# APPENDIX R

# ADEQ 1995 ALERT LEVEL GUIDANCE FOR SOLID WASTE FACILITIES

**Arizona Department of Environmental Quality**
**Waste Programs Division**
**Solid Waste Section**

# ALERT LEVEL GUIDANCE FOR SOLID WASTE FACILITIES - 1995

This document describes one methodology for establishing Alert Levels (ALs) and determining statistically significant increases of constituents in groundwater at Municipal Solid Waste Landfills (MSWLs). MSWLs are required to comply with the groundwater monitoring requirements of 40 CFR 258, Subpart E. The following diagrams and charts are presented to clarify the tolerance interval method discussed in *Technical Guidance Document I* (ADEQ, 1993). *TGD I* and this document were adapted in part from the following EPA guidance documents:

- *Statistical Analysis of Groundwater Monitoring Data at RCRA Facilities, Interim Final Guidance,* Environmental Protection Agency, Office of Solid Waste, Waste Management Division, April 1989

- *Addendum to Interim Final Guidance*, EPA, 1992.

The tolerance interval method is one of several statistical methods described in § 258.53. For each constituent, a numeric value is calculated from background data and compared with future detection monitoring data. Following establishment of these values, a detection data set does not have to be put through a variety of statistical tests in order to prove or disprove a statistically significant increase because the background data has already been transformed into a tolerant, albeit, protective limit. However, this method is only effective for data that is of normal or log normal distribution and does not display significant spatial variation between background and compliance wells.

Background to compliance, or **interwell comparison**, assumes that the two sets of data are from nearly identical water. This would imply that all water has had the same time of infiltration, and same period of contact and chemical reactions with saturated zone sediments. This situation is rare, if not impossible. However, it is the assumption necessary for such comparison. **Intrawell comparison**, has an advantage over interwell comparison. Data from a well is compared with historical data from the same well, thus eliminating spatial variations from one well to another. However, intrawell comparison may be ineffective at sites where the background data may already indicate contamination. The choice between interwell and intrawell comparison is best made after a thorough evaluation of background and compliance well data.

When enough background data is available, tolerance intervals can be calculated. EPA guidance recommends a sample size of eight or more. The mean and standard deviation of the data are calculated to allow for the natural variance of water quality data. Add together the mean, and the product of the standard deviation and a tolerance factor, to get the upper tolerance limit. The method limits the probability of false positives and false negatives (type I and type II errors). In addition, methods are available to handle data that may have non-detections and outliers.

For each constituent, the upper tolerance limit is an AL or AQL and is dependent upon the existence of an MCL or AWQS for that constituent. Subsequent detection monitoring data is compared to the upper tolerance limit established from the background data. If an exceedence of an upper tolerance limit occurs, and is not refuted by § 258.54(c)(3), the owner/operator is required to initiate Assessment Monitoring in accordance with § 258.55.

## Acronyms and Abbreviations

**AL - Alert Level:** an early warning indicator of a potential violation of an Aquifer Water Quality Standard at the applicable point of compliance.

**AQL - Aquifer Quality Limit:** a maximum concentration of a constituent allowed in an aquifer at the point of compliance. Synonymous with AWQS.

**AWQS - Aquifer Water Quality Standards:** numeric water quality standards established by Arizona Revised Statute 49-223 and published in Arizona Administrative Code Title 18, Chapter 11, Article 4 (R18-11-406).

**MCL - Maximum Contaminant Level:** the maximum permissible level of a contaminant in water which is delivered to any user of a public water system.

**MDL - Method Detection Limit:** the minimum concentration of a constituent that can be measured and reported with a 99 percent confidence that the true value is greater than zero in a given matrix containing the analyte.

**PQL - Practical Quantitation Limit:** the lowest level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions.

**Type I Error - False Positive:** incorrectly indicates contamination or an increase in contamination.

**Type II Error - False Negative:** when a test fails to detect contamination or an increase in a concentration of a constituent.

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**Note: This is a recommended method, and may not be applicable, nor appropriate for some facilities. MSWL units located over aquifers with man made impacts or aquifers that exhibit naturally occurring, significant chemical variations, should pursue other statistical methods or consult a professional statistician.**

# Alert Level Guidance

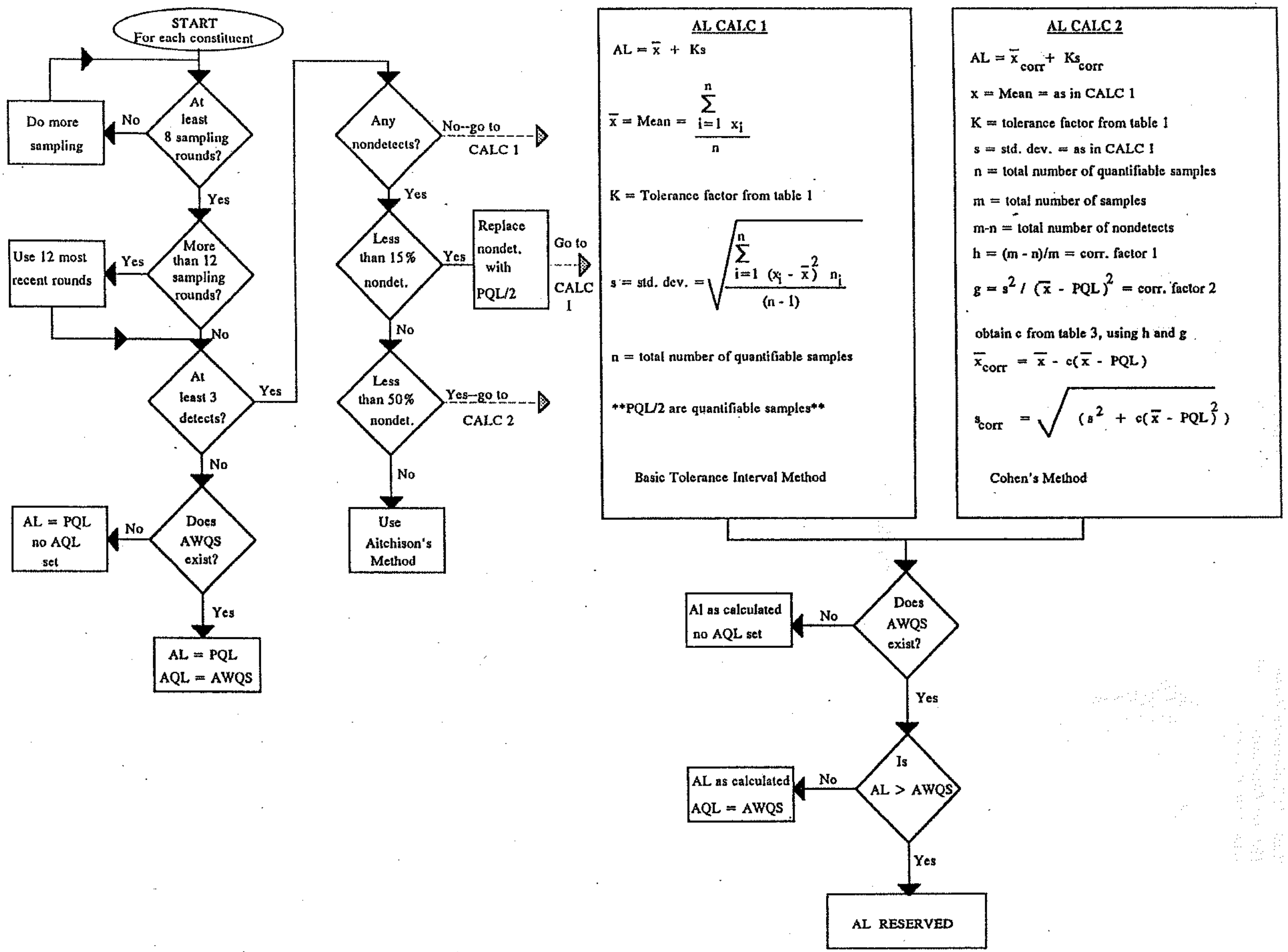

**Table 1: Tolerance Factors (K) for Tolerance Intervals with 95% Confidence.**

| n | K |
|---|---|
| 8 | 3.188 |
| 9 | 3.031 |
| 10 | 2.911 |
| 11 | 2.815 |
| 12 | 2.736 |
| | |
| | |
| | |
| | |
| | |

**Table 2: Critical Values for T (One Sided)**

| n | T |
|---|---|
| 3 | 1.155 |
| 4 | 1.496 |
| 5 | 1.764 |
| 6 | 1.973 |
| 7 | 2.139 |
| 8 | 2.274 |
| 9 | 2.387 |
| 10 | 2.482 |
| 11 | 2.564 |
| 12 | 2.636 |

## Outlier Determination

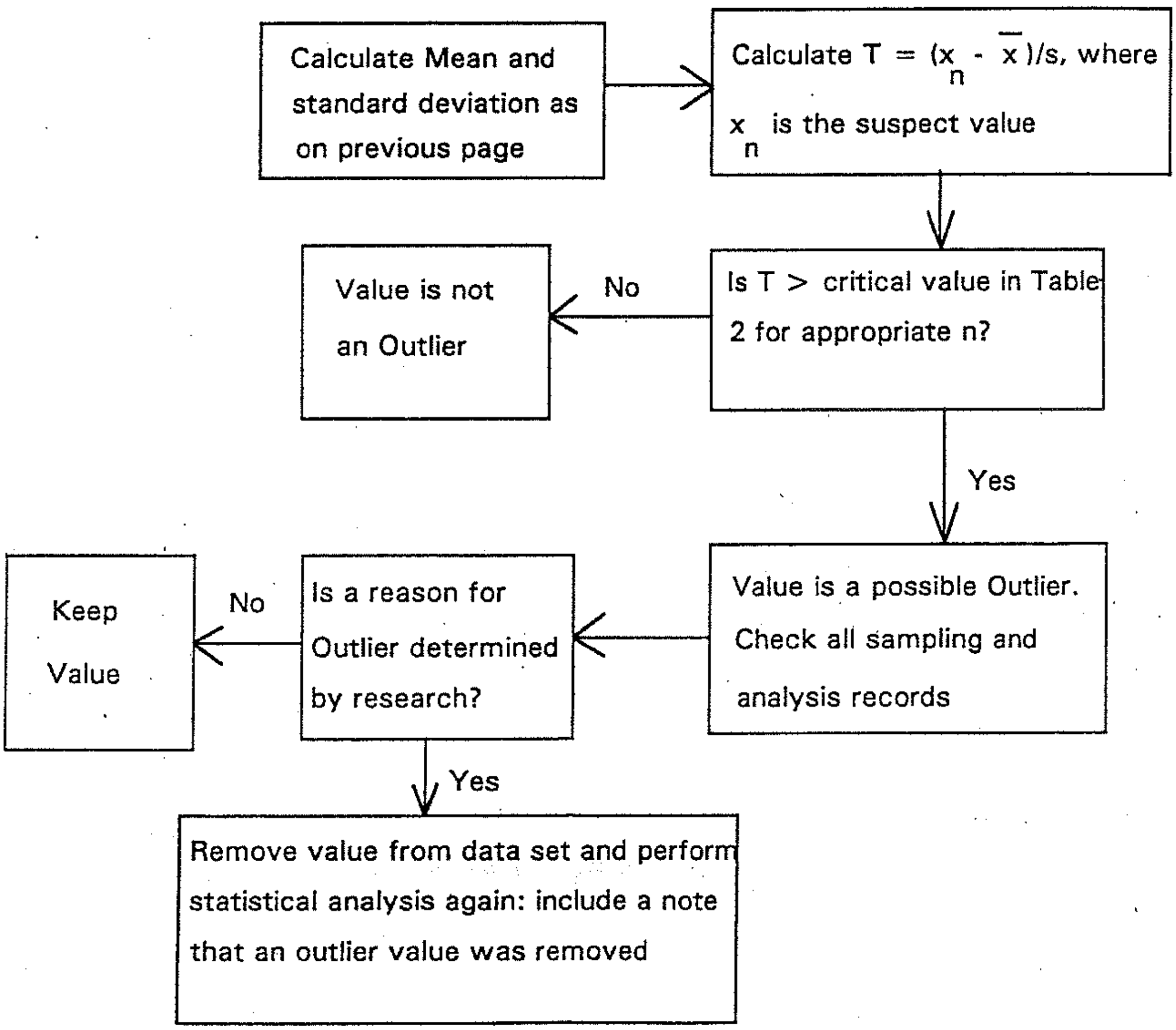

Table 3: Correction for Non-detects

| g\h | 0.01 | 0.02 | 0.03 | 0.04 | 0.05 | 0.06 | 0.07 | 0.08 | 0.09 | 0.1 | 0.15 | 0.2 | h/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.0101 | 0.0204 | 0.030902 | 0.041583 | 0.052507 | 0.063627 | 0.074953 | 0.086488 | 0.09824 | 0.1102 | 0.17342 | 0.24268 | 0 |
| 0.05 | 0.010551 | 0.021294 | 0.032225 | 0.04335 | 0.05467 | 0.066189 | 0.077909 | 0.089834 | 0.10197 | 0.11431 | 0.17935 | 0.25033 | 0.05 |
| 0.1 | 0.01095 | 0.022082 | 0.033398 | 0.044902 | 0.056596 | 0.068483 | 0.080568 | 0.092852 | 0.10534 | 0.11804 | 0.18479 | 0.25741 | 0.1 |
| 0.15 | 0.01131 | 0.022798 | 0.034466 | 0.046318 | 0.058356 | 0.070586 | 0.083009 | 0.095629 | 0.10845 | 0.12148 | 0.18985 | 0.26405 | 0.15 |
| 0.2 | 0.011642 | 0.023459 | 0.035453 | 0.047629 | 0.05999 | 0.072539 | 0.08528 | 0.098216 | 0.11135 | 0.12469 | 0.1946 | 0.27031 | 0.2 |
| 0.25 | 0.011952 | 0.024076 | 0.036377 | 0.048858 | 0.061522 | 0.074372 | 0.087413 | 0.10065 | 0.11408 | 0.12772 | 0.1991 | 0.27626 | 0.25 |
| 0.3 | 0.012243 | 0.024658 | 0.037249 | 0.050018 | 0.062969 | 0.076106 | 0.089433 | 0.10295 | 0.11667 | 0.13059 | 0.20338 | 0.28193 | 0.3 |
| 0.35 | 0.01252 | 0.025211 | 0.038077 | 0.05112 | 0.064345 | 0.077756 | 0.091355 | 0.10515 | 0.11914 | 0.13333 | 0.20747 | 0.28737 | 0.35 |
| 0.4 | 0.012784 | 0.025738 | 0.038866 | 0.052173 | 0.06566 | 0.079332 | 0.093193 | 0.10725 | 0.1215 | 0.13595 | 0.21139 | 0.2926 | 0.4 |
| 0.45 | 0.013036 | 0.026243 | 0.039624 | 0.053182 | 0.066921 | 0.080845 | 0.094958 | 0.10926 | 0.12377 | 0.13847 | 0.21517 | 0.29765 | 0.45 |
| 0.5 | 0.013279 | 0.026728 | 0.040352 | 0.054153 | 0.068135 | 0.082301 | 0.096657 | 0.11121 | 0.12595 | 0.1409 | 0.21882 | 0.30253 | 0.5 |
| 0.55 | 0.013513 | 0.027196 | 0.041054 | 0.055089 | 0.069306 | 0.083708 | 0.098298 | 0.11308 | 0.12806 | 0.14325 | 0.22235 | 0.30725 | 0.55 |
| 0.6 | 0.013739 | 0.027649 | 0.041733 | 0.055995 | 0.070439 | 0.085068 | 0.099887 | 0.1149 | 0.13011 | 0.14552 | 0.22578 | 0.31184 | 0.6 |
| 0.65 | 0.013958 | 0.028087 | 0.042391 | 0.056874 | 0.071538 | 0.086388 | 0.10143 | 0.11666 | 0.13209 | 0.14773 | 0.2291 | 0.3163 | 0.65 |
| 0.7 | 0.014171 | 0.028513 | 0.04303 | 0.057726 | 0.072605 | 0.08767 | 0.10292 | 0.11837 | 0.13402 | 0.14987 | 0.23234 | 0.32065 | 0.7 |
| 0.75 | 0.014378 | 0.028927 | 0.043652 | 0.058556 | 0.073643 | 0.088917 | 0.10438 | 0.12004 | 0.1359 | 0.15196 | 0.2355 | 0.32489 | 0.75 |
| 0.8 | 0.014579 | 0.02933 | 0.044258 | 0.059364 | 0.074655 | 0.090133 | 0.1058 | 0.12617 | 0.13773 | 0.154 | 0.23858 | 0.32903 | 0.8 |
| 0.85 | 0.014775 | 0.029723 | 0.044848 | 0.060153 | 0.075642 | 0.091319 | 0.10719 | 0.12325 | 0.136952 | 0.15599 | 0.24158 | 0.33307 | 0.85 |
| 0.9 | 0.014967 | 0.030107 | 0.045425 | 0.060923 | 0.076606 | 0.092477 | 0.10854 | 0.1248 | 0.14126 | 0.15793 | 0.24452 | 0.33703 | 0.9 |
| 0.95 | 0.015154 | 0.030483 | 0.045989 | 0.061676 | 0.077549 | 0.093611 | 0.10987 | 0.12362 | 0.14297 | 0.15983 | 0.2474 | 0.34091 | 0.95 |
| 1 | 0.015338 | 0.03085 | 0.04654 | 0.062413 | 0.078471 | 0.09472 | 0.11116 | 0.1278 | 0.14465 | 0.1617 | 0.25022 | 0.34471 | 1 |

| g\h | 0.25 | 0.3 | 0.35 | 0.4 | 0.45 | 0.5 | 0.55 | 0.6 | 0.65 | 0.7 | 0.8 | 0.9 | h/g |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | 0.31862 | 0.4021 | 0.4941 | 0.5961 | 0.7096 | 0.8368 | 0.9808 | 1.145 | 1.336 | 1.561 | 2.176 | 3.283 | 0 |
| 0.05 | 0.32793 | 0.413 | 0.5066 | 0.6101 | 0.7252 | 0.854 | 0.9994 | 1.166 | 1.358 | 1.585 | 2.203 | 3.314 | 0.05 |
| 0.1 | 0.33662 | 0.4233 | 0.5184 | 0.6234 | 0.74 | 0.8703 | 1.017 | 1.185 | 1.379 | 1.608 | 2.229 | 3.345 | 0.1 |
| 0.15 | 0.3448 | 0.433 | 0.5296 | 0.6361 | 0.7542 | 0.886 | 1.035 | 1.204 | 1.4 | 1.63 | 2.255 | 3.376 | 0.15 |
| 0.2 | 0.35255 | 0.4422 | 0.5403 | 0.6483 | 0.7678 | 0.9012 | 1.051 | 1.222 | 1.419 | 1.651 | 2.28 | 3.405 | 0.2 |
| 0.25 | 0.35993 | 0.451 | 0.5506 | 0.66 | 0.781 | 0.9158 | 1.067 | 1.24 | 1.439 | 1.672 | 2.305 | 3.435 | 0.25 |
| 0.3 | 0.367 | 0.4595 | 0.5604 | 0.6713 | 0.7937 | 0.93 | 1.083 | 1.257 | 1.457 | 1.693 | 2.329 | 3.464 | 0.3 |
| 0.35 | 0.37379 | 0.4676 | 0.5699 | 0.6821 | 0.806 | 0.9437 | 1.098 | 1.274 | 1.476 | 1.713 | 2.353 | 3.492 | 0.35 |
| 0.4 | 0.38033 | 0.4755 | 0.5791 | 0.6927 | 0.8179 | 0.957 | 1.113 | 1.29 | 1.494 | 1.732 | 2.376 | 3.52 | 0.4 |
| 0.45 | 0.38665 | 0.4831 | 0.588 | 0.7029 | 0.8295 | 0.97 | 1.127 | 1.306 | 1.511 | 1.751 | 2.399 | 3.547 | 0.45 |
| 0.5 | 0.39276 | 0.4904 | 0.5967 | 0.7129 | 0.8408 | 0.9826 | 1.141 | 1.321 | 1.528 | 1.77 | 2.421 | 3.575 | 0.5 |
| 0.55 | 0.3987 | 0.4976 | 0.6051 | 0.7225 | 0.8517 | 0.995 | 1.155 | 1.337 | 1.545 | 1.788 | 2.443 | 3.601 | 0.55 |
| 0.6 | 0.40447 | 0.5045 | 0.6133 | 0.732 | 0.8625 | 1.007 | 1.169 | 1.351 | 1.561 | 1.806 | 2.465 | 3.628 | 0.6 |
| 0.65 | 0.41008 | 0.5114 | 0.6213 | 0.7412 | 0.8729 | 1.019 | 1.182 | 1.366 | 1.577 | 1.824 | 2.486 | 3.654 | 0.65 |
| 0.7 | 0.41555 | 0.518 | 0.6291 | 0.7502 | 0.8832 | 1.03 | 1.195 | 1.38 | 1.593 | 1.841 | 2.507 | 3.679 | 0.7 |
| 0.75 | 0.4209 | 0.5245 | 0.6397 | 0.759 | 0.8932 | 1.042 | 1.207 | 1.394 | 1.608 | 1.858 | 2.528 | 3.705 | 0.75 |
| 0.8 | 0.42612 | 0.5308 | 0.6441 | 0.7676 | 0.9031 | 1.053 | 1.22 | 1.408 | 1.624 | 1.875 | 2.548 | 3.73 | 0.8 |
| 0.85 | 0.43122 | 0.537 | 0.6515 | 0.7761 | 0.9127 | 1.064 | 1.232 | 1.422 | 1.639 | 1.892 | 2.568 | 3.754 | 0.85 |
| 0.9 | 0.43622 | 0.543 | 0.6586 | 0.7844 | 0.9222 | 1.074 | 1.244 | 1.435 | 1.653 | 1.908 | 2.588 | 3.779 | 0.9 |
| 0.95 | 0.44112 | 0.549 | 0.6656 | 0.7925 | 0.9314 | 1.085 | 1.255 | 1.448 | 1.668 | 1.924 | 2.607 | 3.803 | 0.95 |
| 1 | 0.44592 | 0.5548 | 0.6724 | 0.8005 | 0.9406 | 1.095 | 1.267 | 1.461 | 1.682 | 1.94 | 2.626 | 3.827 | 1 |