

# Illinois State Water Survey

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UNIVERSITY OF ILLINOIS . . . . .  
DEAN WILLIAM L. EVERI

WATER RESOURCES BUILDING  
605 E. SPRINGFIELD, CHAMPAIGN

MAIL: BOX 232, URBANA, ILLINOIS 61801

AMEA CODE 217  
PHONE 333-2210

WILLIAM C. ACKERMANN, CHIEF

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MP-30

Illinois State Water Survey  
COSTS OF WELLS AND  
PUMPS : TECHNICAL LETTER

SWS0974

Subject: Technical Letter 10  
Costs of Wells and Pumps

July 1968

This letter concerning the cost of wells and pumps represents one product of research currently under way at the Illinois State Water Survey on the cost of water resources development. Parallel studies are going forward on the cost of water treatment, reconditioning water, sewage treatment, and waste disposal.

Previous technical letters issued have covered subjects as follows: Technical Letter 7, Water Transmission Costs; Technical Letter 8, Cost of Reservoirs in Illinois; and Technical Letter 9, Cost of Pumping Water.

The use of this material will give an estimate of the well and pump costs for projects requiring a given capacity. This is intended only as an instrument for establishing orders of magnitude as a basis for comparisons, and of course does not substitute for detailed engineering studies.

This study is based on information obtained from 142 municipal and industrial water supply wells drilled in Illinois during 1964, 1965, and 1966. All cost data were adjusted to a common 1966 cost level by increasing the 1964 and 1965 cost figures 10 and 5 percent, respectively. This simplified correction technique was proven reasonable according to both The Engineering News Record Cost Indexes and the Handy-Whitman Index of Water Utility Cost.

Well cost data were analyzed for three categories according to the aquifer tapped: sand and gravel, shallow bedrock, and deep sandstone. In the sand and gravel category, tubular and gravel packed wells finished in the glacial materials above bedrock were considered separately.

The following are well diameters that have been used in Illinois for wells in unconsolidated formations (H. F. Smith, 1961, Modern Water Well Design and Construction Procedures, Illinois State Water Survey mimeo report):

<u>Pumping Rate</u> <u>(gpm)</u>	<u>Diameter of well</u> <u>(inches)</u>
125	6
300	8
600	10
1200	12
2000	14
3000	16

### Cost of Wells

A depth-cost relationship for tubular wells finished in sand and gravel is illustrated in figure 1. The mean line and a line representing the mean plus one standard deviation is shown for each group of bottom bore hole diameters in inches. Use of the line representing the mean plus one standard deviation gives an estimate that can be expected to be exceeded only 16 percent of the time.

Making an estimate of cost requires knowing the desired yield and depth of well to be constructed. When the desired yield is known, the diameter of well in inches is determined from the table above. As an example, for a desired yield of 100 gpm the well diameter would be 6 inches. If the desired water bearing aquifer were 100 feet from the surface, the well cost (W.C.) would be computed as follows:

$$W.C. = 845 d^{0.299}$$

$$W.C. = \$3,360$$

where

**W.C.** = well cost in dollars  
**d** = depth of well in feet

This same value can be read directly from the appropriate line on figure 1.

Figures 2, 3, and 4 give the well costs for gravel-packed wells finished in sand and gravel; shallow sandstone, limestone, or dolomite bedrock wells; and deep sandstone wells, respectively.

### Costs of Pumps

Detailed pump costs were studied for 108 of the pumping plants installed in the 142 municipal and industrial water supply wells. Of this total about 45 percent were vertical turbine pumps and the remainder of the submersible turbine type. Pump costs include the normal costs of well houses and control systems but do not include sophisticated automatic control systems.

**Vertical Turbine Pumps.** Selected data were analyzed for 39 vertical turbine pumps with reported capacities of 40 to 3,500 gpm and heads of 30 to 915 feet. The installed pump cost-pump capacity relationship developed for vertical turbine pumps is shown in figure 5. The pump cost (P.C.) can be computed as follows:

$$P.C. = 7.309 Q^{0.453} H^{0.642}$$

where

- P.C. = pump cost in dollars
- Q = pump capacity in gallons per minute (gpm)
- H = total head = depth to nonpumping water level plus drawdown depth plus surface pressure desired, expressed in feet of head

Figure 5 illustrates the general solution for the above equation.

An example estimate follows for the cost of a pump required for a sand and gravel well, given these requirements:

- Desired yield = 200 gpm
- Nonpumping water level = 55 feet
- Specific capacity of aquifer = 10 gpm/ft
- Surface pressure desired = 50 psi

The total head is calculated by:

- Drawdown = pumping rate/specific capacity  
= 200 gpm/10 gpm/ft = 20 feet
- Surface pressure = 50 psi = 50 psi (2.307 ft/psi) = 115 feet
- Total head = 55 + 20 + 115 = 190 feet

Then, the estimated cost of the vertical turbine pump is:

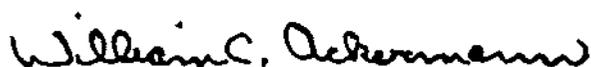
$$\begin{aligned} P.C. &= 7.309 Q^{0.453} H^{0.642} = 7.309 (200)^{0.453} (190)^{0.642} \\ &= (7.309) (11.02) (29.2) \\ P.C. &= \$2,350 \end{aligned}$$

Figure 6 illustrates the general solution for the equation for installed pump costs of submersible turbine pumps which is:

$$P.C. = 5.629 Q^{0.541} H^{0.658}$$

A more detailed explanation of the development of these empirical expressions is given in State Water Survey Circular 98. We hope this information will be useful to you.

Very truly yours,



William C. Ackermann

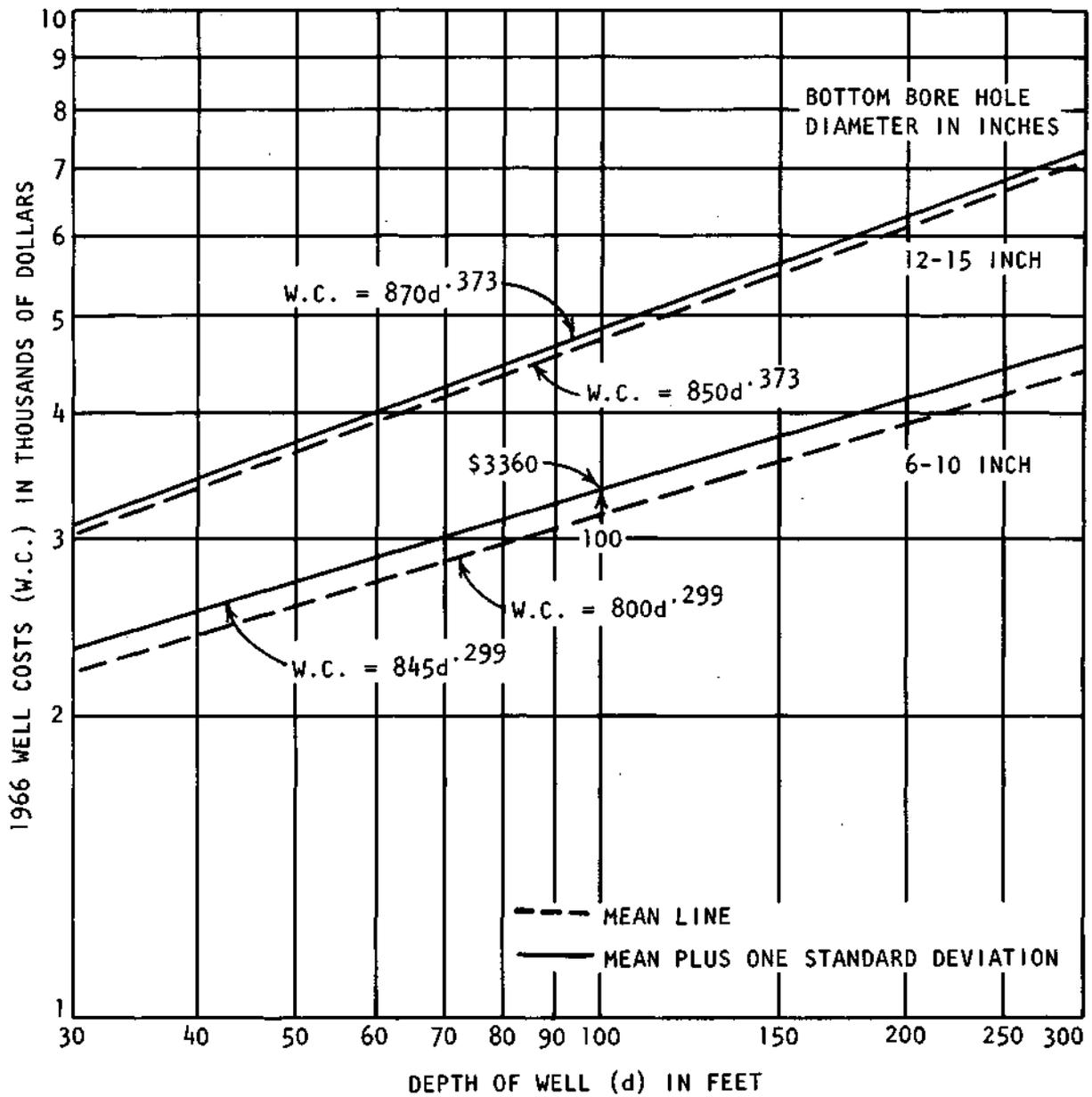


Figure 1. Cost of tubular wells finished in sand and gravel

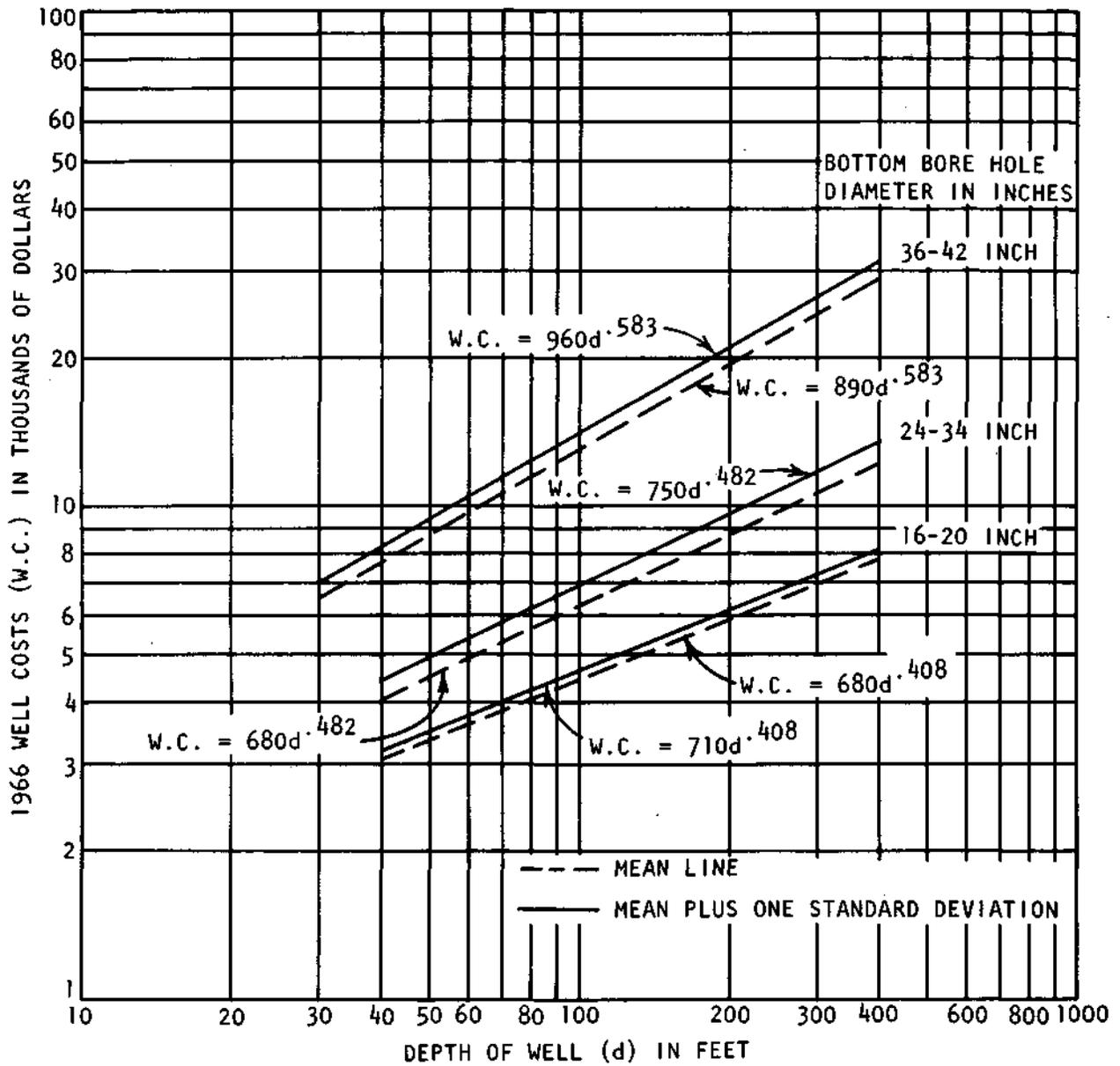


Figure 2. Cost of gravel-packed wells finished in sand and gravel

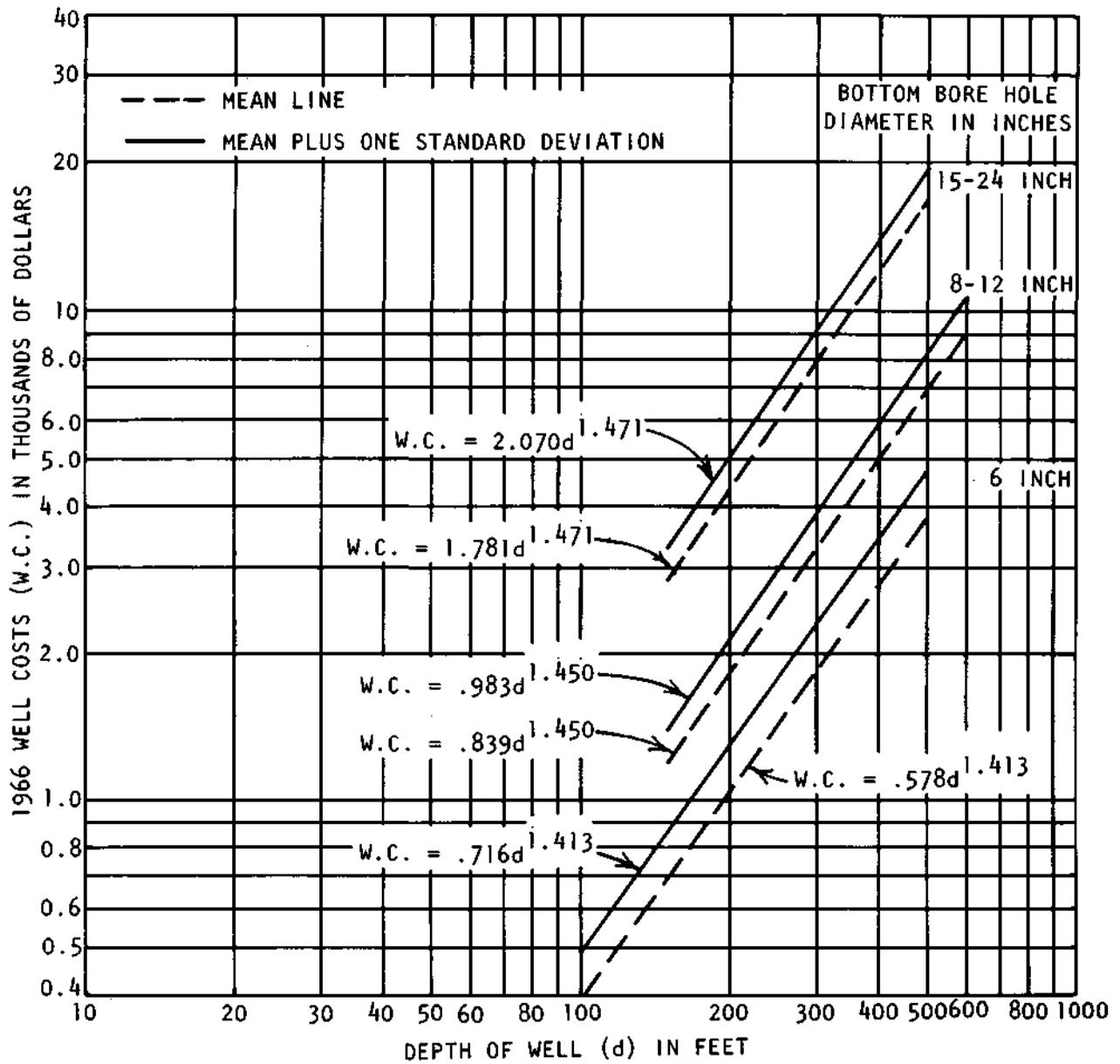


Figure 3. Cost of shallow sandstone, limestone, or dolomite bedrock wells

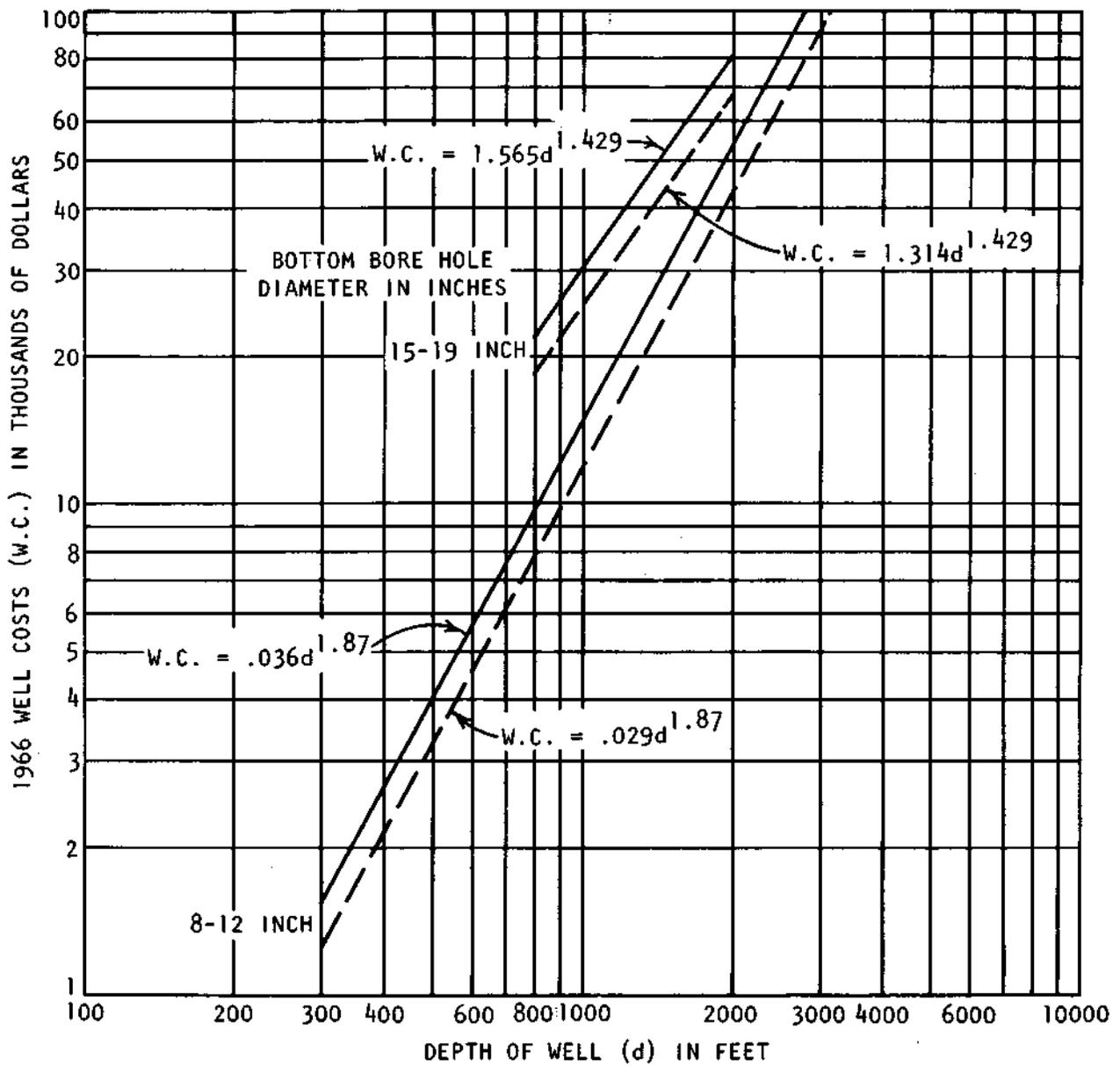


Figure 4. Cost of deep sandstone wells

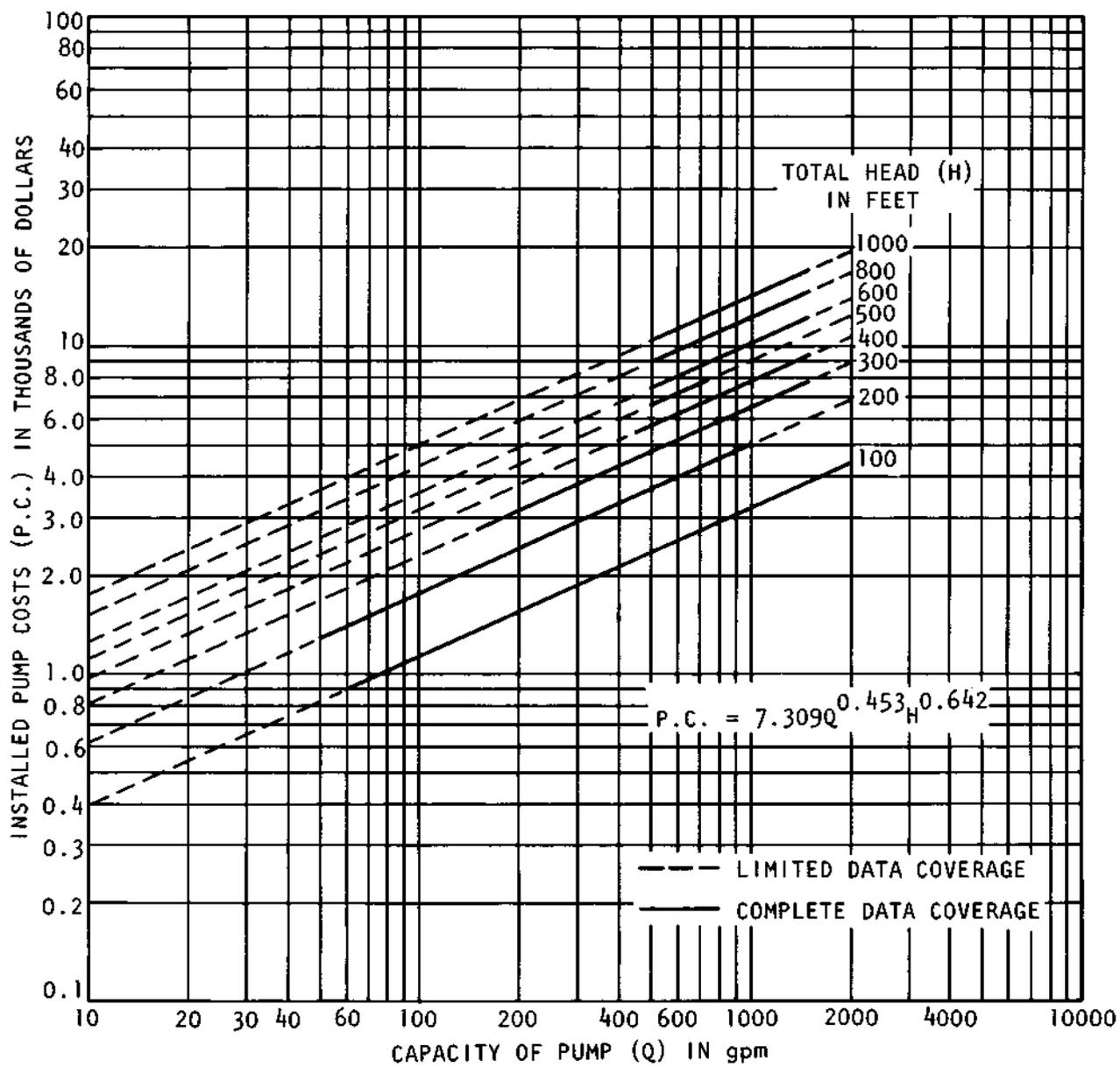


Figure 5. Costs of vertical turbine pumps

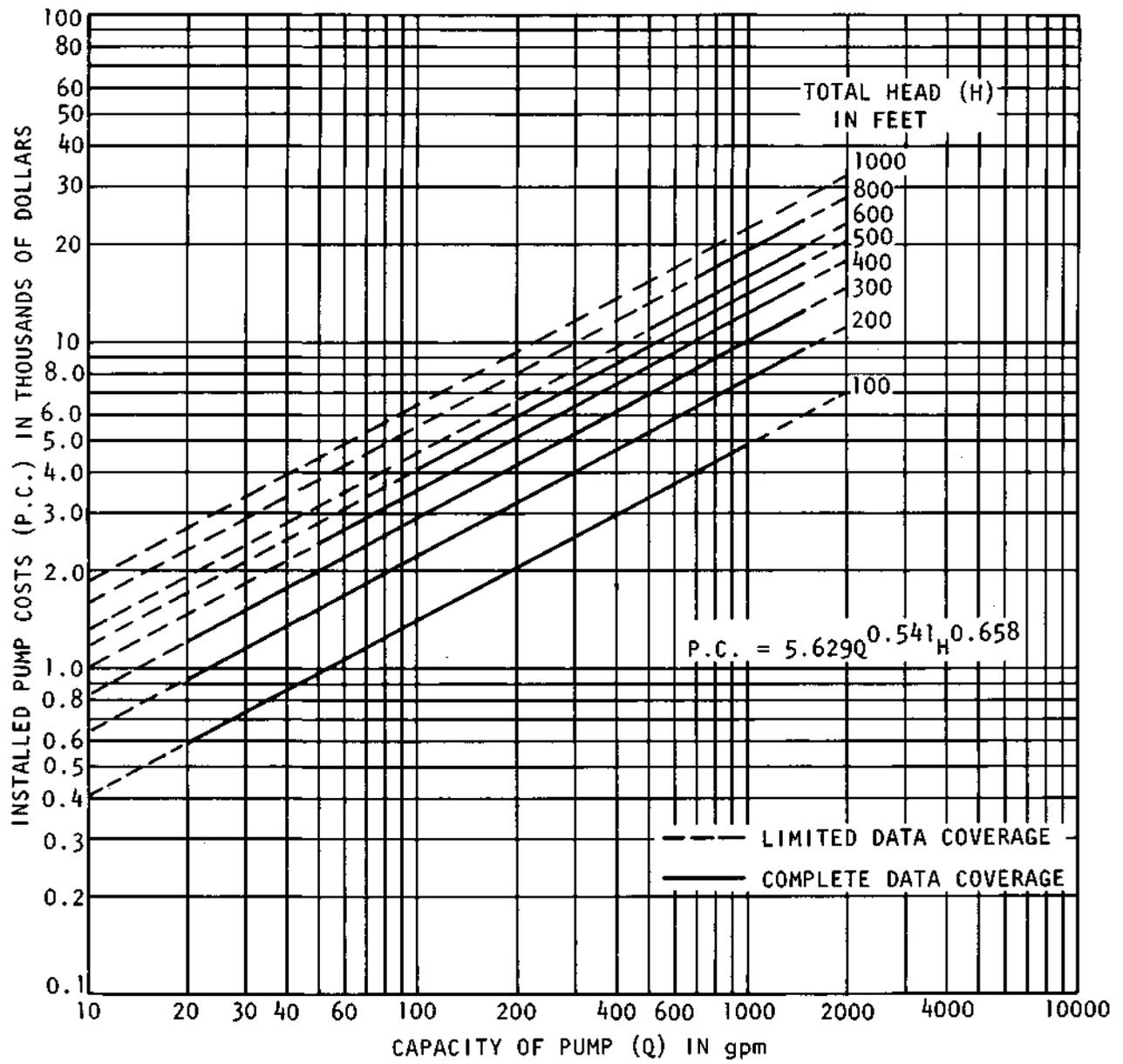


Figure 6. Costs of submersible turbine pumps