**Section 671.APPENDIX D Neuman Equations and Pump Test Procedures for Unconfined or Water Table Aquifers**

If no data is available for unconsolidated or non-fractured bedrock aquifer constants, a pump test can be conducted to determine the lateral radius of influence as follows:

A. At least one fully penetrating observation well is necessary.

B. The pump test should be conducted for at least 48 hours.

1. The flow equation for unconfined aquifers is given by:

|  |  |  |
| --- | --- | --- |
| T | = | 114.6Q W(uA, uB Γ) |
| (ho – h) |

Where:

|  |  |  |
| --- | --- | --- |
| T | = | transmissivity (gallons per day per food) |
| Q | = | production well discharge rate (gallons per minute) |
| ho -h | = | drawdown in the observation well (feet) |
| W(uA, uB Γ) | = | well function for unconfined aquifers, the well function is calculated and (uAΓ), (uB Γ) is obtained from Table B.  |
|  | = |  |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| uA | = | 2693r2 S | (Early phase draw down) |  | Γ | = | r2 Kv |
| Tt |  |  | b2Kh |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| uB | = | 2693r2 Sy | (Late phase draw down) |  | T | = | Khxb |
| Tt |  |  |

Where

|  |  |  |
| --- | --- | --- |
| S | = | storativity (dimensionless) |
| Sy | = | specific yield (dimensionless) |
| t | = | time (minutes) |
| b | = | aquifer saturated thickness (feet) |
| Kv | = | aquifer vertical hydraulic conductivity (gallons per day per square feet) |
| Kh | = | aquifer horizontal hydraulic conductivity (gallons per day per square feet) |
| r | = | distance from the production well to observation well (feet) |

The radius of influence can then be calculated using the following:

|  |  |  |  |
| --- | --- | --- | --- |
| r | = | √ | uBTt |
|  | 2693Sy |  |

Where

|  |  |  |
| --- | --- | --- |
| t | = | time pumped under normal operational conditions (minutes). |

Two sets of type curves are used (Neuman, 1975). Type-A curves are used for early phase drawdown data, and Type-B curves are used for late phase drawdown. The type curves are used to evaluate field data for time and drawdown, which are plotted on logarithmic paper of the same scale. The following procedure can be used:

1. Overlay time drawdown data on Type-B curves. At any match point, the values of W(uB, Γ), uB, t, and ho -h are determined. The value of Γ comes from the type curve. The value of T and Sy is calculated using these values and the following equations:

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| T | = | 114.6Q W(uB Γ) |  | Sy | = | Tt |
| Ho -h |  | 3693r2 |

2. Use the early phase drawdown Type-A curve to calculate W (uA Γ), uA, t, ho -h and S using the Γ value previously determined for the Type-B curve and the following equation:

|  |  |  |
| --- | --- | --- |
| S | = | TtuA |
| 2693r2 |

3. The value of horizontal hydraulic conductivity can be determined using:

|  |  |  |
| --- | --- | --- |
| Kh | = | T |
| b |

4. The vertical hydraulic conductivity can be determined using the following:

|  |  |  |
| --- | --- | --- |
| Kv | = | Γb2 Kh |
| r2 |

1. The lateral radius of influence can then be calculated with the following:

|  |  |  |  |
| --- | --- | --- | --- |
| r | = | √ | uBTt |
|  | 2693Sy |  |