-water area was identified on the Columbia Slope at Ordnance, Oregon. Ground water contained in the basalt aquifers of this area have been declining 4 to 6 feet per year since 1960. The amount of recharge to the deep basalt aquifers of this area is considered to be small. Ground water is being mined at the present time and there is a need for an outside source of water to achieve maximum irrigation development of this area. The deep basalt aquifers cannot sustain continued pumpage at the present rate. Therefore, there must be a reduction in the total ground water being withdrawn from deep wells in this area.

Overlying the deep basalt aquifers are a series of thin localized sand and gravel deposits which yield water to shallow wells. Due to the increasing development of irrigation wells in these gravel deposits, the water levels in shallow wells have declined at a rate of 1 to 3 feet per year. Pumping cones have developed around intensely developed well fields. Pumping drawdowns have caused some wells to break suction during the heavy irrigation season. It is apparent that an outside source of water will also be required for a long term development of these shallow gravel formations. It is expected that some of the shallow wells at Ordnance may become inoperable within the next few years due to local over-pumping of the shallow water body. At the present time, ground-water permits for further ground-water development within the Ordnance or Buttercreek critical ground-water areas of northeastern Oregon are not being issued.

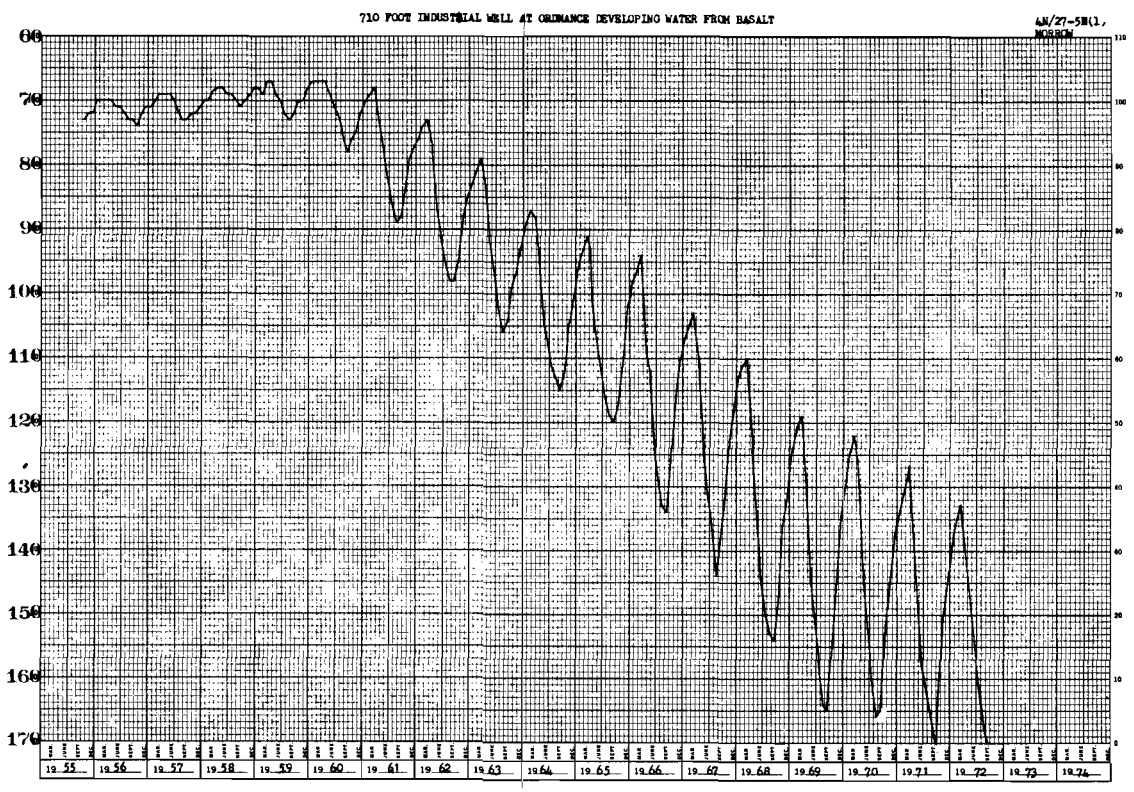


Figure 10 Ordnance critical ground-water area

Immediately adjacent to the Ordnance area is the proposed Buttercreek critical ground-water area which is experiencing water level declines of 8 to 15 feet per year. Deep wells in the Buttercreek area located south and east of Ordnance have in some cases shown water level declines in excess of 35 to 38 feet per year. Further well construction and development within these areas will only accelerate the water level decline. It will therefore be necessary to control existing wells and to restrict pumpage from the basalt aquifers in this critical area. Public hearings are scheduled for early 1974 and the State Engineer's Order setting forth ground-water controls will be issued prior to the 1974 irrigation season.

A fifth proposed critical ground-water area has developed at Bull Mountain-Cooper Mountain in the Tualatin Basin of Washington County. Here, municipal and irrigation wells, constructed in the deep basalt aquifers have shown severe water level declines of 5 to 7 feet per year since the late 1950's and early 60's. By March 1965, the water level declines had increased 8 to 12 feet per year within this critical area. Control boundaries have been identified and permits for ground-water development from the deep basalt aquifers located adjacent to Cooper Mountain and Bull Mountain have not been issued. An overall water level decline of 40 feet has occurred in this critical area and it is apparent that outside sources of water must be developed. Continued overdraft on the deep well system of this portion of the Tualatin Basin may also create a ground-water quality problem by indrafting saline water from underlying marine sedimentary formations. Public hearings were held May 7, 1973 for the Cooper Mountain-Bull Mountain critical ground-water area. The State Engineer's Order controlling wells within this area will be issued in early 1974.

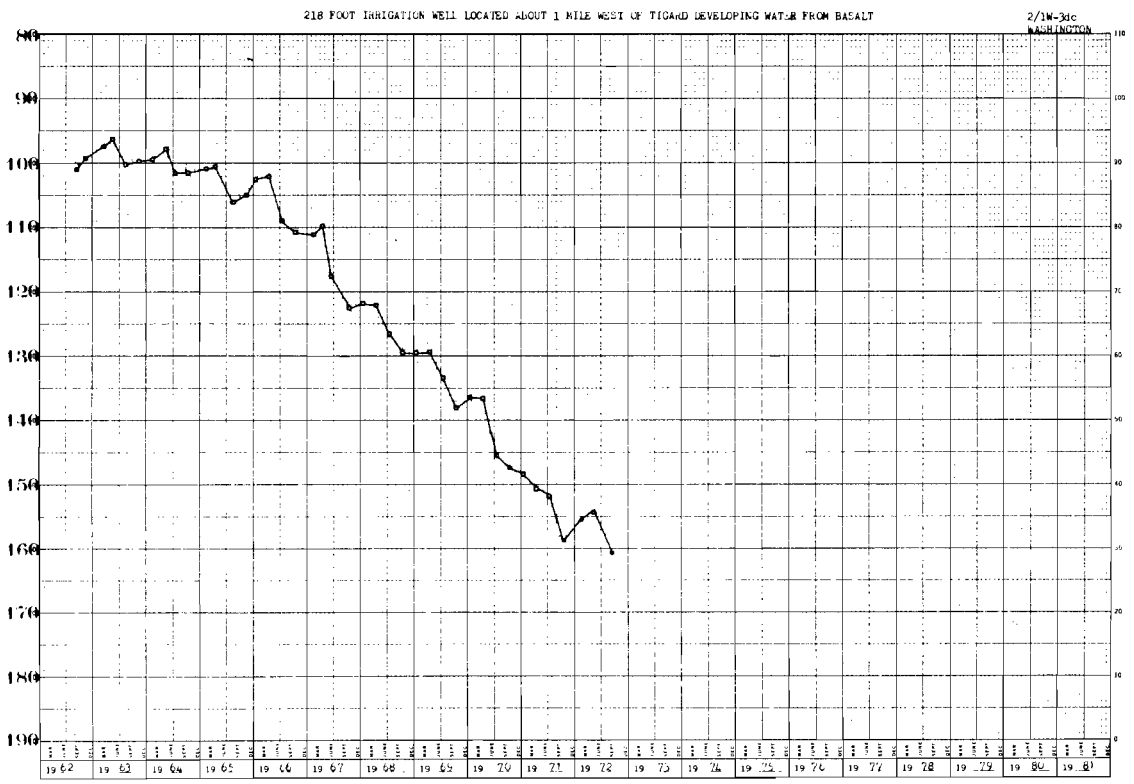


Figure 11 Cooper Mountain-Bull Mountain critical ground-water area

Ground Water Management

Well owners have depended upon nature for replenishing water withdrawn by their wells. The discharge from wells must be restricted to the calculated safe yield or natural basin yield, or it must be mined as a stock resource. Mining, however, places a time limit on the use of ground-water reservoirs for man's use. Until we learn where and how to place large amounts of surplus water underground for later use, we cannot exceed the limits set by nature in the use of ground-water reservoirs. In dealing with basalt aquifers of the northwest, artificial recharge research and computer-based technology are prerequisites for any ground-water management program.

As problems become more and more complex, such as those involved in large investments in land and wells, withdrawal of water from both streams and wells that tap a common source may result in conflicting water rights. Then the solution to ground-water problems will require even more detailed information. The modern approach is for the hydrogeologist to acquire sufficient detailed information concerning both surface and ground-water systems so that aquifer responses can be predicted by computer evaluations. Computers may be used to test the response of an aquifer system to various assumed stresses and permit the selection of the most desirable and equitable distribution of the ground water available within any aquifer system. The financial commitment to such a program will be considerable. Ground-water management problems will require computer analysis within the next few years.

Ground Water Quality Protection

The need for protection of Oregon's ground-water and surface water resources from unnecessary contamination and/or degradation is of prime importance. When water moves through the various openings in the subsurface, some minerals are dissolved by the water and the quality of water changes. In a natural system, the type and amount of minerals that are placed into solution by ground water is a function of: (1) type of material through which the water passes; (2) the volume of water migrating through the material; (3) the residence time or the period of time that the water is in contact with the soils, rocks, and minerals; and (4) a number of interrelated geochemical laws. This natural system is extremely sensitive to outside influence and in Oregon there are a number of well documented cases involving the inadvertent pollution of ground and surface waters by man.

In an effort to clean up the air in heavily populated areas of Oregon, the burning of wastes was essentially prohibited after 1970. This has resulted in a 20 fold increase in the volume of solid wastes. So called "sanitary landfills" have been used in an attempt to dispose of putrescible solid wastes. Wood waste piles are growing to enormous sizes around the state. There has also been a great deal of concern generated about the disposal of environmentally hazardous wastes (EHW) in Oregon.

As previously mentioned, to aid the Department of Environmental Quality (DEQ) in making sound hydrogeologic decisions in the waste disposal field, the 1970 legislature created a new hydrogeologist position in the Office of the State Engineer. The hydrogeologist filling this position is acting as liaison between this office and the Department of Environmental Quality. The duties of this position include not only the investigation of solid waste disposal sites, but also technical assistance to the DEQ upon their request concerning all areas of the state where existing or potential water pollution problems may exist. Hydrogeologists with this office have investigated 22 potential and/or operating solid waste or hazardous waste disposal sites in Oregon during the past biennium, see Figure 3.

The State Engineer has also been involved in a number of existing ground-water pollution problems. The State Engineer has worked closely with other state agencies in evaluating potential nuclear thermal power plant sites and together with the DEQ are now developing a general guideline for the near surface storage and disposal of environmentally hazardous wastes in Oregon. The near surface storage and disposal of environmentally hazardous wastes is favored over the alternative, deep well injection in Oregon. The State Engineer, the Department of Environmental Quality, and the Federal Water Quality Administration are opposed to the disposal or storage of toxic wastes by subsurface injection, without strict control. These controls include not only administrative checks, but also the geologic containment of the injected wastes. There must be a clear demonstration that such wastes will not interfere with the present or the potential uses of subsurface water supplies, contaminate surface water, or otherwise damage the environment. In order to assume this kind of protection to the waters of the state, a full understanding of the flow system involved, including the recharge, transitional, and discharge areas of each basin is required. This work is presently being carried out on a qualitative level by this office. Much more quantitative work will be required in future years.

Basins Investigations

The Oregon State Engineer's Office expanded the Ground Water Basin Investigation Program in June, 1972. This statewide program is intended to determine the general extent and characteristics of each ground-water basin and to ascertain the degree to which ground water may serve as a viable alternative to surface water supplies. The program is funded on a matching basis by the United States Government and the state under Title III of the Water Resources Planning Act of 1965.

The Title III matching funds are made available through Public Law 89-80: 89th Congress, S. 21, July 1965 entitled the Water Resources Planning Act. This act provided for the coordinated planning of water and land resources. It also established: (1) a Water Resources Council and (2) a River Basin Commission, and further provided financial assistance to the state to increase state participation in water and land use planning.

The State Engineer is charged under the Ground Water Act of 1955 with defining Oregon's ground water resources. ORS 537.665 specifically states, "The State Engineer or his authorized assistant shall proceed as rapidly as possible, to identify and define tentatively, the location, extent, depth, and other characteristics of each ground water reservoir in this state, and shall assign to each a distinctive name or number or both, as a means of identification. The State Engineer or his authorized assistant, may make such investigations and gather such data and information as may be essential to a proper understanding of the characteristics of each ground water reservoir and the relative rights to appropriate ground water therefrom."

The State Water Resources Board has transferred part of the Title III funds to the State Engineer in order that ground-water basin studies could be expanded and additional information available for use in conjunction with their surface water investigations programs.

Planning Inquiries

The addition of the new personnel, previously described, has been only an indirect aid to planners at the local and regional levels. However, it should also be emphasized that the addition of these personnel has in no way lessened the work load of those ground-water staff members presently involved in answering public inquiries, water well report processing, licensing of water well contractors and drillers, development and enforcement of water well construction standards, water well inspection, or delineation of critical ground-water areas within the state. It is still not possible with the present staff and the increased work load in all of the above administrative duties to render aid to planning agencies with regard to specific or local ground-water problems.

More than 20 requests from city, county, and regional planners for geologic and ground-water assistance in setting forth meaningful land use plans have been received during the past few years. Their requests include the need for specific information on: (1) the availability and feasibility of developing ground water as a domestic or community water supply; (2) the quality of the local ground-water body; (3) the susceptibility of local shallow ground-water bodies to pollution by septic tank effluent or sewage lagoon seepage; (4) water well design and well yield relationships in community water supply wells; (5) hydrogeologic acceptability of specific areas for surface water reservoirs; (6) water well field development, spacing, and interference problems, and (7) land use planning problems as they relate to the availability of ground-water supplies and septic waste disposal.

Geothermal Wells

The legislative declaration under the Ground Water Act of 1955 states that: "All waters within the state from all sources of supply belong to the public. In order to insure the preservation of the public welfare, safety, and health, it is necessary that beneficial use without waste, within the capacity of the available sources, be the basis, measure, and extent of the right to appropriate ground water. The depletion of ground water supplies below economic levels, impairment of natural ground water by pollution, and wasteful practices in connection with ground water must be prevented or controlled within practical limits." The legislative

policy further states that: "Whenever wasteful use of ground water, impairment of or interference with existing rights to appropriate surface water, declining water levels, interference among wells, overdrawing of ground water supplies, or pollution of ground water exists or impends, controlled use of the ground water concerned be authorized and imposed under voluntary joint action by the State Engineer and the ground water users concerned whenever possible, but by the State Engineer under the police power of the state when such voluntary joint action is not taken or is ineffective."

The 1971 session of the state legislature brought the Department of Geology and Mineral Industries into the field and gave them a certain jurisdiction over some of the geothermal ground waters of the state. There is a serious concern that wells requiring sustained yields of high temperature water may deplete the resource which should remain the property of the public.

All of mans activities in one way or another have a measureable impact on our environment. Each of us should be mindful of our collective appetites for water since it is our most important natural resource and we cannot make substitutions for it. Shortages of both surface and ground water in areas of excessive decline have already emphasized the importance of proper development, protection, regulation, and control to assure the continued availability of our water supply. The State Engineer must consider all aspects of proposed ground-water utilization programs. In discussing the use of geothermal steam for thermal power generation, it should be remembered that it is ground water that serves as the carrier which transports much of the earth's deep seated heat energy to land surface.

This office has on file many ground-water applications, permits, and certificates for the use of thermal ground waters of the state which date back into the late 1920's in areas of eastern Oregon. Many wells within Oregon are using water for air conditioning and heating of office space. Well depths near Portland vary from 50 to 930 feet and ground-water temperatures vary between 61° and 75° Fahrenheit. Hot water wells located at Lakeview and at Burns are used for heating of greenhouses and for irrigation water supplies. Here, the water with temperatures of 160° to 208° Fahrenheit are produced from depths of 800 to 1000 feet and must be cooled for irrigation purposes. Wells and springs at Lakeview provide thermal ground water of 208 to 214 degrees for space heating near Hunter's Lodge and many homes in the Lakeview area.

The largest number being developed is in the Klamath Falls area where about 500 wells produce water from 92° to 238° Fahrenheit. The great variation in both depth and temperature of the wells in this area is believed to be due to: (1) the proximity of the well location to ascending thermal ground water, and (2) the relative permeability of the water-bearing formations. Geothermal ground water is really deep percolating meteoric waters which have encountered rocks of higher temperature. The heated water generally moves laterally over long distances and at great depths and often rises vertically in response to prevailing rock permeabilities and ground-water gradients. Leakage along fault zones and other zones of weakness are common and provide for the surface development of thermal

springs and hot water wells. The deep seated thermal waters of a regional ground-water flow system are hydrologically connected with the shallower ground-water systems. The chemical quality of these deep seated waters is poor and the waters are classified as thermal brines.

At the present time, no one knows whether a dry steam or a wet steam field can be developed in Oregon. It is possible that such fields may interupt the presently established ground-water heat flow in these areas and may cause a reduction or actually destroy the available thermal ground water presently being developed. If it is possible to find and develop geothermal water without injury or prohibition of other ground-water development "fine", but we must be sure that in our exuberance to develop geothermal ground waters we don't overlook the protection required for all of our ground-water resources.

Hydrologic Cycle

Ground water like surface water, originates as precipitation and both are an integral part of the water cycle. The earth's water supply circulates endlessly from oceans to skies, to lands, and finally it returns again to the oceans, see Figure 12.

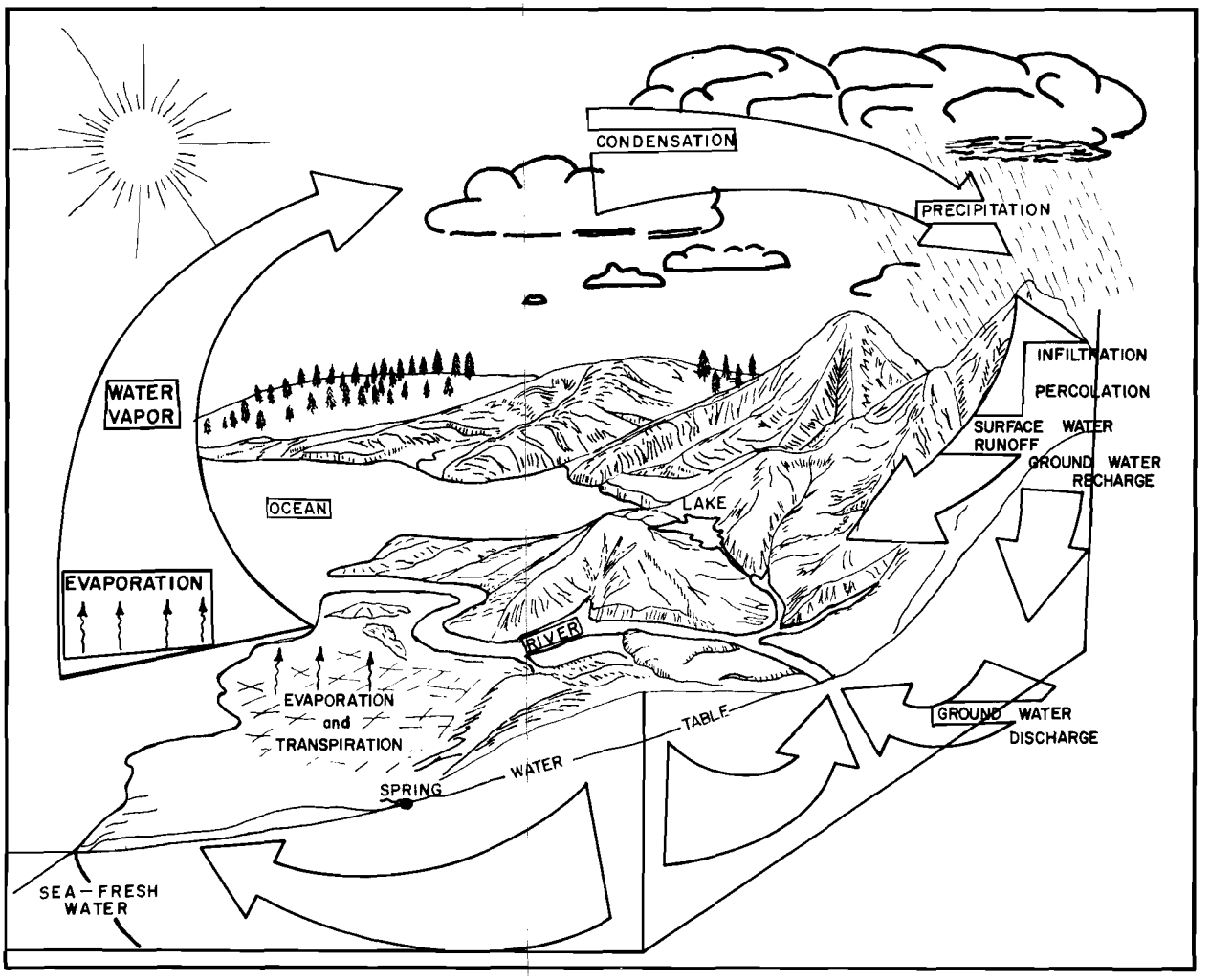


Figure 12

Evaporation from the oceans and surface water bodies is the major contributor of water to the hydrologic cycle. After precipitation reaches land surface, the water either runs off, evaporates, transpires, or seeps into the ground. Eventually, all water is returned to the oceans and upon arrival, it begins again to move through the hydrologic cycle.

Ground Water Recharge

A portion of the precipitation that seeps into the ground in Oregon is abosrbed by soils and plants. The remaining water percolates downward through the water table. The water table marks the elevation below which all pore spaces are filled with water. The water table is not a flat surface as the name implies. It usually forms as a subdued replica of the land surface. The water table stands at higher elevations in mountainous terrains and at lower elevations within stream valleys. Higher elevations on the water table mark the areas of GROUND-WATER RECHARGE. Ground water moves downward and away from recharge areas towards lowlands and ground-water discharge areas.

The major regions of ground-water recharge in the State of Oregon are the Cascade Mountains, the Blue Mountains, the Coast Range, and similar elevated areas possessing permeable formations and receiving large amounts of precipitation. Water well information is generally sparse in mountainous areas and it is difficult to accurately locate the exact recharge boundaries; nevertheless, regional ground-water boundaries normally lie beneath major topographic divides. The major drainage divides in Oregon are shown as solid lines on Figure 3, page 8.

Deep wells are required to withdraw water from ground-water recharge areas. During construction, wells in recharge areas experience progressive water level declines as the wells are deepened.

Ground Water Discharge

Ground water migrates from the mountainous recharge areas, downward, through rock materials toward lowland areas where it reappears as ground-water discharge. A large amount of ground water is forced toward land surface as regional discharge within major valleys such as the Willamette Valley and Harney Valley. Large river channels such as the Willamette, Rogue, and Deschutes Rivers also constitute major ground-water discharge areas. Numerous springs and marsh lands also serve as ground-water discharge areas in Oregon.

Nature has established a balance between natural recharge and natural discharge. Therefore, if there is an increase in the quantity of ground-water recharge, there will also be an increase in the quantity of natural ground water discharged from the basin. If the total amount of recharge is insufficient to maintain a balance with the total basin discharge, the water table elevation must decline.

Wells drilled in discharge areas generally encounter water at shallow depths. As these wells are deepened, a rise in the water level will be experienced.

Ground Water Flow System

Surface water resources can be directly observed and measured. In contrast, ground-water bodies must be observed and measured indirectly. Because ground water is hidden from sight, much mystery (mystic) has been generated around the subject and methods of locating underground waters. Without addressing the subjects of divining rods and water witching, it can be stated that ground water responds to known physical and chemical laws. Ground-water basins are empirically as well as mathematically predictable. There is no room for mysticism or the occult in ground-water hydrology.

A GROUND-WATER BASIN is defined as a three-dimensional volume of water and earth material which contains the entire flow paths of all the water recharging the ground-water system. Important features of any ground-water basin are:

(1) the geometry;
(2) the velocity and direction of ground-water movement;
(3) the water-bearing characteristics of the rock materials; and
(4) the physical and chemical characteristics of the water.

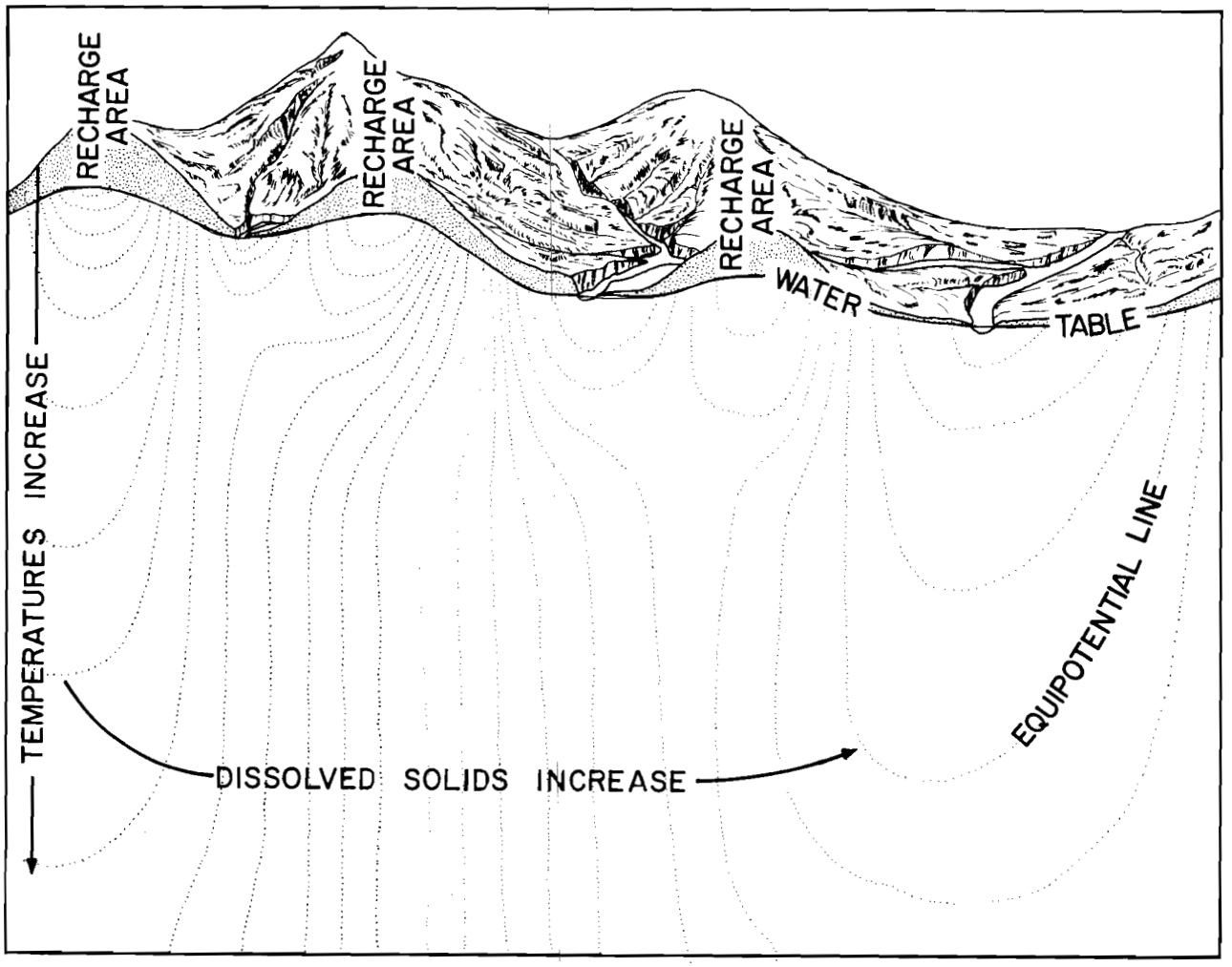


Figure 13

The basin may be simple, involving only one recharge area and one discharge area, or complex involving several recharge and discharge areas. The cutaway drawing shown in Figures 13 through 16 illustrates several commonly occurring features of ground-water basins.

There are three principal types of change occurring in any ground-water basin. These are:

(1) the change in position (movement) of ground water,
(2) the change in temperature,
(3) the change in concentration of chemical constituents, see Figure 5.

The change of dominant importance is the change in position. The energy which causes ground water to move is a consequence of its position and is called potential energy. The dashed lines in Figure 13 are used to define a potential energy field and they are called EQUIPOTENTIAL LINES. The altitude of the water level in a well tightly cased to the bottom specifies the equipotential line. For example, a water level which stands at 500 feet above sea level in a well which is tightly cased to the bottom, defines a point on the 500 foot equipotential line. Ground water moves from high potential to low potential at right angles to equipotential lines.

Temperatures generally increase with depth due to natural heat flow eminating from the interior of the earth. Earth temperatures increase approximately 1 degree Fahrenheit for every 60 feet beneath the first 100 feet below land surface. Variations in earth temperatures from place to place within a ground-water basin is due in large part to ground-water movement.

Note on Figure 13, that natural changes in chemical quality will occur as the ground water moves through the flow system. The degree to which these changes take place, is highly dependent on the solubility of the rock materials, the distance traveled, and the residence time of the water in transit. Generally, the total concentration of dissolved constituents will increase along the flow path. The general deterioration of water quality as the water moves through the system, often leads to a very poor quality water in major discharge areas. These waters have sometimes been mistaken for connate sea waters. Chemical analyses of ground water generally makes possible the differentiation between sea water and brackish ground water.

Natural variations in chemical quality, temperature, and water level fluctuation are all functions of depth, distance, and geologic material through which the ground water moves. A ground-water body can be divided on the basis of size, flow distance, and common water characteristics into three types of flow systems. These are local, intermediate, and regional ground-water flow systems.

Local Ground-Water Flow Systems

Ground water discharged from local ground-water flow systems such as those shown in Figure 14, are recharged in an immediately adjacent recharge area. The local flow system may cover only a few acres

and the water may circulate to depths of less than 100 feet below the water table. Discharge areas of local systems in Oregon have characteristic low ground-water temperatures ranging from 35 to 55 degrees Fahrenheit. These water temperatures are indicative of shallow circulation.

Water from local systems generally contains low concentrations of dissolved chemical constituents unless it moves through very soluble rock types. There is a greater risk of oxygen supported bacterial contamination, however, due to the proximity of the shallow flow system to possible surface contaminants. Seasonal precipitation cycles in Oregon and the shallow nature of local systems cause wells completed in these systems to exhibit seasonal water level changes.

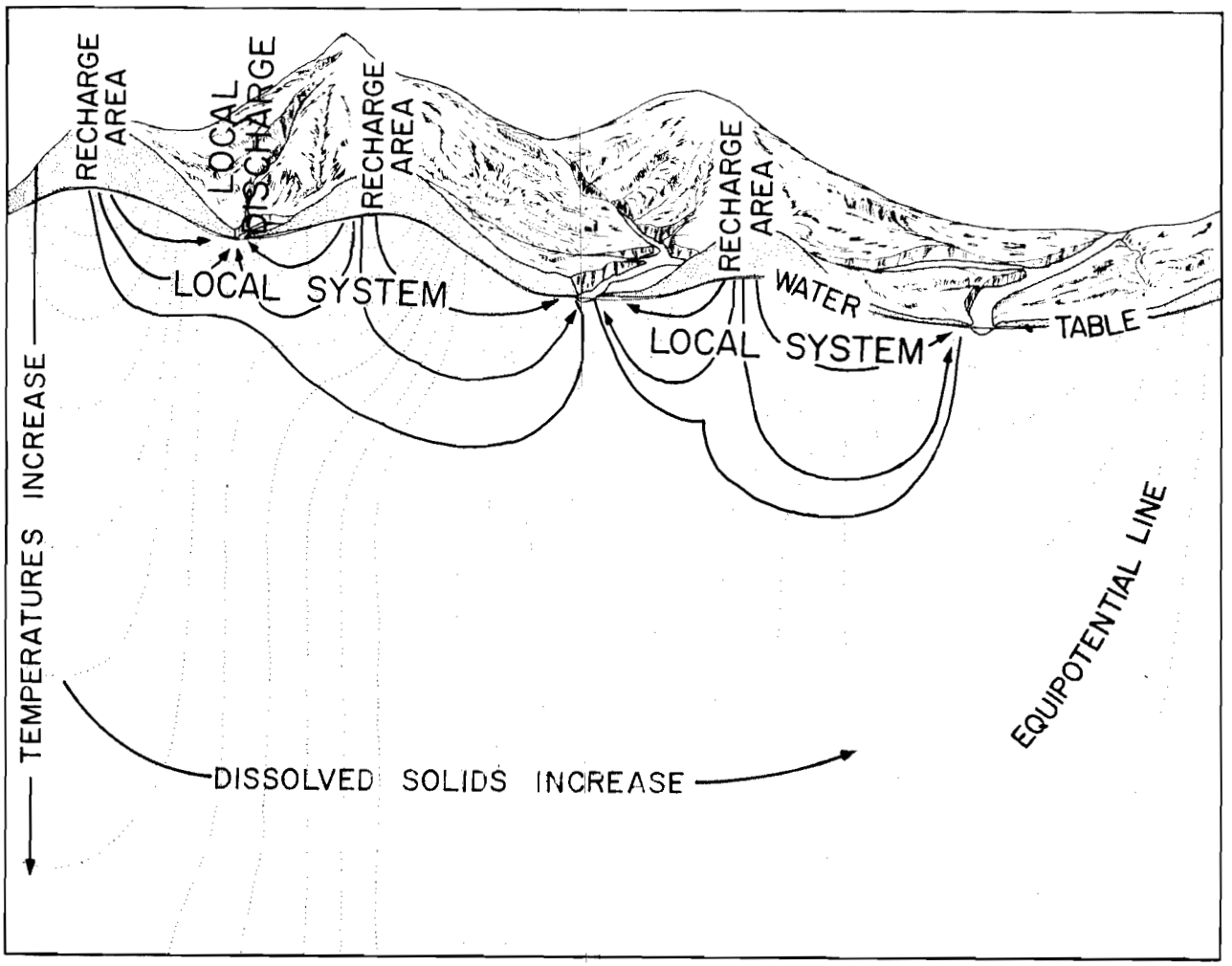


Figure 14

Intermediate Ground-Water Flow Systems

As the name "intermediate" implies, water discharging from intermediate flow systems lies beneath local systems and above regional systems. Intermediate effects are noted in the ground water's chemical

character, temperature, and degree of seasonal water level fluctuation. Ground-water flow systems of intermediate size are characterized by one or more topographic highs and lows, each located between a recharge area and a discharge area. Waters of intermediate discharge areas in Oregon are characterized by temperatures ranging from 45° to 85° Fahrenheit. The quantity of total dissolved solids ranges from 100 to 800 parts per million and averages 100 to 200 parts per million. Included in the figure for total dissolved solids, among others, are values for sodium (10 to 200 parts per million), and chloride (5 to 50 parts per million). Most of the water pumped from wells in Oregon is found to lie somewhere between these extremes. It will be noted in Figure 15 that intermediate discharge areas are also located in areas of local ground-water discharge. Therefore, some variation in the chemical character of water pumped from neighboring wells of varying depths can be expected.

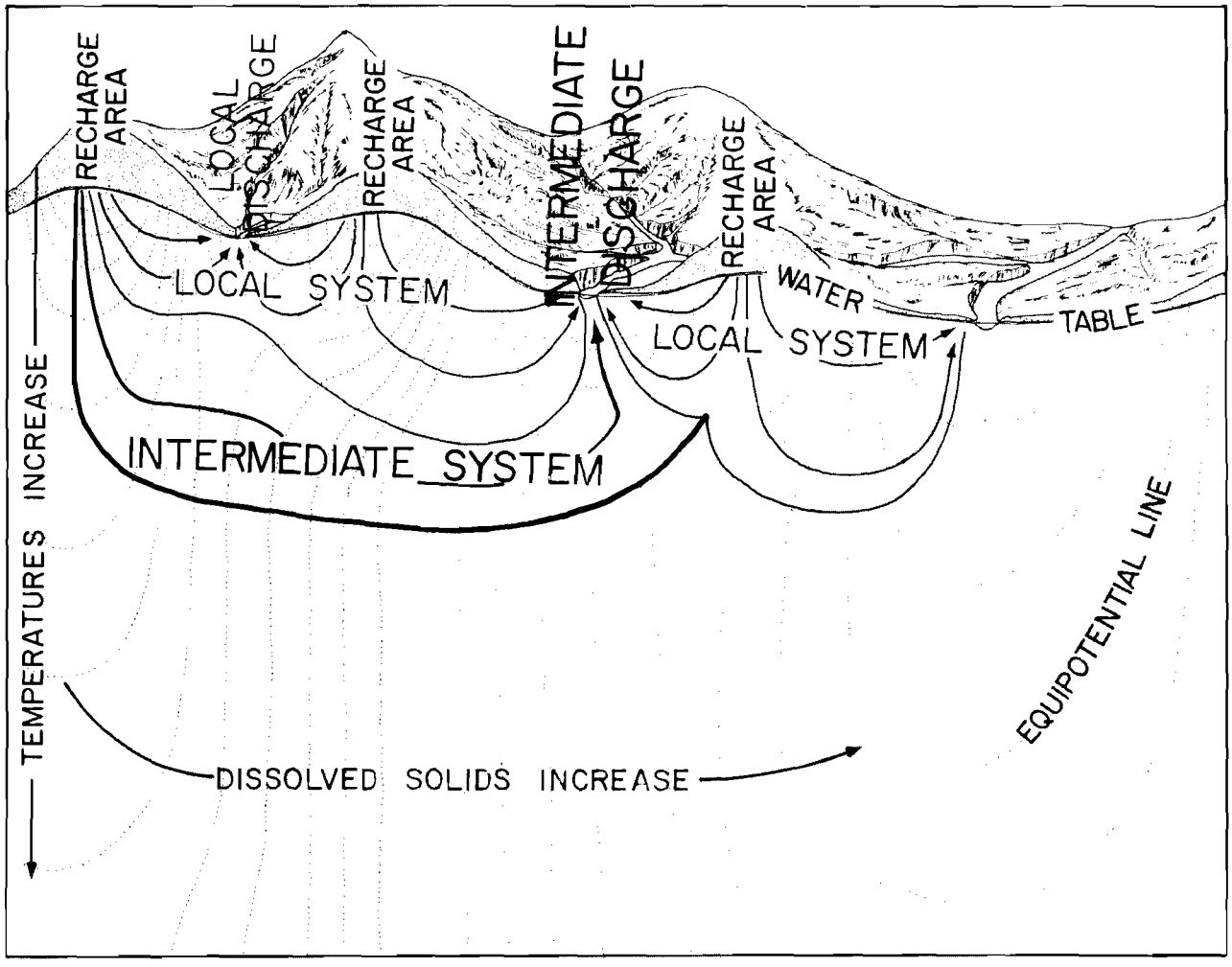


Figure 15

Regional Ground-Water Flow Systems

Regional ground-water flow systems lie deep and at the opposite end of the spectrum from local flow systems. A regional flow system

received recharge from the highest water table elevation in the basin and discharges this water in the lowest part of the basin, see Figure 16. Oregon's major surface water drainage basins generally coincide with the regional ground-water basins as shown on Figure 3. Regional ground water may circulate to depths in excess of 10,000 feet below land surface, with a resulting increase in ground-water temperature. Temperatures from regional systems generally range from 85 degrees Fahrenheit to over 200 degrees Fahrenheit. The highest ground-water temperature recorded in Oregon to date is 238 degrees Fahrenheit from the Pondorosa Nursing Home well in Klamath Falls. Long travel paths, long residence times, and high temperatures aid the solvent properties of water in dissolving chemical constituents, often causing such waters to be unfit for normal domestic uses.

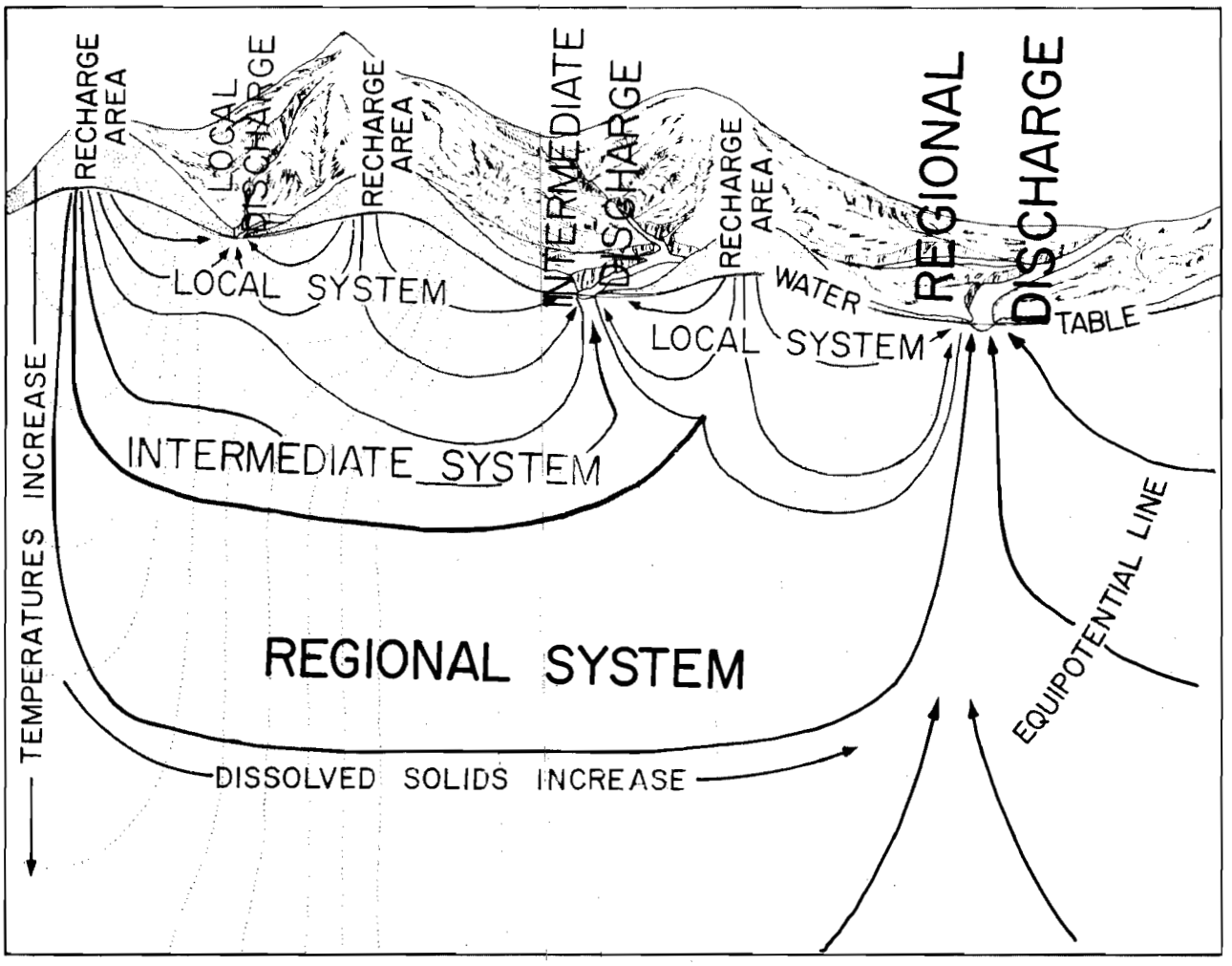
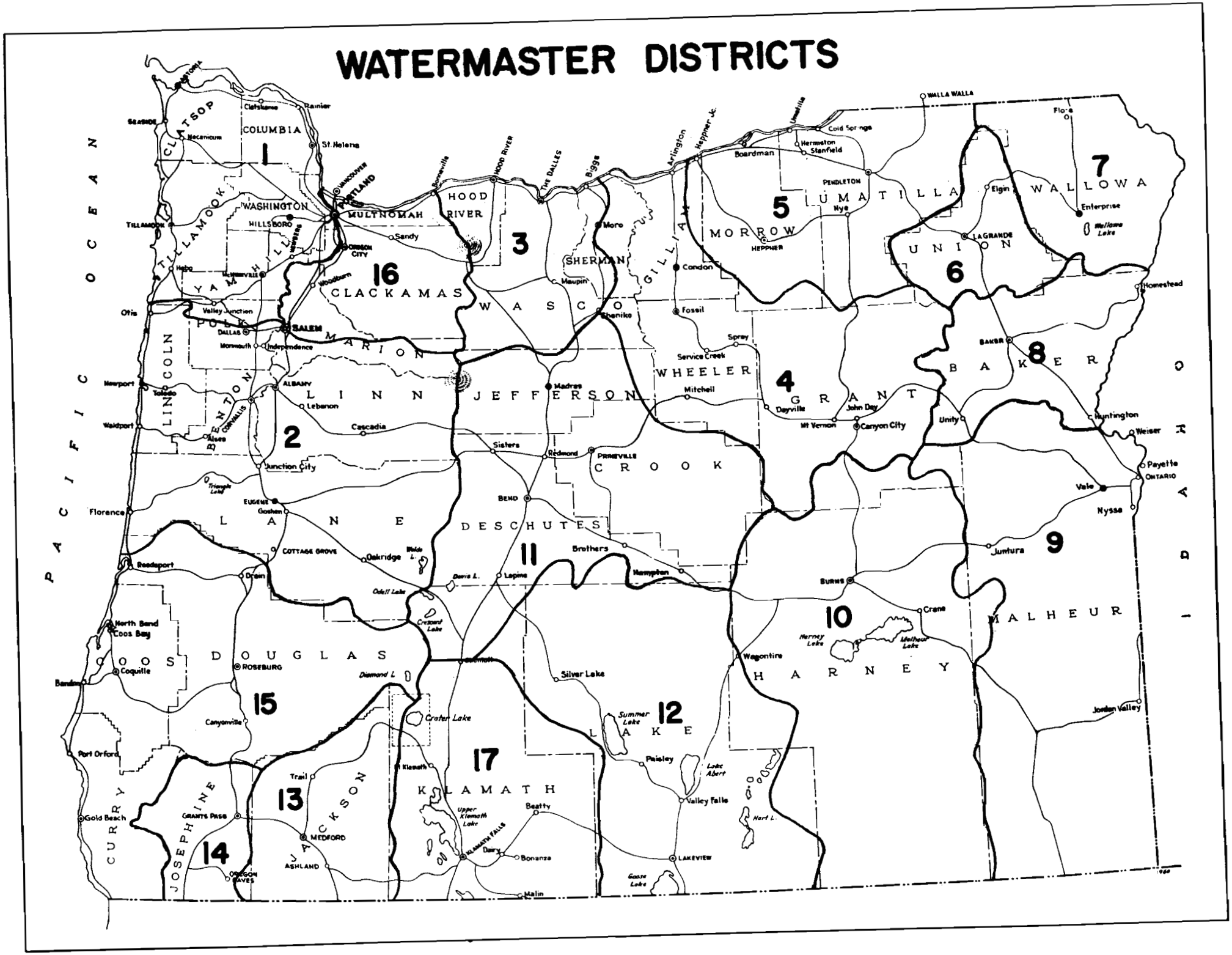


Figure 16

The frictional head loss experienced over long travel paths produce a dampening effect on seasonal water level fluctuations. For this reason, water levels on a regional flow system can be expected to fluctuate only very slightly in the absence of local pumping effects.

WATERMASTER DISTRICTS



TUALATIN VALLEY (1)

The Tualatin Valley is a broad basin that has been partially filled with fine-grained lake deposits composed chiefly of silt and clay. The bedrock, which forms the surrounding hills and underlies the lake deposits, is a series of basaltic lava flows known as the Columbia River Basalt. Ground water occurs in fractures and saturated contact zones between individual lava flows in the basalt formation. The basaltic lava flows are underlain by marine sedimentary rocks that exhibit poor water-bearing properties. Extensive weathering of the upper surface of some basalt flows has reduced the rock to clay which restricts adequate recharge to the aquifers at depth.

Water levels in most shallow wells throughout the Tualatin Valley recover each spring to the previous spring high position. However, some of the wells developing water from the basalt in the Cooper Mountain area have shown a sustained decline in recent years as indicated by the hydrographs of wells 1S/1W-19dd and 1S/2W-26bd. Water level declines are occurring in most of the deep basalt wells in the Bull Mountain and Cooper Mountain areas. This area has been determined a critical ground water area. Controls on deep basalt wells are needed to restrict further ground-water development from the over-appropriated aquifers.

OBSERVATION WELLS

1N/1W-21ca	(Cecil C. Schaefer) is a 390 foot drilled well in basalt located about 8 miles northeast of Hillsboro.
1N/2W-35bc	(E. L. Lewis) is a 23 foot dug well in alluvial sand at Orenco. Periodic water level measurements available from 1951 to date.
1N/3W-36dd	(Terminal Ice & Cold Storage Company) is a 171 foot drilled well in alluvial sand at Hillsboro. Periodic water level measurements available from 1951 to date.
2N/3W-16aa	(Dennis Hall) is a 150 foot drilled well in alluvial gravel deposits located about 4 miles northeast of Banks.
1S/4W-2ad	(Myron Sheeler) is a 78 foot drilled well in alluvial gravel deposits located about 2 miles west of Forest Grove. Water level measurements available from 1951 to date.

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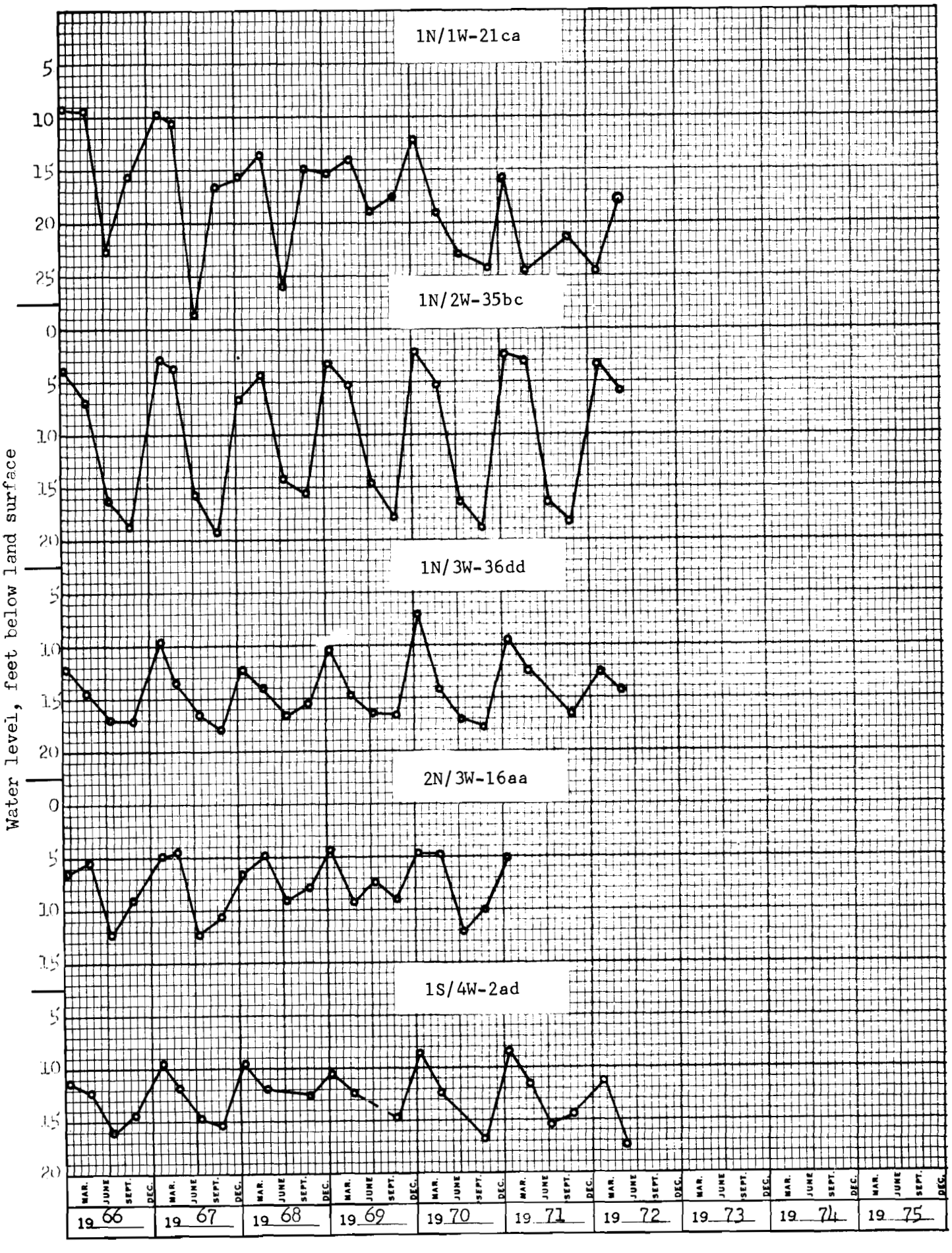
Hart, D. H. and Newcomb, R. C., 1965, Geology and Ground Water of the Tualatin Valley, Oregon: U. S. Geological Survey Water Supply Paper 1697

TUALATIN VALLEY AREA (1)



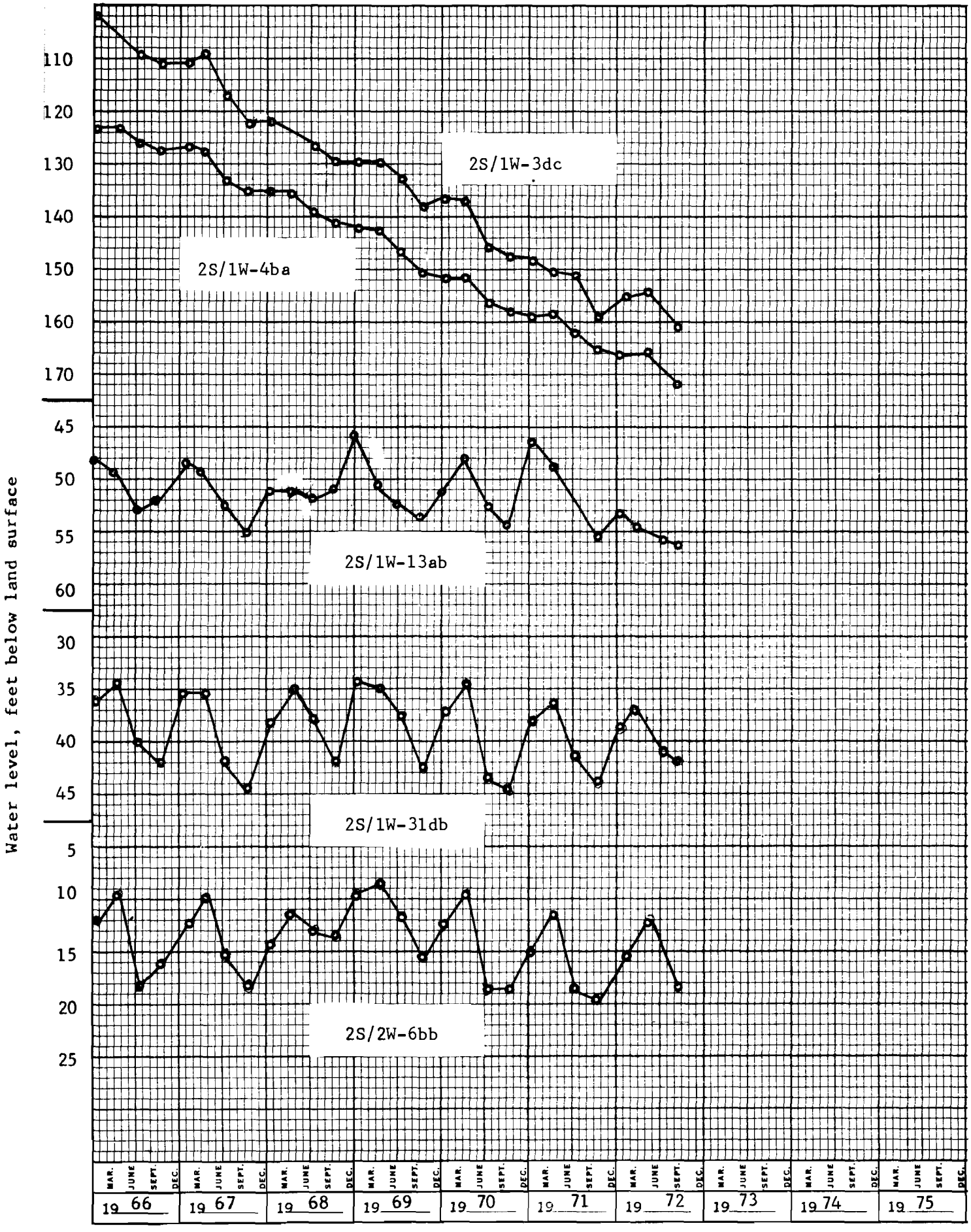
TUALATIN VALLEY (1)

Ground water in the shallow alluvial aquifers is generally replenished each year by the annual precipitation and no problems of declining water levels have developed in the valley sediments. The shallow water table recovers to near land surface and the additional recharge water, is rejected and flows off as surface water. Wells 2S/1W-3dc and 2S/1W-4ba are located immediately west of the Tigard City well field and reflect the pumping influence of the deep basalt wells near Bull Mountain.

OBSERVATION WELLS

2S/1W-3dc	(Leonard S. Davis) is a 218 foot drilled well in basalt located about one mile west of Tigard.
2S/1W-4ba	(Harris H. Hanson) is a 600 foot drilled well in basalt located about 2 miles west of Tigard.
2S/1W-13ab	(Ralph Sittel) is a 162 foot drilled well in sand and gravel located about 1½ miles northeast of Tualatin.
2S/1W-31db	(Charles Kennerly) is a 215 foot drilled well in basalt located about one mile southwest of Sherwood.
2S/2W-6bb	(S. R. Rotchstrom) is a 486 foot well in basalt located about 6 miles south of Hillsboro. Periodic water level measurements available from 1951 to date.

TUALATIN VALLEY (1)



TUALATIN VALLEY (1)

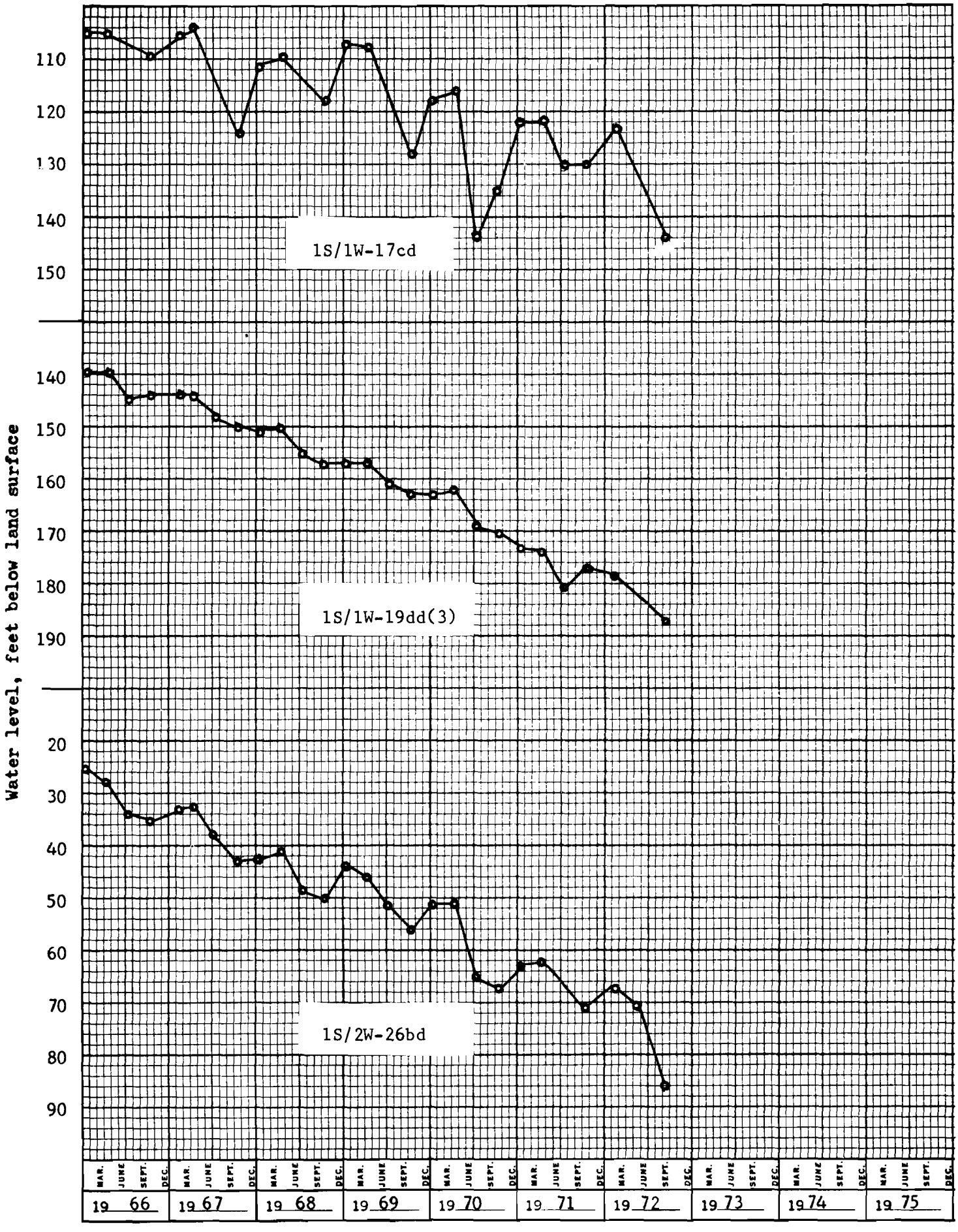
OBSERVATION WELLS

1S/1W-17cd (Schuepbach Bros.) is a 414 foot drilled well in basalt located about 2 miles southwest of Beaverton.

1S/1W-19dd(3) (Earle L. Miller) is a 320 foot drilled well located about 4 miles southwest of Beaverton.

1S/2W-26bd (Karl Schaefer) is a 403 foot drilled well in basalt located about 6 miles southwest of Beaverton. Periodic water level measurements available from 1958 to date.

TUALATIN VALLEY AREA (1)



PORTLAND METROPOLITAN AREA (2)

The westside business district of Portland is one of the most concentrated areas of large ground water developments in the Portland Metropolitan area. Ground water is used for heating and cooling of many of the large office buildings.

The westside business district is underlain by water-bearing alluvial sand and gravel deposits and the Columbia River basalt formation. The water-bearing gravels are separated from the underlying basalt by a section of silt and clay known as the Sandy River Mudstone. Wells develop water from both the gravels and basalt. Many operators have constructed recharge wells for the disposal of waste water to reduce the cost of discharging waste waters to the city sewers. Some operators pump water from the basalt and dispose of water in the gravels and other operators pump water from the gravels and dispose of water into the basalt. This seasonal transfer of water from one formation to another and the difference in water quality and water temperature has created a very complex hydrologic system.

OBSERVATION WELLS

1N/1E-34ccd	(Equitable Savings & Loan Association) is a 158 foot drilled well in gravel located in the Westside Business District.
1N/1E-34ccc	(Dirks Medical Center) is a 418 foot drilled well in basalt located in the Westside Business District.
1S/1E-10cd	(J. Donald Kroeker & Associates) is a 486 foot well in basalt located in Westside Portland near Ross Island.
1N/1E-33dc	(U. S. National Bank, Stadium Branch) is a 563 foot industrial well developing water from basalt.

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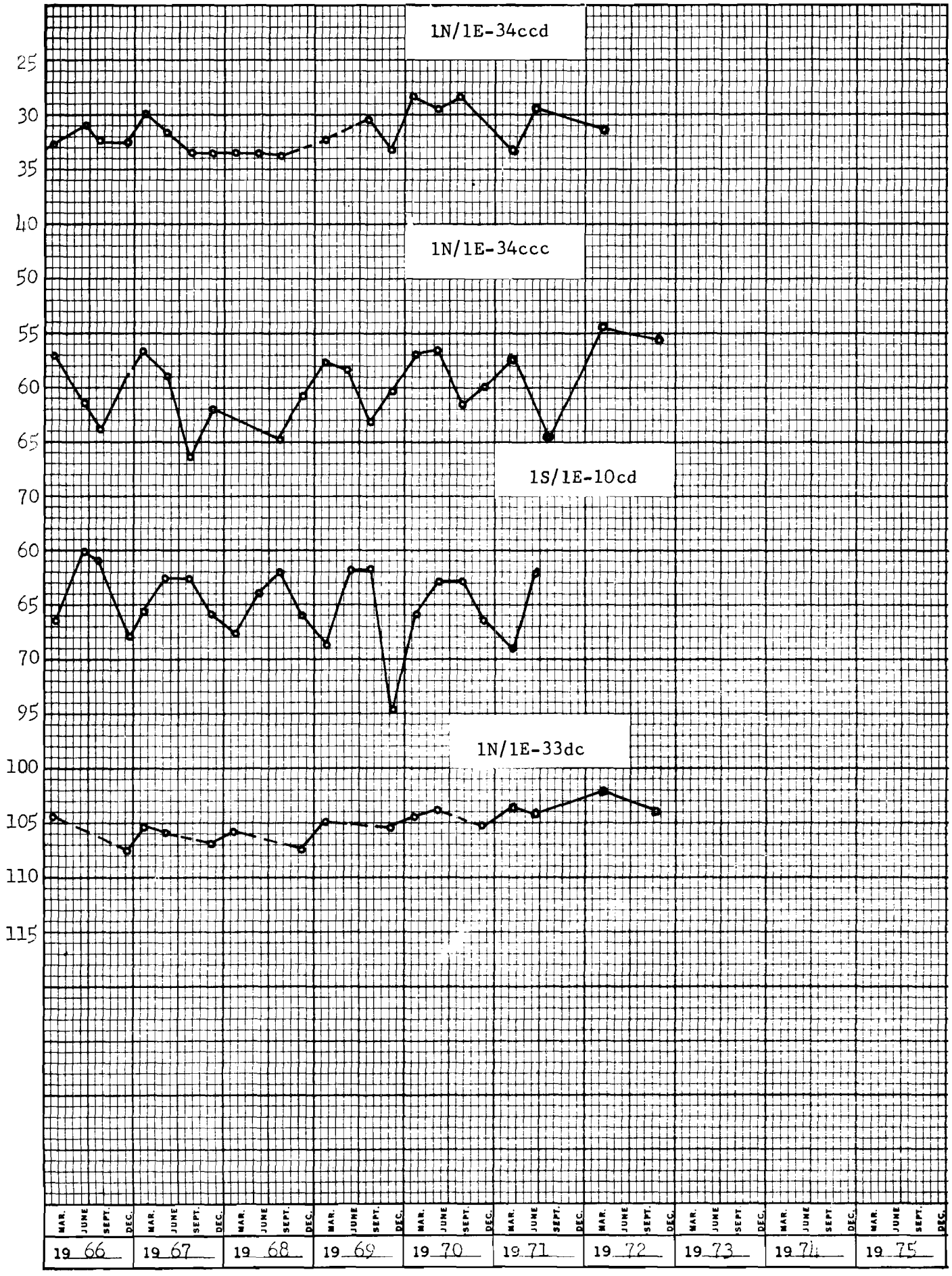
Griffin, W. C., et al., 1956, Water Resources of the Portland, Oregon and Vancouver, Washington area: U. S. Geological Survey Circular 372.

Hogenson, G. M., and Foxworthy, B. L., 1965, Ground water in the East Portland Area, Oregon: U. S. Geological Survey Water Supply Paper 1793.

PORTLAND METROPOLITAN AREA (2)

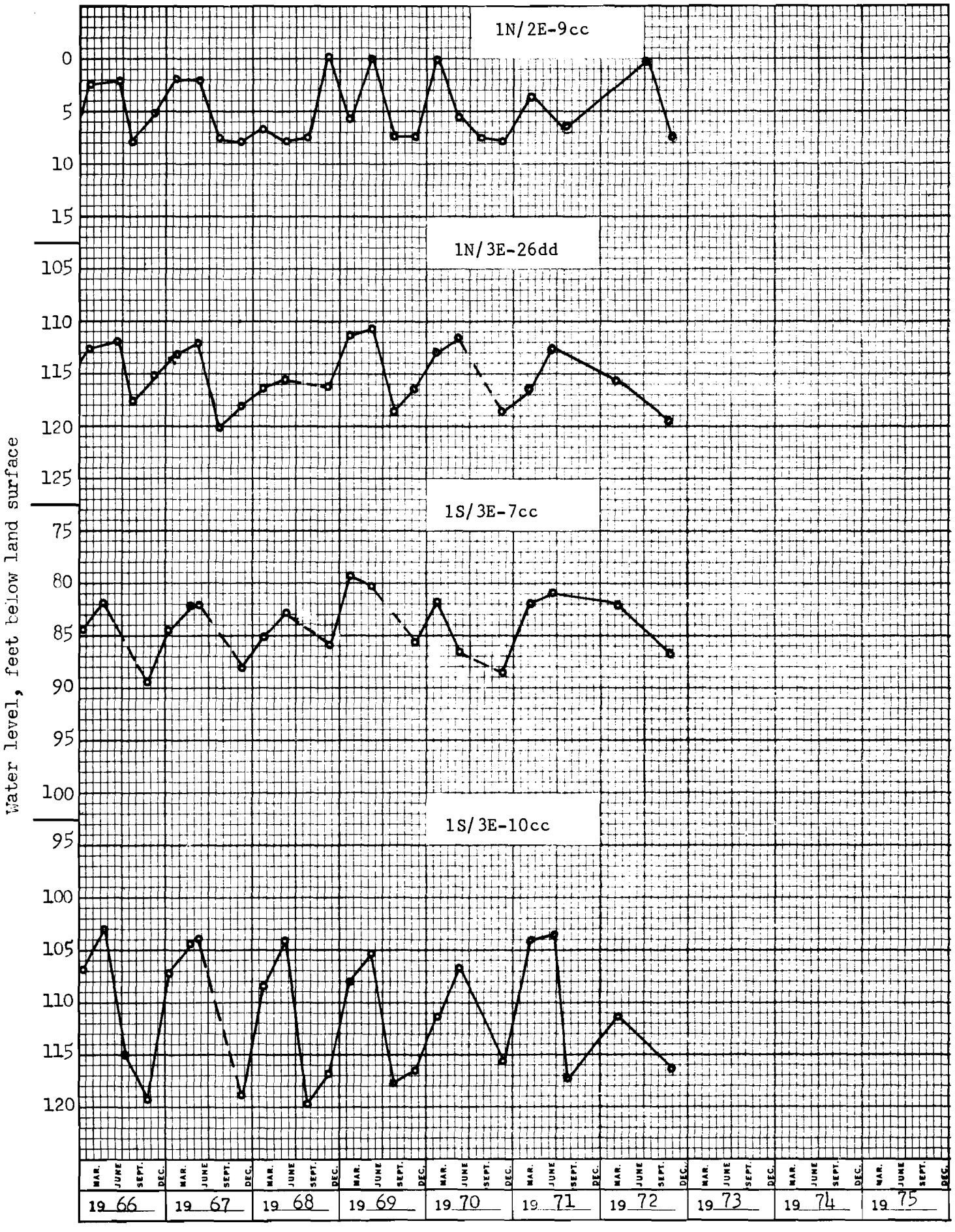


PORTLAND METROPOLITAN AREA (2)

No problems of overdevelopment of the ground water supply are known in the East Portland area. The permeable character of the alluvial deposits provide productive ground water reservoirs. The extensive development of the East Portland area has created a pollution threat in some of the shallow ground water supplies of the area. Ground water storage in this area remains large and is capable of supplying large amounts of water for future municipal and industrial requirements.

OBSERVATION WELLS

1N/2E-9cc	(Port of Portland) is a 155 foot drilled well in sand and gravel located about one mile north of Parkrose.
1N/3E-26dd	(Kazuo Fujii) is a 478 foot drilled well in gravel located about one mile southwest of Troutdale.
1S/3E-7cc	(Meadowland Dairy) is a 261 foot drilled well in sand and gravel located about 2 miles southwest of Gresham.
1S/3E-10cc	(Forest Lawn Memorial Park) is a 715 foot drilled well in gravel located in Gresham.


1N/2E-9cc
1N/3E-26dd
1S/3E-7cc
1S/3E-10cc
Water level, feet below land surface
0
5
10
15
105
110
115
120
125
75
80
85
90
95
100
95
100
105
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MAR.
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19 75

THE DALLES AREA (3)

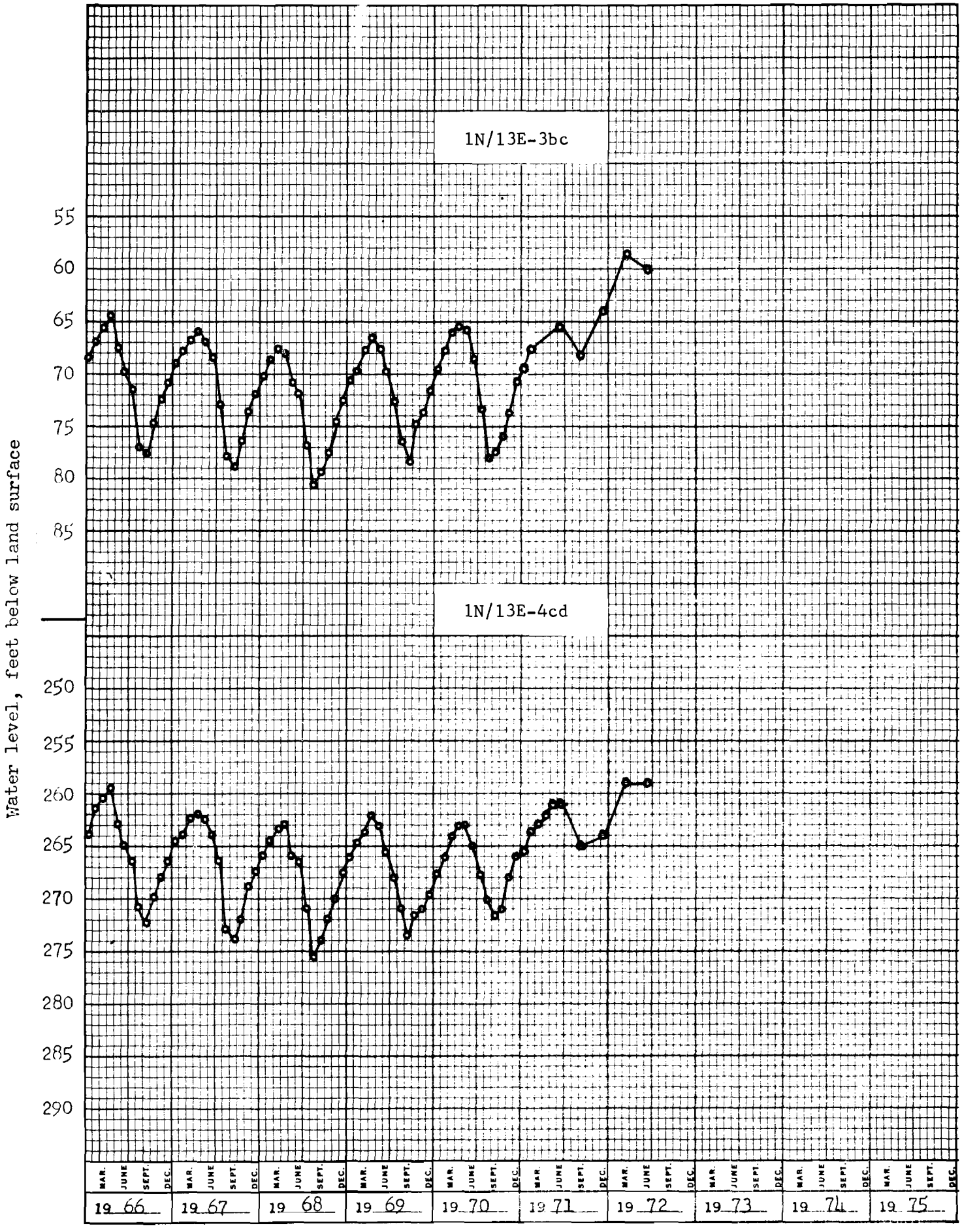
The area in and around Dalles City was declared a "Critical Ground Water Area" in 1959 because of declining water levels. The ground-water reservoir developed by most of the municipal, industrial and irrigation wells develop ground water from a very permeable zone in the Columbia River Basalt formation. This zone has been named The Dalles Ground Water Reservoir and is locally known as "The Dalles Pool". The 1966 spring high position of the water level in The Dalles Ground Water Reservoir was at an altitude of about 39 feet, or some 34 feet below the adjacent level of the Bonneville pool in the Columbia River, which was about the same as the 1965 spring high position. A reduction of ground-water withdrawals has occurred since 1965 due to the operation of The Dalles Irrigation Project. Columbia River water is now available for irrigation. Water levels in The Dalles Ground Water Reservoir stabilized in 1968 and have begun to recover 2 feet per year. Municipal wells at The Dalles appear to be in balance with the aquifer system. Totalizing water meter data for all wells in the critical ground water area at The Dalles has not been reported to the State Engineer's Office; therefore, no estimate of the annual recharge or discharge in The Dalles Pool is available at this date, January, 1973.

OBSERVATION WELLS

1N/13E-3bc	(Dalles City - City Hall Well) is a 200.5 foot drilled well in basalt located in The Dalles. Periodic water level measurements available from 1926-1930; 1951-1952 and 1958 to date.
1N/13E-4cd	(Dalles City - Marx Well) is a 570 foot drilled well in basalt located in The Dalles.

REFERENCES

Piper, A. M., 1932, Geology and ground water resources of The Dalles Region, Oregon: U. S. Geological Survey Water Supply Paper 659-B.


1N/13E-3bc
1N/13E-4cd
Water level, feet below land surface
55
60
65
70
75
80
85
250
255
260
265
270
275
280
285
290
MAR. JUNE SEPT. DEC.
19 66
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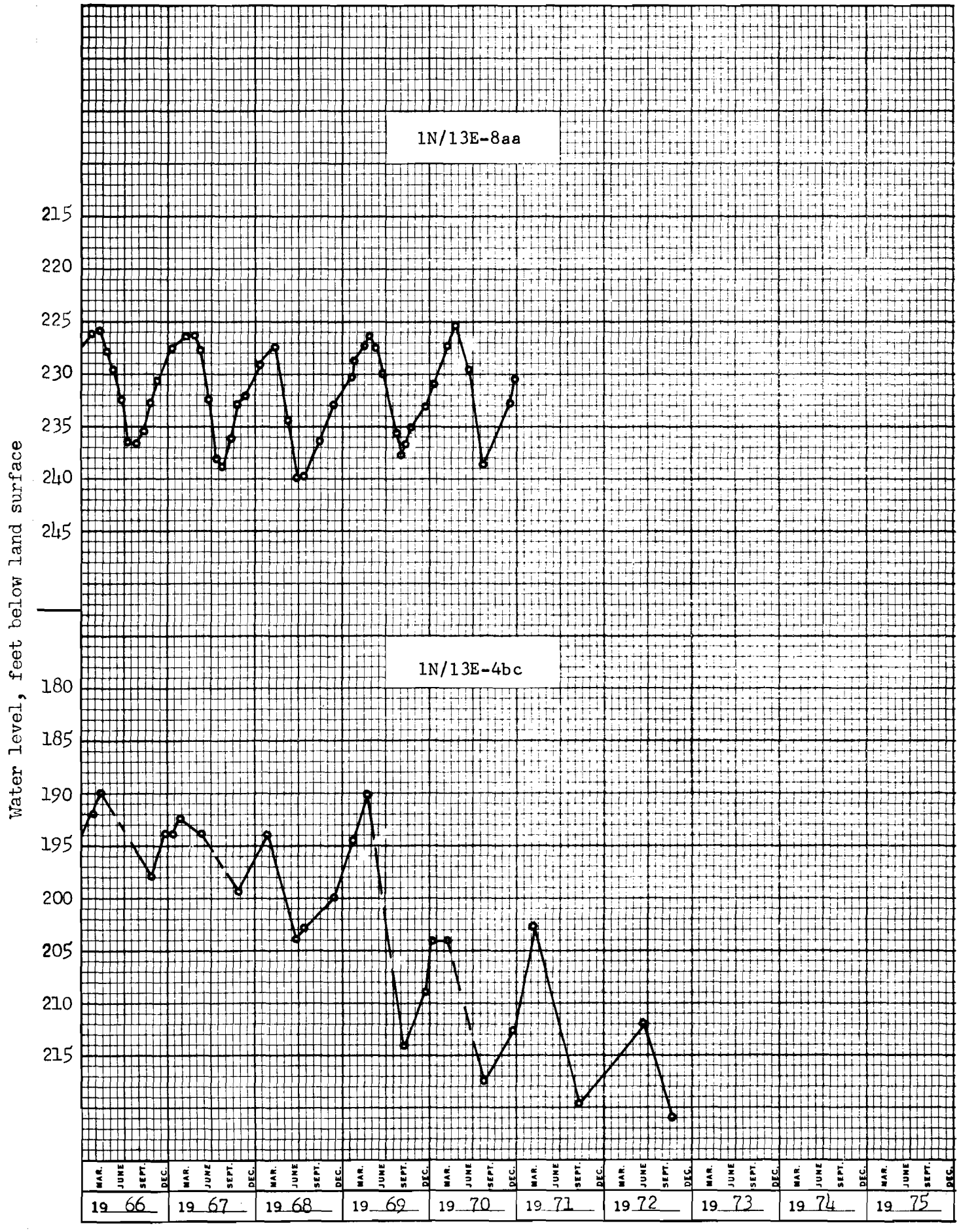
THE DALLES AREA (3)

Ground water declines are continuing in the area west of The Dalles near the irrigation wells operated by the Odd Fellows Cemetery.

OBSERVATION WELLS

1N/13E-8aa	(G. S. Williams) is a 341 foot drilled well in basalt located about one mile south of The Dalles.
1N/13E-4bc	(Odd Fellows Cemetery) is a 306 foot drilled well in basalt located about one mile west of The Dalles. Periodic water level measurements available from 1956 to date.


1N/13E-8aa
1N/13E-4bc
Water level, feet below land surface
215
220
225
230
235
240
245
180
185
190
195
200
205
210
215
MAR. JUNE SEPT. DEC.
19 66
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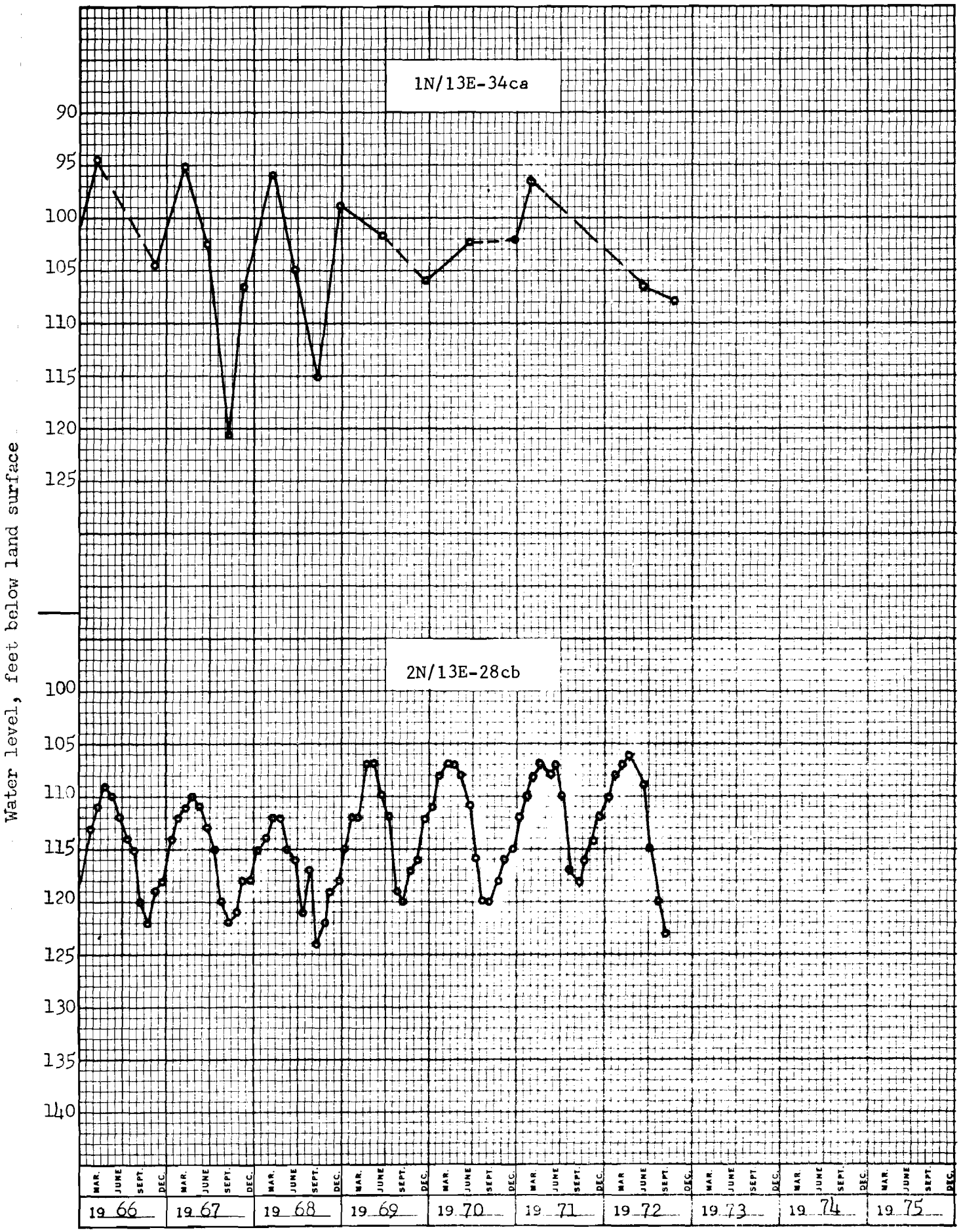
THE DALLES AREA (3)

OBSERVATION WELLS

1N/13E-34ca (George F. Bradley, formerly Westgage) is a 500 foot drilled well in basalt located about 6 miles south of The Dalles in the Fivemile Creek Valley.

2N/13E-28cb (Harvey Aluminum Company) is a 314 foot drilled well in basalt located about 2 miles northwest of The Dalles. Periodic water level measurements available from 1957 to date.


1N/13E-34ca
90
95
100
105
110
115
120
125
2N/13E-28cb
100
105
110
115
120
125
130
135
140
Water level, feet below land surface
MAR. JUNE SEPT. DEC.
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19 72
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19 74
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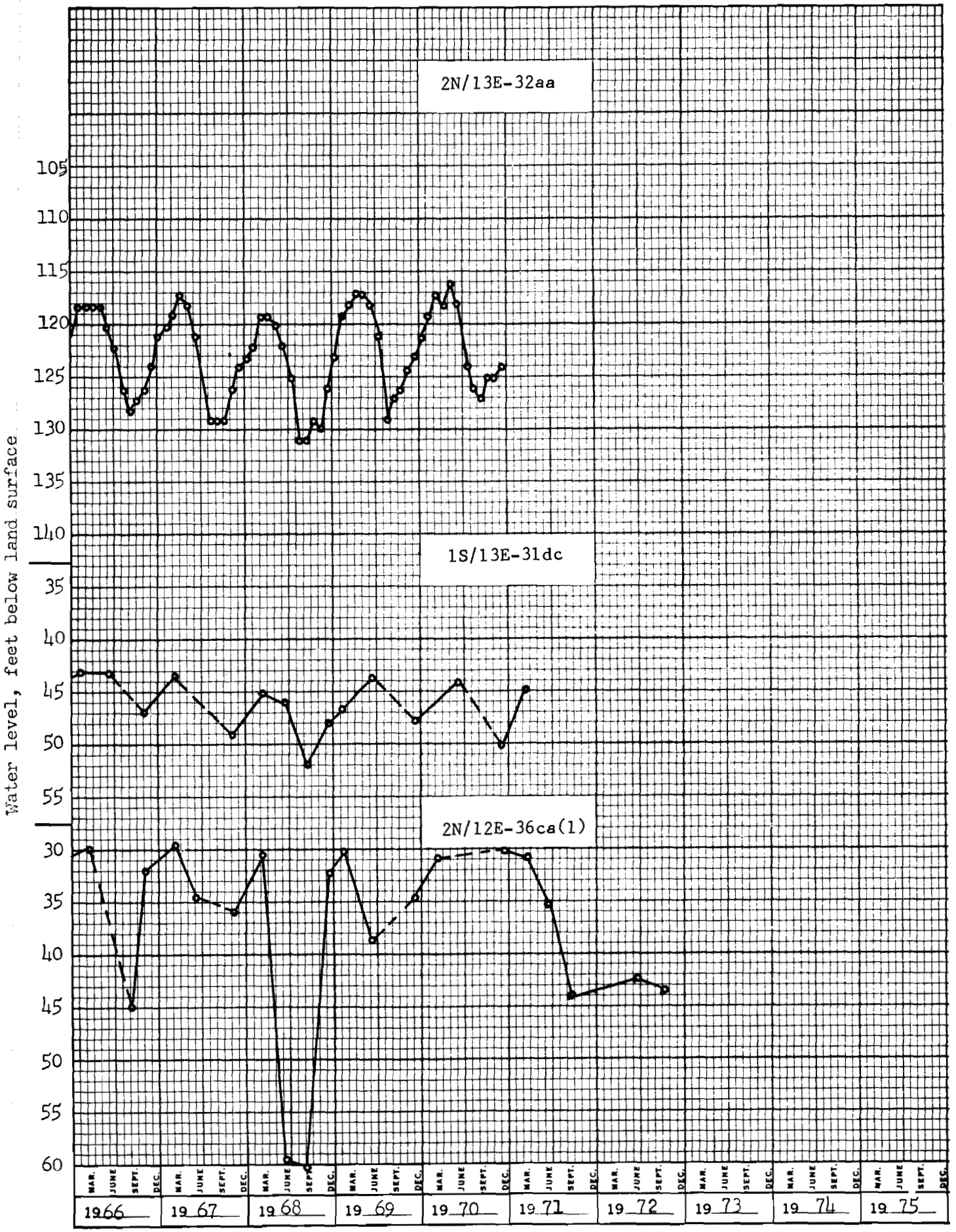
THE DALLES AREA (3)

OBSERVATION WELLS

2N/13E-32aa (Chenowith Irrigation Coop.) is a 275 foot drilled well in basalt located about one mile northwest of The Dalles. Periodic water level measurements available from 1957 to date.

1S/13E-31dc (William L. Hulse) is a 111 foot drilled well in basalt located about 5 miles southwest of Dufur.

2N/12E-36ca(1) (Mrs. James Douthit) is a 302 foot domestic and irrigation well developing water from sandstone.


2N/13E-32aa
1S/13E-31dc
2N/12E-36ca(1)
Water level, feet below land surface
105
110
115
120
125
130
135
140
35
40
45
50
55
30
35
40
45
50
55
60
MAR.
JUNE
SEPT.
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1966
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1975

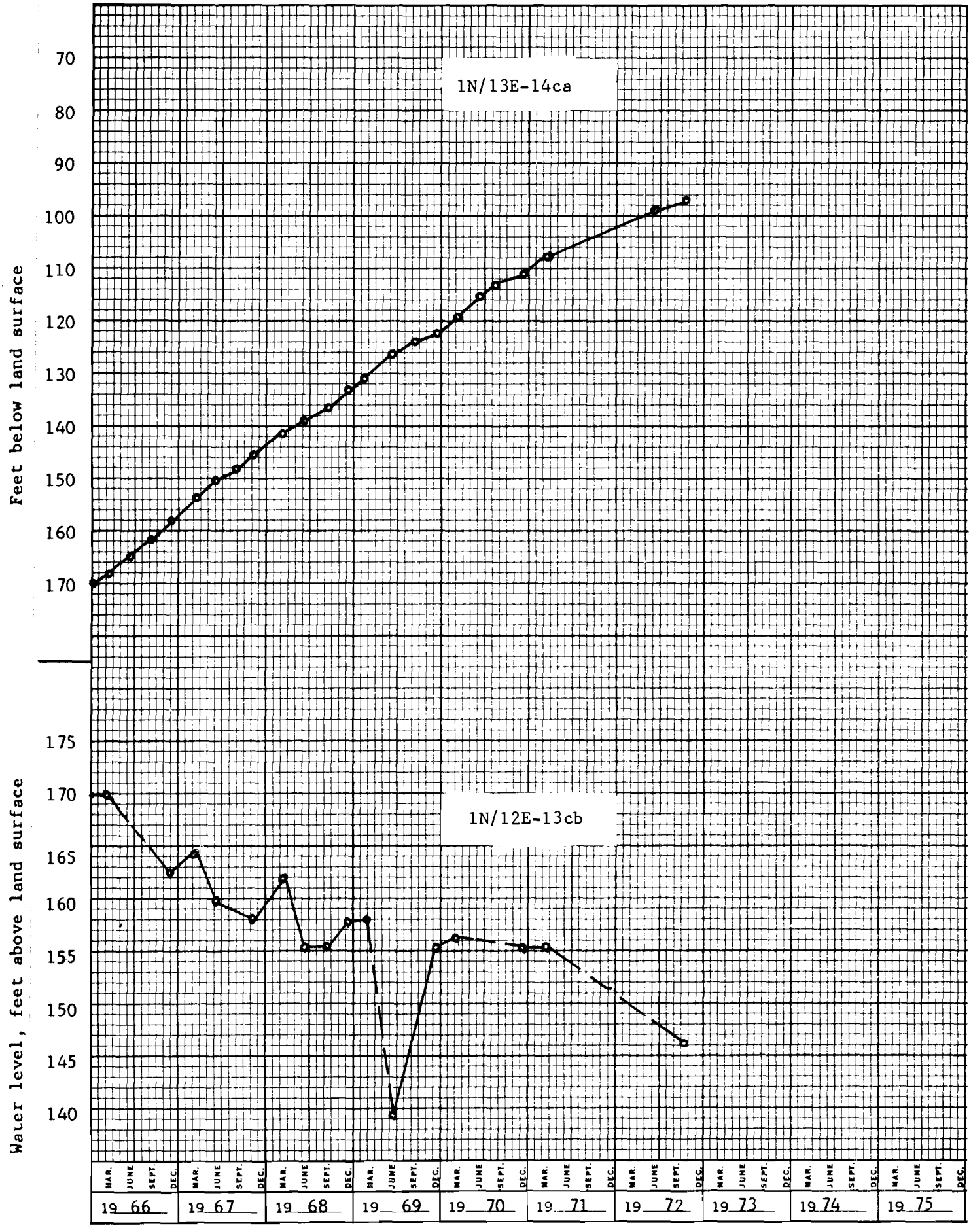
THE DALLES AREA (3)

Artesian pressures in confined aquifers located 2 miles south of The Dalles have been recovering since 1966. The use of imported water from the Columbia River in 1966 has resulted in nonuse of many irrigation wells during the last few years.

OBSERVATION WELLS

1N/13E-14ca	(V. R. Martin) is a 230 foot drilled well in basalt located about 2 miles south of The Dalles in the Threemile Creek Valley.
1N/12E-13cb	(Julius Sandoz) is a 572 foot drilled well in basalt located about 4 miles southwest of The Dalles in the Mill Creek Valley. Periodic water level measurements available from 1957 to date.

THE DALLES AREA (3)



COLUMBIA SLOPE AREA (4)

The Columbia Slope area includes the broad northward sloping area in northern Morrow County and northwestern Umatilla County. A large part of this area is underlain by 30 to 160 feet or more of sand, gravel, and clay deposits that were laid down during the Ice Age. These deposits rest upon a very thick sequence of basaltic lava flows that have been named the Columbia River Basalt formation. This formation is composed of a series of lava flows layered one upon another. Individual flows range from a few feet to a hundred feet or more in thickness. Very fluid basaltic lava welled to the surface from large cracks that opened up in many parts of the Columbia Basin area. The lavas spread out as extensive lakes of molten rock. Long periods of time often separated the outpourings of lava. At times, soil zones and forests developed on the lava surface only to be buried by a subsequent lava flow. Tree casts and petrified wood occur in some locations along the Columbia River Highway in this formation. Porous, scoracious interflow zones, when saturated, form the most productive water-bearing zones in the Columbia River Group.

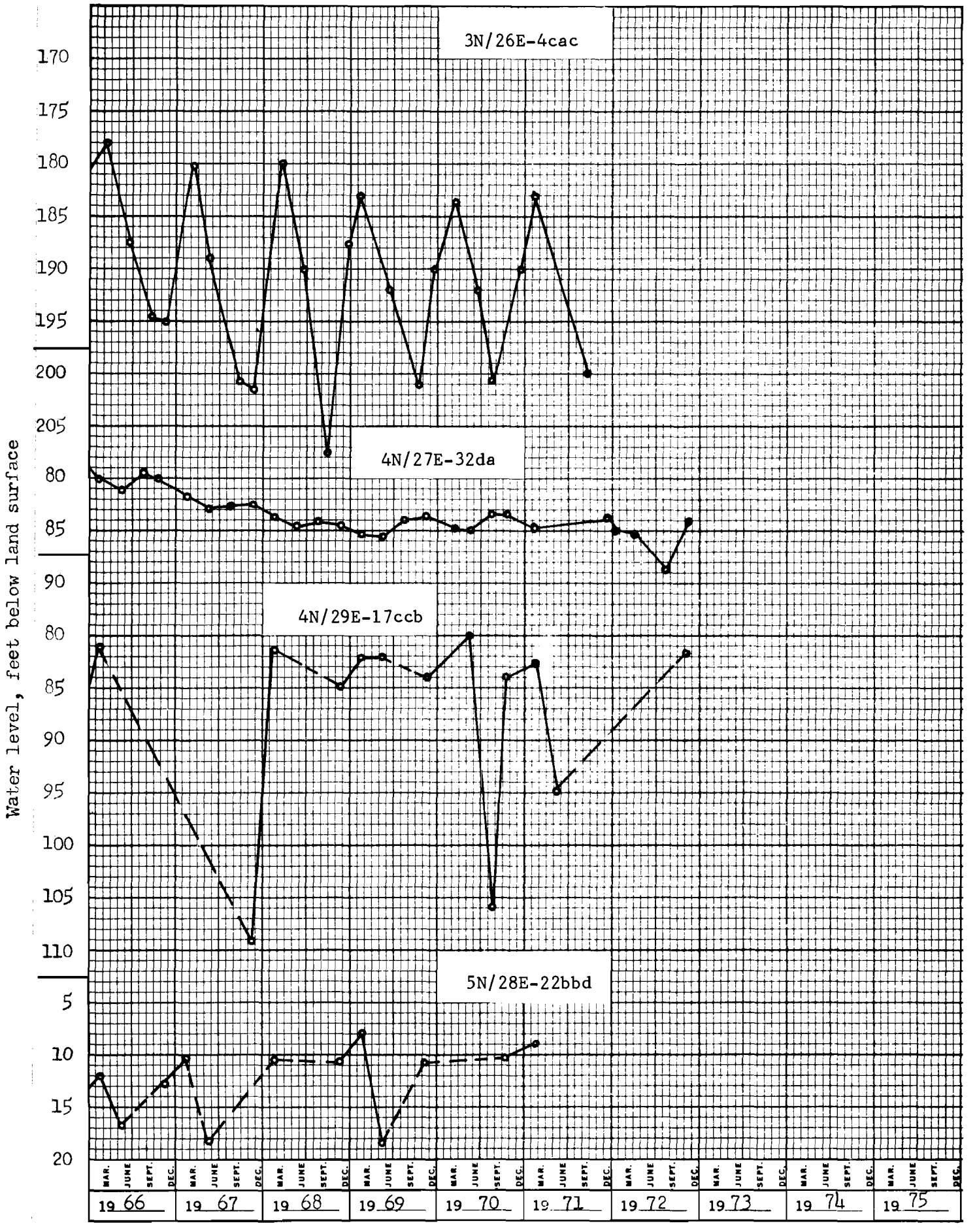
OBSERVATION WELLS

3N/26E-4cac	(Luther Cramer) is a 623 foot drilled well in basalt located about 8 miles southwest of Ordnance.
4N/27E-32da	(R. Holzapfel) is a 310 foot drilled well in basalt located about 2 miles southwest of Ordnance.
4N/29E-17ccb	(Milton Culp) is a 207 foot drilled well in sand located about one mile north of Stanfield.
5N/28E-22bbd	(L. J. Martin, formerly Munson) is a 189 foot drilled well in basalt located about 3 miles south of Umatilla. Periodic water level measurements available from 1953 to date.

REFERENCES

Hogenson, G. M., 1964, Geology and ground water of the Umatilla River Basin, Oregon: U. S. Geological Survey Water Supply Paper 1620.

Robison, James H., 1971, Hydrology of basalt aquifers in the Hermiston-Ordnance area, Umatilla and Morrow Counties, Oregon: U. S. Geological Survey Hydrologic Atlas, HA-387.


3N/26E-4cac
4N/27E-32da
4N/29E-17ccb
5N/28E-22bbd
Water level, feet below land surface
170
175
180
185
190
195
200
205
80
85
90
80
85
90
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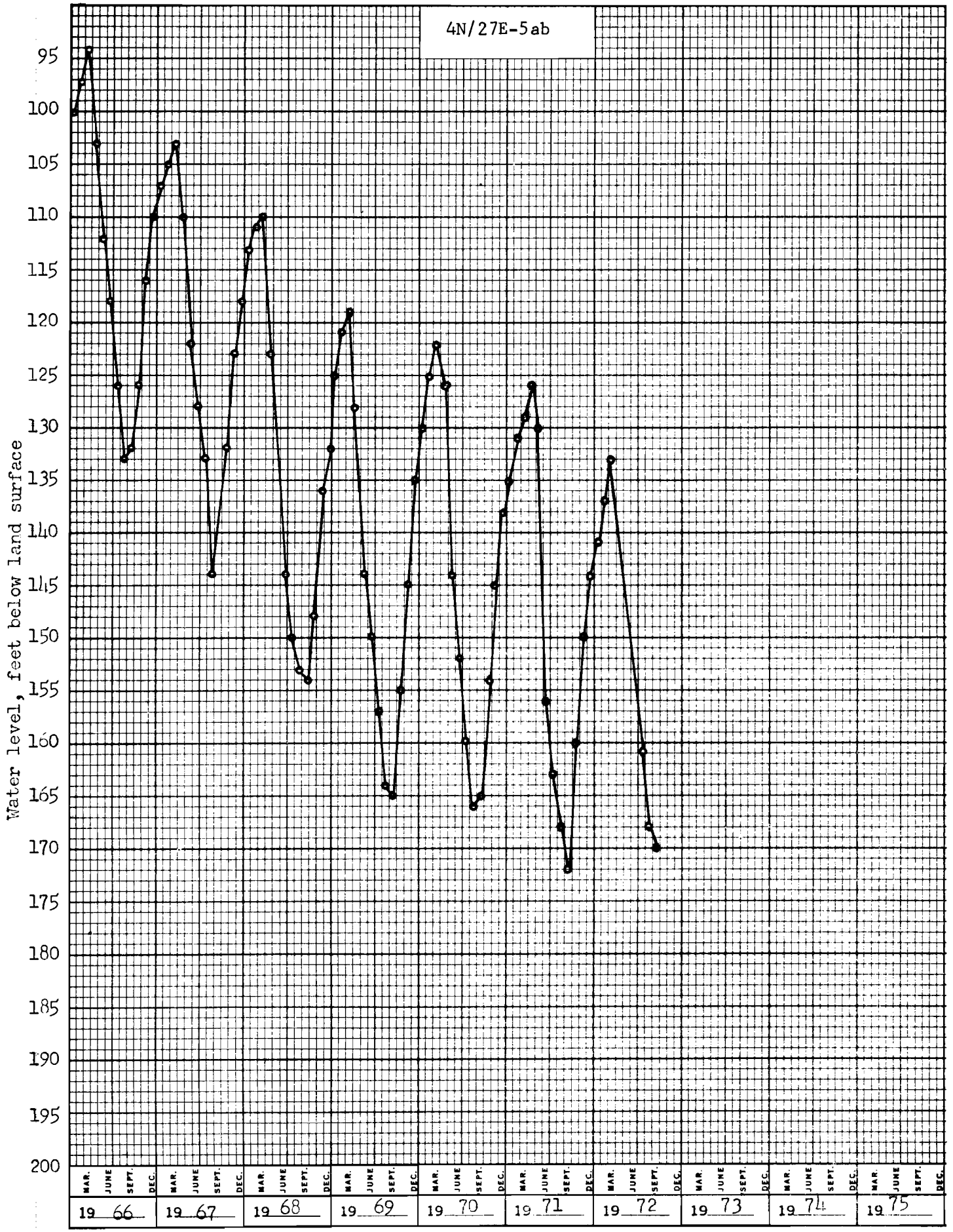
COLUMBIA SLOPE AREA (4)

Most of the Columbia River Basalt formation has low porosity. The per cent of open space for the storage of water is low, probably averaging less than one to three per cent. Part of this porosity was formed by shrinkage cracks that formed when the lava consolidated, part was formed by the bubble holes that develop near the upper and lower surfaces of individual lava flows by expanding gases. These inflated and rubbly, broken zones form the contacts between lava flows. Shrinkage cracks and bubble holes are generally interconnected to a degree that allows for the easy passage of water. The contact zones between flows are at places very permeable and serve as the chief zones for the development of ground water. Generally several such permeable zones must be penetrated by wells in order to develop an adequate water supply for the larger capacity wells.

OBSERVATION WELL

4N/27E-5ab (Umatilla Army Depot - Well No. 6) is a 710 foot drilled well in basalt located at Ordnance. Periodic water level measurements available from 1955 to date.


4N/27E-5ab
Water level, feet below land surface
95
100
105
110
115
120
125
130
135
140
145
150
155
160
165
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175
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MAR. JUNE SEPT. DEC.
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COLUMBIA SLOPE AREA (4)

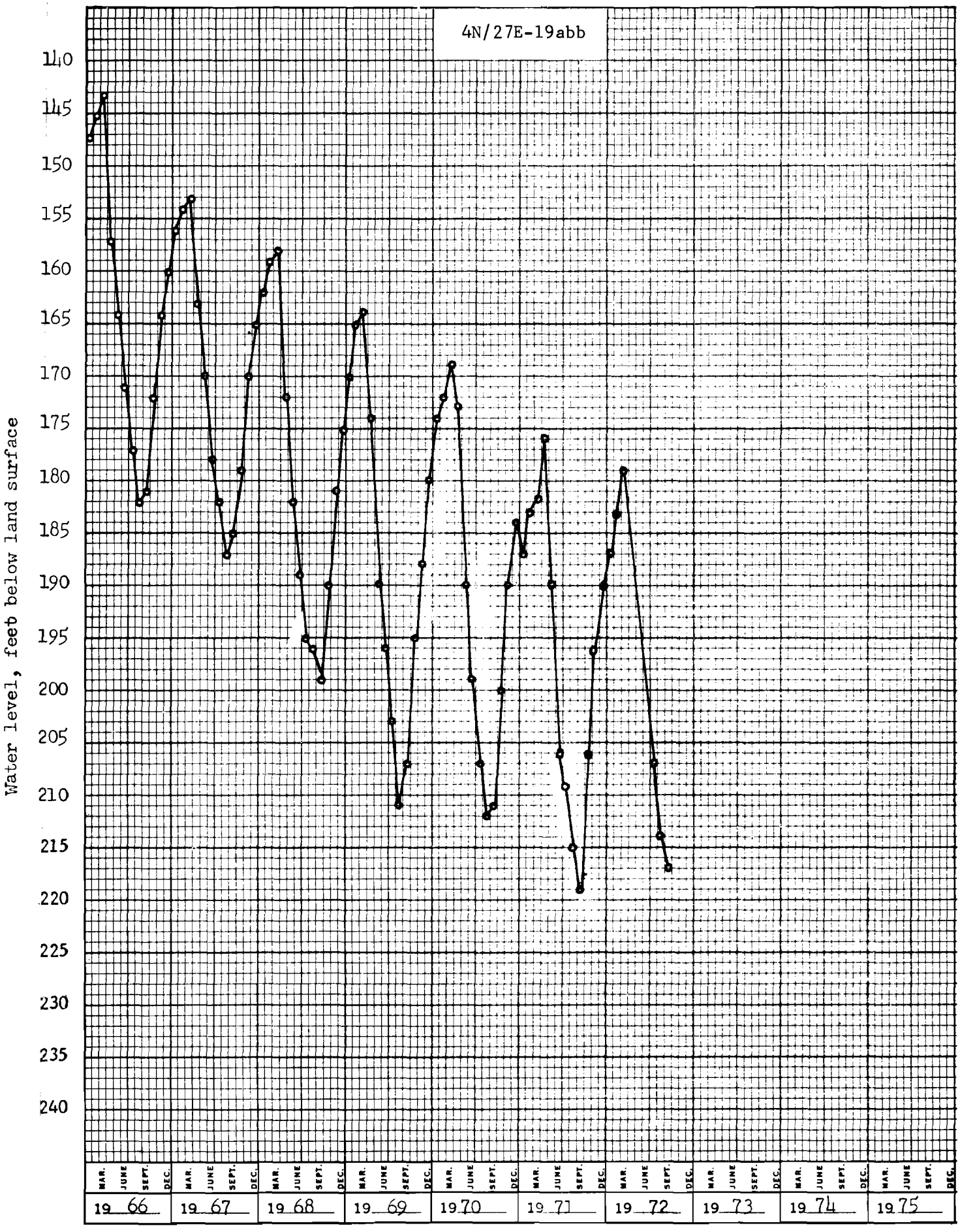
Ground water occurring in the shallow gravels overlying the basalt aquifers derives some recharge from irrigation water imported into the area. The shallow water-bearing zones in the underlying basalt formation are believed to be poorly connected with the overlying gravels. Continued development of the shallow gravel aquifers at Ordnance has resulted in an overdraft of the shallow ground-water body. The gravels vary from 30 to 160 feet in thickness. The coarse gravel filled channel deposits support the larger producing wells of the area. Sustained water level declines of 1 to 4 feet per year have been observed in gravel wells during the last three years. Controls will be required to prevent further water level decline in the shallow gravel aquifer.

The deep water-bearing zones in the basalt are hydraulically separated from the shallow water-bearing zone and receive little or no annual recharge. The meager amount of pumping from these deep zones in the past few years has been sufficient to cause a major decline in water levels and it appears that we are mining the available ground-water supply from these deep zones. Whenever annual pumping exceeds the rate of annual recharge, water levels must decline. Both gravel and basalt aquifers are critical and wells will be controlled to stabilize the position of the zone of saturation.

OBSERVATION WELL

4N/27E-19abb (Umatilla Army Depot - Well No. 4) is a 600 foot drilled well in basalt located at Ordnance. Periodic water level measurements available from 1955 to date.

COLUMBIA SLOPE AREA (4)



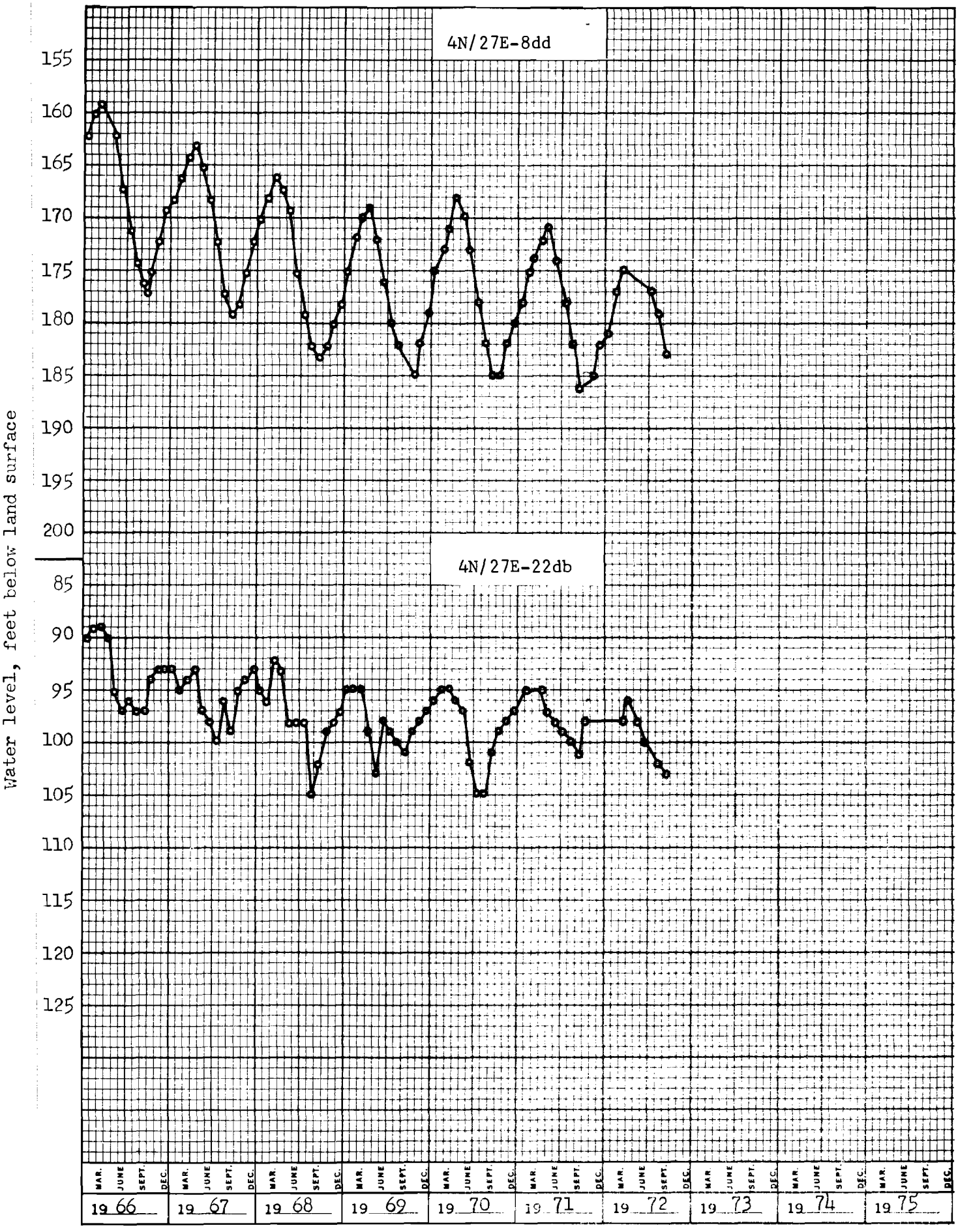
COLUMBIA SLOPE AREA (4)

OBSERVATION WELLS

4N/27E-8dd (Umatilla Army Depot - Well No. 3) is a 453 foot drilled well in basalt located at Ordnance. Periodic water level measurements available from 1950-1951 and from 1961 to date.

4N/27E-22db (Umatilla Army Depot - Well No. 2) is a 360 foot drilled well in basalt located at Ordnance. Periodic water level measurements available from 1950-1951 and from 1954 to date.

COLUMBIA SLOPE AREA (4)



MILTON-FREEWATER AREA (5)

Milton-Freewater is located at the head of a large alluvial fan where the Walla Walla River flows out of the Blue Mountains. The fan is composed of coarse alluvium and is recharged by the Walla Walla River and irrigation diversions. High ground water levels in many of the wells occurs during the irrigation season. The permeable character of the alluvial gravels and the extensive recharge from irrigation creates a pollution threat to all shallow wells on the alluvial fan.

The alluvial fan is underlain at depth by the Columbia River Basalt formation. Some of the deep wells in the Milton-Freewater area, which develop ground water from the basalt, have been declining in recent years.

OBSERVATION WELLS

5N/35E-1ba (William A. Bingman) is a 32.5 foot dug well in gravel located near Milton-Freewater. Periodic water level measurements available from 1933 to date.

5N/35E-2ba (K. A. Townsend) is a 22 foot dug well in sand and gravel located about one mile west of Milton-Freewater. Periodic water level measurements available from 1933 to date.

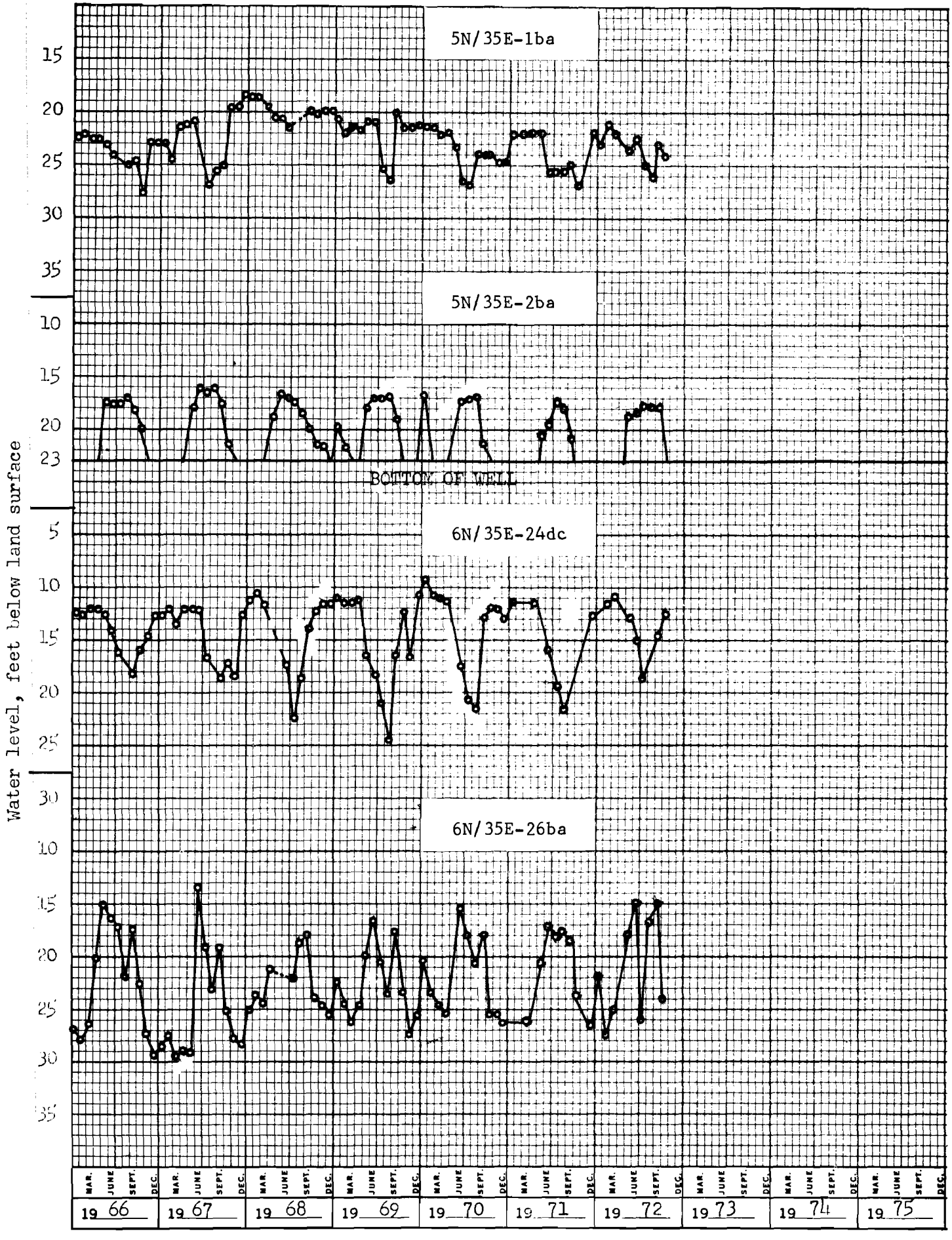
6N/35E-24dc (George H. Ransom) is a 165 foot dug and drilled well in gravel located about 3 miles north of Milton-Freewater. Periodic water level measurements available from 1933 to date.

6N/35E-26ba (Earl Ransom) is a 110 foot dug and drilled well in gravel located about 2 miles north of Milton-Freewater. Periodic water level measurements available from 1933 to date.

REFERENCES

Newcomb, R. C., 1951, Preliminary report on the ground water resources of the Walla Walla Basin, Washington-Oregon: U. S. Geological Survey open-file report.

MILTON-FREEWATER AREA (5)



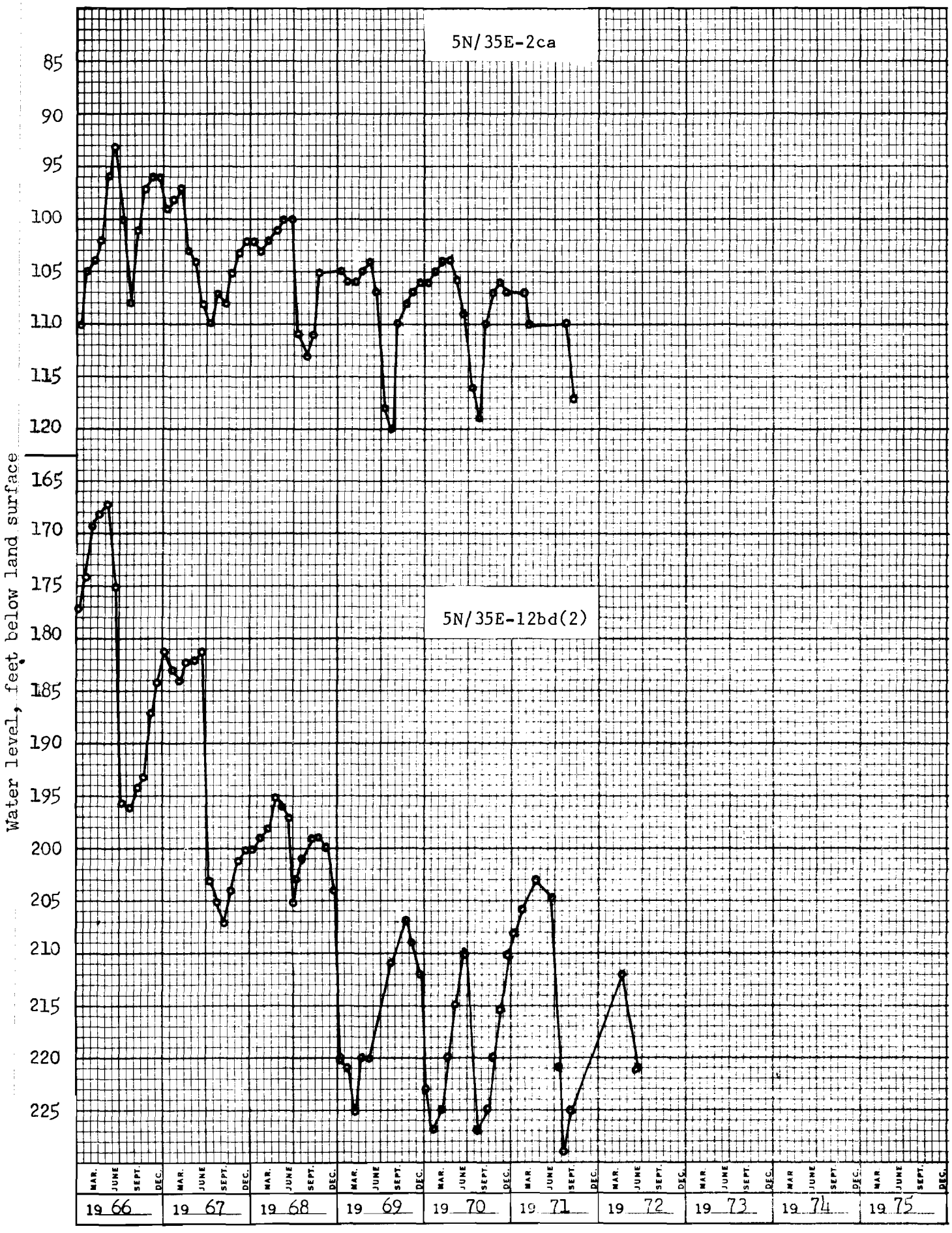
MILTON-FREEWATER AREA (5)

OBSERVATION WELLS

5N/35E-2ca (City of Milton-Freewater - Well No. 6) is a 952 foot drilled well in Columbia River Basalt located within the city of Milton-Freewater. Periodic water level measurements available from 1954 to date.

5N/35E-12bd(2) (City of Milton-Freewater - Well No. 2) is a 902 foot drilled well in Columbia River Basalt located within the city of Milton-Freewater. Periodic water level measurements available from 1954 to date.

MILTON-FREEWATER (5)



PENDLETON-PILOT ROCK AREA (6)

The Pendleton-Pilot Rock area lies in a structural valley formed in the Columbia River Basalt formation. This structural valley has been partially filled with sand and gravel deposits. The deep wells all develop water from the basalt formation. Some water level declines have been reported in the Weston area.

The uncertainty of being able to develop large ground-water supplies in the Columbia River at every location was demonstrated in 1965 by the construction of a 1,500 foot well at Pendleton which had a capacity of only 525 gallons per minute with 361 feet of drawdown. A new well at Pilot Rock encountered artesian conditions at a depth of 880 feet. Continued development here has resulted in a reduction of artesian head of 2 to 5 feet per year since 1966.

OBSERVATION WELLS

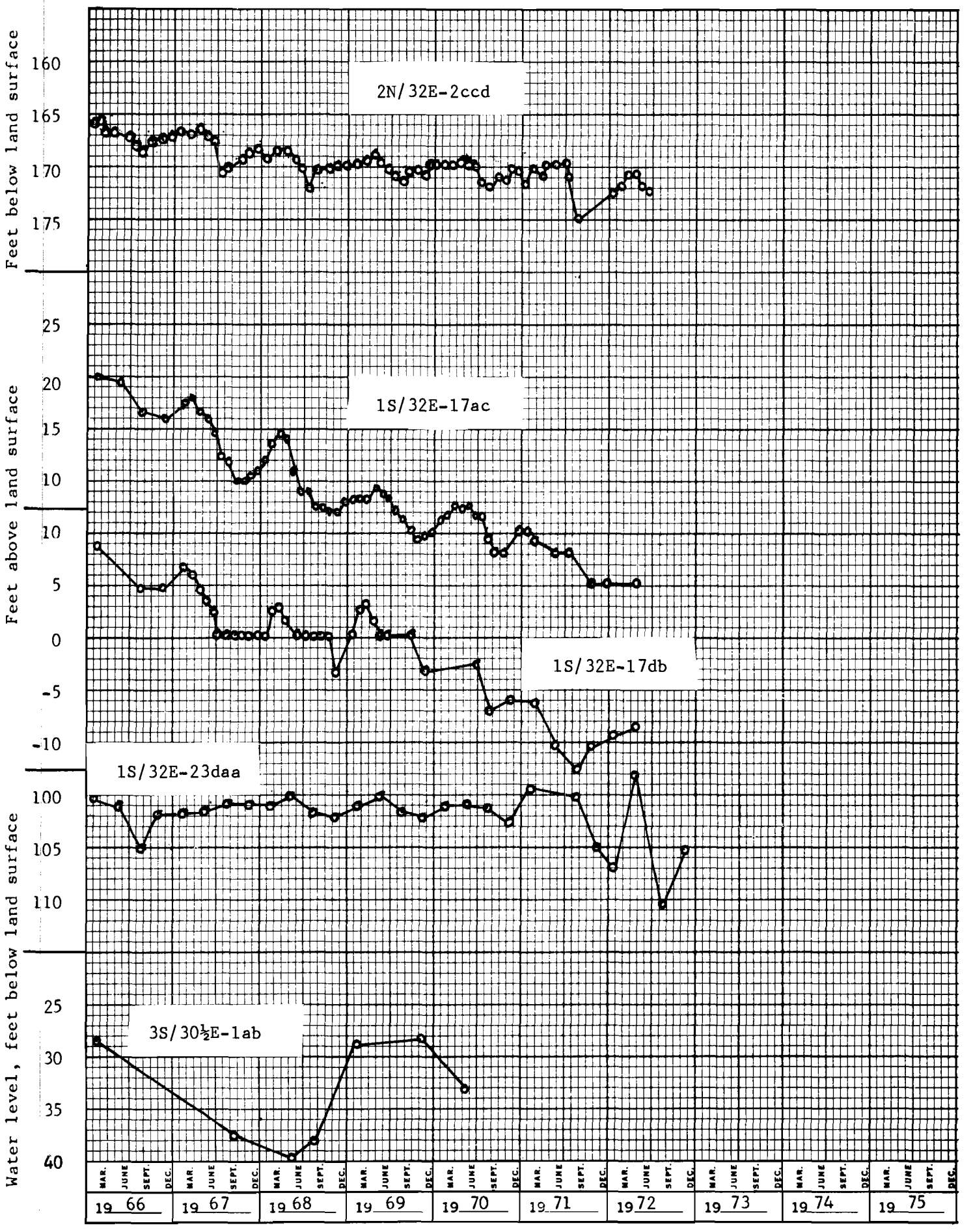
2N/32E-2ccd	(City of Pendleton - Stillman Park Well) is a 700 foot drilled well in Columbia River Basalt located within the city of Pendleton.
1S/32E-17ac	(City of Pilot Rock - Well No. 1) is a 309 foot artesian well drilled in Columbia River Basalt located within the city of Pilot Rock.
1S/32E-17db	(City of Pilot Rock - Well No. 2) is a 486 foot artesian well drilled in Columbia River Basalt located within the city of Pilot Rock.
1S/32E-23daa	(Hilmer Horn) is a 774 foot drilled well in basalt located about 4 miles southeast of Pilot Rock.
3S/30½E-1ab	(Joseph Pedro) is a 99 foot drilled well in basalt located about 10 miles southwest of Pilot Rock. Periodic water level measurements available from 1953 to date.

REFERENCES

Brown, Stuart G., 1955, Inquiry into the reported interference between artesian wells near Pilot Rock, Oregon: U. S. Geological Survey open-file report.

Hogenson, G. M., 1964, Geology and ground water of the Umatilla River Basin, Oregon: U. S. Geological Survey Water Supply Paper 1620.

PENDLETON-PILOT ROCK AREA



GRANDE RONDE VALLEY (7)

The Grande Ronde Valley is a broad, deep structural valley that has been partially filled with lake and stream deposited clays, silts, sands, and gravels. The occurrence of coarse-grained sand and gravel deposits is usually limited to the alluvial fans that have formed where the larger streams flow into the valley. The deeper materials in the basin fill are fine-grained silts and clays.

The basin is underlain by the Columbia River Basalt formation which contains confined ground water. Wells drilled into the basalt generally flow at the surface.

New irrigation wells have been drilled during the past few years. Some of these develop several thousand gallons per minute from the sand and gravel deposits.

It appears that the permeable alluvial deposits can withstand a large additional development without creating a serious problem of declining water levels. At the present time, large amounts of the precipitation which would be available for ground water recharge is being rejected because the ground water reservoir in the alluvial deposits are full to overflowing. Additional pumping during the irrigation season would cause a lowering of the water table and create additional ground-water storage space.

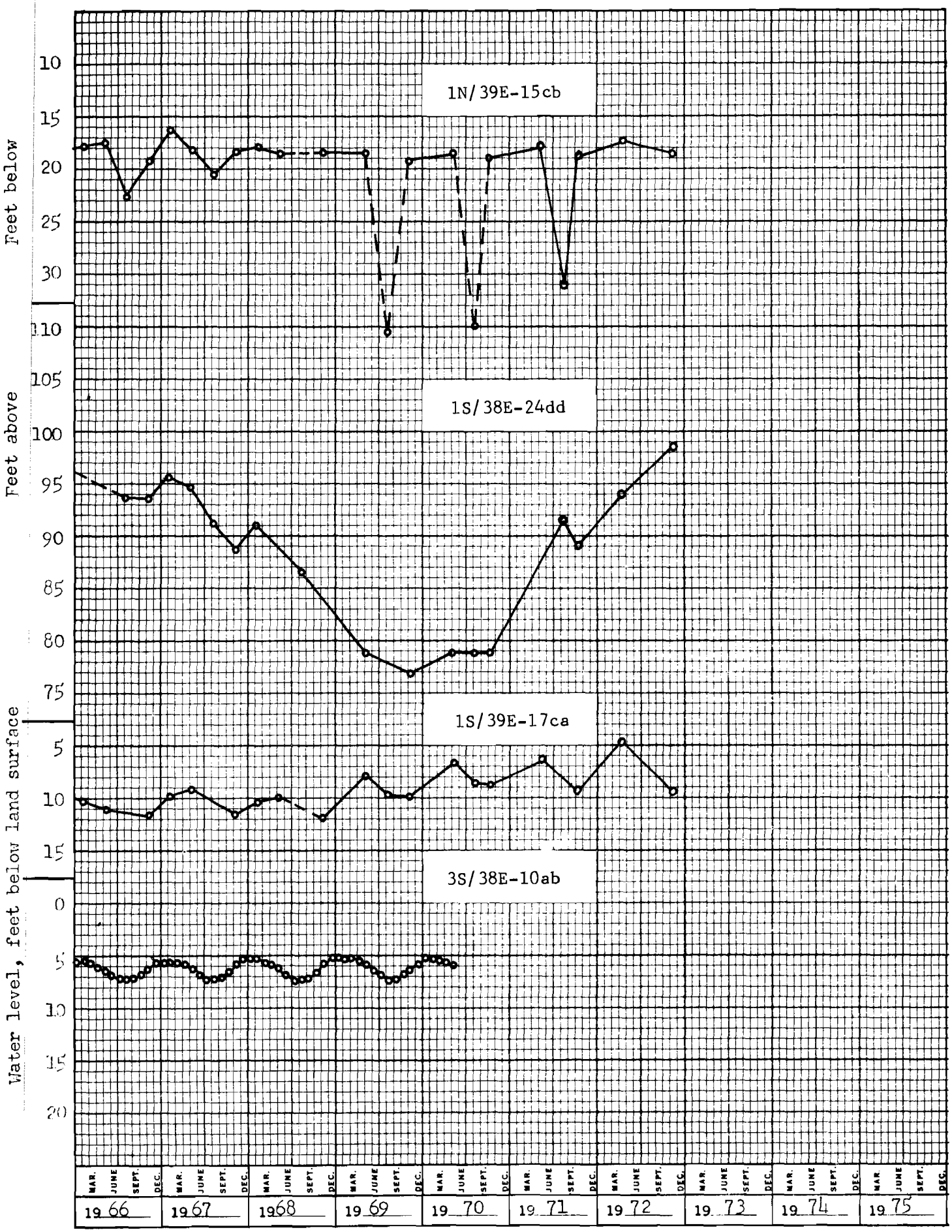
OBSERVATION WELLS

1N/39E-15cb	(Jim Morgan) is a 130 foot drilled well in sand and gravel located near Elgin.
1S/38E-24dd	(H. L. Wagner) is a 1150 foot artesian well drilled in basalt located about 3 miles west of Imbler. Periodic water level measurements available from 1950 to date.
1S/39E-17ca	(A. F. Furman) is a 44.6 foot drilled well in sand located near Imbler. Periodic water level measurements available from 1940 to date.
3S/38E-10ab	(Union County) is an 11 foot dug well in sand and gravel located about 2 miles east of La Grande. Periodic water level measurements available from 1936, and from 1938 to 1970.

REFERENCES

Hampton, E. R., and Brown, S. G., 1964, Geology and ground water resources of the Upper Grande Ronde River Basin, Union County, Oregon: U. S. Geological Survey Water Supply Paper 1597.

GRANDE RONDE VALLEY (7)



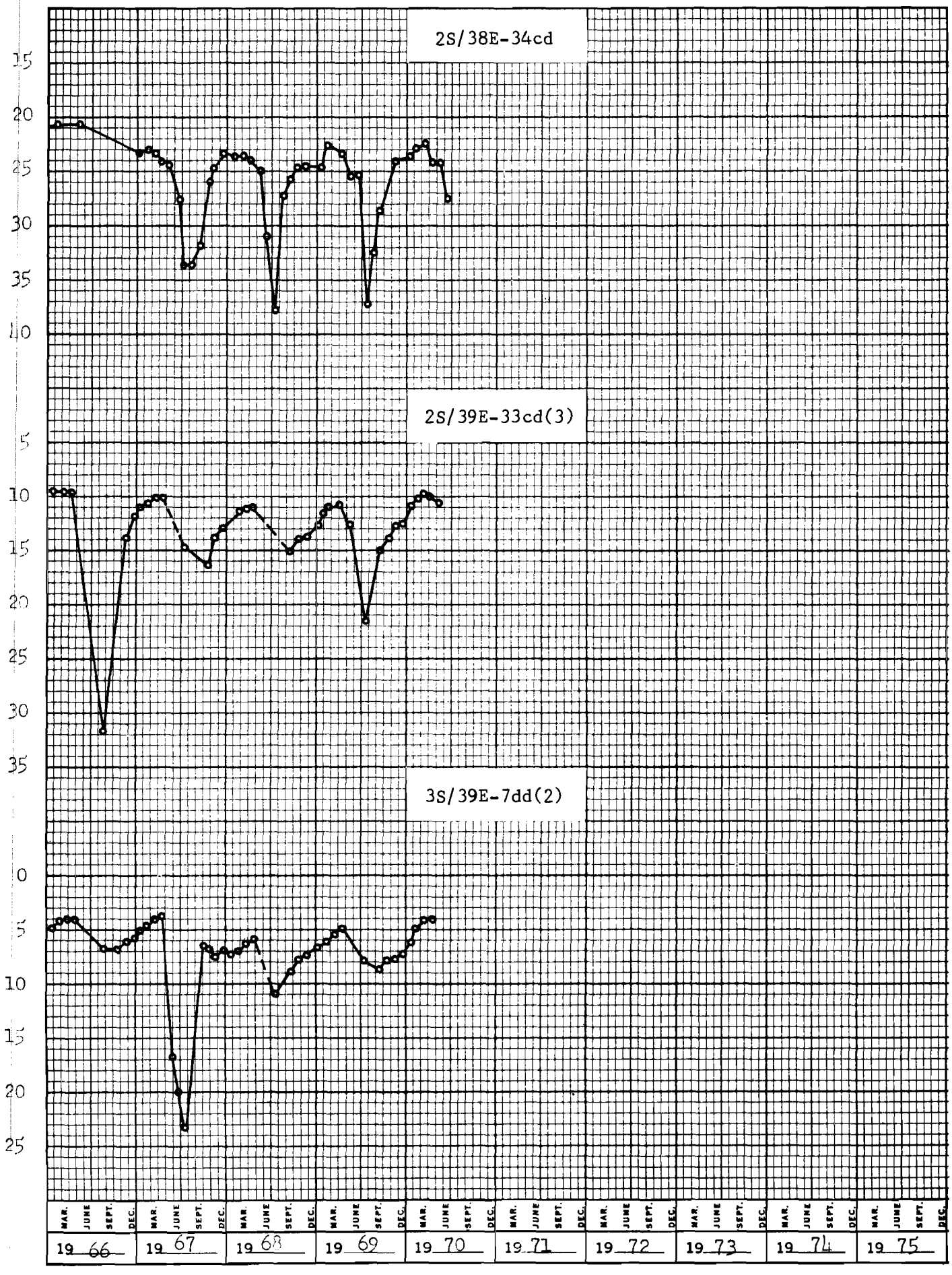
GRANDE RONDE VALLEY (7)

OBSERVATION WELLS

2S/38E-34cd (Island City) is a 315 foot municipal well in Island City developing water from gravel.

2S/39E-33cd(3) (Wilfred Hamann) is a 255 foot drilled well in sand and gravel located about 6 miles east of La Grande.

3S/39E-7dd(2) (Stanley Weishaar) is a 375 foot drilled well in sand and gravel located about 5 miles southeast of Island City.


2S/38E-34cd
15
20
25
30
35
40
2S/39E-33cd(3)
5
10
15
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30
35
3S/39E-7dd(2)
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BAKER VALLEY (8)

The Baker Valley is a broad structural basin that has been partially filled with lake and stream deposits. The coarser-grained sand and gravel deposits are confined to the large alluvial fans that have been formed by streams flowing out of the Elkhorn Mountains.

At many places in the Baker Valley the water table is at or near land surface. This indicates that the ground-water reservoirs are full. Ground-water developments in some areas of the valley would aid in solving drainage problems. A 650 foot well was drilled near the City of Baker during 1965 that was tested at a yield of 2,000 gallons per minute with 100 feet of drawdown. Part of the ground water was developed from the alluvial gravels and part from the permeable volcanic rocks that were encountered in the bottom 150 feet of the well.

OBSERVATION WELLS

8S/39E-22bdd	(Baker County) is a 12 foot dug well in sand and gravel located in the Baker Valley near Wingville. Periodic water level measurements available from 1938 to date.
8S/40E-19bbb	(Baker County) is a 9 foot dug well in sand and gravel located in the Baker Valley near Wingville. Periodic water level measurements available from 1938 to date.
9S/39E-2ccc	(Kermit Hansen) is a 321 foot drilled well in gravel located about 4 miles northwest of Baker. Periodic water level measurements available from 1949 to date.
9S/40E-18dcd	(Paul V. Hill) is a 575 foot drilled well in gravel located about one mile west of Baker.
6S/39E-20ba	(Ed McCanse) is a 562 foot drilled well in gravel located about 2 miles west of North Powder.

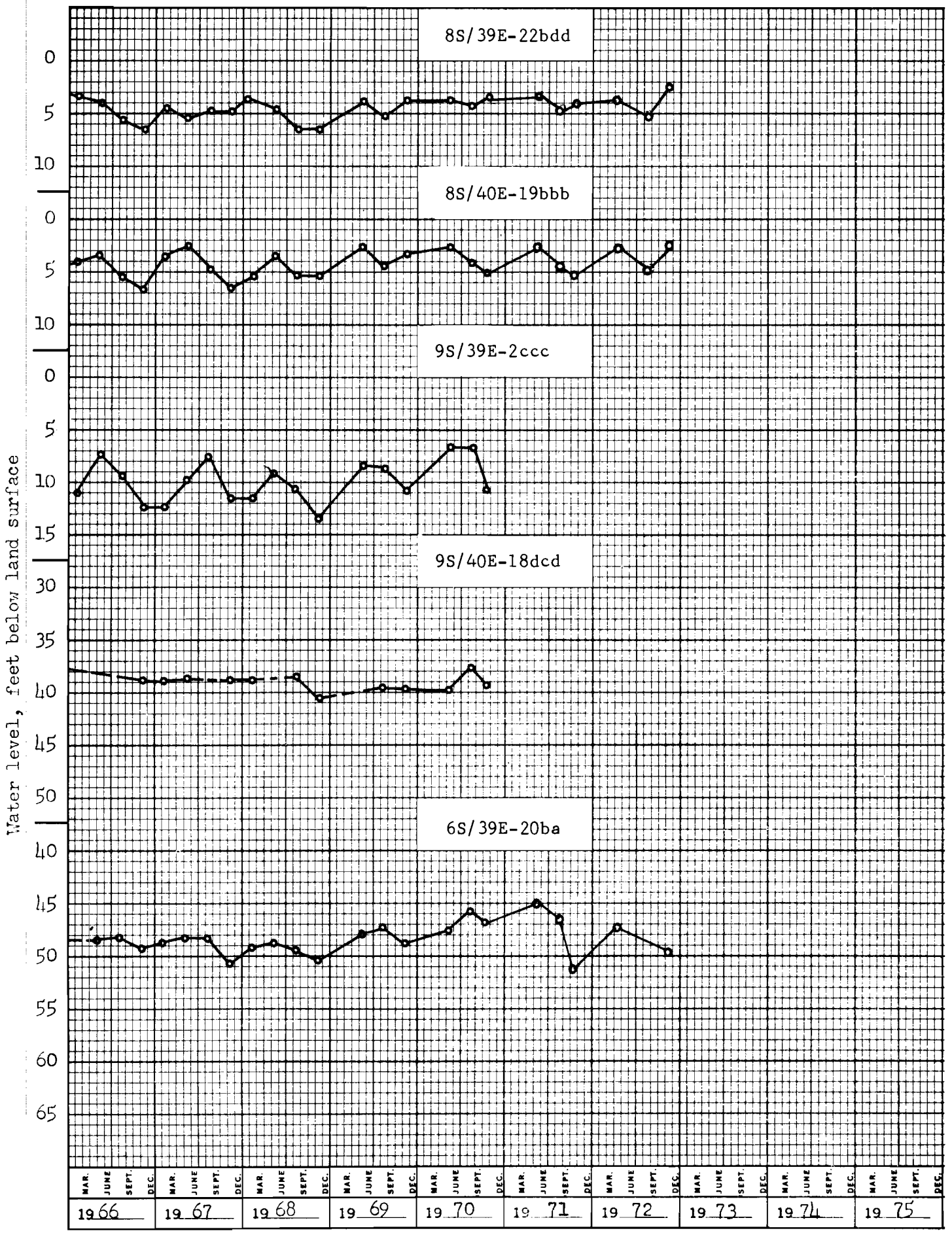
REFERENCES

Ducret, G. L., Jr., and Anderson, D. G., 1965, Records of wells, water levels, and chemical quality of water in Baker Valley, Baker County, Oregon.

Lystrom, D. J., Nees, W. L., and Hampton, E. R., 1967, Ground water of Baker Valley, Baker County, Oregon: U. S. Geological Survey Hydrologic Atlas HA-242.

Trauger, Frederick D., 1951, Ground water resources of Baker Valley, Baker County, Oregon: U. S. Geological Survey open-file report.

BAKER VALLEY (8)



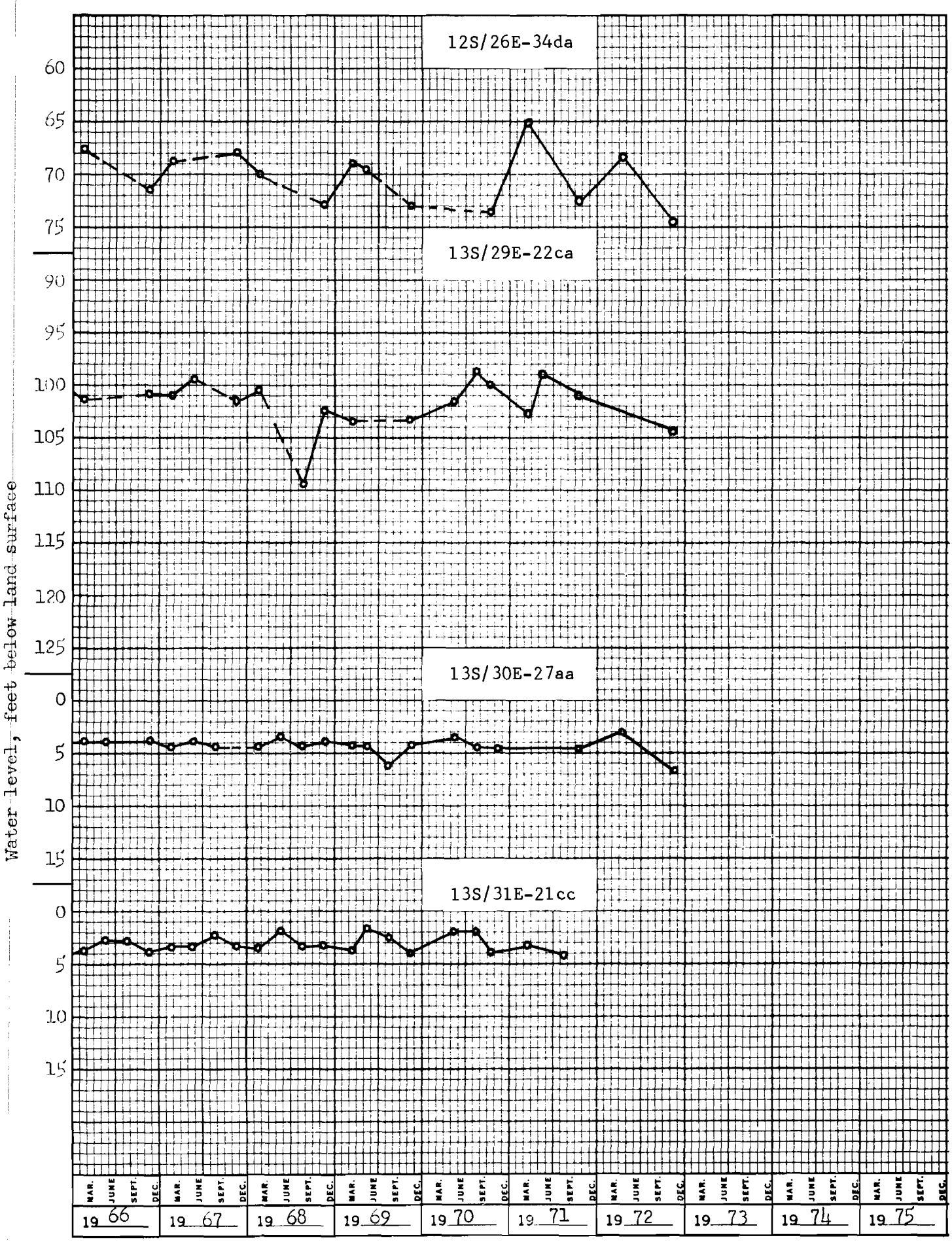
UPPER JOHN DAY VALLEY (9)

The upper John Day Valley is a long, narrow valley that extends from Dayville to Prairie City. The valley floor is generally less than a mile in width and is bordered by steep valley walls. The flood plain is underlain by coarse alluvial deposits of sand, gravel and boulders. Ground water in these permeable deposits is at most places hydraulically connected with the adjacent river. Ground-water developments from the alluvial deposits have been made through the use of sumps or ponds and shallow drilled wells. The extreme permeability of the alluvial deposits and their shallow occurrence makes the ground water readily subject to pollution problems.

Near John Day, the Columbia River Basalt formation extends below the alluvial deposits and some deep wells have encountered confined ground water in the lavas. The John Day formation which underlies the alluvial deposits in the Dayville area has very low permeability and is generally capable of yielding only small supplies of ground water. Structural folding and faulting has also disrupted some aquifer units along the John Day Valley fault system making large capacity well construction highly exploratory.

OBSERVATION WELLS

12S/26E-34da	(Dayville Cemetery) is a 465 foot drilled well in sand and gravel located about 3 miles southwest of Dayville.
13S/29E-22ca	(Curtis Martin) is a 215 foot drilled well in gravel located about 6 miles west of Mt. Vernon.
13S/30E-27aa	(State Highway Department - Clyde Holliday Wayside Park) is a 155 foot drilled well in basalt located about one mile east of Mt. Vernon.
13S/31E-21cc	(Mt. View Country Club) is a 10 foot dug well in gravel located about one mile west of John Day.


12S/26E-34da
13S/29E-22ca
13S/30E-27aa
13S/31E-21cc
Water level, feet below land surface
60
65
70
75
90
95
100
105
110
115
120
125
0
5
10
15
0
5
10
15
MAR.
JUNE
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COW VALLEY AREA (10)

Cow Valley is a small upland basin in northern Malheur County that was delcared a critical ground water area in 1959 on the basis of declining water levels. The valley has been closed to further ground water developments and existing irrigation wells have been restricted to the duty of water of three acre feet per acre. Water levels in wells have stabilized with an average pumpage of about 3,410 acre feet per year during the last four years. Ground-water withdrawals for the period of 1951-1972 are given below:

GROUND WATER PUMPAGE

Year	Acre Feet	Year	Acre Feet
1951	1826	1962	5110
1952	3451	1963	3520
1953	2564	1964	3553
1954	5494	1965	4344
1955	6058	1966	4696
1956	5611	1967	4211
1957	5980	1968	4693
1958	5080	1969	3154
1959	5588	1970	3745
1960	4722	1971	3374
1961	5495	1972	3365

OBSERVATION WELLS

15S/40E-2da (Max Holloway No. 1) is a 421 foot drilled well in sand and gravel located within Cow Valley. Periodic water level measurements available from 1950 to date.

15S/40E-2cc (Rankin Crow No. 2) is a 310 foot drilled well in sand and gravel located within Cow Valley. Periodic water level measurements available from 1950 to date.

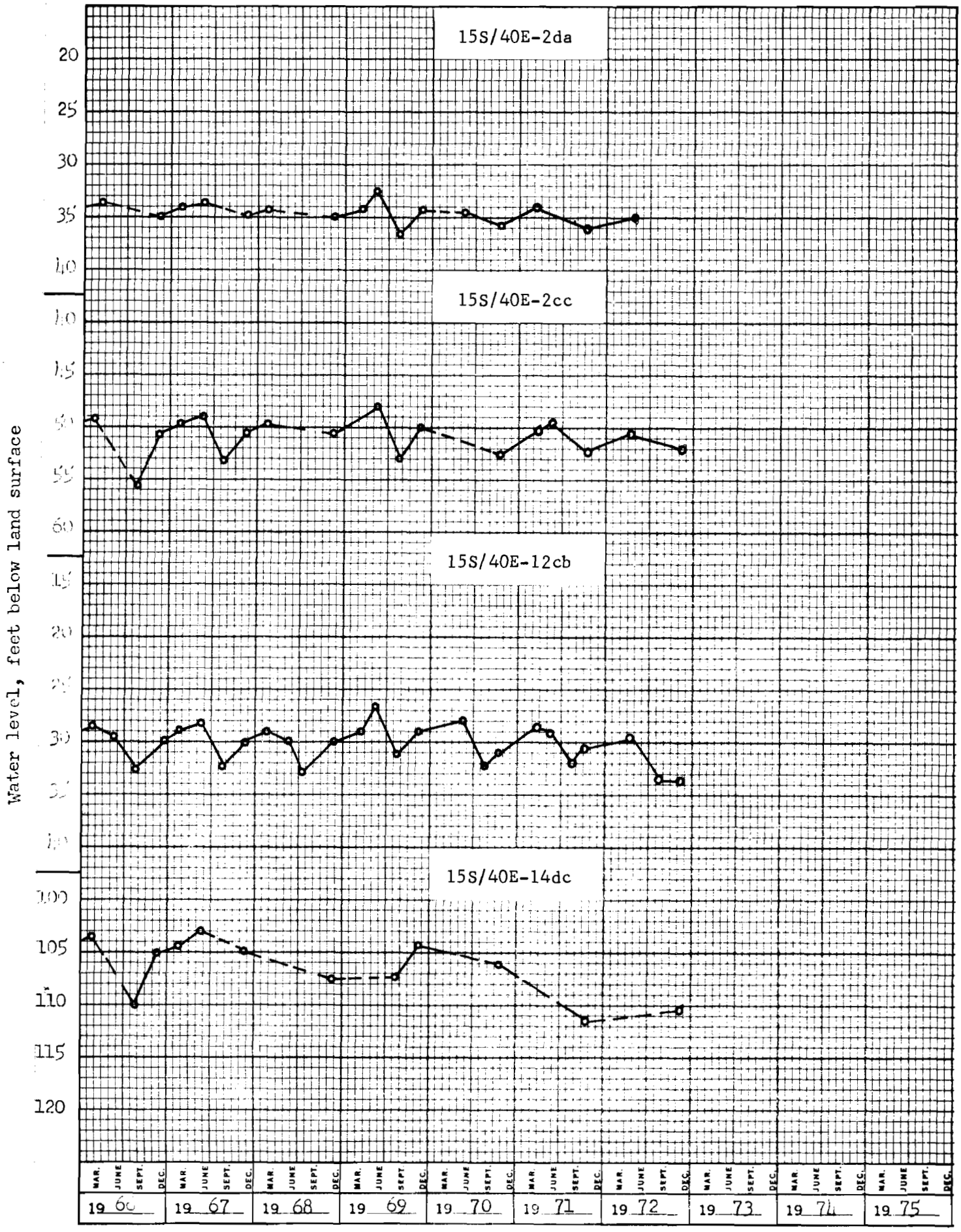
15S/40E-12cb (Guss Davis No. 3) is a 280 foot drilled well in basalt located within Cow Valley. Periodic water level measurements available from 1955 to date.

15S/40E-14dc (Rankin Crow No. 8) is a 248 foot drilled well in basalt located within Cow Valley. Periodic water level measurements available from 1954 to date.

REFERENCES

Brown, S. G., and Newcomb, R. C., 1962, Ground water resources of Cow Valley, Malheur County, Oregon: U. S. Geological Survey Water Supply Paper 1619-M.

COW VALLEY AREA (10)



COW VALLEY AREA (10)

OBSERVATION WELLS

15S/40E-1ba (Altha Anderson) is a 330 foot drilled well in sand and gravel located within Cow Valley. Periodic water level measurements available from 1954 to date.

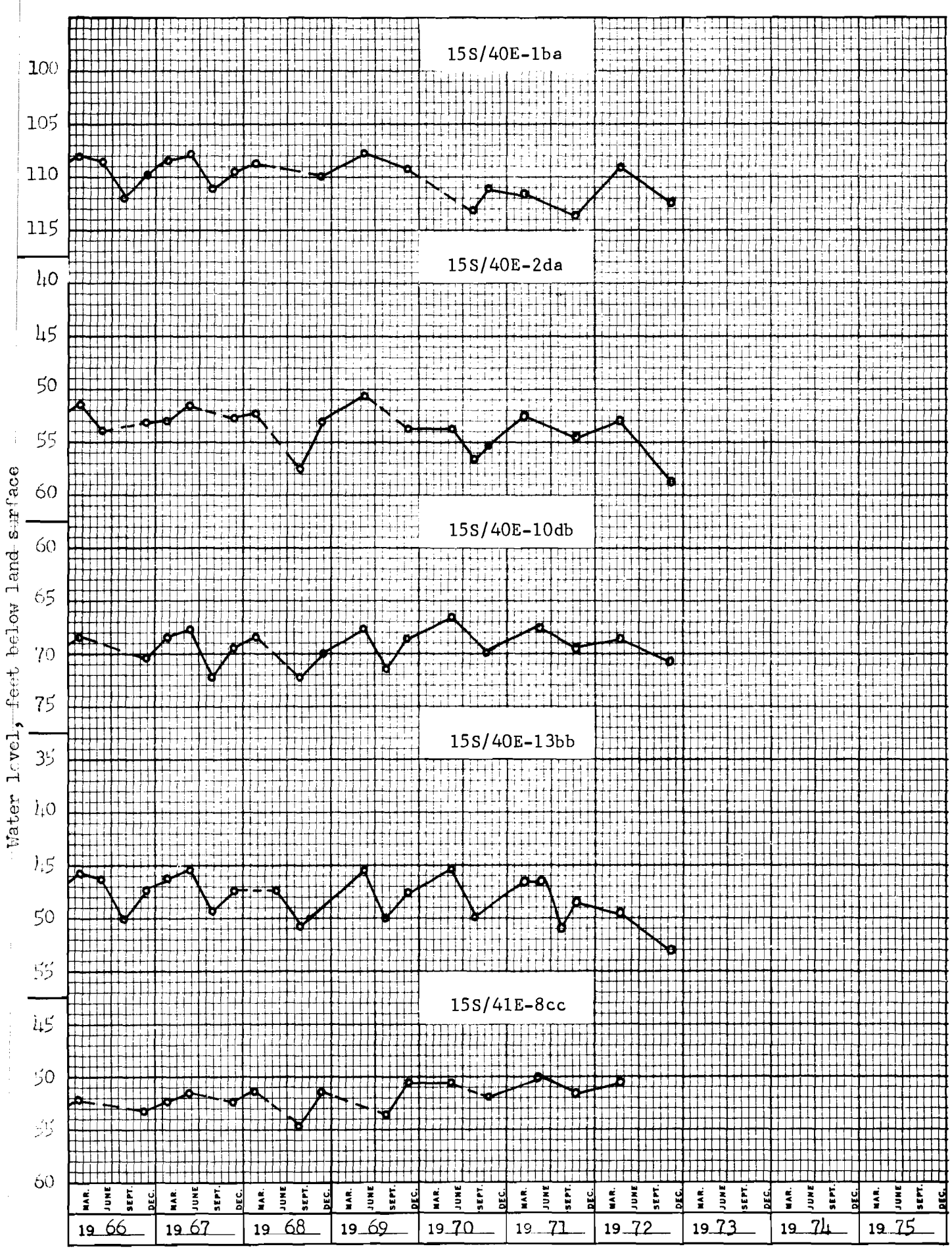
15S/40E-2da (Max Holloway No. 2) is a 535 foot drilled well in sand and gravel located within Cow Valley. Periodic water level measurements available from 1954 to date.

15S/40E-10db (Rankin Crow No. 9) is a 1000 foot drilled well in sand and gravel located within Cow Valley. Periodic water level measurements available from 1954 to date.

15S/40E-13bb (Guss Davis No. 1) is a 300 foot drilled well in basalt located within Cow Valley. Periodic water level measurements available from 1955 to date.

15S/41E-8cc (Rankin Crow No. 6) is a 338 foot drilled well in basalt located within Cow Valley. Periodic water level measurements available from 1953 to date.

COW VALLEY AREA (10)



SOUTHERN MALHEUR AREA (11)

The Southern Malheur area is located within the basin and range country of southeast Oregon. The area has been broken by block faulting into many basin and mountain ridge areas. The faulting has also divided the area into numerous disconnected ground-water reservoirs. A large part of the area is underlain by permeable volcanic rocks; however, the low precipitation incident to the area limits the amount of ground water recharge. The main source of recharge is snowmelt runoff from the ridges and hills during the spring months. To date, there has been very little ground-water development in this area, however, the area should be able to sustain moderate sized ground-water developments without serious problems.

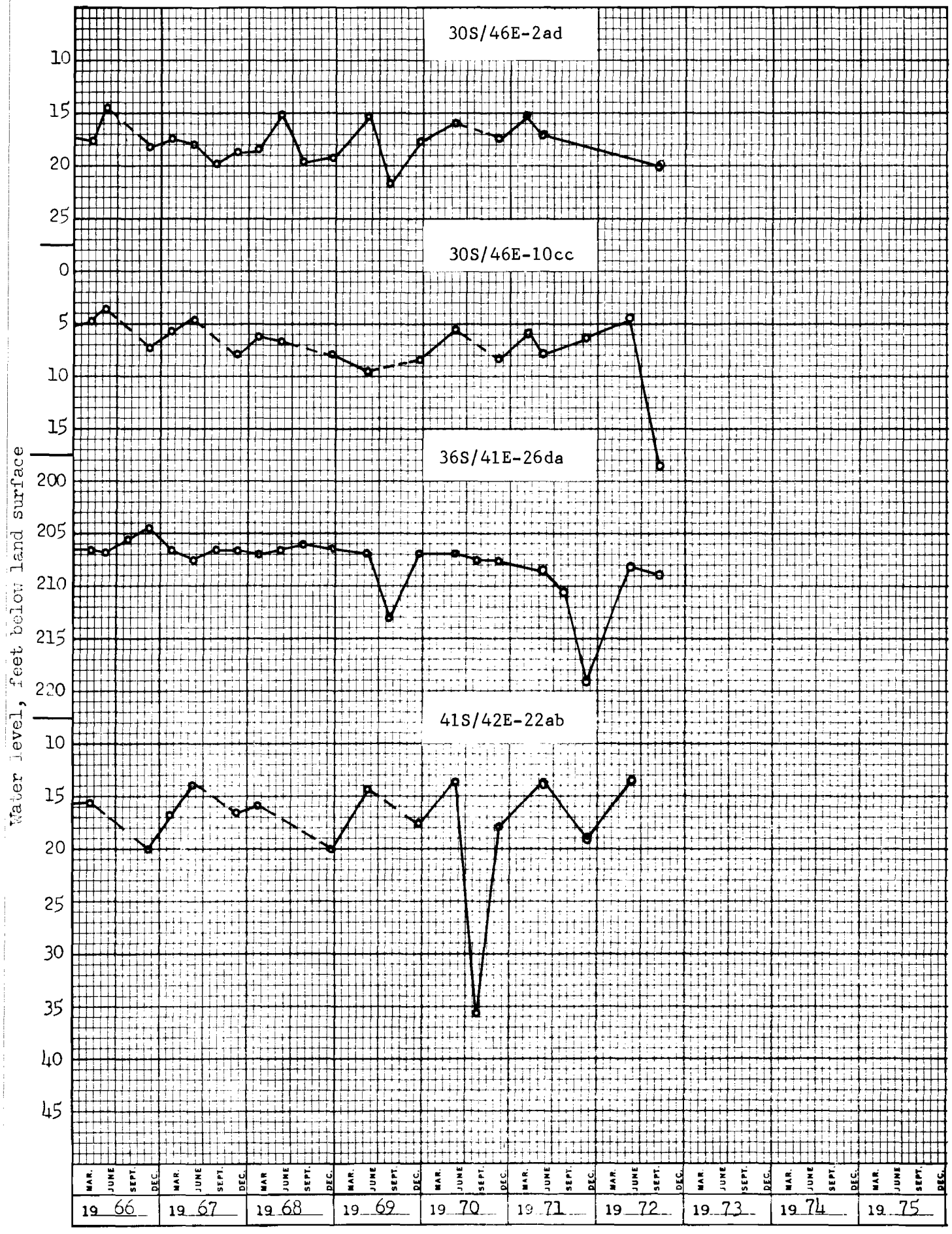
OBSERVATION WELLS

30S/46E-2ad	(Jordan Valley Cemetery District) is a 221 foot drilled well in sandstone located in Jordan Valley.
30S/46E-10cc	(Jaca Brothers) is a 420 foot drilled well in sand located about 2 miles southwest of Jordan Valley.
36S/41E-26da	(State Highway Department - Basque Maintenance Station) is a 222 foot drilled well in basalt located about one mile northwest of Basque.
41S/42E-22ab	(Lucky 7 Ranch) is a 615 foot drilled well in gravel located about 2 miles west of McDermitt.

REFERENCES

Newcomb, R. C., 1961, Ground water in the western part of the Cow Creek and Soldier Creek grazing units, Malheur County, Oregon: U. S. Geological Survey Water Supply Paper 1475-E.

SOUTHERN MALHEUR AREA (11)



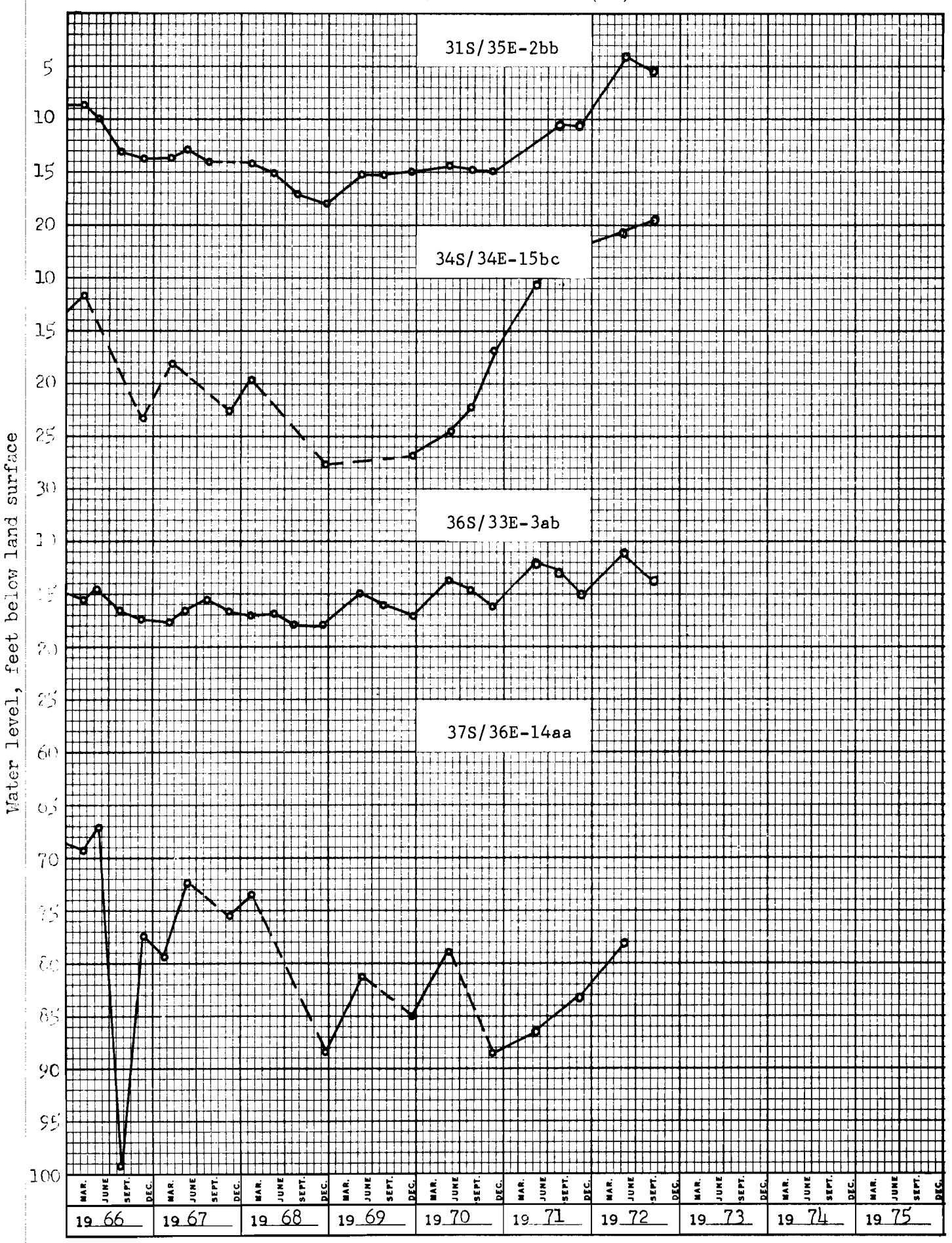
SOUTHERN HARNEY AREA (12)

The Southern Harney area, like the Southern Malheur area, has been divided by faulting into many basins and ridges. Steens Mountain, the largest and most prominent fault-block mountain in the northwest, is located in this area. This mountain is bordered on the east by the Alvord Valley and on the west by the Donner and Blitzen Valley and the Catlow Valley. The various basins in the area have been partially filled with alluvium derived from the adjacent ridges and hills. Recharge comes chiefly from snowmelt during the spring months. The larger basins as the Alvord Valley, the Donner and Blitzen Valley and the Catlow Valley are believed to contain large supplies of ground water. Recharge to these larger basins is related to the snowfall on the Steens Mountain.

OBSERVATION WELLS

31S/35E-2bb	(Fred Pallock) is a 32 foot drilled well in alluvium located near Juniper Lake. Periodic water level measurements available from 1954 to date.
34S/34E-15bc	(Alvord Ranch) is a 300 foot drilled well in lava located about 8 miles northeast of Andrews.
36S/33E-3ab	(Allied Property Inc.) is a 403 foot irrigation well developing water from gravel and volcanic rock.
37S/36E-14aa	(Whitehorse Ranch) is a 792 foot drilled well in basalt located about 28 miles northeast of Fields.

SOUTHERN HARNEY AREA (12)



HARNEY BASIN (13)

The Harney Basin is a large closed structural basin that has been partially filled with lake and stream deposits and volcanic debris. The water table lies close to land surface beneath the entire basin floor and the underlying ground-water reservoirs are near full capacity. From the available information, it appears that this basin can sustain large ground-water developments without serious problems of overdraft. Some decline of artesian pressures near Hines is expected.

OBSERVATION WELLS

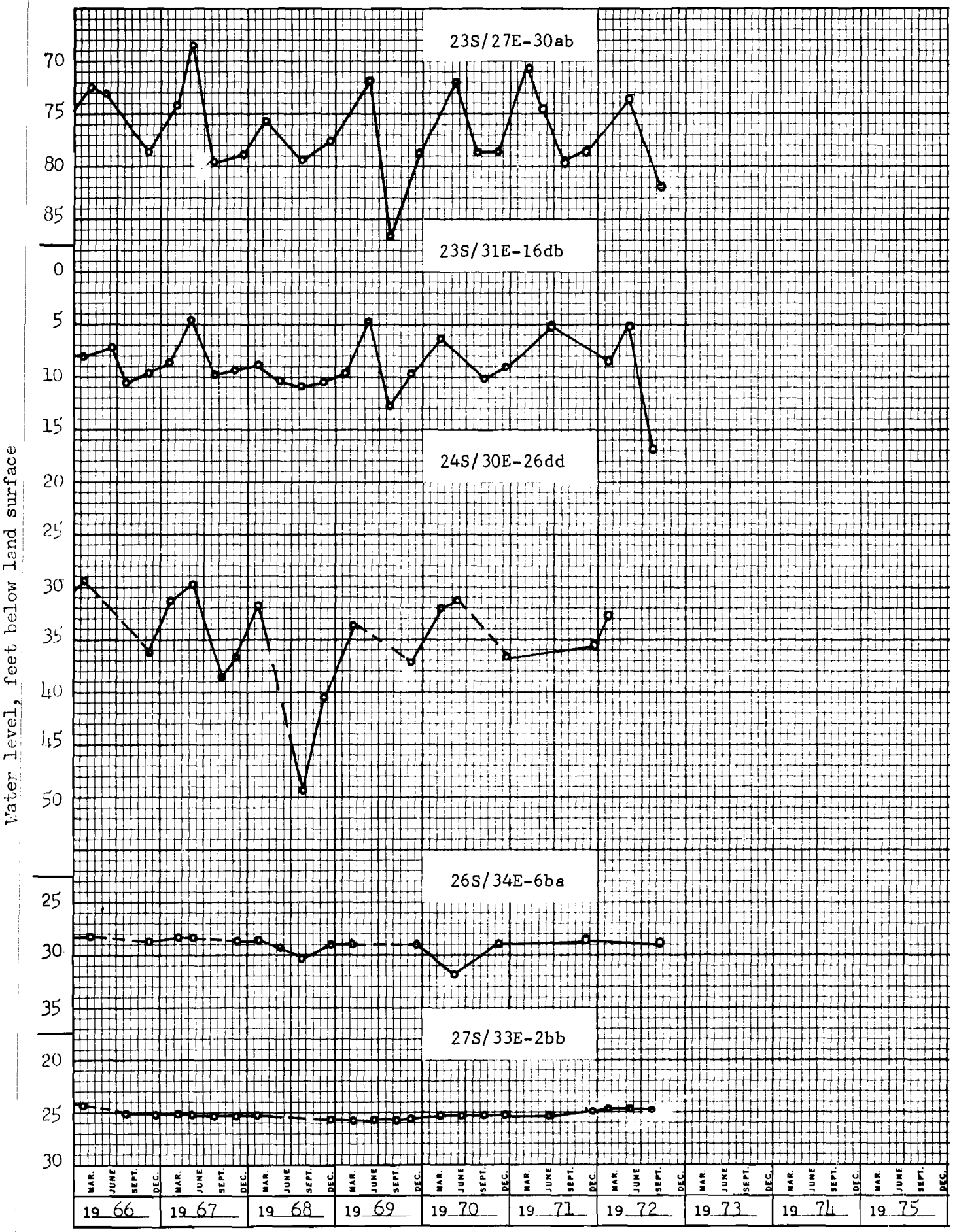
23S/27E-30ab	(Green Valley Ranch) is a 268 foot drilled well in gravel (?) located about one mile northwest of Riley.
23S/31E-16db	(T. Allen Jones) is a 300 foot drilled well in gravel located about 2 miles southeast of Burns. Periodic water level measurements available from 1930 to 1932, 1956 and from 1960 to date.
24S/30E-26dd	(John Campbell) is a 501 foot drilled well in sand and gravel located about 9 miles southwest of Burns.
26S/34E-6ba	(John J. Fecht) is a 260 foot drilled well in sand located about 4½ miles south of Crane.
27S/33E-2bb	(R. F. Upton) is a 176 foot drilled well in lava and cinders located about 2 miles southwest of New Princeton.

REFERENCES

Leonard, A. R., 1970, Ground water resources in Harney Valley, Harney County, Oregon: State Engineer's Ground Water Report No. 16.

Piper, A. M., et al, 1939, Geology and ground water resources of the Harney Basin, Oregon: U. S. Geological Survey Water Supply Paper 841.

HARNEY BASIN (13)



HARNEY BASIN (13)

OBSERVATION WELLS

22S/31E-34cc (Burtt Schroder, formerly Lazraus) is a 288 foot drilled well in sand and gravel located about 3 miles northeast of Burns. Periodic water level measurements available from 1930 to 1936 and from 1938 to date.

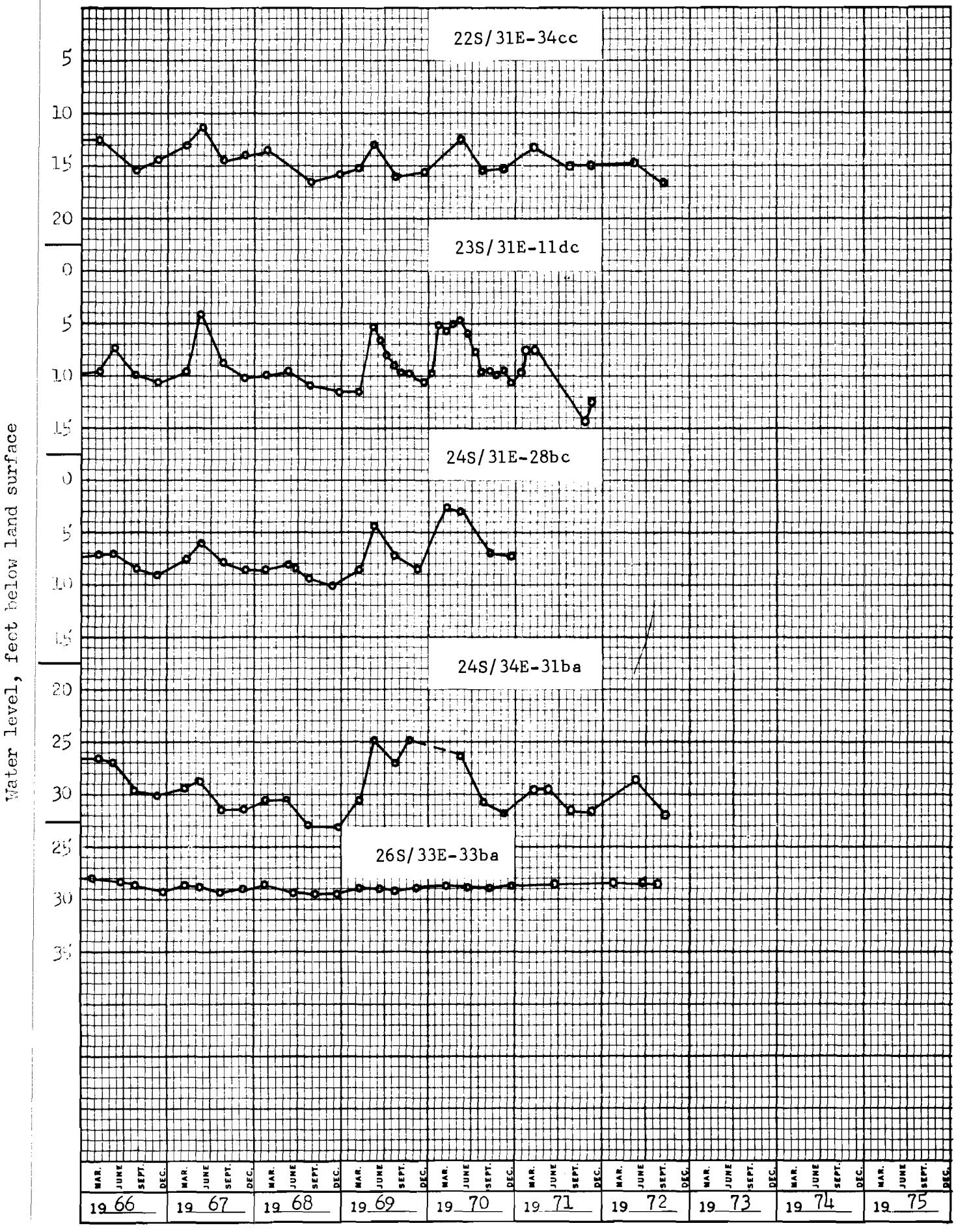
23S/31E-11dc (E. N. Sewell) is a 120 foot drilled well in gravel located about 4 miles east of Burns.

24S/31E-28bc (Harney County) is a 17 foot dug well in gravel located about 9 miles southeast of Burns. Periodic water level measurements available from 1936 and from 1938 to 1970.

24S/34E-31ba (John Rossberg) is a 305 foot drilled well in lava and cinders located about 2 miles north of Crane.

26S/33E-33ba (D. Edward Owen, formerly Forslund) is a 300 foot drilled well in cinders located about 3½ miles west of New Princeton. Periodic water level measurements available from 1958 to date.

HARNEY BASIN (13)



WARNER VALLEY (14)

Warner Valley is a long narrow structural valley located in southeastern Lake County. The valley is bordered by fault block mountains that have contributed materials for the partial filling of this basin. This valley forms a regional ground-water discharge area which supports hot water wells and springs. Exploration for geothermal well development is expected within the next two years.

Most of the ground-water aquifers underlying the basin are filled and water levels are at or near land surface. Though large supplies of ground water underlie this valley, the annual recharge to the area is low.

OBSERVATION WELLS

35S/24E-9da (U.S. B.L.M.) is a 376.5 foot drilled well in basalt located about 8 miles north of Hart Lake. Periodic water level measurements available from 1949 to date.

36S/24E-27bbd (Con Lynch) is a 255 foot drilled well in cinders (?) located about one mile east of Plush.

36S/24E-33abb (Con Taylor) is a 262 foot drilled well in gravel and lava located about one mile east of Plush.

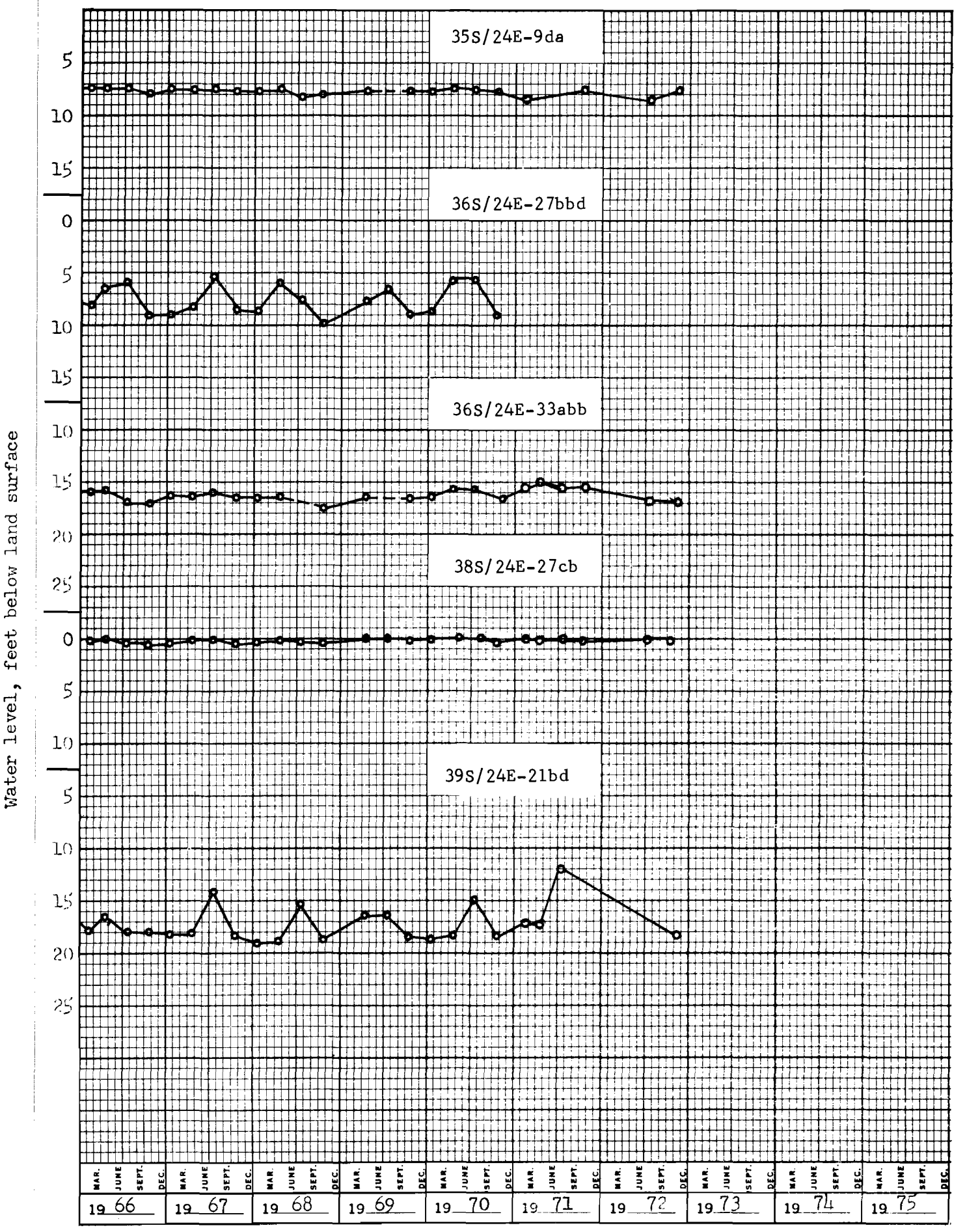
38S/24E-27cb (Charles Crump) is an 81 foot drilled well in gravel located near Crump Lake. Periodic water level measurements available from 1948 to date.

39S/24E-21bd (J. G. Dyke) is a 165 foot drilled well in gravel located in Adel. Periodic water level measurements available from 1948 to date.

REFERENCES

Trauger, Frederick D., 1950, Basic ground water data in Lake County, Oregon: U. S. Geological Survey open file report.

WARNER VALLEY (14)



GOOSE LAKE BASIN (15)

The Goose Lake Basin is a large structural basin located in southeastern Lake County. This basin has been partially filled with stream and lake deposits. The stream deposited sands and gravels usually occur where alluvial fans have been built into the basin. Some of the alluvial deposits have been buried by fine-grained lake sediments which tend to confine the ground water and cause some wells to flow. Buried organic debris in the basin fill deposits often creates water quality problems with respect to iron and hydrogen sulfide and methane gas.

In general, the water table stands close to land surface and a large quantity of ground water is in storage in this basin. Ground water developments for irrigation are few in number but are expected to increase.

OBSERVATION WELLS

37S/20E-34ddb (Robert Weir) is an 808 foot drilled well in gravel located about 9 miles north of Lakeview.

39S/19E-34ad (William Hoffman) is a 110 foot drilled well in sand and gravel located about 7 miles west of Lakeview.

39S/20E-9aaa (Lakeview Mining) is an 800 foot drilled well in sand and gravel located in Lakeview.

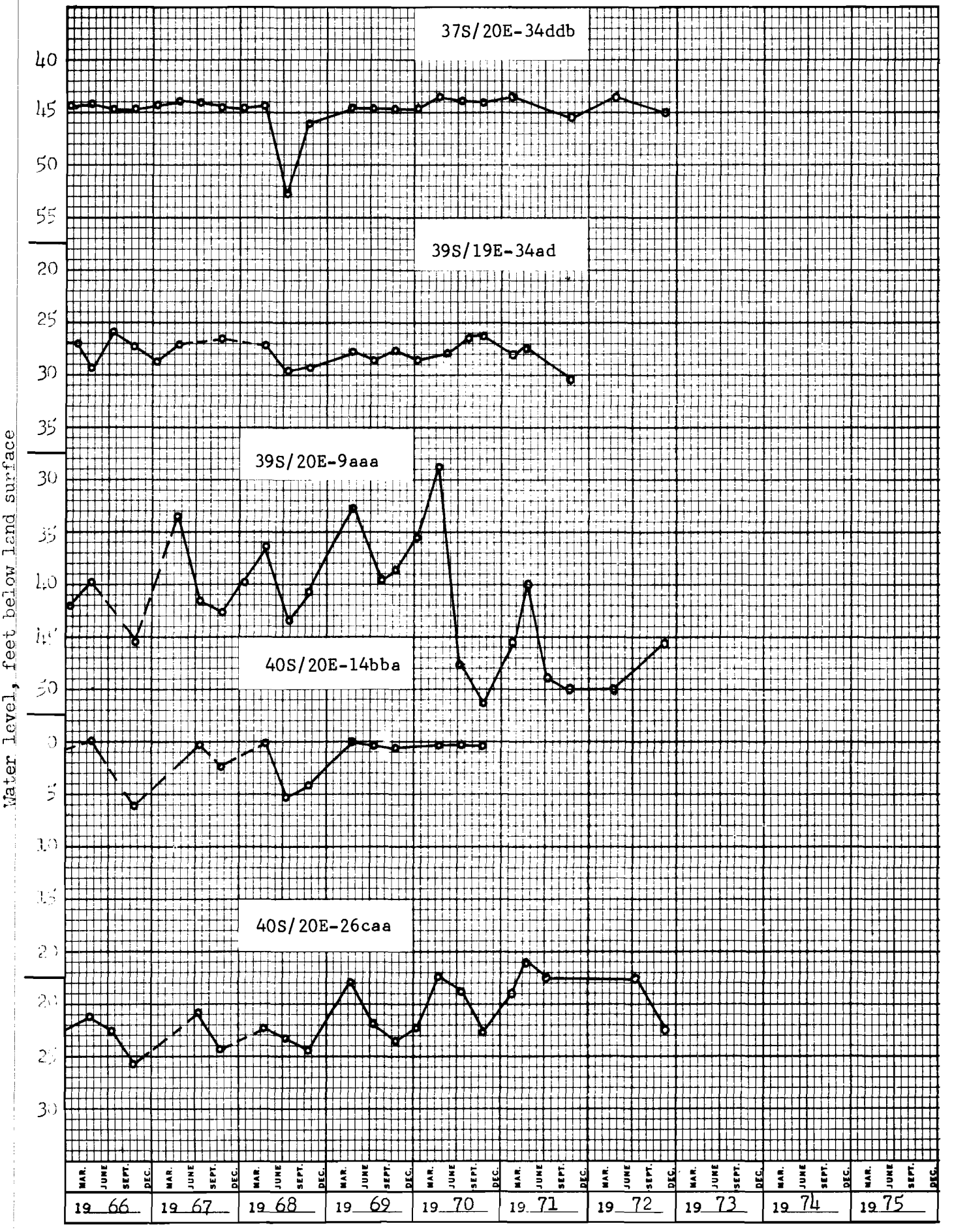
40S/20E-14bba (Snyder and Alexis) is a 305 foot drilled well in sand and gravel located about 5 miles south of Lakeview.

40S/20E-26caa (Neal Elliott) is a 190 foot drilled well in sand and gravel located about 8 miles south of Lakeview.

REFERENCES

Trauger, Frederick D., 1950, Basic ground water data in Lake County, Oregon: U. S. Geological Survey open file report.

GOOSE LAKE BASIN (15)



YONNA VALLEY (16)

Yonna Valley is a broad basin in southern Klamath County that is surrounded by fault block mountains. The valley is drained by several small streams that are tributary to Lost River.

A large part of the valley floor is underlain by sedimentary strata of siltstone, tuffaceous sandstone, diatomite and volcanic ash. These strata, which have been named the Yonna Formation, have low permeability and are generally capable of yielding only small supplies of ground water. A sequence of volcanic rock which underlies the Yonna Formation generally has high permeability and is generally capable of yielding large supplies of ground water to deep wells. It appears that the ground water reservoirs in the Yonna Valley can withstand substantial development without serious problems.

OBSERVATION WELLS

38S/11E-6dda (B. J. Jendrzejewski) is a 194-foot drilled well in broken lava located about 5 miles northeast of Dairy. Periodic water level measurements available from 1957 to date.

38S/11½E-12cca (Frank Challis) is a 150-foot drilled well in porous lava located about 4 miles northeast of Dairy. Periodic water level measurements available from 1949 to date.

38S/11½E-13ccc (William Konig) is a 600-foot drilled well in diatomaceous material located about 3 miles northeast of Dairy. Periodic water level measurements available from 1948 to date.

38S/11½E-15dda (Frank R. White) is a 495-foot drilled well in lava and cinders located about 2 miles north of Dairy. Periodic water level measurements available from 1948 and from 1950 to date.

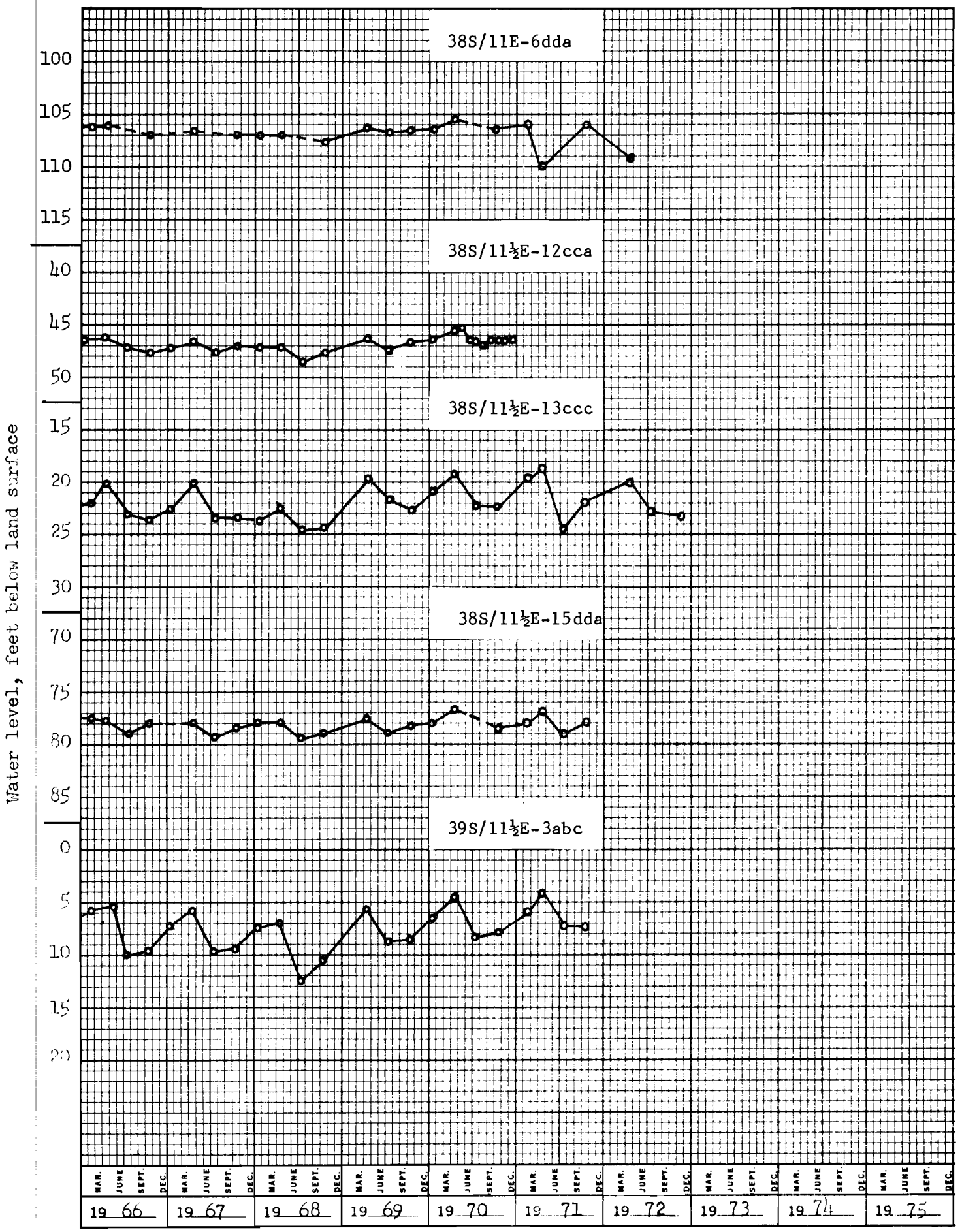
39S/11½E-3abc (L. J. Horton) is a 102-foot drilled well in lava and cinders located about one mile south of Dairy. Periodic water level measurements available from 1957 to date.

REFERENCES

Meyers, Joseph D. and Newcomb, R. C., 1952, Geology and ground water resources of the Swan Lake - Yonna Valleys area, Klamath County, Oregon: U. S. Geological Survey open file report.

Newcomb, R. C. and Hart, D. H., 1958, Preliminary report on the ground water resources of the Klamath River Basin, Oregon: U. S. Geological Survey open file report.

YONNA VALLEY (16)



SWAN LAKE VALLEY (17)

The Swan Lake Valley is a closed basin lying immediately west of Yonna Valley. This rift valley, has been partially filled with fine-grained lake deposits. These fine-grained lake beds are believed capable of yielding only small supplies of ground water.

Large ground water supplies have been obtained from deep wells drilled into the volcanic rocks that surround and underlie the lake beds. A 295-foot well drilled into the volcanic rocks in 1965 was tested at 2,850 gallons per minute with only eight feet of drawdown.

OBSERVATION WELLS

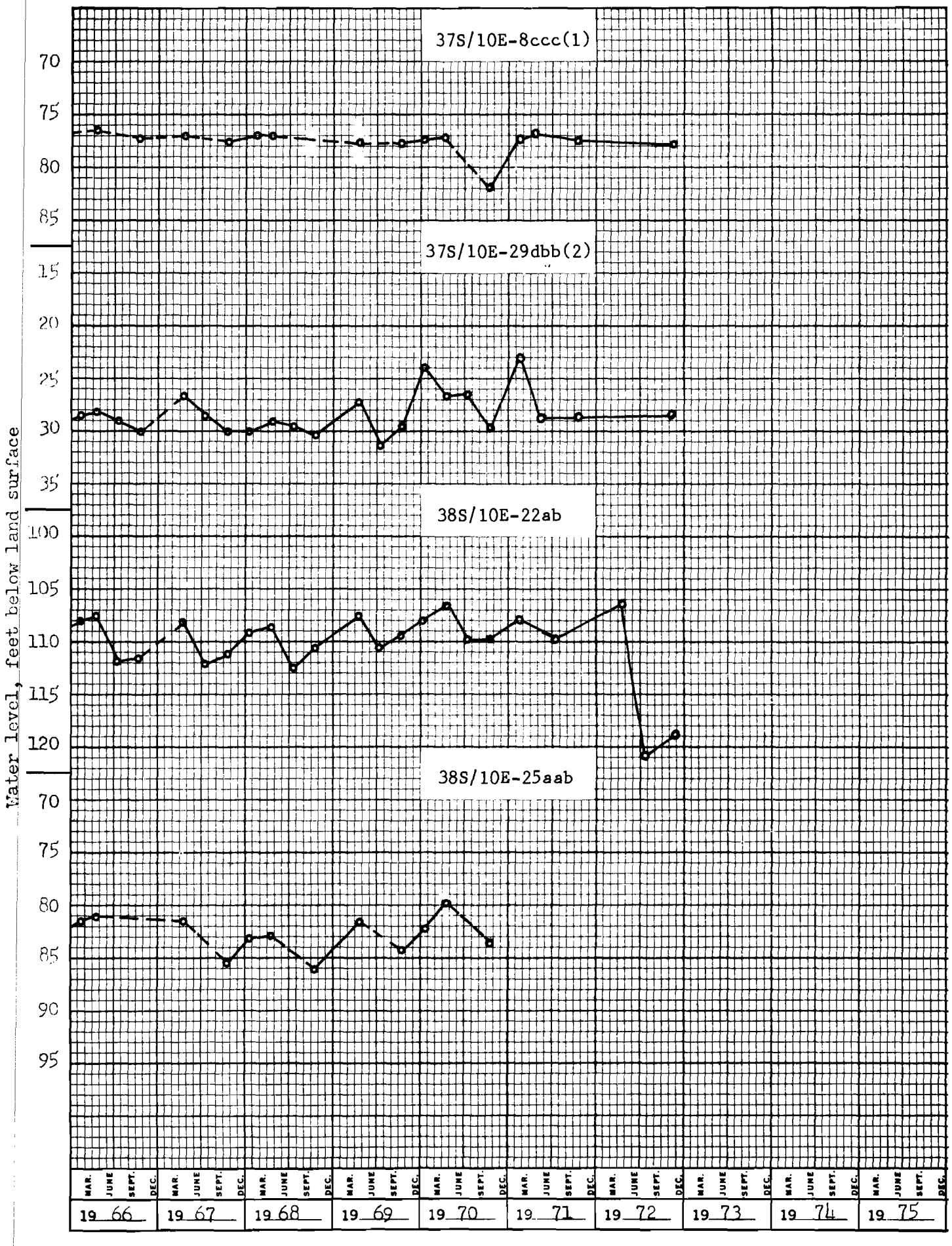
37S/10E-8ccc(1)	(Edgewood Ranch) is a 281-foot drilled well in cinders located about 10 miles northeast of Klamath Falls.
37S/10E-29dbb(2)	(Edgewood Ranch) is a 800-foot drilled well in gravel located about 8 miles northeast of Klamath Falls. Periodic water level measurements available from 1949 to date.
38S/10E-22ab	(Mike Short) is a 460-foot drilled well in lava located about 8 miles northeast of Klamath Falls. Periodic water level measurements available from 1957 to date.
38S/10E-25aab	(Garrison Mitchell) is a 524-foot drilled well in lava and cinders located about 4 miles west of Dairy. Periodic water level measurements available from 1957 and 1958.

REFERENCES

Meyers, Joseph D. and Newcomb, R. C., 1952, Geology and Ground Water Resources of the Swan Lake - Yonna Valleys area, Klamath County, Oregon: U. S. Geological Survey open file report.

Newcomb, R. C. and Hart, D. H., 1958, Preliminary Report on the Ground Water Resources of the Klamath River Basin, Oregon: U. S. Geological Survey open file report.

SWAN LAKE VALLEY (17)



SPRAGUE RIVER VALLEY (18)

The Sprague River Valley which extends from the community of Sprague River to Bly, is underlain by some of the most productive ground water reservoirs in the state. The productive wells in the Bly area develop ground water from porous lava and cinders. One well was tested at 3,500 gallons per minute with no apparent drawdown. In the Beatty area, deep wells drilled into the lavas and cinders underlying the Yonna formation develop confined ground water. Some of these wells have artesian flows of 1,000 gallons per minute or more and have pumping capacities exceeding 2,000 gallons per minute. Similar artesian conditions extend down the valley to near the community of Sprague River.

OBSERVATION WELLS

35S/8E-1bcb (Henry Wolff) is a 101 foot drilled well in sand and gravel located about 9 miles east of Chiloquin. Periodic water level measurements available from 1954 to date.

35S/10E-19ab (Ted Chrume) is a 360 foot drilled well in sand located about 6 miles northwest of Sprague River. Periodic water level measurements available from 1954 to date.

36S/10E-14acd (K. R. Newlun) is a 527 foot drilled well in volcanic rock located in Sprague River.

36S/11E-36aab (Bill Gallaher, formerly McBain) is a 223 foot drilled well in basalt located about 5 miles southwest of Baetty. Periodic water level measurements available from 1954 to date.

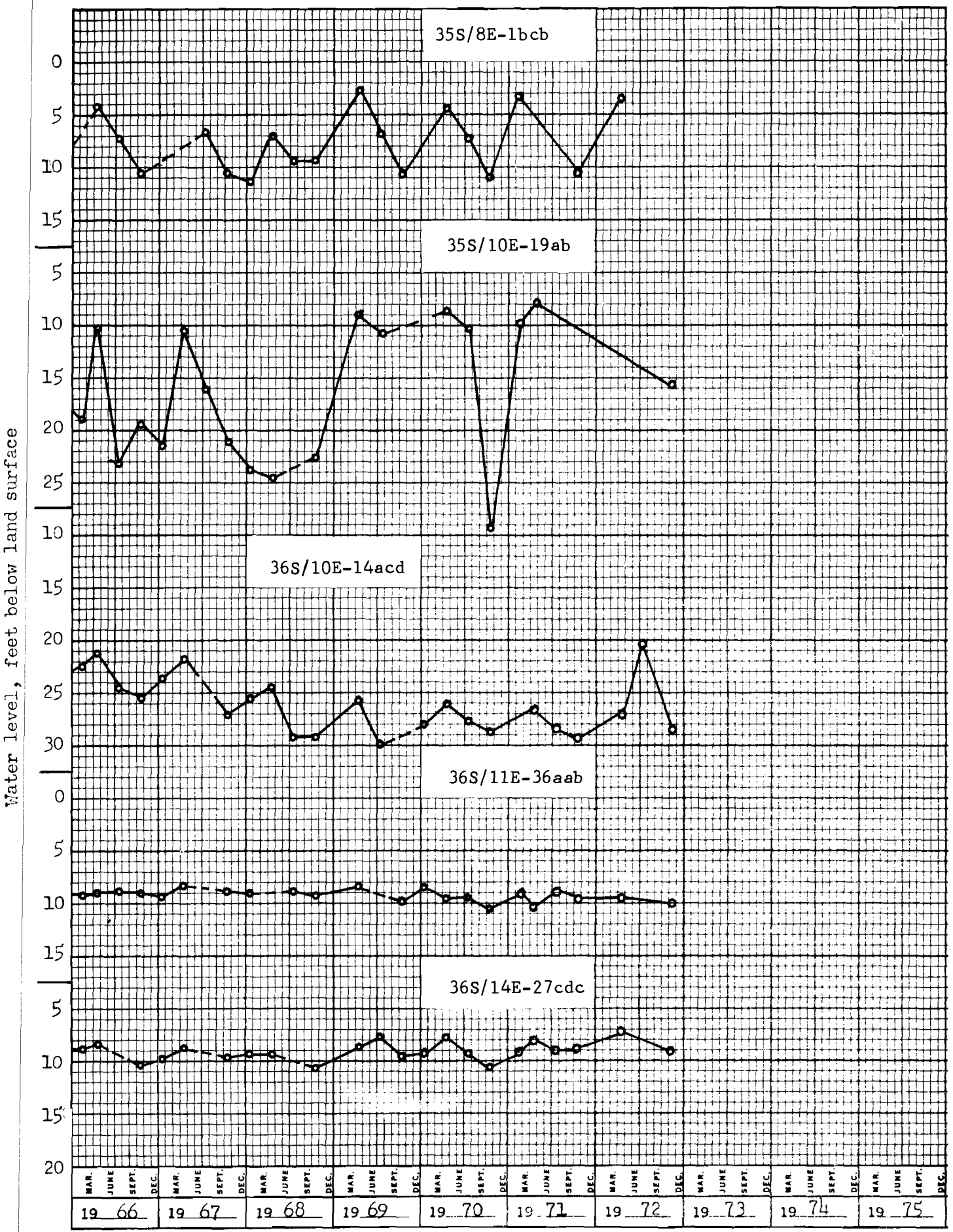
36S/14E-27cdc (Henry Gerber) is a 438 foot drilled well in volcanic rock located about one mile north of Bly.

REFERENCES

Illian, J. R., 1970, Interim report on the ground water in the Klamath Basin, Oregon: State Engineer Report.

Newcomb, R. C., and Hart, D. H., 1958, Preliminary report on the ground-water resources of the Klamath River Basin, Oregon: U. S. Geological Survey open file report.

SPRAGUE RIVER VALLEY (18)



FORT ROCK AREA (19)

The Fort Rock area is a broad structural basin in northern Lake County and includes the Christmas Lake and Fossil Lake areas.

Subdivision of large tracts of land in this basin has sparked the construction of wells and the development of ground water supplies. Numerous water level measurements throughout the area show a marked similarity in the fluctuations of the water table. In general, the trend of water levels in this area is related to long term changes in the amount of annual precipitation occurring in the surrounding upland areas. Water levels remain high. No serious problems of declining water levels have developed in this area.

OBSERVATION WELLS

26S/14E-5aa (V. A. Wagers) is an 83.4 foot drilled well in sand located about one mile west of Fort Rock. Periodic water level measurements available from 1940 to 1970. Well was dropped from observation well net in 1970.

26S/14E-12baa (Elmer Kohler) is a 200 foot drilled well in sand located about 2½ miles southeast of Fort Rock. Periodic water level measurements available from 1958 to date.

26S/15E-31aa (Nick Klerk) is a 225 foot drilled well in volcanic rock located about 7 miles southeast of Fort Rock. Periodic water level measurements available from 1949 to 1970. Well was dropped from observation well net in 1970.

27S/15E-4aca (M. Y. Parks) is a 257 foot drilled well in lava and cinders located about 9 miles southeast of Fort Rock. Periodic water level measurements available from 1932, 1935-1936 and from 1938 to date.

27S/16E-13abb (Robert Morehouse) is a 560 foot drilled well in gravel and rock located in Christmas Lake Valley.

27S/17E-22ddd (Century Ranch) is a 54 foot drilled well in sand located in Christmas Lake Valley. Periodic water level measurements available from 1938, 1940-1944 and from 1946 to 1970. Well was dropped from observation well net in 1970.

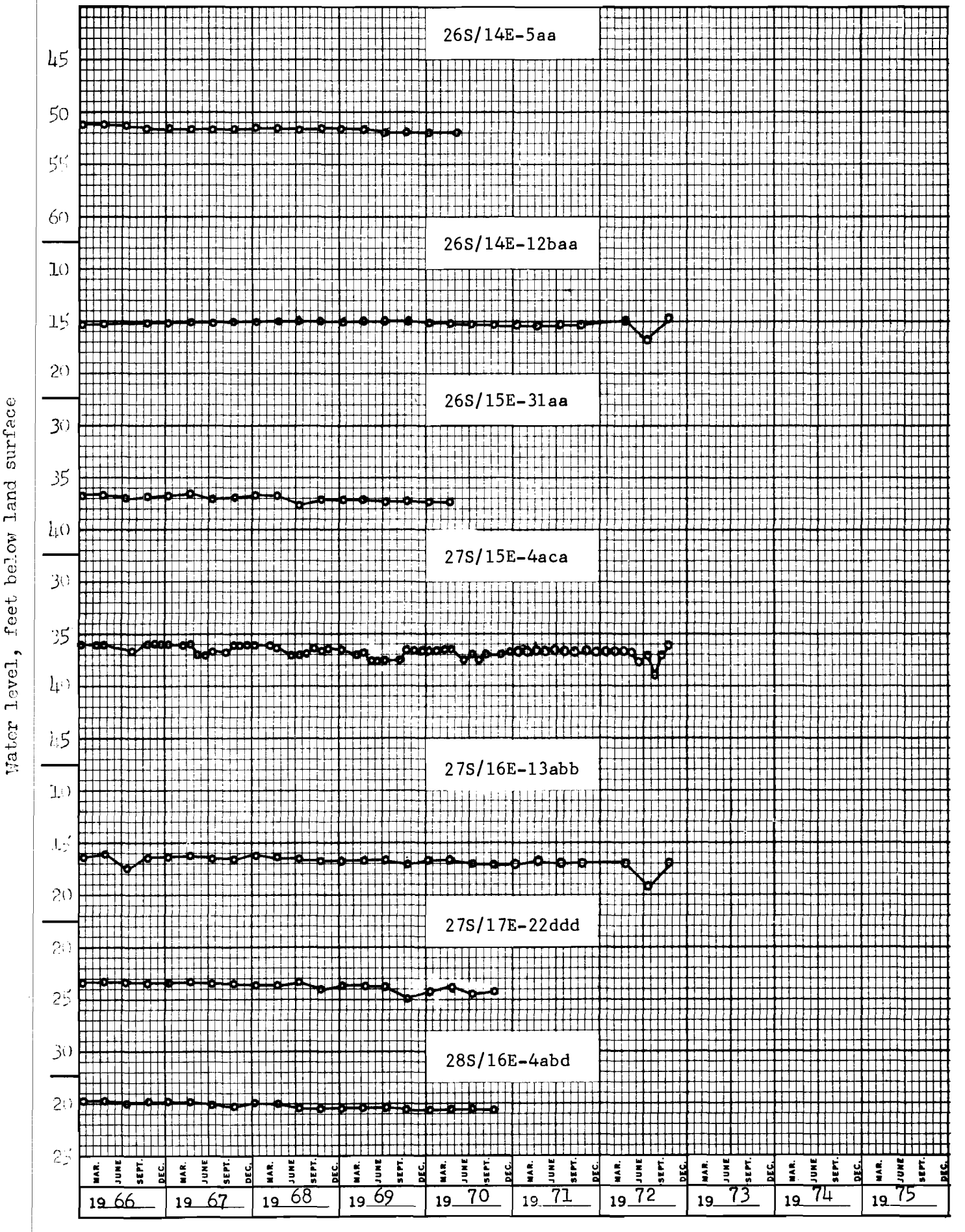
28S/16E-4abd (U.S. B. L.M.) is a 707 foot drilled well in lava located in Christmas Lake Valley. Periodic water level measurements available from 1958 to 1970. Well was dropped from observation well net in 1970.

REFERENCES

Hampton, E. R., 1962, Geologic factors that control the occurrence and availability of ground water in the Fort Rock Basin, Lake County, Oregon: U. S. Geological Survey Professional Paper 383-B.

Trauger, F. D., 1950, Basic ground water data in Lake County, Oregon: U. S. Geological Survey open file report.

FORT ROCK AREA (19)



CHEMULT-LAPINE-SISTERS AREA (20)

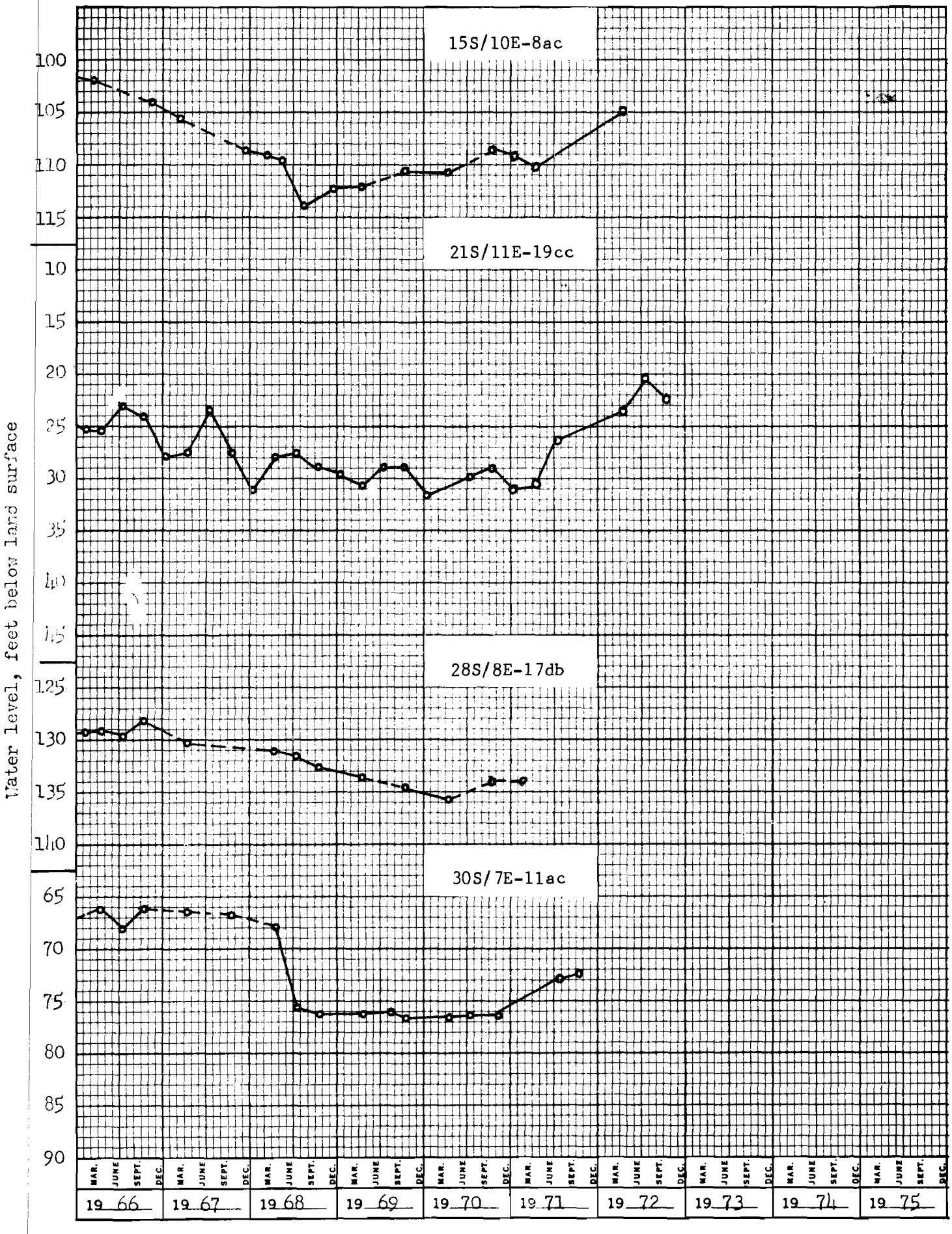
The eastern slope of the Cascade Mountains contains many ground-water reservoirs. The most permeable of these are generally associated with the younger volcanic rocks and associated cinder deposits. As the demand for additional water in this area increases, and as the availability of surface water supplies becomes so costly or unobtainable, communities, industries, and possibly agriculture will turn to the development of ground water supplies. Large capacity wells can be obtained throughout large parts of the area.

Water levels in many of the wells in this area, which have been declining slowly during the period 1959-1964, showed a marked reverse in trend in 1965 and are now rising. These changes are believed due to changes in ground-water recharge which is controlled by climatic conditions.

OBSERVATION WELLS

15S/10E-8ac	(Ross Hammond) is a 228 foot drilled well in volcanic rock located near Sisters.
21S/11E-19cc	(Inez Kellems) is a 100 foot drilled well in sand located about 6 miles north of LaPine. Periodic water level measurements available from 1945 to date.
28S/8E-17db	(Winema Lumber Company) is a 361 foot drilled well in lava located about 7 miles south of Chemult.
30S/7E-11ac	(Crown Zellerbach Corp.) is a 123 foot drilled well in lava located about 18 miles southwest of Chemult near Klamath Marsh. Periodic water level measurements available from 1954 to date.

CHEMULT-LAPINE-SISTERS AREA (20)



PRINEVILLE AREA (21)

The Prineville area includes the Ochoco Creek and Crooked River Valleys in and around the City of Prineville. Ground water occurs at shallow depth in the sandy alluvial deposits and from a single sand and gravel stratum that lies at the base of the alluvial deposits. The shallow ground-water reservoir contains unconfined ground water. Wells in these deposits usually provide yields that are less than 20 gallons per minute.

The thin sand and gravel stratum lying at the base of the alluvial deposits contains confined ground water that at places has an artesian head of from 70 to 80 feet above land surface. At Prineville, wells have been constructed in this confined ground-water reservoir with yields in excess of 500 gallons per minute.

Recharge to the confined ground water reservoir is believed to come from leakage in irrigation canals and irrigation in the area north and northwest of Prineville. (Between 1957 and 1960 some decline of water levels was noted in the artesian wells.) Placement of new subdivisions and sewage disposal systems will be important in protecting shallow aquifers of this area.

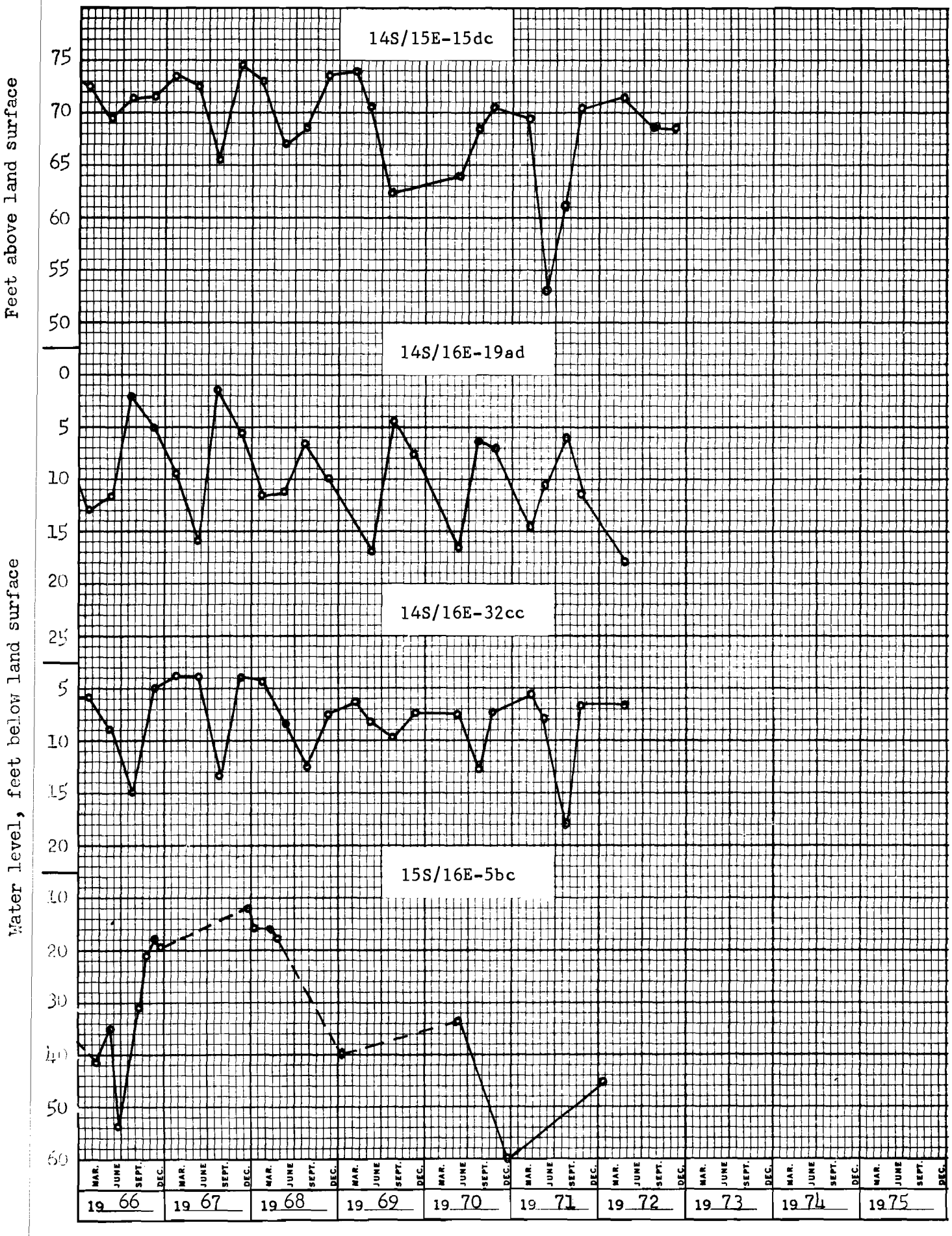
OBSERVATION WELLS

14S/15E-15dc	(L. H. McPhetridge) is a 210 foot artesian well drilled in sand and gravel located about 4 miles northwest of Prineville. Periodic water level measurements available from 1945 to date.
14S/16E-19ad	(Leslie Clausen) is a 47 foot drilled well in sand located about 2 miles northwest of Prineville. Periodic water level measurements available from 1944 and from 1947 to date.
14S/16E-32cc	(E. E. Wagoner) is a 160 foot drilled well in sand and gravel located within Prineville. Periodic water level measurements available from 1944 to date.
15S/16E-5bc	(Pacific Power and Light Company) is a 252 foot drilled well in sand and gravel located within Prineville.

REFERENCES

Robinson, J. W., and Price, Don, 1963, Ground water in the Prineville area, Crook County, Oregon: U. S. Geological Survey Water Supply Paper 1619-P.

PRINEVILLE AREA (21)



MEDFORD AREA (22)

The Medford area, like other parts of southwestern Oregon, is noted for its lack of permeable ground-water reservoirs. Most wells produce adequate domestic or small group domestic supplies. The development of large ground-water supplies in this area for irrigation or industrial purposes is not likely. Thin fine-grained deposits of sand and gravel adjacent to Bear Creek are very subject to pollution and offers meager domestic water supplies.

OBSERVATION WELLS

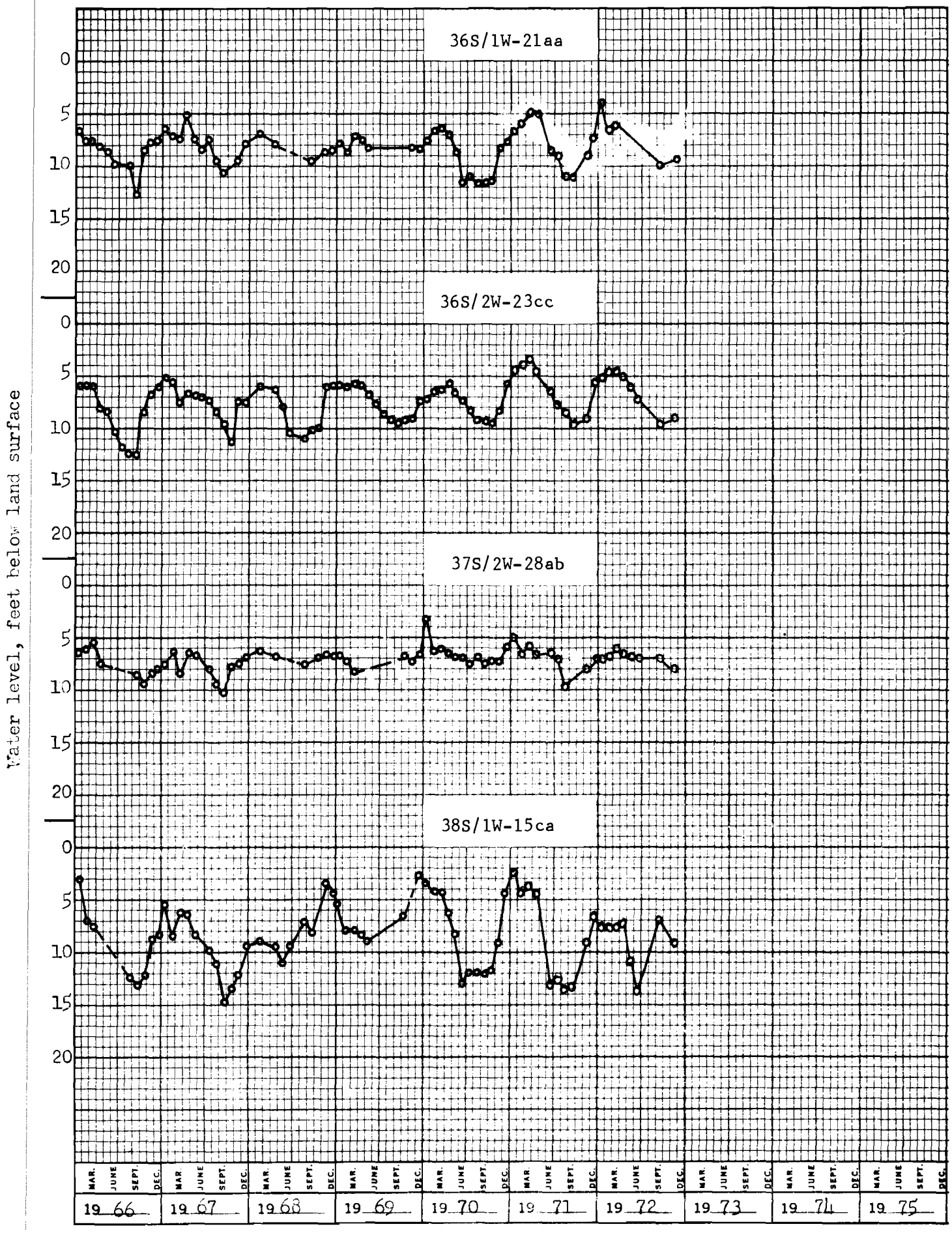
36S/1W-21aa	(Bud Hoover) is a 95 foot drilled well in shale located about 7 miles northeast of Medford near White City.
36S/2W-23cc	(U.S.G.S.) is a 110 foot drilled well in sand and gravel located about 3 miles west of White City.
37S/2W-28ab	(Southern Oregon Experimental Station) is a 145 foot drilled well in sedimentary rock located about 2 miles northeast of Jacksonville.
38S/1W-15ca	(City of Phoenix) is a 41 foot drilled well in sedimentary rock located in Phoenix.

REFERENCES

Robison, J. H., 1971, Availability and quality of ground water in the Medford area, Jackson County, Oregon: U. S. Geological Survey Hydrologic Atlas, HA-392.

Robison, J. H., 1972, Availability and quality of ground water in the Ashland Quadrangle, Jackson County, Oregon: U. S. Geological Survey Hydrologic Atlas, HA-421.

MEDFORD AREA (22)



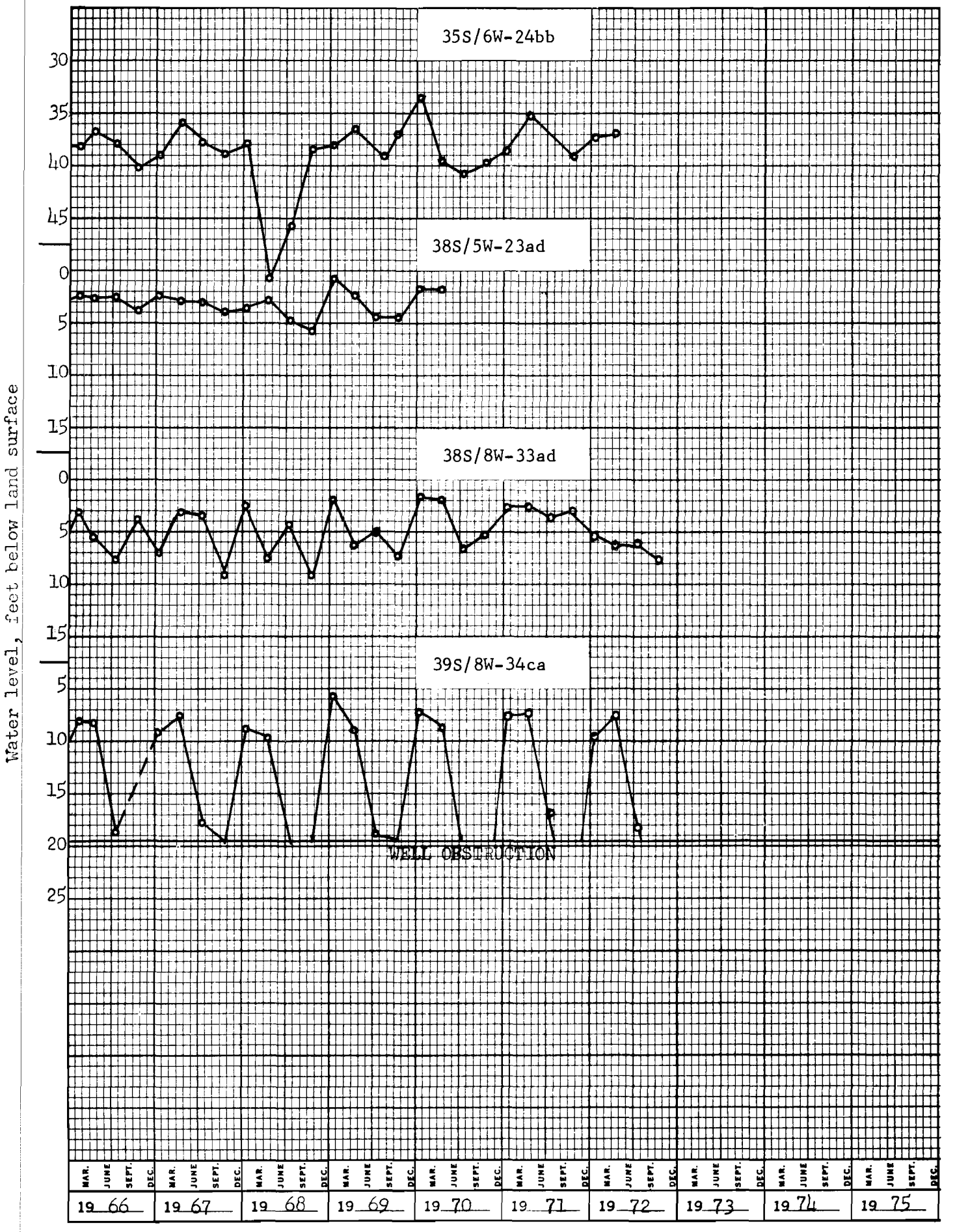
GRANTS PASS AREA (23)

The Grants Pass area of southwestern Oregon, is also noted for the lack of permeable ground-water reservoirs. Most wells produce adequate domestic supplies or small group domestic supplies. The development of large ground-water supplies in this area for irrigation or industrial purposes is not likely. Mountain building forces of the Siskiyou Mountain range has squeezed and altered the water-bearing characteristics of many rock units in southwest Oregon. Weathered granitic rocks provide moderate domestic water supplies; however, sewage disposal in crowded areas threaten shallow aquifers.

OBSERVATION WELLS

35S/6W-24bb	(Oregon State Highway Department) is a 123 foot drilled well in granite located about 5 miles northwest of Grants Pass.
38S/5W-23ad	(John Katzenbach) is a 62 foot drilled well in gravel located about 2 miles southwest of Provolt. Well was destroyed in 1970.
38S/8W-33ad	(J. R. Smith) is a 29 foot drilled well in sand and gravel located about 2 miles north of Kerby.
39S/8W-34ca	(U.S.G.S.) is a 119 foot drilled well in sand and gravel located about 3 miles southeast of Cave Junction. Periodic water level measurements available from 1952 to date.

GRANTS PASS AREA (23)



COOS BAY AREA (24) - BANDON

The sand dune area lying along the coast north of Coos Bay contains the most productive ground water reservoirs in the entire coastal area. The dune sands which exceed several hundred feet in thickness, absorb large amounts of the heavy precipitation which occurs along the coast. It is estimated that the sand dunes in this area are capable of sustaining a yield of over 2,000,000 gallons per day per square mile. Salt water encroachment is a threat in areas of excessive development.

To date, only a small part of the ground water supply in this area has been developed and put to use.

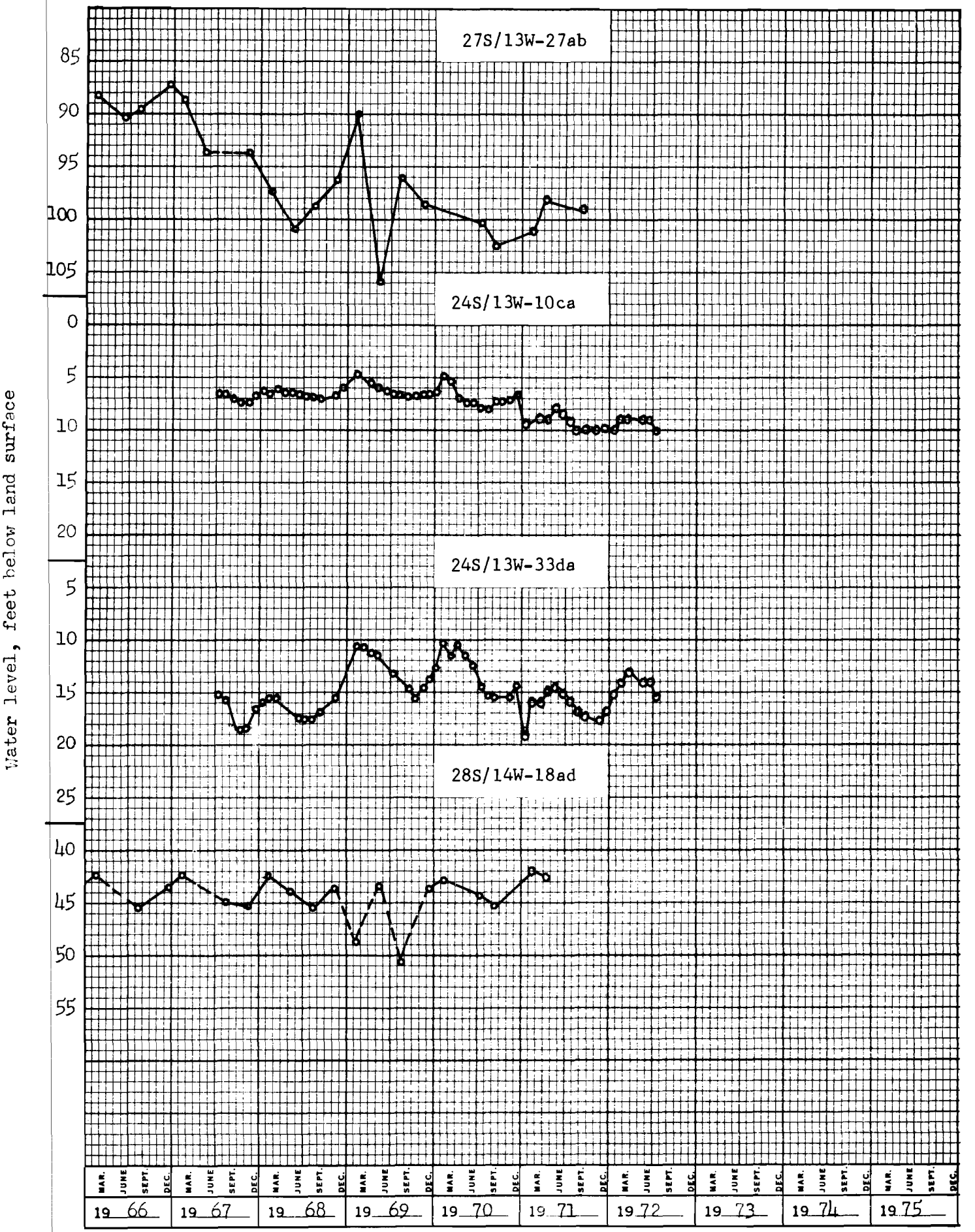
OBSERVATION WELLS

27S/13W-27ab	(City of Coquille) is a 150-foot drilled well in sandstone located about 3 miles northwest of Coquille.
24S/13W-10ca	(Coos Bay - North Bend Water Board) is a 121.5 foot well about 6 miles north of North Bend developing water from sand.
24S/13W-33da	(Coos Bay - North Bend Water Board, formerly P.P. & L.) is a 20-foot jetted well in sand located about 2 miles north of North Bend. Periodic water level measurements available from 1957 to date.
28S/14W-18ad	(Bullards Beach State Park) is a 75-foot drilled well in sand located about 1½ miles north of Bandon.

REFERENCES

Brown, S. G., and Newcomb, R. C., 1963, Ground Water Resources of the Coastal Sand Dune Area North of Coos Bay, Oregon: U. S. Geological Survey Water Supply Paper 1619-D.

COOS BAY AREA (24)



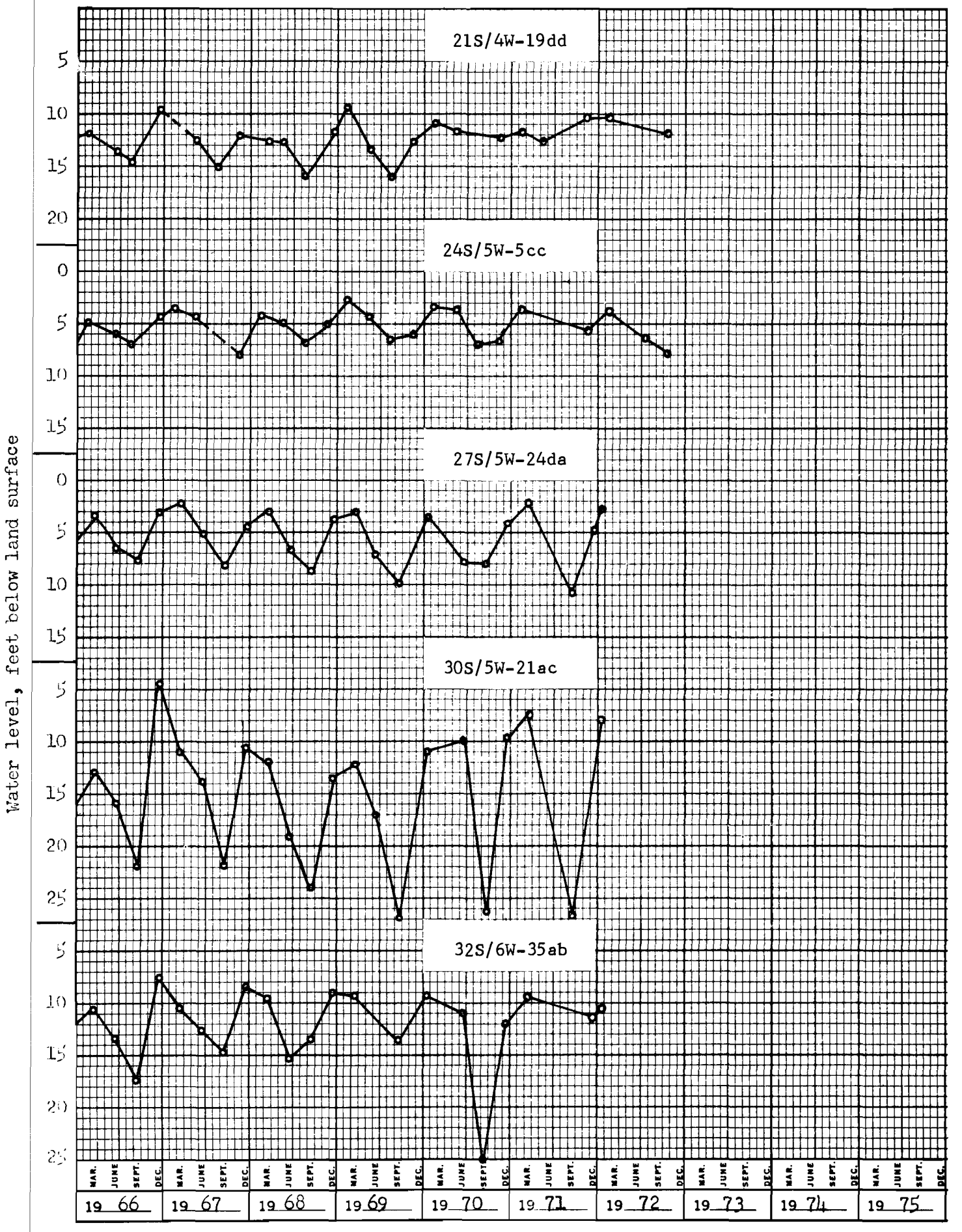
UMPQUA RIVER VALLEY (25)

The Umpqua River Valley is underlain by relatively impermeable rock formations composed of sandstone and shales. Wells in this area generally yield only small supplies of water. The development of large ground water supplies for irrigation or industrial purposes in this area is unlikely. Water quality often shows excessive amounts of iron in deep drilled wells.

OBSERVATION WELLS

21S/4W-19dd	(Douglas County Parks Department) is a 110-foot drilled well in sedimentary rock located in Curtin.
24S/5W-5cc	(Rex Tollefson) is a 80-foot drilled well in shale located about 6 miles north of Oakland.
27S/5W-24da	(Douglas County Parks Department) is a 116-foot drilled well in sedimentary rock located about 6 miles east of Roseburg.
30S/5W-21ac	(Douglas County Parks Department) is a 90-foot drilled well in marine sediments located about one mile north of Canyonville.
32S/6W-35ab	(George H. Wells) is a 100-foot drilled well in sand and gravel located about 2 miles southeast of Glendale.

UMPQUA RIVER BASIN (25)



WILLAMETTE BASIN - LANE COUNTY (26)

The Willamette River Valley receives large quantities of water available for ground water recharge. The rapidly varying character and aerial extent of the various geologic units causes marked differences in recharge and the availability of ground water. One of the major differences is the contrast between the lava rocks of the Cascade Mountains and the marine sediments of the Coast Range Mountains. The runoff characteristics of these two areas greatly affect ground water recharge. The Cascade Mountains are in large part composed of young volcanic rocks, while large areas of the Coast Range are composed of marine sedimentary rock and older volcanic rocks. The swift mountain streams flowing off the volcanic terrain of the Cascade Range carry coarse alluvial sediments that have been deposited in the alluvial fans along the eastern margin of the Willamette Valley. Slower moving streams flowing off the softer marine sediments and weathered volcanic rocks of the Coast Range deposited relatively fine-grained deposits of clay, silt, and sand along the western margin of the valley.

OBSERVATION WELLS

16S/2W-34cdd	(M. A. Nadeau) is a 73 foot drilled well in sand and gravel located about one mile south of Mohawk.
16S/3W-32acd	(Leo Sidwell) is a 39 foot drilled well in sand and gravel located about one-half mile west of Coburg. Periodic water level measurements available from 1928-1930, 1935-1936 and from 1938 to date.
17S/2W-32bad	(Weyerhaeuser Timber Company) is a 175 foot drilled well in sand and gravel located near Springfield.
17S/4W-33aba	(Westlawn Memorial Cemetery) is a 150 foot drilled well in sand and gravel located about 3 miles west of Eugene.
19S/3W-3ccb	(Oregon State Game Commission) is a 200 foot drilled well in sandstone located about 4 miles northwest of Creswell.

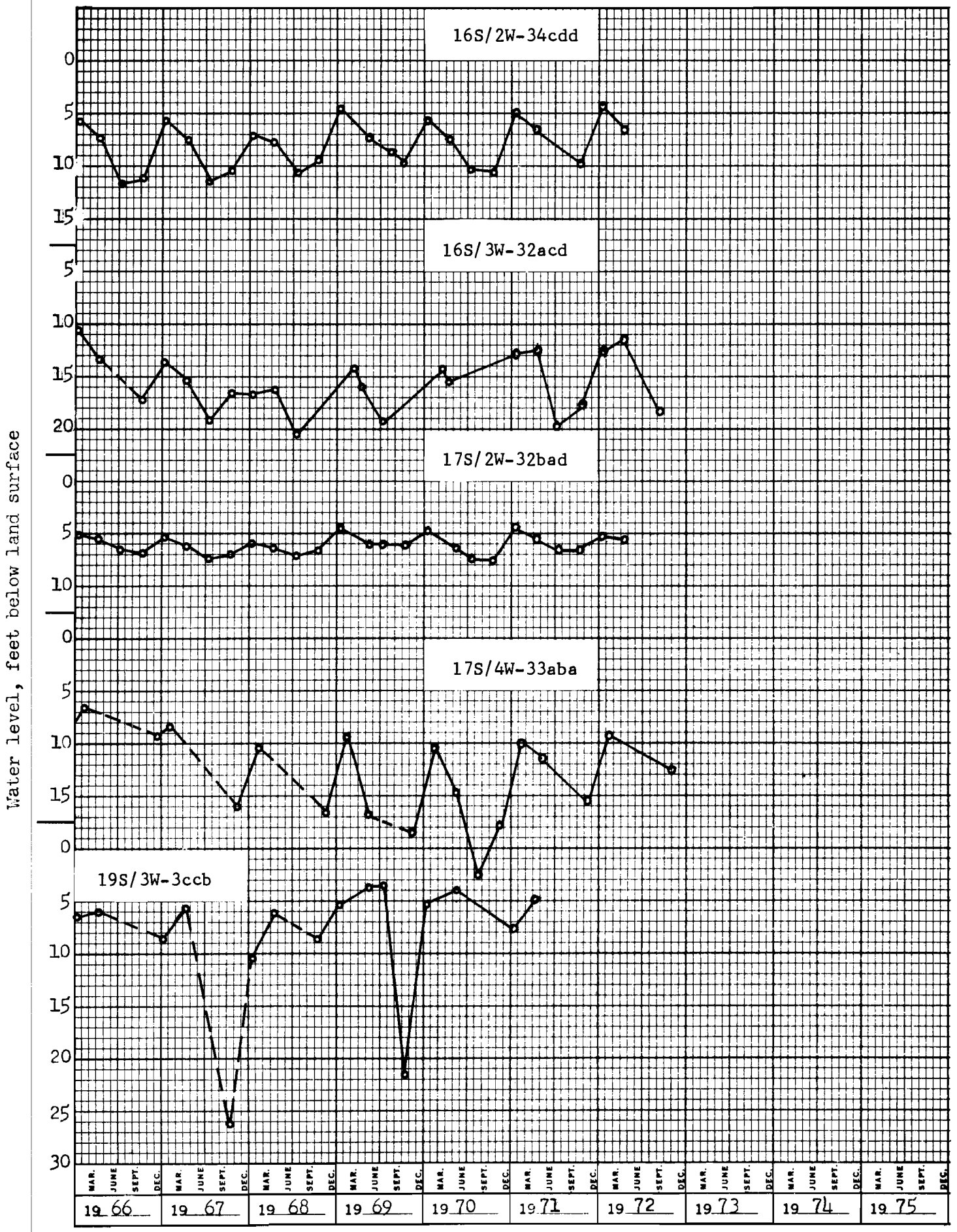
REFERENCES

Frank, F. J., and Nyra A. Johnson, 1970, Selected ground-water data in the Eugene-Springfield area, Southern Willamette Valley, Oregon: State Engineer's Ground Water Report No. 14.

Frank, F. J., and Nyra A. Johnson, 1973, Ground water in the Eugene-Springfield Area, Southern Willamette Valley, Oregon: U. S. Geological Survey Water Supply Paper 2018.

Piper, Arthur, 1942, Ground water-resources of the Willamette Valley Oregon: U. S. Geological Survey Water Supply Paper 890.

WILLAMETTE BASIN (26) - LANE COUNTY



The difference in character of the alluvial sediments from one side of the valley to the other accounts for the great difference in the availability of ground water in these two areas. Productive ground water reservoirs are common along the eastern half of the valley but are missing along most of the western side of the valley.

In Lane County, the productive ground water reservoirs are chiefly related to the alluvial deposits of the McKenzie and Willamette Rivers. Older marine and volcanic rocks underlying the alluvial deposits are generally fine-grained and are capable of yielding only small supplies of ground water. The permeable character and shallow occurrence of the alluvial deposits creates a serious threat of ground water pollution. Surface sources of pollution can be easily transmitted to shallow ground water bodies.

In Linn County, the productive ground water reservoirs are similar to those in Lane County being chiefly the alluvial deposits along the Willamette and Santiam Rivers. The older formations underlying the alluvial deposits are generally of low permeability and not capable of yielding large supplies of ground water.

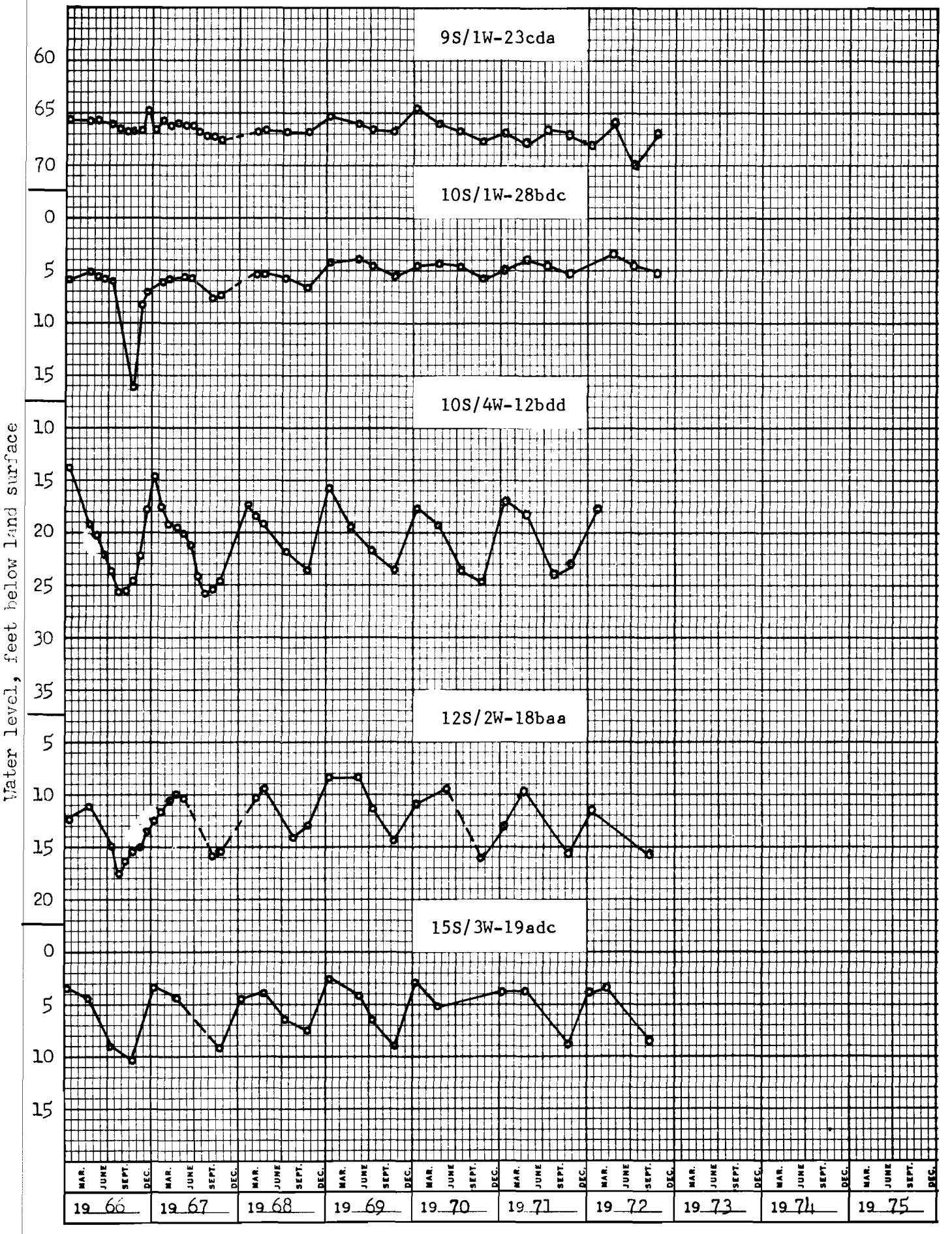
OBSERVATION WELLS

9S/1W-23cda	(Charles Hecht) is a 93-foot drilled well in sedimentary rock located about 2 miles southeast of Stayton.
10S/1W-28bdc	(Grant Farris) is a 172-foot drilled well in blue shale located about 3 miles southeast of Scio.
10S/4W-12bdd	(Henry Hoefer) is a 32-foot drilled well in gravel located about 7 miles north of Albany. Periodic water level measurements available from 1928-1930, 1935-1936, and from 1938 to date.
12S/2W-18baa	(Henry DeManette) is a 175-foot drilled well in sedimentary rock located bbout 4 miles west of Lebanon.
15S/3W-19adc	(Edgar B. Grimes) is a 98-foot drilled well in sand and gravel located about 4 miles southeast of Harrisburg.

REFERENCES

Piper, Arthur, 1942, Ground water resources of the Willamette Valley, Oregon: U. S. Geological Survey Water Supply Paper 890.

WILLAMETTE BASIN (26) - LINN COUNTY



WILLAMETTE BASIN - BENTON COUNTY (26)

Most of the upland areas in Benton County are underlain with volcanic rocks or marine sedimentary rocks. These formations have low permeability and are generally capable of yielding only small supplies of ground water. The older alluvium along the western margin of the Willamette Valley, which was derived from the Coast Range, is generally fine-grained and capable of yielding only small supplies of ground water. The most productive ground water reservoir is the alluvial gravels underlying the flood plain of the Willamette River along the eastern edge of the county. Many of the shallow wells in the gravel alluvium have been developed to yields ranging from 500 to 1,000 gallons per minute. The extreme permeability of these materials and their near surface occurrence makes this source of ground water subject to pollution problems.

OBSERVATION WELLS

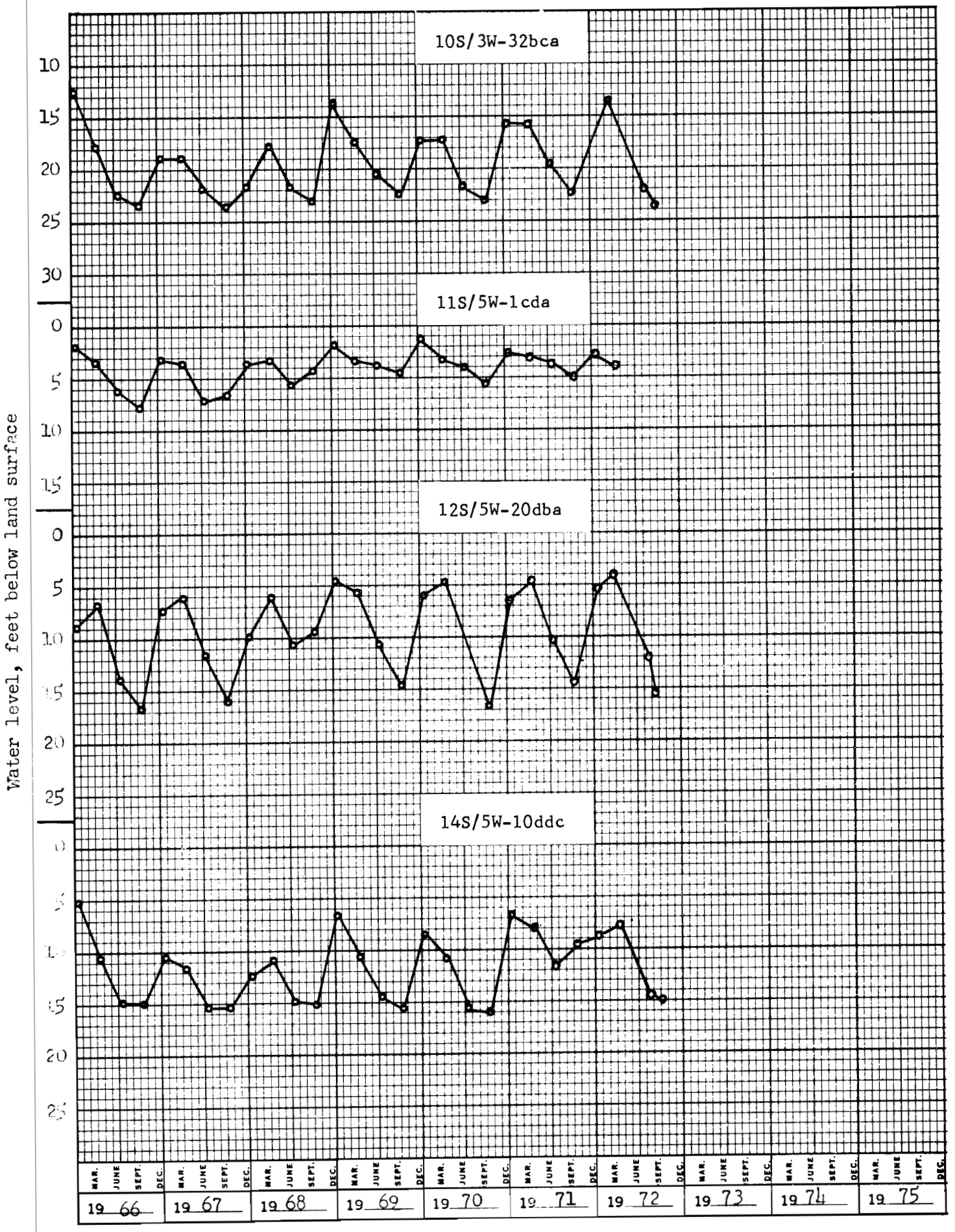
10S/3W-32bca	(D. E. Nebergall) is a 90 foot drilled well in sand located about one mile northeast of Albany.
11S/5W-1cda	(Edward G. Skoubo) is an 89 foot drilled well in sand rock located about 4 miles northeast of Corvallis.
12S/5W-20dba	(C. A. McDonald) is a 100 foot drilled well in sand and gravel located about 3 miles southwest of Corvallis.
14S/5W-10ddc	(Chris Lindseth) is a 19 foot driven well in silt located about 4 miles north of Monroe. Periodic water level measurements available from 1929-1930, 1935-1936, and from 1938 to date.

REFERENCES

Frank, F. J., and Nyra A. Johnson, 1972, Ground water data in the Corvallis Albany Area, Central Willamette Valley, Oregon: State Engineer's Ground Water Report No. 17.

Piper, Arthur, 1942, Ground-water resources of the Willamette Valley, Oregon: U. S. Geological Survey Water Supply Paper 890.

WILLAMETTE BASIN (26) - BENTON COUNTY



The most productive ground water reservoirs in Polk County are the sand and gravel deposits underlying the flood plain of the Willamette River. At places, these deposits are capable of yielding more than 1,000 gallons per minute to properly constructed wells. A high iron content of the ground water in some of these alluvial deposits may restrict the use of this supply.

Most of the other rock units in Polk County, with the exception of the basaltic lava flows underlying the Eola Hills are fine-grained and are generally capable of yielding only small supplies of ground water. Deep wells drilled into the marine sedimentary rocks which underlie a large part of the county often encounter salt water. The lavas underlying the eastern slope of the Eola Hills are generally capable of yielding small to moderate supplies of water.

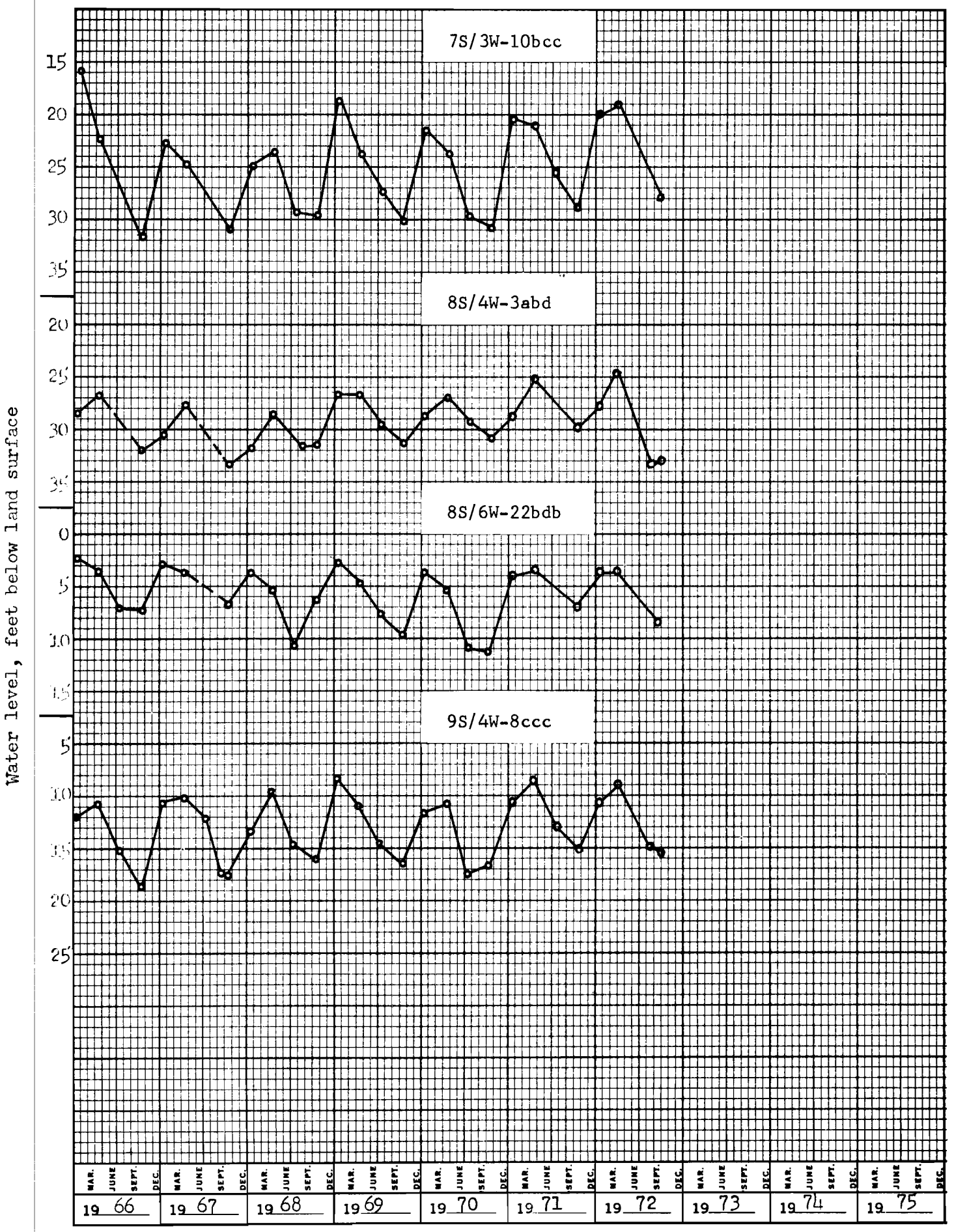
OBSERVATION WELLS

7S/3W-10bcc	(Leland P. Brandt) is a 150-foot drilled well in sand and gravel located about 3 miles north of Salem.
8S/4W-3abd	(Theodore C. Muller) is a 60-foot drilled well in gravel located about 4 miles southeast of Rickreall.
8S/6W-22bdb	(Edward Bakke) is a 79-foot drilled well in marine sediments located about one mile east of Falls City.
9S/4W-8ccc	(D. W. Christianson) is a 120-foot drilled well in sand and gravel located about 8 miles south of Independence.

REFERENCES

Price, Don, and Johnson, Nyra A., 1965, Selected Ground Water Data in the Eola-Amity Hills Area, Northern Willamette Valley, Oregon: State Engineer Ground Water Report No. 7.

WILLAMETTE BASIN (26) - POLK COUNTY



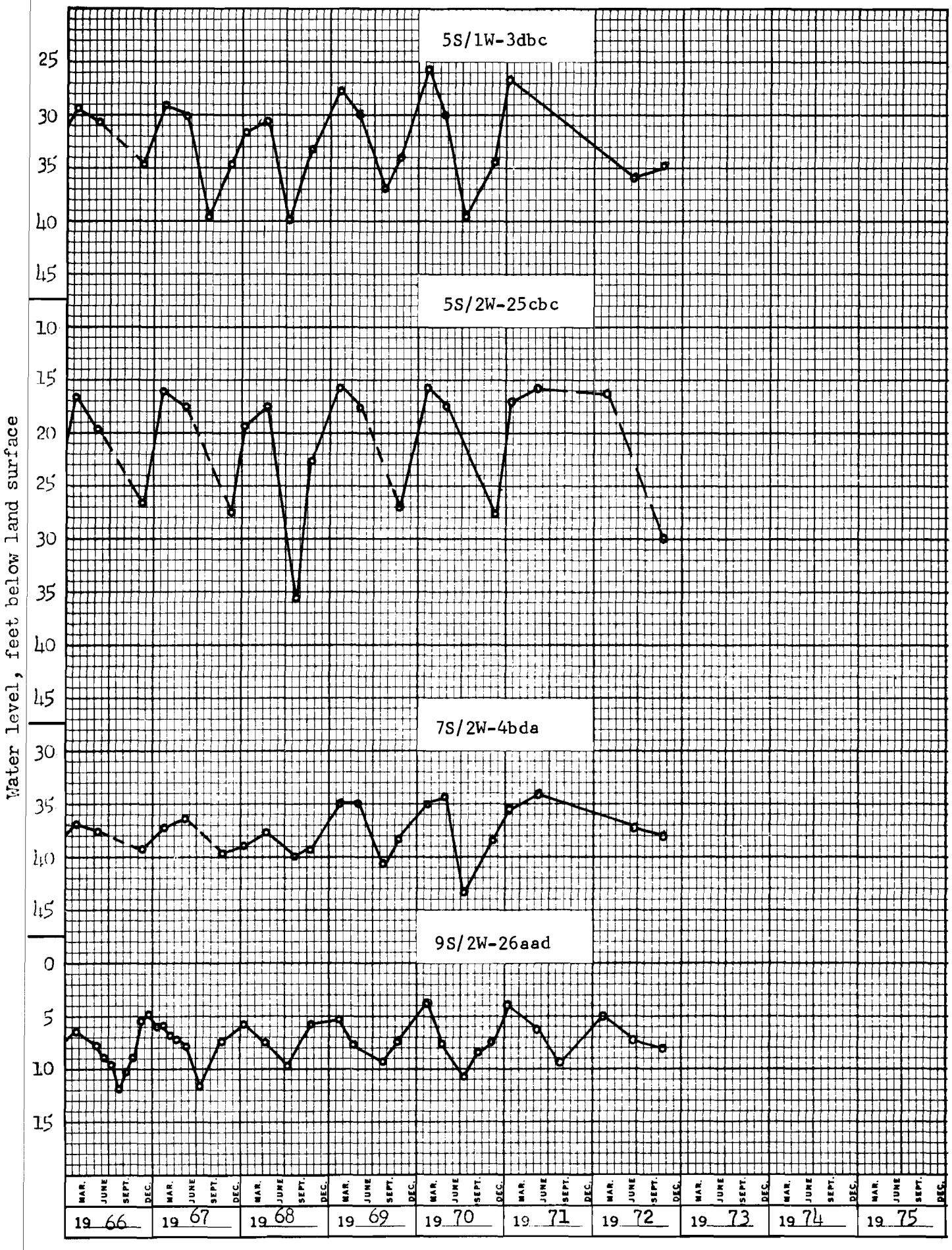
The most productive ground water reservoirs in Marion County are the alluvial gravels underlying the flood plain of the Willamette River and the older gravel strata underlying the French Prairie area.

The Geological Survey investigation has found that recharge has been more than ample to replace the annual discharge from the ground water reservoir underlying the French Prairie area. During 1960, the pumpage was in the order of 20,000 acre feet, which represented only about 8% of the total volume naturally discharged from the area each year. The total natural discharge was estimated to have been 258,000 acre feet. They concluded that an additional lowering of the water table by 5 feet each irrigation season would result in a more efficient utilization of the ground water reservoir by providing additional storage space to hold water that is now generally rejected during the spring months. This would increase the total available ground water supply in this area to as much as 388,000 acre feet per year. As the amount of water required to irrigate the area is estimated to be about 100,000 acre feet, there appears to be an ample ground water supply available to irrigate the entire area without fear of an overdraft on the ground water reservoir.

OBSERVATION WELLS

5S/1W-3dbc	(Manton Carl, formerly Ramlo) is a 102-foot drilled well in gravel located about one mile south of Hubbard.
5S/2W-25cbc	(Sam Brown) is a 252-foot drilled well in sand and gravel located about one mile east of Gervais. Periodic water level measurements available from 1929-1930, 1935-1936, and from 1938 to date.
7S/2W-4bda	(P. W. Woelke) is a 165-foot drilled well in sand and gravel located about 4 miles northeast of Salem.
9S/2W-26aad	(Louis C. Scofield) is a 25-foot drilled well in gravel located about 3 miles south of West Stayton.

WILLAMETTE VALLEY (26) - MARION COUNTY



OBSERVATION WELLS

4S/1W-23acc (Donald Olmstead) is a 57-foot dug well in silt and sand located about 3 miles southwest of Aurora. Periodic water level measurements available from 1945 to date.

4S/2W-22cbc (Kirk Brothers) is a 117-foot drilled well in sand located about 3 miles east of St. Paul. Periodic water level measurements available from 1957 to date.

6S/2W-18acd (E. A. Hillyer) is a 140-foot drilled well in sand and gravel located about 2 miles southwest of Brooks. Periodic water level measurements available from 1957 to date.

8S/3W-11ccc (City of Salem) is a 270-foot drilled well in basalt located within Salem.

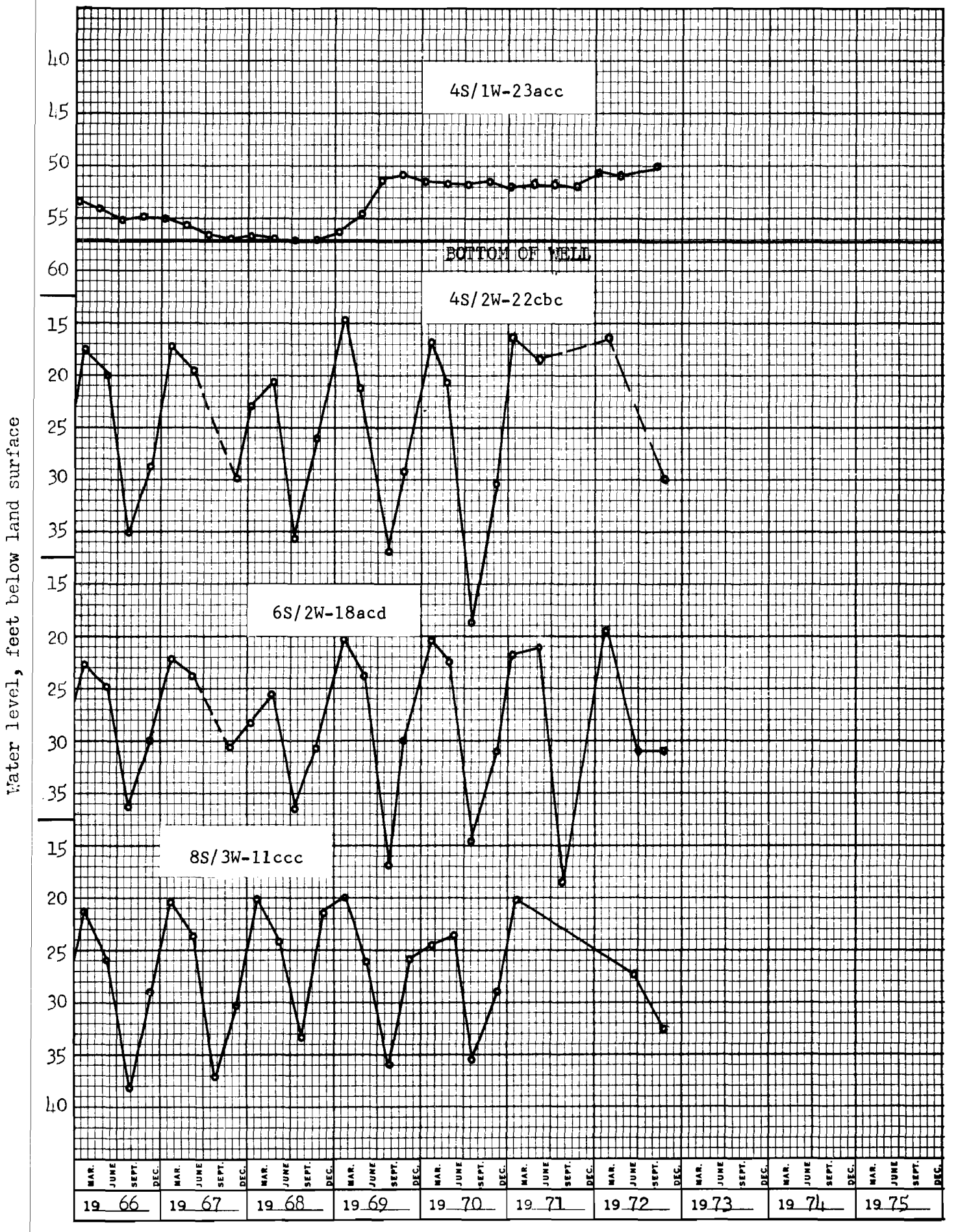
REFERENCES

Hampton, E. R., 1963, Records of wells, water levels, and chemical quality of ground water in the Molalla-Salem Slope area, Northern Willamette Valley, Oregon: State Engineer Ground Water Report No. 2.

Price, Don, 1961, Records of wells, water levels and chemical quality of ground water in the French Prairie-Mission Bottom area, Northern Willamette Valley, Oregon: State Engineer Ground Water Report No. 1.

Price, Don, 1965, Ground Water conditions and availability on the French Prairie area, Northern Willamette Valley, Oregon: U. S. Geological Survey open file report.

WILLAMETTE VALLEY (26) - MARION COUNTY



WILLAMETTE BASIN - YAMHILL COUNTY (26)

The most productive ground water reservoirs in Yamhill County are the alluvial sand and gravel deposits along the Willamette River. Some of these deposits have been developed to yields ranging from 500 to 800 gallons per minute. The alluvial deposits along the Yamhill River are thin and fine grained and are generally capable of furnishing only small supplies of ground water. The marine sedimentary rocks that underlie large parts of Yamhill County have low permeability and yield only small supplies of ground water. Some of the wells drilled into these marine rocks have encountered salt water.

OBSERVATION WELLS

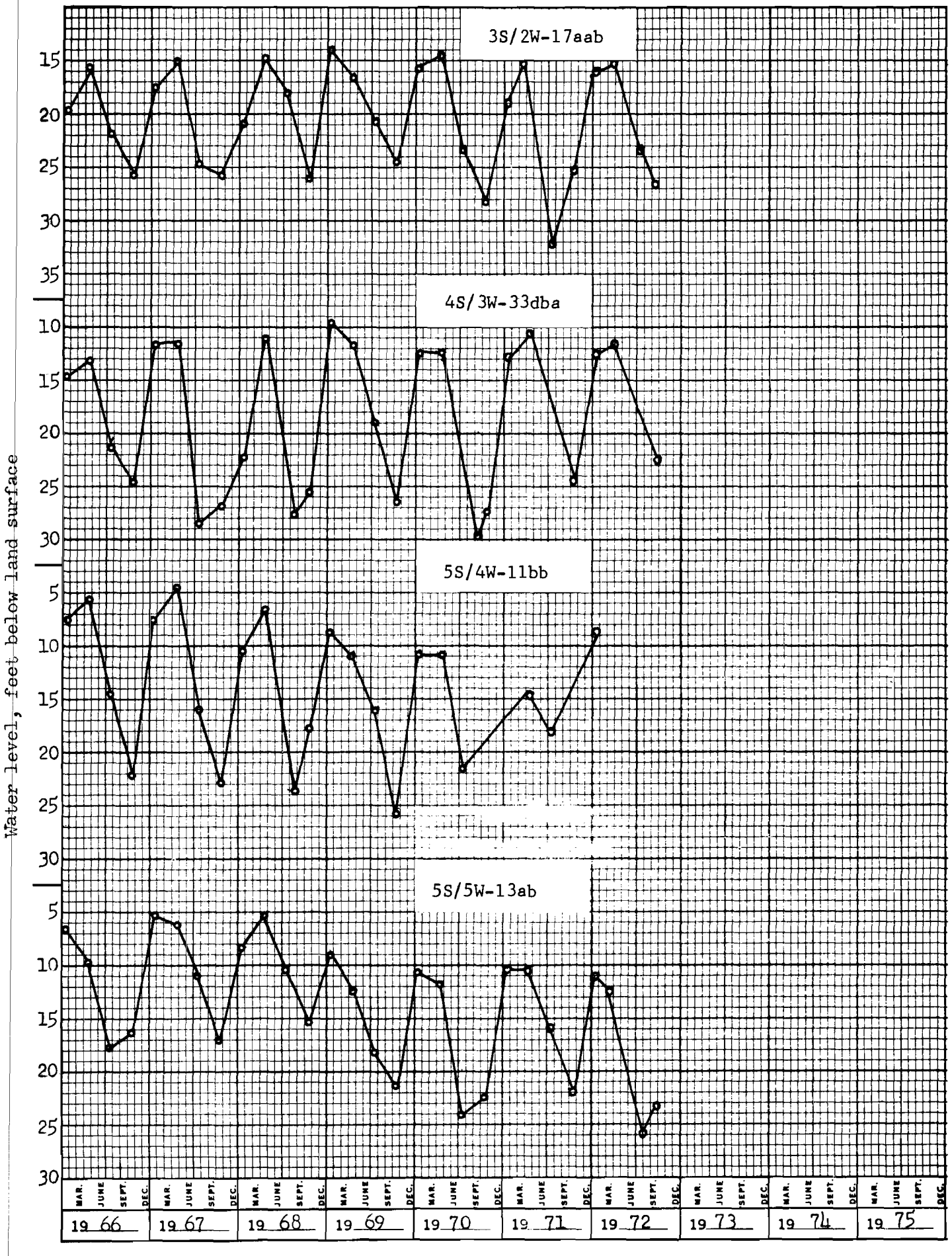
3S/2W-17aab	(Mack Bennett) is a 200.5-foot drilled well in basalt located about 1 mile northeast of Newberg.
4S/3W-33dba	(Clayton J. Trent) is a 220-foot drilled well in sand located about 4 miles south of Dayton.
5S/4W-11bb	(Norman J. Longhurst) is a 96-foot drilled well in black sand located about 3 miles east of Whiteson.
5S/5W-13ab	(George Fuller) is a 64-foot drilled well in sand and gravel located about 7 miles southwest of McMinnville. Periodic water level measurements available from 1928-1930, 1935-1936 and from 1938 to date.

REFERENCES

Piper, Arthur, 1942, Ground water resources of the Willamette Valley, Oregon: U. S. Geological Survey Water Supply Paper 890.

Price, Don, and Johnson, Nyra A., 1965, Selected Ground Water Data in the Eola-Amity Hills Area, Northern Willamette Valley, Oregon: State Engineer Ground Water Report No. 7.

WILLAMETTE BASIN (26) - YAMHILL COUNTY



WILLAMETTE BASIN - CLACKAMAS COUNTY (26)

The Columbia River Basalt formation is an important source of ground water in Clackamas County. It serves as a source of water in the Wilsonville, Lake Oswego, and Milwaukie areas. Water from weathered basalt formations is often high in dissolved iron and some areas of "red water" exist in the county. A clay mantle formed by the weathering of the basalt on many of the uplands tends to restrict recharge.

In the Canby-Aurora area, moderately large supplies of ground water have been developed in alluvial deposits.

OBSERVATION WELLS

2S/2E-15bb	(Byrum W. Morehouse) is a 347 foot drilled well in sand and gravel located near Gladstone.
2S/4E-4dd	(M. K. Smith) is a 400 foot drilled well in sand and gravel located about 2 miles east of Boring.
3S/1W-10cc	(Charles Jenkins) is a 115 foot drilled well in Columbia River Basalt located about 2 miles north of Wilsonville. Periodic water level measurements available from 1951 to date.
3S/1E-34cd	(Frank Delforge) is a 218 foot drilled well in sand and gravel located about 1 mile east of Canby.

REFERENCES

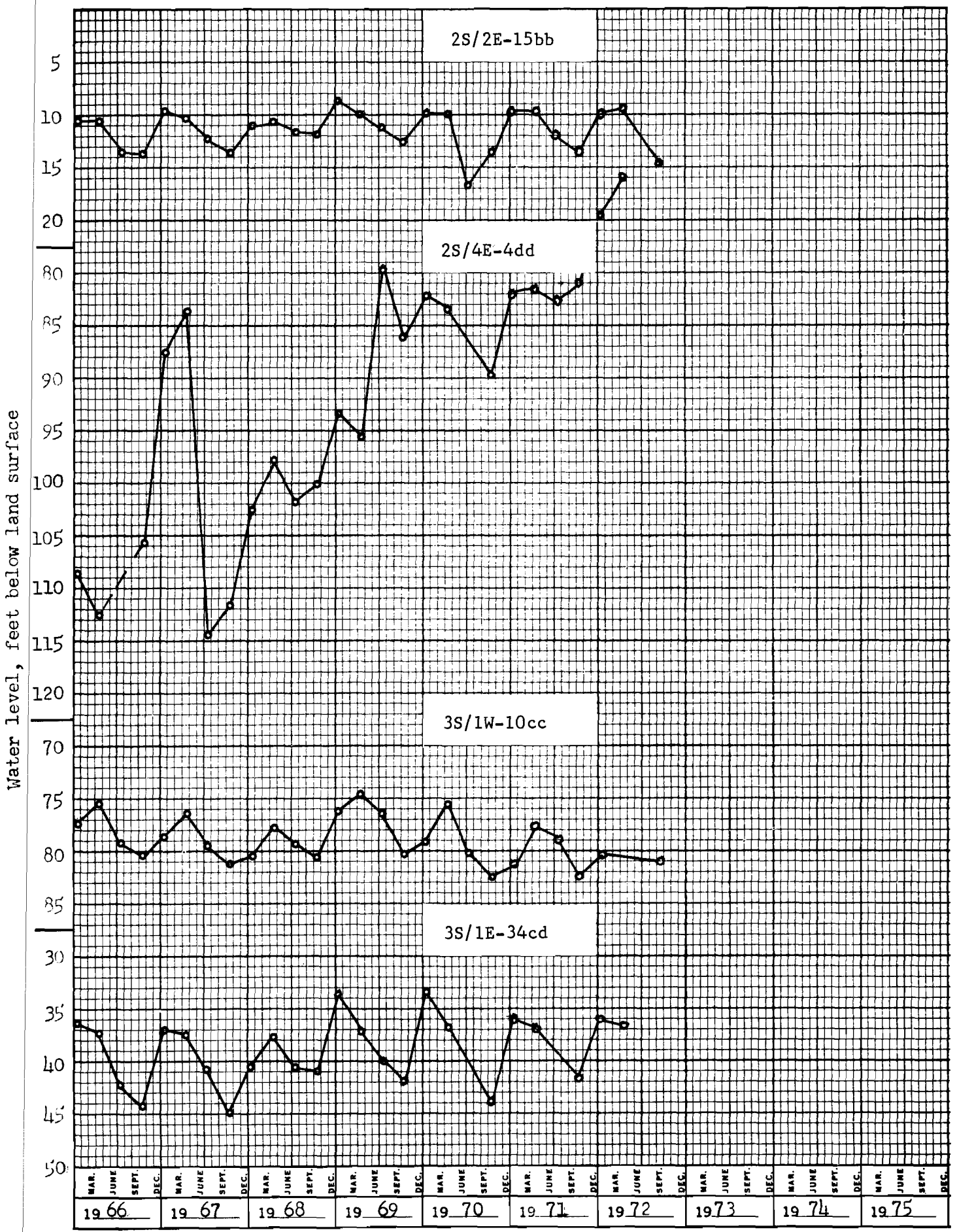
Foxworthy, B. L., et al, 1964, Records of wells and springs, water levels and chemical quality of ground water in the East Portland area, Oregon: State Engineer Ground Water Report No. 3.

Hampton, E. R., 1963, Records of wells, water levels and chemical quality of ground water in the Molalla-Salem Slope area, Northern Willamette Valley, Oregon: State Engineer Ground Water Report No. 2.

Hampton, E. R., 1972, Geology and ground water of Molalla-Salem Slope area, Northern Willamette Valley, Oregon: U. S. Geological Survey Water Supply Paper 1997.

Hogenson, G. M., and Foxworthy, B. L., 1965, Ground water in the East Portland area, Oregon: U. S. Geological Survey Water Supply Paper 1793.

WILLAMETTE BASIN (26) - CLACKAMAS COUNTY



TILLAMOOK AREA (27)

The Tillamook area includes the broad valley occupied by the Wilson, Trask, and Tillamook Rivers in and adjacent to the town of Tillamook. The present valley was formed by the gradual filling of Tillamook Bay with alluvial deposits. These deposits, which at places extend to depths of 150 feet or more, form the only productive ground water reservoir in the area. Some of the wells drilled into these deposits have been developed to yield as much as 600 gallons per minute.

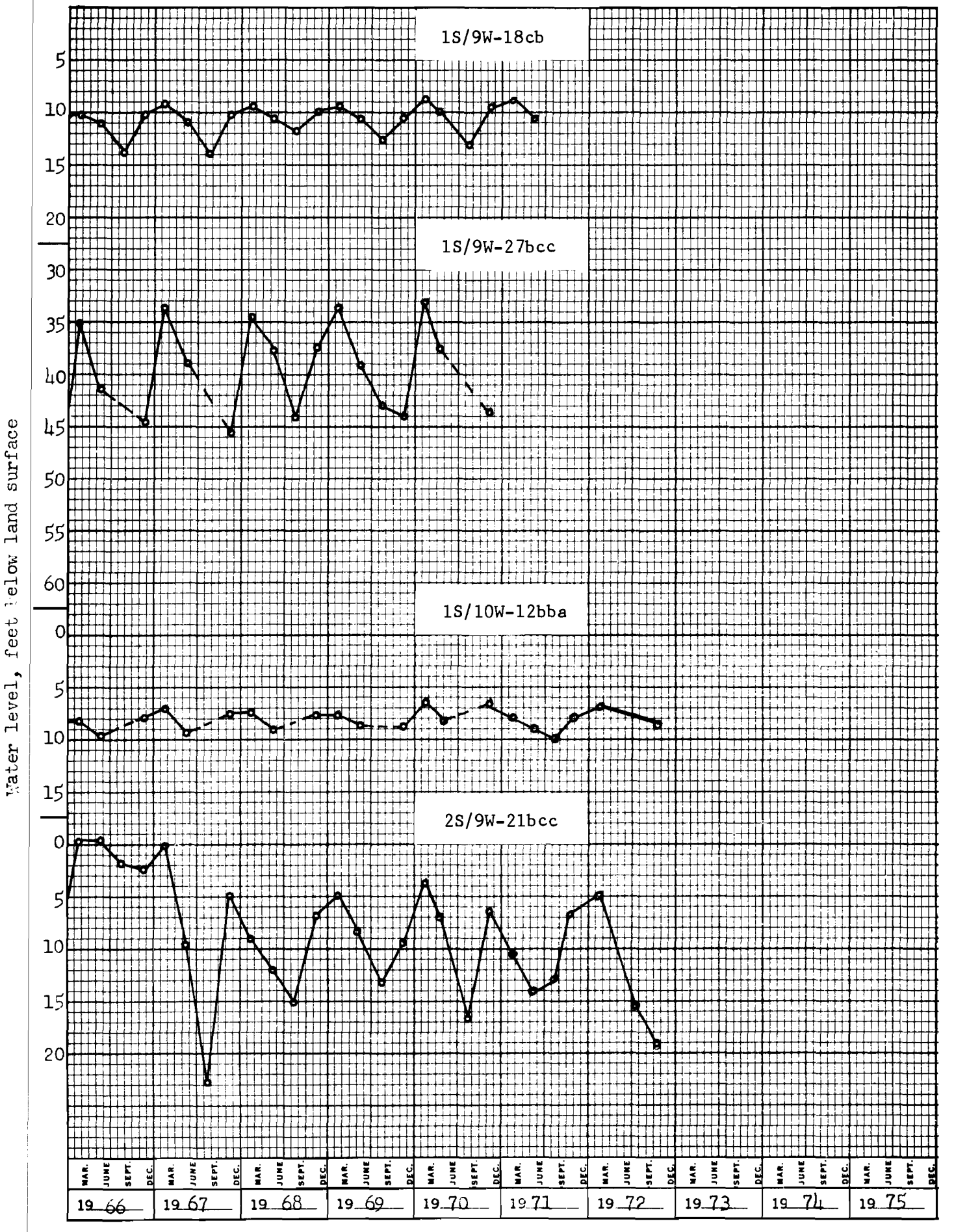
The marine sedimentary rocks which underlie the alluvial deposits and form the surrounding hills have low permeability and are capable of yielding only small supplies of ground water.

The large amount of precipitation incident to the area fills the ground water reservoirs early in the winter and large amounts of the water available for recharge is rejected.

OBSERVATION WELLS

1S/9W-18cb	(Green Acres Motel) is a 187 foot drilled well in gravel located about 2 miles north of Tillamook. This well was dropped from the observation well net in 1971.
1S/9W-27bcc	(Virgil Chadwick) is a 197 foot drilled well in gravel located about 2½ miles east of Tillamook. This well was dropped from observation well net in 1970.
1S/10W-12bba	(Leo and Robert Wassmer) is an 80 foot drilled well in gravel located about 3½ miles northwest of Tillamook near Idaville.
2S/9W-21bcc	(Vern Darby) is a 128 foot drilled well in gravel located about 7 miles southeast of Tillamook.

TILLAMOOK AREA (27)



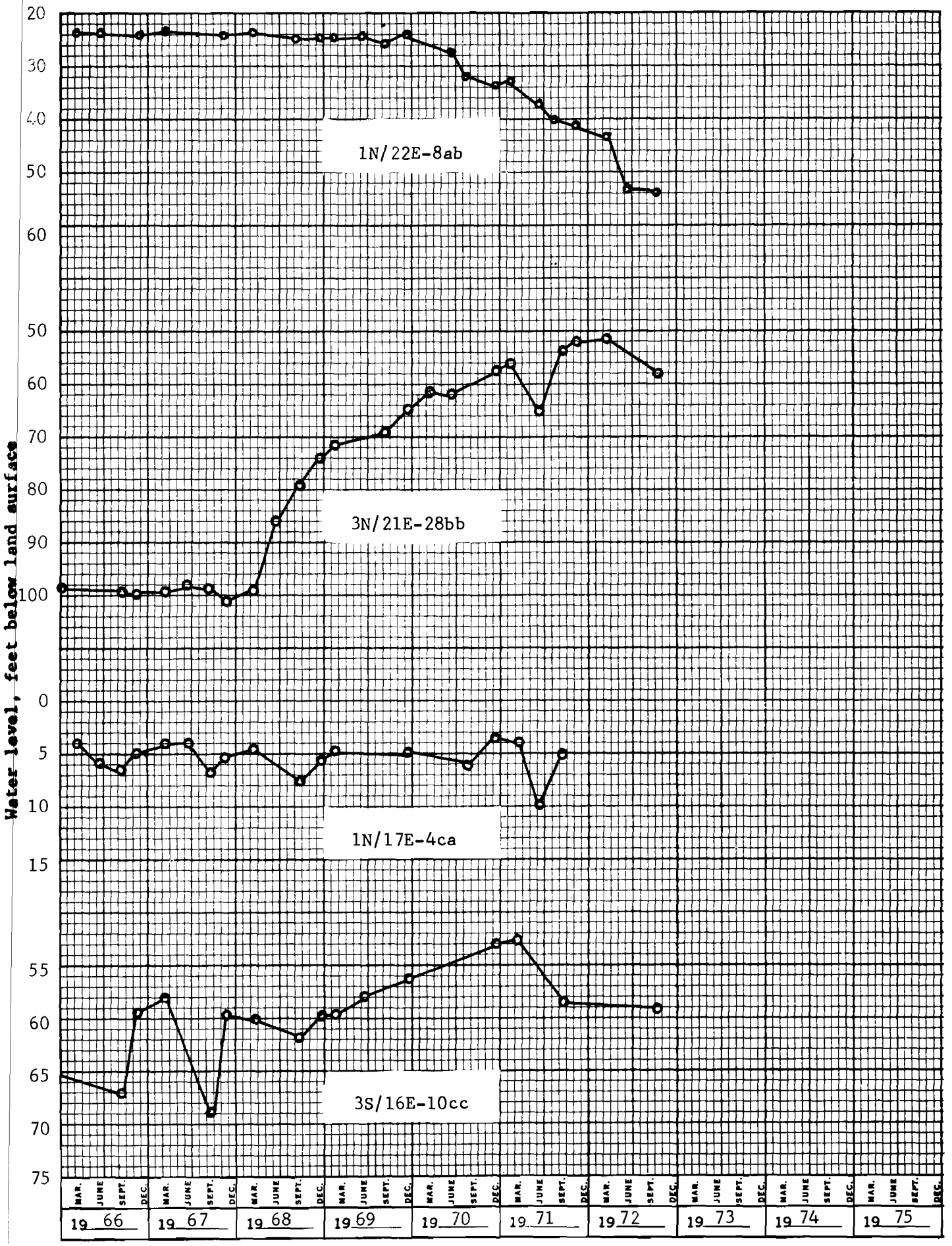
GILLIAM - SHERMAN COUNTY (28)

Much of the area in Gilliam and Sherman County is formed by the northward dipping basaltic plateaus known as the "Columbia Slope". Much of the area is made up of a thick sequence of basaltic lava flows. These units become increasingly thin toward the southern boundary of the area. Contact zones between flows are usually inflated and are capable of transmitting ground water in zones lying below the regional water table. Water levels often stand at considerable depths below land surface on the upland plateaus. The annual recharge occurs in the higher elevations to the south and moves down-gradient toward the Columbia River. Artesian wells are not uncommon in the inclined basaltic lava rocks. Much of the surface of the basalts has been covered by a blanket of wind blown silt and loess deposits. Shallow domestic wells are often developed in perched water table areas in these deposits. The storage coefficient of the basaltic lavas is low, generally less than 1 to 3 per cent. Therefore, any moderate well field development is expected to result in some water level decline in these aquifers. Water levels in wells adjacent to the John Day Dam and reservoir on the Columbia River have responded to the change in base level of the river of approximately 40 feet. See hydrograph 3N/21E-28bb.

OBSERVATION WELLS

1N/22E-8ab	(D. L. Lemon) is a 229 foot drilled well in basalt located about 10 miles southeast of Arlington.
3N/21E-28bb	(City of Arlington) is a 619 foot drilled well in basalt located within Arlington.
1N/17E-4ca	(Phillip G. O'Meara) is a 712 foot drilled well in basalt located near Wasco.
3S/16E-10cc	(E. J. Hartley) is a 126 foot drilled well in basalt located about 4 miles south of Grass Valley.

GILLIAM - SHERMAN COUNTY (28)



LIST OF OBSERVATION WELLS

WELL NO.	OWNER	RECORDS AVAILABLE
	BAKER COUNTY	
7S/39E-3ab	L. H. Williams	1963-
7S/39E-20ccb	City of Baker	1936-
7S/39E-28cb	Martha Traverso et al	1963-
7S/40E-33dbc	Walter Colton	1964-
8S/39E-22bdd	Baker County	1936- 1/
8S/40E-14adb	Frank Tetrault	1969-
8S/40E-19bbb	Baker County	1936- 1/
8S/40E-23aaa	Baker County	1936-1970 2/
8S/41E-14abd	Steward - Morrissey Inc.	1963-
8S/46E-15ab	Lewis Laird	1964-
9S/39E-2ccc	Kermit Hansen	1949- 1/
9S/40E-1ccb	Arlie Patton	1964-
9S/40E-18dcb	Paul V. Hill	1963- 1/
12S/38E-27aa	Hereford Community Church	1968-
13S/37E-17ac	Unity School District 30J	1964-
	BENTON COUNTY	
10S/3W-31bda	Springhill Country Club	1965-
10S/3W-32bcb	D. E. Nebergall	1962- 1/
10S/4W-10cc	George Ambrosek	1965-
10S/6W-21aba	John Maloney	1965-
10S/6W-21abb	Thomas Maloney	1970-
11S/4W-5cdd	Oregon State University Farm	1965-
11S/4W-5ddb	Oregon State University Farm	1965-
11S/4W-19cbd	Oregon State University	1962-
11S/5W-1cda	Edward C. Skoubo	1962- 1/
12S/5W-8aaa	Donald L. Russell	1962-
12S/5W-20dca	C. A. McDonald	1962- 1/
12S/6W-12cdd	Hobin Lumber Company	1962-
12S/6W-35cb	Carl Solberg	1968-
13S/5W-7dd(2)	Claude Mariner	1966-
13S/5W-22ab	Malcolm Thompson	1965-
14S/5W-10ddc	Chris Lindseth	1962- 1/
	CLACKAMAS COUNTY	
2S/1E-2ccb	City of Lake Oswego	1964-
2S/1E-4ca	Chester Bohlman	1963-1968 2/
2S/1E-21ccc	Paul Riegelmann	1963-
2S/2E-15bbb	Byrum Morehouse	1962- 1/
2S/3E-2acc	Vernon DeYoung	1962-
2S/3E-6bdb	Lewis Isaacs	1962-
2S/3E-10bab	Mas Fujimoto	1962-
2S/3E-31caa	Howard DeLano	1962-
2S/4E-4ddb	M. K. Smith	1962- 1/
2S/4E-5cbb	Earl Meiers	1962-
2S/4E-7aba	Jerry Tate (O'Shia)	1962-
2S/4E-27bab	Sandy Farms	1962-
2S/4E-29dad	Virgil Nelson	1962-
2S/5E-18aca	Frank Leitheiser	1962-
3S/1W-10ccd	Charles Jenkins	1951- 1/
3S/1W-14dcb	Black Inc.	1951-1968 2/
3S/1W-15cac	Dammasch State Hospital	1959-
3S/1W-16ddd	Dammasch State Hospital	1961-
3S/1W-23aaa	Tuefel Holly Farm	1964-
3S/1W-25dba	Oregon State Experimental Farm	1963-
3S/1E-7add	Frank Hoyt	1963-
3S/1E-26bcd	Amil R. Slaby	1962-
3S/1E-32ddb	D & S Farm Inc.	1962-1971 2/
3S/1E-34bdc	Ivan Arneson	1962-
3S/1E-34cdb	Frank Delforge	1962- 1/
3S/1E-36ccd	Joe Demsher Jr.	1960-
3S/1E-36ccc(2)	L. H. Davis	1960-
3S/2E-35aba	F. H. Hunt	1965-
3S/4E-26cdb	W. O. Youngberg	1963-
4S/1E-4adb	John W. Beck	1962-
4S/1E-20bac	Robert May	1965-
5S/1E-5dd	A. D. Rogie	1962-
5S/1E-18acc	Warren Bremer	1962-
5S/2E-5cb	Norman Simmons	1965-
5S/2E-17ac	Howard Brockart	1963-
5S/3E-5aa	Marvin W. O'Dell	1965-
6S/2E-14aba	Harry Schoenborn	1963-
	CLATSOP COUNTY	
8N/7W-24aa	Oregon State Game Commission	1963-
8N/8W-27ba	Howard T. Multhauf	1963-
	COLUMBIA COUNTY	
4N/1W-31cd	John Havlic	1967-
4N/2W-12cdd	Joseph Blaha	1969-
4N/2W-13bd	Paul J. DeShazer	1963-
5N/1W-17dd	Shell Oil Company	1965-1968 2/
5N/1W-21bdb	City of St. Helens	1969-
7N/3W-13aa	Rainier Cemetery District	1968-
	COOS COUNTY	
23S/13W-34aca	Coos Bay-North Bend Water Board	1957-
24S/13W-10cab(3)	Coos Bay-North Bend Water Board	1957-
24S/13W-28cdc	Coos Bay-North Bend Water Board	1957- 2/
24S/13W-33ac	Coos Bay-North Bend Water Board	1957- 2/
24S/13W-33daa	Coos Bay-North Bend Water Board	1967- 1/
25S/13W-4bdc	Coos Bay-North Bend Water Board	1967-
25S/13W-4cb	Coos Bay-North Bend Water Board	1956-1967 2/
27S/13W-27ba	City of Coquille	1963- 1/
28S/14W-18ad	Bullard Beach State Park	1965- 1/
	CROOK COUNTY	
14S/15E-15dcb	L. H. McPhetridge	1945- 1/
14S/15E-20daa	Boston Cattle Company	1968-
14S/16E-19add	Leslie Clauson	1944- 1/
14S/16E-31bbc	Pacific Power & Light Company	1964-
14S/16E-31dcd	Pacific Power & Light Company	1964-
14S/16E-32cbd	Pacific Power & Light Company	1964-
14S/16E-32ccd	E. E. Wagoner	1944- 1/
15S/16E-5bcb	Pacific Power & Light Company	1964-
15S/16E-5bc(3)	Pacific Power & Light Company	1964-
15S/16E-6aac	Dorn Brothers	1944-1965 2/
20S/22E-25dd	G. I. Ranch	1964-
21S/22E-3bb	G. I. Ranch	1963-
	CURRY COUNTY	
41S/13W-9ac	Roger Oliver	1967-
41S/13W-9dc	Minnie Glendenin	1966-
41S/13W-9dc(2)	E. L. Rigdon	1966-
41S/13W-9ba	Robert Swan	1967-
	DESCHUTES COUNTY	
14S/10E-7dc	Pine Rock Ranch	1963-
15S/10E-8ac(2)	Ross Hammond	1960- 1/
15S/13E-18adc	Bonneville Power Administration	1970-
19S/11E-32cc	Sunriver Prop. Inc.	1967-
20S/11E-6dc	Sunriver Prop. Inc.	1967-
21S/11E-19ccc	Inez Kellems	1945- 1/
22S/21E-8ac	Elton Jackson	1959-1969 2/
22S/21E-16bb	Hampton Butte Grazing Corp.	1961-
	DOUGLAS COUNTY	
21S/4W-19dd	Douglas County Parks Dept.	1963- 1/
23S/5W-15cc	W. S. Carlson	1963-
24S/5W-5cc	Ray Graves	1963- 1/
26S/5W-6aba	Stanley Mohr	1963-
27S/5W-24da	Douglas County Parks Dept.	1963- 1/
29S/8W-16bc(2)	Walter Plikat	1967-
30S/5W-21ac	Douglas County Parks Dept.	1963- 1/
32S/6W-35ab	George H. Wells	1963- 1/

1/ Hydrograph of this well shown in this report
2/ Measurements discontinued

LIST OF OBSERVATION WELLS

WELL NO.	OWNER	RECORDS AVAILABLE
	GILLIAM COUNTY	
1N/22E-5db	Robert Root	1965-
1N/22E-8ab	D. L. Lemon	1964- 1/
3N/21E-28bb	City of Arlington	1964- 1/
3N/21E-34ab	E. M. Hulden	1964
	GRANT COUNTY	
9S/30E-26ac	L. F. McGirr	1966- 2/
10S/28E-8ac	Theron King	1966-
11S/29E-25db	Cecil Bryant	1966-
11S/30E-6aa	Frank McGirr	1966-
12S/26E-34da	Dayville Cemetery	1963- 1/
13S/29E-22ca	Curtice Martin	1962- 1/
13S/30E-27aa	Oregon State Highway Dept.	1964- 1/
13S/31E-21cc	Mt. View Country Club	1963- 1/
13S/31E-23cb	City of John Day	1962-
13S/31E-26bd	City of John Day	1962
16S/30E-28dd	Robert Lemcke	1966-
17S/31E-2ba	Wesley Kriege	1966-
18S/31E-12aa	Harry Pon	1966-
	HARNEY COUNTY	
19S/31E-13ac	Harry Pon	1966-
19S/31E-13da	Harry Pon	1966-
22S/30E-27ddc	Werner Arntz	1966-
22S/31E-28dda	Harry Pon	1966-
22S/31E-34ccb	L. F. Lazaus	1930- 1/
22S/31E-36bab	Robert Smith	1963-
22S/32½E-30cdb	Jack McGee	1966-
22S/33E-27adc	John Temple	1966-
23S/27E-30ab	Green Valley Ranch	1962- 1/
23S/30E-36bbc	Baker Ranch	1971-
23S/31E-3bbb	Harney County	1936-1971 2/
23S/31E-5aac	Harry Pon	1962-
23S/31E-11dcc(1)	E. Sewell	1959- 1/
23S/31E-11dcc(2)	E. Sewell	1959-
23S/31E-14aab	Harney County	1936-1971 2/
23S/31E-16bcc	Harney County	1936-1971
23S/31E-16dbb	T. Allen Jones	1930- 1/
23S/31E-33bcc	Harney County	1936-1971 2/
23S/32E-3aad	Meadowland Ranches Inc.	1965-
23S/32E-7cab	Dorland Ray	1928-
23S/32E-28aba	Bar Nag Ranch	1966-
23S/32E-29adb	Roy Duhaime	1968-
23S/32E-30ddd	Harney County	1936-1971 2/
23S/32½E-1bbb	Dick & Ed McConville	1965-
23S/33E-36ad	Kenneth Mann	1966-1971 2/
23S/34E-31add	Miller Bros. Ranch	1971-
24S/27E-11ba	Silver Creek Ranch	1968-
24S/30E-7cdd	Adolf Kisle	1966-
24S/30E-26ddc	John Campbell	1960- 1/
24S/31E-28bcc	Harney County	1936- 1/ 2/
24S/32½E-30ddc	Ansel Marshall (Catterson)	1963-
24S/34E-31acb	John Rossberg	1959- 1/
24S/34E-31cbd	John Rossberg	1963-
24S/34E-31dcb	John Rossberg	1960-1969 2/
24S/34E-31dda	John Rossberg	1959-1969 2/
25S/30E-34ab	Forrest Reed	1963-
25S/31E-4cba	James Stahl	1962-1970 1/ 2/
25S/31E-29ccb	Edgar Koeneman	1964-1970 2/
25S/34E-30dcc	Forrest Skinner	1960-
26S/31E-26bba	Harney Co. Land Development Corp.	1965-1968 2/
26S/31E-34ddd	Marcus J. Haines	1964-
26S/33E-13daa	Lester Thompson	1962-
26S/33E-19ccc	De B. Forslund	1959-
26S/33E-19ddc	De B. Forslund	1959-
26S/33E-28cbc	De B. Forslund	1958-1970 2/
26S/33E-33baa	De B. Forslund	1958- 1/
26S/33E-34acc	Guy Leslie	1956
26S/33E-34ccs	George H. Merrick	1958-1970 2/
26S/34E-6ba	John J. Fecht	1960- 1/
26S/34E-6dab	H. C. Fitchett	1960-1968 2/
26S/34E-19db	F. E. Jones	1959-
27S/31E-1acb	Fred Briggs	1961-1968 2/
27S/33E-2bbb	R. F. Upton	1956- 1/
27S/36E-33ac	Flolea Holly	1963-
31S/35E-1bb	Fred Pallock	1954- 1/
33s/34E-24bb	Alvord Ranch	1965-
34S/34E-15bc	Alvord Ranch	1962- 1/
35S/33E-34dc	Andrew Shull	1958- 2/
36S/33E-3ab	Allied Properties Inc.	1962- 1/
36S/36E-16dc	Gaylen Frazier	1969-
37S/36E-10cb	Whitehorse Ranch	1962-
37S/36E-14aa	Whitehorse Ranch	1962- 1/
37S/36E-15cb	Whitehorse Ranch	1962-
39S/35E-4cc	Warren McLean	1964-
39S/35E-25db	Trout Creek Ranch	1967-
	HOOD RIVER COUNTY	
2N/8E-5ca	U. S. Forest Service	1965-
2N/10E-4db(1)	W. B. Graham (White)	1964-
2N/10E-4db(2)	B. Ross Evans	1964-1969 2/
	JACKSON COUNTY	
36S/1W-21aa	Bud Hoover	1960- 1/
36S/2W-23ccb	U. S. Geological Survey	1953- 1/
36S/2W-25ad	Alex Legler	1960-
37S/2W-28aab	So. Oregon Experimental Station	1960- 1/
38S/1W-15ca	City of Phoenix	1960- 1/
	JEFFERSON COUNTY	
11S/12E-21aa	Portland General Electric Co.	1962-
11S/12E-26da	Portland General Electric Co.	1962-
11S/13E-1bb	City of Madras	1964-
12S/13E-6bb	Fred Degner	1964-1967 2/
12S/15E-21cc	Morrow Brothers	1965-
13S/14E-33da	Buckner Brothers	1964-
	JOSEPHINE COUNTY	
33S/6W-15cc	Southern Pacific Railroad	1963-
35S/6W-21aca	Bate Lumber Company	1961-
35S/6W-24bbd	Oregon State Highway Dept.	1963- 1/
36S/5W-31cad	Grants Pass Golf Club Inc.	1964-
36S/6W-27ac(1)	Fort Vancy Job Corps Center	1966-1967 2/
36S/6W-27ac(2)	Fort Vancy Job Corps Center	1966-
38S/5W-23ad	John Katzenbach	1961-1970 1/ 2/
38S/8W-33ad	J. R. Smith	1961- 1/
39S/5W-6db	Brown Bros. Lumber Co. Inc.	1962-
39S/8W-17da	Joseph Ollis	1961-
39S/8W-34caa	U. S. Geological Survey	1952- 1/
	KLAMATH COUNTY	
25S/8E-1bb	U. S. Forest Service	1966-
27S/8E-20aa	U. S. Forest Service	1963-
28S/8E-17dbd	Boise Cascade	1962- 1/
29S/8E-7ddd	Boise Cascade Corp.	1968-
30S/7E-11dab	Crown Zellerbach Inc.	1954- 1/
31S/7E-1adc	Swanson Cattle Co.	1962-
34S/7E-9adb	Collier State Park	1955-
34S/8E-28ddc	Rafter MD Ranch	1967-
35S/7E-34cb	H. C. Spicer	1965-
35S/8E-1bcc	Henry Wolff	1954- 1/
35S/10E-19aca	Ted Chrume	1954- 1/
35S/10E-29cab	G. D. Hazen	1967-
36S/10E-14acc	C. J. Emmich	1962- 1/
36S/11E-17dcc	Ernest Firsick	1967-
36S/11E-20dca	Yanisx Ranch (Bertran)	1962-
36S/11E-36aab	Bill Gallaher (McBain)	1954- 1/
36S/12E-12dcc(1)	Weyerhaeuser Timber Co.	1962-

1/ Hydrograph of this well shown in this report
2/ Measurements discontinued

LIST OF OBSERVATION WELLS

WELL NO.	OWNER	RECORDS AVAILABLE
36S/12E-14ccb	Jim Godowa (Rec. Hall)	1954-
36S/12E-28adb	Mike Deely	1962-
36S/14E-7add	Harry Obenchain	1962-
36S/14E-25bcb	Gerber, Montgomery & Reed	1962-
36S/14E-27cdc	Henry Gerber	1962- 1/
36S/14E-35ddd	Ruth Hall	1962-1971 2/
37S/10E-8ccc	Edgewood Ranch	1961- 1/
37S/10E-18aca	Cliff McMillan	1961-1967 2/
37S/10E-19ada	H. D. Whiteline	1961-
37S/10E-29dbb(1)	Edgewood Ranch	1949-
37S/10E-29dbb(2)	Edgewood Ranch	1949- 1/
37S/10E-30abc	Fred Coleman	1961-
37S/11½E-36add	Donald Schreiner	1957-
38S/9E-28dc	Seventh Day Adventist Church	1968-
38S/10E-9cbc(1)	R. & S. Ranch	1949-
38S/10E-13bbb(1)	Swan Lake Ranch	1949-
38S/10E-16dcd	Mrs. Maude E. Liskey	1957-
38S/10E-22baa	Mike Short	1957- 1/
38S/10E-23bdd	Lloyd Goldbek	1957-
38S/10E-25aab(1)	Garrison Mitchell	1957-1971 1/ 2/
38S/11E-6dda	B. J. Jendrzejewski	1957- 1/
38S/11½E-6cad	Swan Lake Ranch	1957-
38S/11½E-7ddd	Swan Lake Ranch	1952-1970 2/
38S/11½E-11ada	Frank & Mathilda Challis	1957-1971 2/
38S/11½E-12cca(3)	Frank Challis	1949- 1/
38S/11½E-13aca	R. M. Robertson	1948-1971 2/
38S/11½E-13ccc	Herman Pendegreft	1948- 1/
38S/11½E-15dda	George McCollum	1948- 1/
38S/11½E-25cbb	Richard Hoefler	1949-1971 2/
38S/11½E-30cba	Swan Lake Ranch	1957-1971 2/
38S/11½E-30ddd	David Moore (Wheeler)	1957-1971 2/
38S/11½E-30dac	David Moore (Wheeler)	1948-
39S/9E-34cd	Harry Wagner	1964-
39S/10E-8da	Mt. Calvary Cemetery Ass'n	1965-
39S/11E-10ddd	Lost River Cemetery	1963-
39S/11E-20aad	Robert Woods	1964-
39S/11E-26abd(1)	H. D. Knox	1966-
39S/11½E-8abc	L. J. Horton	1957- 1/
39S/11½E-28ddd	B. E. Smith	1954-
39S/12E-29dbc	Eva Adams	1954-
39S/12E-35add	Cummings	1954-
40S/9E-27cd	Otis Osborn	1968-
40S/11E-11bad	A. W. Schaup	1954-
40S/11E-13bda(2)	Carl Rajnus	1963-
40S/11E-29ab	J. Randall Pope	1968-
40S/12E-33ba	Clark Unruh	1965-
41S/9E-12aa	O'Conner Livestock Co.	1968
41S/10E-10ca	Fotheringham Brothers	1964-1966 2/
41S/12E-3cba	George Rajnus	1954-
41S/12E-19ac	D. P. Reid	1954-
41S/14E-8cca	Charles Kilgore	1954-
	LAKE COUNTY	
25S/14E-15bcc	Ira A. Dutcher	1932-
25S/14E-16ad	Marion Cook	1956-1971 2/
25S/14E-19dd	R. A. Long	1948-1967 2/
25S/14E-22bb	C. B. Webster	1949-1970 2/
25S/14E-29da	Banfield Veterans Hospital	1956-
25S/14E-36cc	Joe & Minnie Stitz	1956-1970 2/
25S/18E-9cc	Alferd L. Prevost	1968-
25S/19E-31dc	O. E. White	1963-
26S/14E-2bb	U. S. B. L. M.	1948-1970 2/
26S/14E-3bb	Fred Meyers	1956-
26S/14E-5aa	V. A. Wagers	1940-1970 1/ 2/
26S/14E-12aa	Sheldon D. Kelley	1948-1969 2/
26S/14E-12ba	Elmer Kohler	1958- 1/
26S/14E-13cc	Andrew Bettencourt	1957-1971 2/
26S/14E-20cc	G. R. Boatwright	1940-1970 2/
26S/14E-21dd(2)	U. S. B. L. M.	1940-1970 2/
26S/14E-23bb	U. S. B. L. M.	1959-
26S/14E-24cd	Jack Kittridge	1956-1970 2/
26S/14E-33ba	U. S. B. L. M.	1940-1970 2/
26S/15E-5bab	N. J. Widendja	1957-1970 2/
26S/15E-6ab	Glenn Irwin	1955-
26S/15E-6ad	Glenn Irwin	1960-1967 2/
26S/15E-17dd	Morehouse Ranch	1940-1971 2/
26S/15E-20bb	U. S. B. L. M.	1940-
26S/15E-20dc	Hugh L. Wahl	1956-1968 2/
26S/15E-22abb	M. Y. Parks	1932-
26S/15E-28da	M. Y. Parks	1962-1964 2/
26S/15E-29ab	Delbert M. Wilson	1962-1964 2/
26S/15E-29bc	Hugh L. Wahl	1940-1970 2/
26S/15E-31aa(3)	Nick Klerk	1949-1970 1/ 2/
26S/15E-31bc	Nick Klerk	1949-1967 2/
26S/15E-31da	Robert R. Tuttle	1956-1968 2/
26S/15E-32bc(1)	Robert R. Tuttle	1956-
26S/15E-32bc(2)	Robert R. Tuttle	1956- 2/
26S/15E-33ac	Merritt Parks	1962-1970 2/
26S/15E-34cc	Merritt Parks	1956-1970 2/
26S/15E-34dc	C. W. Boley	1956-1969 2/
26S/18E-8ad	M. Penn Philips Co.	1968-
26S/18E-26ab	Robert Bothern	1963-
26S/18E-30adc	Sam K. Morehouse	1959-
27S/15E-2bc(1)	C. C. Miles	1949-1968 2/
27S/15E-2bc(2)	C. C. Miles	1956-
27S/15E-2ad(2)	Lawrence B. Iverson	1949-
27S/15E-3ab	Easton Claridge	1956-1968 2/
27S/15E-3da	Easton Claridge	1949-1970 2/
27S/15E-4aca(1)	M. Y. Parks	1932- 1/
27S/15E-4aca(2)	M. Y. Parks	1932-1968 2/
27S/15E-11ad	K. O. Buick	1961-1971 2/
28S/15E-11da	K. O. Buick	1956-1970 2/
27S/15E-13bb	Jess Miles	1949-
27S/15E-24ba	Darrell Bowen	1959-1970 2/
27S/15E-24cb	Darrell Bowen	1961-
27S/15E-24ccc	Darrell Bowen	1948-1969 2/
27S/15E-25bc	Alfred Smithee (Koehler)	1956-1970 2/
27S/16E-7bb	Wayne Dubois	1956-1968 2/
27S/16E-7bd	Wayne Dubois	1961-1970 2/
27S/16E-13aa	Robert Morehouse	1955-1970 2/
27S/16E-13abb	Robert Morehouse	1958- 1/
27S/16E-13cb	Robert Morehouse	1955-1971 2/
27S/16E-26cd	John Beck	1963-
27S/16E-32bd	Lowe & Whipple	1956-
27S/16E-32dc	Miller E. Follis	1957-
27S/16E-34cab	Dr. George E. Mallet	1957-1970 2/
27S/17E-10dd	M. Penn Philips Co.	1961-
27S/17E-14cc	U. S. B. L. M.	1961-1970 2/
27S/17E-21dc	James Bobst	1962-1966 2/
27S/17E-22bb	Helmar Gustafson	1962-1970 2/
27S/17E-22ddd	Century Ranch	1938-1970 1/ 2/
27S/17E-27ddb	Century Ranch	1961-1968 2/
27S/17E-27bdd	Century Ranch	1952-
27S/18E-6bcb	Rose T. Morici	1940-
27S/18E-6bdb	Marianne Aiassa	1959-1968 2/
27S/18E-6ac	Clinton B. Carrico	1956-1968 2/
27S/18E-6ad	Hugh L. Wahl	1962-1964 2/
27S/18E-6db	Clinton B. Carrico	1956-
27S/18E-12aaa	John Pettus	1961-1971 2/
27S/18E-18cc	Jack Gillette	1959-1970 2/
27S/18E-21aaa	U. S. B. L. M.	1955-
27S/19E-18cc	View Point Ranch	1957-
27S/19E-19dc	View Point Ranch	1957-
27S/19E-29bd	View Point Ranch	1961-1968 2/
27S/19E-32ba	View Point Ranch	1958-1968 2/
28S/14E-20ab	Lawrence Iverson	1965-
28S/14E-21dcb	U. S. Forest Service	1963-1970 2/
28S/14E-25ba	ZX Ranch	1964-
28S/15E-13cd	View Point Ranch	1958-1969 2/
28S/15E-14adc	View Point Ranch	1956-
28S/16E-4ab	U. S. B. L. M.	1958-1971 2/
28S/16E-4bb	U. S. B. L. M.	1956-1970 2/
28S/16E-5bd	Miller E. Follis	1959-1967 2/
28S/16E-5cd	Miller E. Follis	1959-1970 2/
28S/16E-5dc	Miller E. Follis	1959-1967 2/
28S/16E-19ba	View Point Ranch	1960-1970 2/
29S/23E-3dac	U. S. B. L. M.	1945-
30S/16E-1bd	Oregon State Game Commission	1963-
32S/23E-5aa	U. S. B. L. M.	1964-
33S/18E-13aa	Alan & Van Withers	1963-
34S/19E-16cc	Howard Beschler	1962-
34S/19E-23ac	ZX Ranch	1959-
35S/24E-9dad	U. S. B. L. M.	1949- 1/
36S/21E-6aba	S. V. Carroll	1950-

1/ Hydrograph of this well shown in this report
2/ Measurements discontinued

LIST OF OBSERVATION WELLS

WELL NO.	OWNER	RECORDS AVAILABLE
36S/24E-4ab	Joe Banasco	1962-
36S/24E-27bb	Con Lynch	1961-1971 1/ 2/
36S/24E-28cbb	Lloyd Griael	1949-
36S/24E-28cc	Joe Rombo	1960-1968 2/
36S/24E-32aab	James Kiely	1940-1970 2/
36S/24E-33ab	Con Taylor Ranch Inc.	1960- 1/
37S/20E-34dd	Robert Weir Jr.	1962- 1/
38S/20E-33bd	Jack Stooksberry	1964-
38S/24E-27cbb	Charles Crump	1948- 1/
39S/19E-13dc	Elmo Angeles	1968-
39S/19E-34add	William Hoffman	1960- 1/
39S/20E-9aa	Lakeview Mining	1965- 1/
39S/24E-21bd	J. G. Dyke	1948- 1/
40S/19E-19db	Clyde Fenimore	1965-
40S/20E-14bba	Snider & Alexia	1957-1970 1/ 2/
40S/20E-26ca	Neal Elliott	1959- 1/
	LANE COUNTY	
16S/2W-34cdc	M. A. Nadiau	1962- 1/
16S/3W-acd	Leo Sidwell	1950- 1/
16S/3W-32dbd	Leon Funke	1966-
16S/4W-4ab	John Hentze	1965-
16S/4W-16 cac	Shadow Hills Golf Course	1965-
16S/4W-29da	Elbert Hill	1965-
17S/1W-29ac	Glen Vaughn	1965-
17S/1W-29dd	Ed Hull	1965-
17S/2W-32bad	Weyerhaeuser Timber Co.	1962- 1/
17S/3W-17bca	Smith Gardens	1962-
17S/3W-19cac	Gheen Irrigation Works	1966-
17S/3W-22aa	C. E. Blakely	1966-
17S/3W-28dcb	Chase Gardens	1962-
17S/4W-4dcb	Seneca Sawmill	1962-
17S/4W-33aba	West Lawn Memorial Cemetery	1962- 1/
17S/5W-13bdd	Leo Burtis	1962-
17S/6W-36dca	Oscar E. Williams	1963-
18S/2W-27bd	George Potter	1965-
18S/2W-35ca	Richard Lyday	1965-
18S/4W-3cad	Nils Hult	1963-
18S/5W-19ac	Crow-Applegate School Dist. 66	1966-
18S/10W-11aa	United States Plywood	1963-
18S/12W-14cdd(4)	U. S. Geological Survey	1961-
18S/12W-34dc	Camp Florence	1964-
19S/2W-7dd	J. L. Getchell	1962-
19S/3W-3cc	Oregon State Game Commission	1962-
19S/3W-11ba	O. C. Luchterhand	1963-
20S/3W-11ba	Gettings Creek Rest Area	1966-
21S/3E-16da	City of Oakridge	1966-
	LINCOLN COUNTY	
6S/10W-33bd	A. A. Corkhill	1964-
8S/10W-17dbd	A. E. Howard	1964-
10S/10W-3cbb	Don Preasey	1964-
11S/9W-9ad	Eddyville High School	1964-
11S/10W-20ca	Joe W. Brown	1964-
	LINN COUNTY	
9S/1W-14dca	John Fery	1964-
9S/1W-23cda	Charles Hecht	1962- 1/
9S/2E-27bdb	North Santiam Plywood Co.	1966-
10S/1W-5cab	A. M. Hendrickson	1962-
10S/1W-28bdb	Grant Farris	1962- 1/
10S/2W-8cca	William Uppstad	1957-
10S/2W-12cc	Red Crown Mills	1962-
10S/2W-21ddd	H. C. Robertson	1962-
10S/3W-21cd	Walter Powell	1970-
10S/4W-12bdd	Henry Hoefer	1928- 1/
11S/2W-3bbc	Sam Looney	1962-
11S/2W-6abd	George C. Scheler	1962-
11S/2W-26bdd	Marvin Ufford	1966-
11S/2W-29adc	Neal Hollingsworth	1962-
11S/3W-13aaa	Loren A. Nelson	1962-
11S/3W-15bda	Joe Kennel	1962-
11S/3W-26aaa	Leonard Roth	1962-
11S/4W-24cbd	Raymond Maddy	1969-
12S/1W-29cca	Pineway Golf Club Inc.	1964-
12S/1W-29cd	Hubert J. Griffiths	1964-
12S/1W-30ddb	Pineway Golf Club Inc.	1962-
12S/2W-2bad	Ken Watters	1962-
12S/2W-14abc	Wilbur Parrish	1941-1967 2/
12S/2W-18bad	Henry DeManette	1962- 1/
12S/3W-5caa	George N. Chandler	1962-
12S/3W-29cdd	R. L. Wirth	1962-
12S/4W-21cab	R. C. Mang	1962-
12S/4W-35cdc	Paul Pugh	1962-
13S/3W-13aaa	Frank Cochran	1962-
13S/3W-34ccd	Jacob Ogle	1928-1969 2/
13S/3W-36ad	Thomas P. Irwin	1962-
13S/1E-27ba(1)	Verdge Stephenson	1964-1969 2/
13S/1E-27ba(2)	Les Austin	1964-1969 2/
13S/1E-27ba(3)	U. S. Government	1964-1965 2/
13S/1E-27bb(1)	Roy Lewis	1964-
13S/1E-27bb(2)	Denver Davis	1964-1969 2/
13S/1E-27bd	U. S. Government	1964-1969 2/
13S/1E-27ac(1)	U. S. Government	1964-1969 2/
13S/1E-27ac(2)	U. S. Government	1964-1966 2/
13S/1E-27ac(3)	Paul Tucker	1964-1969 2/
13S/1E-27da	U. S. Government	1964-
13S/1E-27db(1)	Warren Vasey	1964-1969 2/
13S/1E-27db(2)	U. S. Government	1964-1969 2/
13S/1E-27db(3)	Lawrence Alvin	1964-
14S/2W-10bd	J. I. McCord	1970-
14S/3W-7ddc	Henry H. Kirk	1962-
15S/3W-19acd	Edgar B. Grimes	1962- 1/
	MALHEUR COUNTY	
14S/38E-28aa	Jerry Farley	1964-
14S/39E-21bd(2)	Ralph Duncan	1962-
14S/39E-21dc	Mary J. Molthan	1962-
14S/39E-29ba	John Molthan	1962-
14S/39E-29bc	John Molthan	1962-
14S/39E-32ad	Ray Duncan	1962-
15S/40E-1bad	Altha Anderson	1953- 1/
15S/40E-2daa	Max Holloway	1949- 1/
15S/40E-2cad	Max Holloway	1955-
15S/40E-2cba	Max Holloway	1952- 1/
15S/40E-2ccb	Rankin Crow	1950- 1/
15S/40E-2dcc	Rankin Crow	1956-1969 2/
15S/40E-10abc	Rankin Crow	1950-
15S/40E-10dbc	Rankin Crow	1953- 1/
15S/40E-11cdb	Rankin Crow	1950-
15S/40E-12cbb	Guss Davis	1955- 1/
15S/40E-12dcc	Guss Davis	1954-
15S/40E-13bba	Guss Davis	1955- 1/
15S/40E-13acc	Guss Davis	1955-
15S/40E-14dcb	Rankin Crow	1951- 1/
15S/41E-6cbc	Rankin Crow	1958-
15S/41E-8cbc	Rankin Crow	1951- 1/
15S/42E-25ab	Mark J. Velsmeyer	1961-
16S/43E-5db	Estel B. Moser	1966-
16S/43E-16dc	Ralph Altig	1962-
17S/44E-11db	John Stringer	1961-
17S/44E-25ad	C. N. Durrett	1961-
18S/41E-8dca	Roy C. Stewart	1963-
18S/41E-15cc	Grady Romans	1968-
18S/44E-18ac	Paul Fleming	1965-
18S/45E-21bb	K. T. Loomis	1962-
18S/46E-19cc	Glen Hutchinson	1962-
18S/46E-23dc	Kay Teramure	1962-
18S/47E-17bbb	Earl Weaver	1950-
19S/42E-35bbb	John E. O'Toole	1963-
19S/43E-2cb	Trenkel Brothers	1961-
19S/43E-3bc	Floyd Baughn	1961-
19S/43E-3db	Floyd Baughn	1961-
19S/43E-10ad	Thomas J. Davis	1961-
20S/46E-28ac	George Mendszona	1962-
21S/38E-17dca	Walter Bodkin	1955-

1/ Hydrograph of this well shown in this report
2/ Measurements Discontinued

LIST OF OBSERVATION WELLS

WELL NO.	OWNER	RECORDS AVAILABLE
21S/38E-17dd	U. S. Geological Survey	1958-
21S/46E-2bd	Willis Bertram	1965-
28S/37E-23ddd	Earl Obenchain	1950-
29S/37E-17cc	Fred Pallock	1965-
29S/45E-36dd	Jeff Anderson	1966-
29S/46E-31ca	Cowgill Ranch	1964-
30S/46E-2ad	Jordan Valley Cemetery Dist.	1962- 1/
30S/46E-10cc	Jaca Brothers	1963- 1/
32S/40E-18dbc	Clarence J. Eckstein	1950-
34S/39E-13cbc	U. S. Government	1954-
36S/41E-26dad	Oregon State Highway Dept.	1961- 1/
41S/42E-22ba	Lucky 7 Ranch	1962- 1/
41S/43E-19 aa	Victor Albisu	1955-
	MARION COUNTY	
3S/1W-33ad	Klupenger Nursery	1965-
4S/1W-2ba(2)	Will E. Dreher	1965-
4S/1W-5cdc	Joseph Leavy	1965-
4S/1W-23acc	Donald Olmstead	1945- 1/
4S/1W-32adb	Emmett T. Rose	1960-
4S/2W-2acb	Champoeg State Park	1963-
4S/2W-4bad	Dr. C. A. Bump	1928
4S/2W-4bd	John A. Gearin	1957-
4S/2W-8aca	Nelson Tribbett	1960-
4S/2W-15bdb	W. O. Wildmar	1957-
4S/2W-17cba	Lester Ernst	1957-
4S/2W-18aaa	John P. McCarthy	1957-
4S/2W-22cbc	Kirk Brothers	1957- 1/
4S/2W-28cc	J. B. Wolf	1957-
4S/2W-29ada	Richard McKay	1960-
4S/2W-34ddc	Charles Johnson	1928-
5S/1W-3dbc	Manton Carl (Ramlo)	1959- 1/
5S/1W-7cdb	City of Woodburn	1963-
5S/1W-9caa	S. Gayken	1963-1971 2/
5S/1W-17bdc	General Foods Corp.	1962-
5S/1W-17cb(4)	General Foods Corp.	1963-
5S/1W-17cc(1)	General Foods Corp.	1962-
5S/1W-17cc(2)	General Foods Corp.	1962-
5S/1W-18abc(1)	City of Woodburn	1962-1970 2/
5S/1W-18abc(2)	City of Woodburn	1962-
5S/1W-18dca	Lawrence J. Paradis	1962-
5S/1W-18dd	Lawrence J. Paradis	1962-1968 2/
5S/2W-1dd	City of Woodburn	1965-
5S/2W-bcd	William J. Manegre	1957-
5S/2W-16bbb	James E. Davidson	1958-
5S/2W-19ddc	Jesse W. Lucas	1957-
5S/2W-25cbd	Sam H. Brown	1929- 1/
6S/1W-1aca	James Butsch	1962-
6S/1W-1cd	Mark Purdy	1962-
6S/1W-6cc	Wm. Jebousek	1968-
6S/1W-18bbc	James Hollin	1962-
6S/1W-28caa	Tony Schultz	1962-
6S/2W-5ccd	Fred Zelinsky	1957-
6S/2W-17da(2)	Sam Ramp	1962-
6S/2W-18acd	E. A. Hillyer	1957- 1/
6S/2W-35ab	Richard Tuve	1963-
6S/3W-34ac	Juanita Manuel	1957-
6S/3W-34cc	Henry Schmidt	1963-
6S/1E-7cbb	Sheldon Johnson	1928-
7S/1W-8da	Merle Kaufman	1964-
7S/1W-27cca	Keith Johnson	1962-
7S/2W-4bca	P. W. Woelke	1962- 1/
7S/2W-18ab	Emery Alderman	1962-
7S/2W-26acc	Corneilius Bateson	1962-
7S/2W-28cbb	Gordon Backe	1970-
7S/2W-30cd	Robert DeBow	1968-
7S/2W-31bb	William Roth	1963-1967 2/
7S/3W-11bdd	Harvey Machine Co. Inc.	1960-
7S/3W-23cc	Pacific Mutual Life Insurance Co.	1962-
7S/3W-27aa	State Labor & Industries Building	1963-
7S/3W-31ac	Carl Heyden	1962-
7S/3W-31ca	E. C. Boje	1962-1969 2/
7S/3W-31cd	Illahe Country Club	1962-1969 2/
7S/3W-31dc	Illahe Country Club	1962-1965 2/
7S/3W-32db	Salem Golf Course	1962-
7S/1E-28aa	Willard Benson	1962-1966 2/
8S/1W-28acd	Josephine Gerspacher	1962-
8S/1W-32bbc	Earl Saiser	1962-
8S/1W-35baa	Richard Schumacher	1962-
8S/2W-11cdb	Reich Brothers	1962-
8S/2W-33dbb	Anna Etzel	1963-
8S/3W-3cba	Salem Heights	1962-1965 2/
8S/3W-4cb(1)	Carroll Nelson	1962-
8S/3W-4cb(2)	Robert Dalton	1964-
8S/3W-5dd	E. A. Meola	1964-
8S/3W-6ab	Illahe Country Club	1962-1966 2/
8S/3W-6bb	Harry Eyerly	1962-
8S/3W-9cdd	City of Salem	1960-
8S/3W-10dbd	City of Salem	1967-1968 2/
8S/3W-10dbb	City of Salem	1959-
8S/3W-11ccc	City of Salem	1962-
8S/3W-18dd	Adrian Withers	1962-
8S/3W-23cbb	W. G. Steveley	1962-
8S/3W-28da(2)	Friends Church	1962-
8S/3W-33da	L. J. Philpott	1962-
8S/4W-27cb	4-D Farms	1963-
9S/1W-1bcc	Etzel Brothers	1958-1968 2/
9S/1W-2bcc	Ed Hassler	1968-
9S/1W-2ddd	Al Etzel	1963-
9S/1W-12abb	William Ripp	1961-
9S/2W/24cdd	Boyd Hilton	1963-
9S/2W-24ddc	A. F. Keithley	1957-
9S/2W-26aad	Louis Scofield	1961- 1/
9S/3W-34dad	Ted Riggle	1964-
9S/1E-3bcc	Ted Etzel	1965-
9S/3E-30dab	Howard Fenner	1964-
10S/3W-13baa	E. W. Hart	1962-
10S/3W-13bda	E. W. Hart	1962-
10S/5E-2da	James Colmer	1966-
	MORROW COUNTY	
1N/26E-10aac	William Doherty	1965-
1N/26E-26cbd	Kenneth Turner	1963-1969 2/
1N/26E-26ccc	Keneth Turner	1969-
1N/27E-3ac	George Luciani	1965-
1N/27E-10aa	Earl Wattenburger	1961-
1N/27E-10ac	Earl Wattenburger	1963-1970 2/
1N/27E-10adb	W. Floyd Hoskins	1961-
1N/27E-24ddd	Antone J. Vey	1961-
1N/28E-28ba	Antone J. Vey	1960-
1N/28E-28bbd	Antone J. Vey	1958-
2N/23E-17ddd	Hynd Brothers Inc.	1964-
2N/23E-28cc	Krebs Brothers	1968-
2N/26E-18daa	Delwin O. Nelson	1970-
2N/26E-20db	Nelson-Tucker Ranches	1967-1970 2/
2N/27E-20daa	Ed Tucker	1961-1969 2/
3N/26E-4aad	Mildred F. Cramer	1962-
3N/26E-4ba	Mildred F. Cramer	1962-1965 2/
3N/36E-4ccc	Luther W. Cramer	1962- 1/
3N/26E-5cbd	Otto J. Hellberg	1962-
3N/26E-10aba	Waldo H. Cramer	1962-
3N/26E-10dcc	Ernest R. Cramer	1962-
3N/26E-10dbd	Ernest R. Cramer	1962-
4N/25E-9ac	Boardman Cemetery Association	1965-
4N/26E-25bcb	Fred Andrews	1953-
4N/27E-5aba	Umatilla Army Depot	1960- 1/
4N/27E-5ba	Umatilla Army Depot	1962-
4N/27E-8dda	Umatilla Army Depot	1961- 1/
4N/27E-18cdb	Umatilla Army Depot	1960-
4N/27E-19baa	Umatilla Army Depot	1962- 1/
4N/27E-20cb	Union Pacific Railroad	1965-
4N/27E-28bd(2)	Scott Chapman	1962-
4N/27E-32aba	Roy G. Holzapfel	1962-
4N/27E-32dab	Roy G. Holzapfel	1962- 1/
4N/27E-33dab	McDole Brothers	1962-
1S/24E-7bd	A. H. Marick	1965-
1S/24E-35aad	Darrell Padburg	1970-
1S/25E-34dc	Lexington Cemetery	1968-
1S/29E-3aa	Antone J. Vey	1963-
2S/24E-36da	Terrell Benge	1964-
2S/26E-7acb	Don Evans	1970-

1/ Hydrograph of this well shown in this report
2/ Measurements Discontinued

LIST OF OBSERVATION WELLS

WELL NO.	OWNER	RECORDS AVAILABLE
	MULTNOMAH COUNTY	
1N/1E-33bbd	Good Samaritan Hospital	1961-1970 1/ 2/
1N/1E-33dbc	Fred Meyer Inc.	1961-1967 2/
1N/1E-33dc	U. S. National Bank	1946- 1/
1N/1E-33dc	Weisfield's Inc.	1940- 1/
1N/1E-34cdc(3)	Equitable Savings & Loan	1961-
1N/1E-34ccb(3)	Pittock Block Inc.	1961-1969 1/ 2/
1N/1E-34cdc(6)	Lipman Wolfe & Co.	1961-
1N/1E-34ccb(1)	Dirks Medical Center	1961- 1/
1N/1E-34ccb(3)	Federal Reserve Bank	1961-1967 2/
1N/1E-34cca(13)	U. S. National Bank	1961-
1N/1E-34cdc (7)	First National Bank	1959-1969 2/
1N/2E-9cc	Port of Portland	1963- 1/
1N/2E-23aa	Joe A. Grosjaques	1970-
1N/3E-26dd	Kazuo Fujii	1963- 1/
1S/1E-3bbd	Pacific Power & Light Co.	1961-1967 2/
1S/1E-3bba(2)	Pacific Service Building	1961-
1S/1E-3bcb(1)	Oregonian Publishing Co.	1961-
1S/1E-3bcb(2)	Oregonian Publishing Co.	1961-
1S/1E-3bcb(3)	Oregonian Publishing Co.	1961-1968 2/
1S/1E-3cbb(1)	Pacific Northwest Bell	1963-
1S/1E-3cbb(2)	Pacific Northwest Bell	1963-
1S/1E-4aa(2)	Medical-Dental Building	1958-1969 2/
1S/1E-10cd	J. Donald Kroeker	1961- 1/
1S/3E-7cc	Meadowland Dairy	1964- 1/
1S/3E-10cc	Forest Lawn Memorial Park	1963- 1/
	POLK COUNTY	
6S/3W-7ada	D. L. Gingerich	1963-
6S/4W-17cba	John Romig	1963-
7S/3W-10bcd	Leland P. Brandt	1962- 1/
7S/3W-17db	Robert W. Straub	1969-
7S/3W-18bbd(1)	Orchard Heights Water District	1965-
7S/3W-18bbd(2)	Orchard Heights Water District	1965-
7S/3W-30bd(1)	R. L. Forster	1965-
7S/3W-30bd(2)	R. L. Forster	1966-1968 2/
7S/4W-6ddb	Art Leppin	1965-
8S/4W-3ab	Theodore C. Muller	1962- 1/
8S/4W-21bc(2)	Boise Cascade Corp.	1962-
8S/5W-13ad	Milo Jensen	1963-
8S/6W-22bd	Edward Bakke	1962- 1/
8S/6W-25dd	Max B. Morton	1963-
9S/4W-8cc	D. W. Christianson	1963- 1/
9S/4W-11bd	Donald Cobine	1965-
	SHERMAN COUNTY	
1N/17E-4ca	Philip G. O'Meara	1963- 1/
1N/17E-16ba	L. P. Haven	1964-
2N/16E-8dc	Isami Taubota	1968-
3N/17E-31da	Isami Taubota	1969-
3S/16E-10cc	E. J. Hartley	1963- 1/
	TILLAMOOK COUNTY	
1S/9W-18cb	Green Acres Motel	1962-1970 1/ 2/
1S/9W-19ba	Tillamook Veneer	1962-
1S/9W-27ab	Gaylord Shively	1962-
1S/9W-27bc	Virgil Chadwick	1962-1971 1/ 2/
1S/9W-29bc	Norman Burdick	1962-1971 2/
1S/9W-29db	Fairview Water Dist. Inc.	1962-
1S/9W-29ca	Fairview Water Dist. Inc.	1962-1969 2/
1S/9W-31bc	Lester E. Armstrong	1962-1971 2/
1S/9W-31cd	Tillamook Water Comm.	1962-
1S/9W-32cd	Elbert Leonnig	1962-
1S/10W-12bb	Leo & Robert Wassmer	1962- 1/
1S/10W-26ab	Rudolph John Fenk	1962-
1S/10W-36dd	Frank Emmenegger	1962-1971 2/
2S/9W-5bc	Tillamook Water Comm.	1962-
2S/9W-6ac	M. J. Jenck	1962-1971 2/
2S/9W-6da	Connie & Judy Dye	1962-1969 2/
2S/9W-21bc	Vern Darby	1962- 1/
4S/10W-19da	Lloyd McKillip	1968-
4S/10W-27bd	James C. Trent	1965-
	UMATILLA COUNTY	
1N/32E-10db	Skyview Memorial Park	1965-
1N/32E-22acc	J. L. Eldridge	1967-
2N/27E-1bda	Claussie Ammon	1961-
2N/27E-11add	Clarence L. Hansen	1961-
2N/27E-12bba	Clarence L. Hansen	1961-
2N/27E-14cc	Oscar D. McCarty	1968-
2N/27E-26cad	Sarvia Springs Ranch	1962-
2N/27E-27bca	John F. Kilkenny	1961-1969 2/
2N/27E-27cbc	Thomas Ashbeck	1968-
2N/28E-7aad	Oliver Abney	1969-
2N/30E-28bdc	Cunningham Sheep Co.	1961-
2N/32E-2ccc	City of Pendleton	1961 1/
2N/32E-16ba	City of Pendleton	1967-
3N/27E-ddd	George Wallace	1961-
3N/27E-36adc	George Wallace	1961-
3N/28E-8aa	Henry Walker	1967-
3N/28E-28cbb	E. A. Betz	1967-
3N/34E-3bac	Berkley Davis	1953-
4N/27E-22cda	Umatilla Army Depot	1960-
4N/27E-22dbd	Umatilla Army Depot	1960- 1/
4N/27E-27da(1)	Hansell Brothers	1965-
4N/27E-27da(2)	Hansell Brothers	1967-
4N/27E-34bb	Marvin McDole	1966-
4N/27E-36bba	Lyle Miller	1961-
4N/28E-10bda	City of Hermiston	1964-
4N/29E-5dda	John Hershey	1963-
4N/29E-17cc(2)	Milton Culp	1961- 1/
4N/29E-18daa	Milton Culp	1961-
4N/29E-32cac	City of Stanfield	1964-
4N/32E-2cb	L. King	1953-
5N/28E-22bba	L. J. Martin (Munson)	1953- 1/
5N/34E-16ddd	R. M. Thompson	1953-
5N/35E-1bad	William A. Bingman	1933- 1/
5N/35E-1bcc	City of Milton-Freewater	1963-
5N/35E-2bad	K. A. Townsend	1933- 1/
5N/35E-2ca	City of Milton-Freewater	1954- 1/
5N/35E-2daa	City of Milton-Freewater	1954-
5N/35E-3ada	Walter Miller	1933-
5N/35E-12bdb	City of Milton-Freewater	1954-
5N/35E-12bdd	City of Milton-Freewater	1954- 1/
5N/36E-18cb	City of Milton-Freewater	1964-1966 2/
6N/35E-14cad	Conrad Miller	1933-
6N/35E-20aca	J. E. Courtney	1933-
6N/35E-24dcc	George H. Ransom	1933- 1/
6N/35E-26bad	Earl Ransom	1933- 1/
6N/35E-28ada	W. J. Rand	1933-1969 2/
6N/35E-28ccd	Lottie McKnight	1933-
6N/35E-30cbb	Dan Selleck	1933-
6N/35E-34baa	James A. Reese	1933-
6N/35E-36bab	James Busch	1933-
6N/35E-36add	Walter Herman	1933-
6N/36E-20db(2)	D. K. Smith	1966-
1S/32E-9cad	Wayne Chapman	1961-1969 2/
1S/32E-17adb	City of Pilot Rock	1961- 1/
1S/32E-17dba	City of Pilot Rock	1961- 1/
1S/32E-19cd	Arnold Hoeft	1964-
1S/32E-23daa	Hilmer Horn	1961- 1/
3S/30½E-1abb	Joseph Pedro	1953- 1/
	UNION COUNTY	
1N/39E-4cb	Lee Smith	1964-

1/ Hydrograph of this well shown in this report
2/ Measurements discontinued

LIST OF OBSERVATION WELLS

WELL NO.	OWNER	RECORDS AVAILABLE
1N/39E-15cb	Jim Morgan	1964- 1/
1S/38E-24ddc	H. L. Wagner	1950- 1/
1S/39E-17cad	A. F. Furman	1940- 1/
1S/39E-20bab	Clayton Fox	1964- 2/
2S/38E-29bc	Tant Bothman	1967-
2S/38E-34cd	Island City	1963- 1/
2S/39E-33cd(3)	Wilfred Hamann	1964- 1/
3S/38E-6add	City of La Grande	1957-
3S/38E-6dca	Dr. Gilstrap	1957-
3S/38E-10aba	Union County	1936-1970 1/ 2/
3S/39E-7add(2)	Stanley Weishaar	1964- 1/
4S/39E-11ad(2)	W. H. Woodruff	1964-
5S/40E-7ca	Emmitt Briegel	1964- 2/
6S/39E-20bac	Edson R. McCanse	1962- 1/
6S/39E-20dcb	Edson R. McCanse	1962-1967 2/
	WALLOWA COUNTY	
1N/42E-11ca	City of Wallowa	1967-
1S/45E-20da	Leroy Flemming	1968-
1S/45E-21bb	Gregory Wieck	1967-
	WASCO COUNTY	
1N/12E-13cb	Julius Sandoz	1957- 1/
1N/12E-13dca	Kenneth Kortge	1957-
1N/12E-23bb(2)	Paul M. Martin	1962-
1N/12E-28cd	City of The Dalles	1963-
1N/13E-1bda	3-Mile Irrigation Coop. Inc.	1959-
1N/13E-3bca	City of The Dalles	1959- 1/
1N/13E-3acd	Columbia Fruit Growers	1956-
1N/13E-4bad	P. J. Stadelman	1960-
1N/13E-4bcd	Odd Fellows Cemetery	1956- 1/
1N/13E-4bdd	City of The Dalles	1959-
1N/13E-4cdb	City of The Dalles	1959- 1/
1N/13E-5acb	Cherry Heights Irr. Coop.	1959-
1N/13E-8aac	G. S. Williams	1960- 1/
1N/13E-8cba	City of The Dalles (Mill Creek)	1959-
1N/13E-14cab	V. R. Martin (Douthit)	1959- 1/
1N/13E-15aca	Parklawn Memorial Gardens	1959-
1N/13E-17ba	George M. Davis et. al.	1958-
1N/13E-18cab	Gladys L. Rogers	1957-
1N/13E-32acd	Milton F. Martin	1946-
1N/13E-32acb	Milton F. Martin	1956-1964 2/
1n/13E-32cb	Dr. John H. Skirving	1957-
1N/13E-33cbb	Sanders Brothers	1960-
1N/13E-34cab	George Bradley (Westgate)	1960- 1/
2N/12E-7bc	Darrel Evans	1963-
2N/12E-7ad(2)	A. Francois	1963-
2N/12E-25ddc	E. A. Kuck	1947-
2N/12E-36bd	William Hertel	1962-
2N/12E-36ca(1)	Mrs. James Douthit	1962- 1/
2N/12E-36ca(2)	J. Kenneth Fleck	1962-1969 2/
2N/12E-36ca(3)	W. S. Nelson	1962-1968 2/
2N/13E-28ca	Harvey Aluminum Co.	1957-
2N/13E-28cb	Harvey Aluminum Co.	1957- 1/
2N/13E-28cc	Harvey Aluminum Co.	1957-
2N/13E-28cd	Harvey Aluminum Co.	1957-
2N/13E-32aa	Chenowith Irrigation Coop.	1957- 1/
2N/13E-32da(4)	Chenowith Irrigation Coop.	1957-
1S/13E-31dc	Bill Hulse	1962-
4S/13E-9ba	E. J. Schilling	1962-
	WASHINGTON COUNTY	
1N/1W-21cab	Cecil C. Schaefer	1964-
1N/2W-8bca	T. R. Connell	1951-
1N/2W-11bab	Albert Zander	1951-
1N/2W-35bcc	E. L. Lewis	1951- 1/
1N/3W-15adb	Art Salzwedel	1951-
1N/3W-18cb(2)	Sunset Grove Golf Club	1970-
1N/3W-19bab	A. J. Giesbers	1951-
1N/3W-36ddc	Terminal Ice & Cold Storage Co.	1951- 1/
2N/2W-30bb	Felix Devlaeminck	1964-
2N/3W-16aa	Dennis Hall	1964-
2N/4W-24bd	Erwin Mead	1963-
2N/4W-33aca	Julius Winterfield	1963-
1S/1W-11cca	City of Beaverton	1964-
1S/1W-17cd	Aloha-Huber Water District	1959- 1/
1S/1W-19dd(3)	Earle L. Miller	1961- 1/
1S/1W-21dda	John Klotz	1970-
1S/1W-21dd	Elinore Shively	1948-1969 2/
1S/2W-13dca	L. T. Wright	1961-
1S/2W-23ac	Ed. M. Jannsen	1965-
1S/2W-24bc	Edward Berger	1957-
1S/2W-26ac	Baker Rock Crushing	1961-
1S/2W-26bdc	Karl Schaefer	1958- 1/
1S/2W-26dcd	Warren Northwest Inc.	1961-
1S/2W-28aab	John Watts	1966-
1S/3W-21bab	Ernest Meyer	1964-
1S/4W-2adc	Myron Sheelar	1951- 1/
2S/1W-3dcc	Leonard S. Davis	1962- 1/
2S/1W-4ba(2)	Harris H. Hanson	1962- 1/
2S/1W-4acc	Tigard Water District	1962-
2S/1W-7acd	Fred Mathias	1970-
2S/1W-10bba	Tigard Water District	1962-
2S/1W-11bcb	Tigard Water District	1962-
2S/1W-11cb	Walter Engler	1962-
2S/1W-13ab(2)	Ralph Sittel	1960- 1/
2S/1W-13db(2)	L. C. Endicott	1960-
2S/1W-14ccc	A. J. Martinazzi	1951-
2S/1W-18da	James Hasuike	1962-
2S/1W-31db	Charles Kennerly	1963- 1/
2S/1W-32bd(3)	City of Sherwood	1963-
2S/2W-2dcb	Louis Hesse	1965-
2S/2W-6bbb	S. R. Rotchstrom	1951- 1/
2S/2W-16cc(1)	Mountainside Cemetery	1964-1967 2/
2S/2W-16cc(2)	Mountainside Cemetery	1968-
	WHEELER COUNTY	
12S/23E-14dd	Lillie Collins	1963-
	YAMHILL COUNTY	
2S/3W-31ac	E. W. Leffler	1963-
2S/4W-13ac	George Woell	1962-
3S/2W-17aa	Mack Bennett	1962- 1/
3S/2W-19cc	Valley View Memorial Park	1965-
3S/3W-26ac	City of Dundee	1962-
3S/3W-30da(2)	Trappist Abbey	1962-
3S/4W-19cc	Austin Warner	1962-
4S/3W-6ccb	City of Lafayette	1962-
4S/3W-33dba	Clayton J. Trent	1962- 1/
4S/4W-24ddd	Ross Cruickshank	1962-
4S/4W-27bcb	J. L. Wilcox	1962-
4S/5W-12da	Frank Setniker	1968-
5S/3W-9cdd	Howard Baker	1962-
5S/3W-21acb	Louie W. McGee	1962-
5S/3W-21ccd	Fred C. Stockhoff	1962-
5S/3W-30ddb	Barbara Fuqua (Rogers)	1962-
5S/4W-1aba	Earle F. Day	1962-
5S/4W-11bba	Norman J. Longhurst	1962- 1/
5S/4W-20ccc	City of Amity	1962-
5S/4W-25acb	Peter Parvin	1962-
5S/4W-27bcd	Alf DeRaeve	1962-
5S/5W-13abc	George Fuller	1928- 1/
5S/6W-34bb	Northwest Ring Co.	1968-
6S/3W-4bbb	Lloyd L. Lind	1962-

1/ Hydrograph of this well shown in this report
2/ Measurements discontinued