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STATISTICAL QUALITY CONTROL FOR YEAR 2003
WATER WELL MEASUREMENTS

by

John C. Davis

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Introduction

The year 2003 Quality Control and Assurance Program for observation well water-level measurements in western Kansas is patterned after the quality assurance techniques developed during annual field work and statistical analyses conducted since 1997. This discussion of procedures is adapted from Miller, Davis, and Olea (1997), incorporating adjustments in the program that were noted in Davis (2001).

The primary variable measured in the water well observation program is depth to water in an observation well. This primary variable is associated with three secondary variables; the ground elevation, east-west coordinate, and north-south coordinate of the well. The secondary variables serve to locate the primary variable in space, and make it possible to determine spatial relationships between observation wells, including mapping the water table and calculating changes in aquifer volume. Historically, the three location variables were determined initially by the U.S. Geological Survey for each well and not re-determined unless a serious error in the original coordinates was suspected. In the 1997 ground water observation measurement program conducted by the Kansas Geological Survey, the geographic (latitude and longitude) coordinates of all wells were re-determined by GPS techniques. In subsequent year's measurement programs, all observation wells were again re-determined by GPS. "Selective Availability," which limited the resolution of GPS measurements, was turned off by the Federal government in 2001, so locations determined that year were substituted for previous determinations. For a few locations where year 2001 GPS measurements were not taken, measurements made in 2002 are used.

In addition, several secondary characteristics of the observation wells and of the measurement procedure were noted in order to determine if these influence the quality of the measurements being made (these measurements are referred to as *exogenous variables*). As part of the quality control program, water level measurements were repeated two or more times on 175 wells, yielding a collection of 203 quality control observations. Because these data include replicates, they provide an additional check on estimates of the influence of well conditions or measuring techniques on water levels. A subsequent round of measurements resampled 50 wells selected at random from the original set for quality assurance purposes. These wells were measured two or more times for a set of 58 quality assurance values.

The primary variable, depth to water, changes with geographic location and differences in topography so much that these factors will overwhelm all other sources of variation. Because of this, any errors in location may have a profound effect on the water table elevation. To avoid the complications of simultaneously considering uncertainties in the secondary variables, this statistical quality control study is based on first differences

(specifically, the difference between 2003 and 2002 depth-to-water measurements). The secondary variables cancel out, leaving only the difference in depth, which is numerically identical to the year's change in water level. In this statistical quality control study, the difference between 2003 and 2002 corrected depth measurements is abbreviated "'03-'02." If the water table is lower this year, the variable **'03-'02** will be a positive number. There were 492 wells measured in the current program, but three of these were not measured in 2002, so there are a total of 489 wells having the variable **'03-'02**. This is six fewer than the number of measurements available last year.

The objective in our quality control study is to identify and assess possible sources of unwanted variation in water level measurements made by the KGS. The purpose of the analysis is to provide guidance to the KGS field measurement program, to suggest ways in which field measurements might be improved, and to provide information necessary to identify past or current measurements that are suspect. The statistical quality control and field measurement programs have been intimately intertwined from the outset when the KGS assumed responsibility in 1997 for measuring observation wells formerly measured by the USGS. A comparison of results from 2003 with those from previous years shows that the desired improvements in the measurement program continue to be achieved through quality control.

Statistical Procedures

Preliminary examination detected three wells that deviated from last year's measurement by significant amounts; reexamination disclosed that their values contained typographical errors which were corrected. Three wells that were measured in this year's program were not measured in 2002, so for them the variable **'03-'02** cannot be calculated. All repeated measurements are excluded from this analysis to avoid inflating the total variance. 489 observations are included in the initial statistical analysis, which is an unbalanced analysis of variance (ANOVA) procedure designed to estimate the influence of different well characteristics and procedural differences on variable **'03-'02**. The following variables have been recorded for each well.

1. Depth to water

2. GPS longitude

3. GPS latitude

4. Date

5. Measurer's initials

6. Well Access
   1 = good
   0 = poor

7. Weighted Tape
   1 = yes

0 = no

8. Oil on Water
   1 = yes
   0 = no

9. Chalk Cut Quality
   2 = excellent
   1 = good
   0 = poor

In addition, the data file contains several variables that do not enter into the analyses. These include a unique USGS ID number and KGS ID designation, a surface elevation, a legal description of the well location, and a decimal latitude and longitude (obtained by LEO conversion of the legal description). There are other variables that are used for statistical analyses, taken from the historical records. These are **Well Use**, the purpose for which water from the well is used, and **Aquifer Code**, which describes the primary source of water in the well. The manner in which aquifer code values were assigned is summarized in Miller, Davis, and Olea (1997).

10. Well Use
    H = household water supply
    S = stock water supply
    I = irrigation
    U = unused observation
    Z = animal disposal

11. Aquifer Code
    KD = Cretaceous Dakota aquifer
    KJ = undifferentiated Cretaceous/Jurassic aquifer
    KN = Cretaceous Niobrara aquifer
    QA = Quaternary alluvium aquifer
    QAQU = Quaternary alluvium and undifferentiated aquifers
    QAQUTO = Quaternary alluvium and undifferentiated aquifers and Tertiary Ogallala aquifer
    QATO = Quaternary alluvium and Tertiary Ogallala aquifers
    QU = Quaternary undifferentiated aquifer
    QUTO = Quaternary undifferentiated and Tertiary Ogallala aquifers
    QUTOKJ = Quaternary undifferentiated, Tertiary Ogallala, and Cretaceous/Jurassic aquifers
    QUTOKD = Quaternary undifferentiated, Tertiary Ogallala, and Cretaceous Dakota aquifers
    TO = Tertiary Ogallala aquifer
    TOKD = Tertiary Ogallala and Cretaceous Dakota aquifers
    TOKJ = Tertiary Ogallala and undifferentiated Cretaceous/Jurassic aquifers

Note that, as in 2002, the set of aquifer codes used in 2003 differs slightly from that used prior to 2002 because of changes in the areas where the KGS measures wells. In addition, the aquifer code QUKD is not used because the single well assigned this code

was not measured in 2003. The initial statistical model includes all exogenous variables recorded during the quality control study that may contribute to the variability in the response, '03-'02, plus the variables **Well Use** and **Aquifer Code**. In contrast to the 2002 measurement program, the only exogenous variable to contribute significantly to the total variance is an operator effect measured by the variable **Measurer**. As expected, there are significant contributions to total variance from **Well Use** and **Aquifer Code**.

Analysis of Variance table for initial model

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob>F
Model	29	604.4319	20.8425	2.4089	<0.0001
Measurer	6	111.3776	18.5629	2.1454	0.0472*
Well Access	1	19.7194	19.7194	2.2791	0.1318ns
Weighted Tape	1	18.9069	18.9069	2.1852	0.1400ns
Well Use	4	37.4985	9.3746	1.0835	0.3641ns
Oil on Water	1	2.7463	2.7463	0.3174	0.5735ns
Chalk Cut Quality	2	136.1233	68.0617	7.8662	0.0004**
Aquifer Code	13	260.6781	20.0522	2.1520	0.0088**
Error	454	3928.1827	8.6524		
Total	483	4532.6147			

RSquare 0.13

A revised model was run that combined aquifers into classes similar to those used in 1997 through 2002. This 5-part classification distinguishes between (1) wells that tap alluvial aquifers, (2) wells that tap both alluvial aquifers and other unconsolidated aquifers, (3) wells drawing from the High Plains aquifer, (4) wells into bedrock aquifers, and (5) wells that draw from both bedrock and unconsolidated aquifers. This has the effect of reducing the degrees of freedom required for the model and thus increasing the sensitivity of the analysis for detecting other influences.

Analysis of Variance table for grouped aquifers

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob>F
Model	19	419.2629	22.0665	2.4892	0.0005ç
Measurer	6	106.5518	17.7586	2.0032	0.0638ns
Well Access	1	21.4159	21.4159	2.4158	0.1208ns
Weighted Tape	1	27.1791	27.1791	3.0659	0.0806ns
Well Use	4	62.6359	15.6590	1.7664	0.1344ns
Oil on Water	1	4.3418	4.3418	0.4898	0.4844ns
Chalk Cut Quality	2	140.5487	70.2744	7.9279	0.0004**
Aquifer Group	4	75.5091	18.8773	2.1294	0.0762ns
Error	464	4113.3518	8.8650		
Total	483	4532.6147			

RSquare 0.09

The surprising result is that none of the exogenous variables except **Chalk Cut Quality** are significant when aquifers are grouped. Most unexpected of all is that **Aquifer Group** itself is not a significant source of variation although **Aquifer Code** is a significant source of variation, indicating that there are significant differences in **'03-'02** between individual aquifers that are obscured when the aquifers are combined into groups.

Unfortunately, past models are not directly comparable because there are different numbers of degrees of freedom assigned to some variables, and the response (annual change in water level) has significantly different variances from year to year. The pattern of alternating magnitude of variance in the response variable continues this year, which has a significantly higher variance than measurements made in 2002. Although the year-to-year changes in total variance are highly significant, the cause remains speculative (Davis, 2001) but may be due in part to the fact that the response variable is a first-order difference.

One way to improve the statistical results of the measurement program is to discard wells in which exogenous variables make unusually high contributions to the total variance, arguing that the readings from such wells are atypical and likely erroneous. Of four wells exhibiting extreme changes in water level in 2003, only one (25S 25W 32CDD 01) exhibits the alternating annual rise and fall that suggests poorly controlled measurements. The other wells exhibit a pattern of a continuing and even accelerating decline in water level (34S 35W 26ACC 01 and 30S 32W 22BBB 01), or a steady rise in water level (33S 37W 35ACD 01).

Importance of contributing variables

We can determine the relative contributions of each category of the contributing variables by examining the least-squares means (averages) of **'03-'02** for a specified state of a variable, while holding all other variables at their average value. (In statistical terms, these averages are referred to as the *expected values* of the variables.) A positive value indicates the average depth to water in a well is greater in 2003 than in 2002 (the water level has declined from last year's measurement). That is, the elevation of the water level in the well is lower than it was previously. The following list gives the least-squares means for the complete data set.

Operator

Level	Original Least Sq Mean
BBW	3.7414
DRL	3.9141
JMA	3.1801
JMH	3.7991
NC	4.1541
NP*	4.8270
RDM	4.0622

*indicates new operator in 2003

Well Access

Level	Original Least Sq Mean
0	3.5657
1	4.3423

Weighted Tape

Level	Original Least Sq Mean
0	4.4525
1	3.4555

Well Use

Level	Original Least Sq Mean
H	2.6239
I	3.5699
S	2.2427
U	3.6929
Z	7.6405

Oil on Water

Level	Original Least Sq Mean
0	4.0866
1	3.8214

Chalk Cut

Level	Original Least Sq Mean
0	6.6799
1	2.3597
2	2.8224

Geologic Group

Level	Original Least Sq Mean
1 (Cretaceous)	4.1139
2 (Alluvium)	2.9334
3 (Al. + Tert.)	4.3011
4 (Tertiary)	4.5027
5 (Tert. + K)	3.9189

Summary of the Analyses of Variance

Year 2003 measurements show significant or highly significant variations attributable to **Measurer** and **Chalk Cut** in addition to differences between the aquifer being tapped by the well. The standard deviation of variable **'03-'02** is 3.86 ft., which is more than the standard deviation of variable **'02-'01** (2.56 ft.), the standard deviation of variable **'01-'00** (3.07 ft), or the standard deviation of variable **'00-'99** (2.69 ft.), but less than the standard deviation of variable **'99-'98** (4.21 ft.). The median decline in water level from 2002 to 2003 is 2.50 ft., more than double the decline from 2001 to 2002 (1.09 ft.) and greater than the median decline from 2000 to 2001 (1.39 ft.). This year's decline is much greater than earlier declines including the 1999 to 2000 decline of 0.31 ft., the 1998 to 1999 decline (0.72 ft.) and the decline between 1997 to 1998 (0.41 ft.).

The significant differences between measurers are mostly attributable to **NP** (who tended to produce deeper than expected measurements). However, when aquifers are grouped into classes, the increase in degrees of freedom available for error results in the measurements made by **JMA** (whose measurements tended to be shallower than expected) also becoming significantly different. The same change in degrees of freedom results in **Well Use** becoming a significant source in variance, attributable to stock water wells (**S**) being shallower than expected.

An unexpected consequence of combing individual aquifers into groups is that the differences between **Aquifer Groups** for **'03-'02** are not significant, although the individual **Geologic Units** themselves are a significant contributor to the variance in **'03-'02**. Water levels measured in 2002 in exclusively Cretaceous aquifers (Group 1) show mean declines of over 4.1 ft. from 2002, which is less than the mean decline of 5.3 ft. between 2001 and 2002. The water level in the Ogalalla aquifer (Group 4) shows a greater mean decline (4.5 ft.) than in the previous year (over 3.5 ft.). Measurements made in wells tapping alluvial aquifers (Group 2) show the smallest decline of 2.9 ft., but this was greater than last year's decline of 2.2 ft. or the previous year's slight increase in average water level. Wells in alluvial plus other sources (Group 3) show a decline in mean water level of 4.3 ft. Water levels in wells tapping Cretaceous aquifers plus Quaternary and/or Tertiary aquifers (Group 5) tend to be 3.9 ft. deeper on average this year. The only significant difference in the annual change in water level among **Aquifer Groups** is due to the difference between Group 2 and Group 4. A comparison with last years measurements shows that the decline is water level is significantly greater in **'03-'02** than in **'02-'01** for all groups except for Group 1. (Statistics for 2003 can only be compared in detail with those from 2002 and 2001 because of the change in responsibility for wells in two counties that occurred after year 2000.)

The ANOVA equation can be used to create an expected value and residual (difference between observed and expected value) for each well. The distribution of residuals should be approximately normal. Examination of the residual outliers will reveal any well measurements which cannot be explained by extreme combinations of the different sources of variation. The residual plot, shown in Figure 1, is more peaked than normal and skewed to negative values. Outliers, or extreme values, are measurements which differ from their expected values by more than ±10 feet. Five wells have been identified by this process. These wells show changes in water level between 2002 and 2003 that are outside the range expected. These well measurements may be correct and reflect unusual changes in aquifer level; the wrong wells may have been measured in

one year or the other; or changes in well construction or other factors may have altered the measurability of a well. The five wells, with their residuals, are:

Well ID	Residual, ft.
25S 25W 32CDD 01	-11.96
33S 37W 35ACD 01	-11.91
23S 33W 28CDC 01	10.10
30S 32W 22BBB 01	13.04
34S 35W 26ACC 01	13.14

A positive residual indicates that the 2003 water level is lower than predicted in a well with a declining water level, or is not as high as predicted in a well with an increasing water level. A negative residual indicates that the 2003 water level has declined less than predicted in a well with a declining water level, or has risen more than predicted in a well with a rising water table. None of these wells have unusual characteristics that make their current behavior suspect. Because only a few wells had questionable measurements, the decision was again made not to have a post-season remeasurement program in 2003.

Quality Assurance (remeasurement) Program

The year 2003 Quality Assurance program of random remeasurements resulted in QA data that contained no statistically significant sources of variation. Fifty randomly selected QA wells were remeasured by experienced personnel during the period when the regular field measurement program was underway. These were combined with data from the regular measurement program, to yield 125 measurements for statistical quality control. The fact that the QA program did not detect any significant exogenous sources of variation is a testament to the Survey's quality control efforts, and indicates that previous year's training in measurement techniques, plus the continuing refinement of the well measurement network, have been successful. The variance among the QA replicates is essentially identical to the variance of the complete data set. However, the most extreme value of **'03–'02** among the QA wells is only –10.8 ft., compared to an extreme of 16.4 ft. in the complete data set.

Conclusions

The purpose of the Quality Control and Assurance Program is to identify wells and procedural conditions that may contribute significantly to the variance of **Depth to Water** measured in observation wells, and which do not reflect true changes in the water table elevation. Gathering Quality Control information requires little additional effort by the field crews, emphasizes the importance of procedural consistency, and certifies performance. Quality Control for the year 2003 field season, like the preceding two seasons, is remarkably free of inconsistencies compared to earlier field seasons. The results can be interpreted as demonstrating the value of training and the desirability of deleting troublesome wells from the monitoring program. Although this year the QA process did not identify any specific wells as troublesome, and did not flag any well locations which required verification before being permanently incorporated into the WIZARD data base, the importance of the Quality Control and Assurance Program

remains unchanged. The continual improvement of data collected in the Water Well Measurement Program indicates the value of the program.

The Quality Control program has achieved its objectives of identifying and quantifying sources of unwanted variation in observation well data collection, and in flagging wells whose measurements require verification. It detected only five suspect values, confirming the benefits of "cleaning" the data base in past years. As the Quality Control process is routinely applied to KGS observation well measurements in the future, and particularly if it is applied to the entire Kansas observation well network, the quality of the groundwater measurement data will continue to be progressively improved with time.

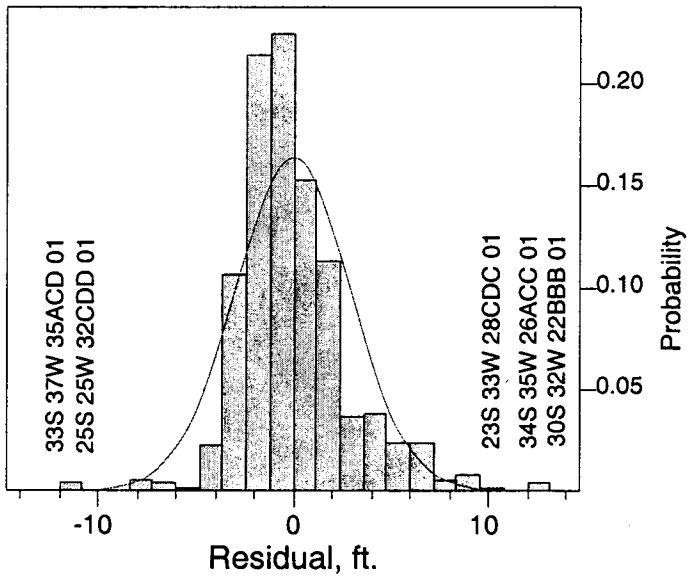

Figure 1. Histogram of residuals from predicted change in water level **'03-'02**, as estimated by regression model. Curve is fitted normal distribution with same mean and variance as residuals. Wells whose change in water level deviates more than 10 feet from the predicted value are indicated.

References

Davis, J.C., 2001, Statistical Quality Control For Yr. 2001 Water Well Measurements: Kansas Geological Survey Open-File Report No. 2001-2, 23 p.

Miller, R.D., J.C. Davis, and R.A. Olea, 1997, Acquisition Activity, Statistical Quality Control, and Spatial Quality Control for 1997 Annual Water Level Data Acquired by the Kansas Geological Survey: Kansas Geological Survey Open-File Report No. 97-33, 45 p.

Miller, R.D., J.C. Davis, and R.A. Olea, 1998, 1998 Annual Water Level Raw Data Report for Kansas: Kansas Geological Survey Open-File Report No. 98-7, 275 p., 6 plates, and 1 compact disk.

2003 appendix A

Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
1	1	01S 38W 02CDC 01	RDM	1	1	I	1	2	QA	2	27.72	26.91	0.81
2	1	01S 38W 08DCC 01	RDM	1	1	I	0	2	QA	2	16.21	15.76	0.45
3	1	01S 38W 30BDC 01	RDM	1	1	I	0	2	QA	2	13.39	10.47	2.92
4	2	01S 38W 30BDC 01	RDM	1	1	I	0	2	QA	2	13.5	10.47	3.03
5	1	01S 39W 25CBC 01	RDM	1	1	U	0	2	QA	2	10.4	9.83	0.57
6	1	02S 37W 33DCC 01	RDM	1	1	I	0	2	TO	4	216.44	215.97	0.47
7	1	02S 40W 28DBA 01	NC	1	1	I	0	2	TO	4	110.28	110.18	0.1
8	1	02S 40W 32BCB 01	NC	0	1	I	0	2	TO	4	129.21	129.22	-0.01
9	1	02S 41W 27BBD 01	NC	1	1	I	0	2	TO	4	200.24	200.05	0.19
10	1	02S 41W 33DBC 01	NC	1	1	I	0	2	TO	4	237.93	236.93	1
11	1	03S 37W 19BBC 01	NP	1	1	I	0	2	TO	4	231.05	227.83	3.22
12	1	03S 37W 21DDD 01	NP	1	1	I	0	2	TO	4	223.66	222.25	1.41
13	2	03S 37W 21DDD 01	NP	1	1	I	0	1	TO	4	223.69	222.25	1.44
14	1	03S 37W 36ADB 01	RDM	1	1	I	1	1	TO	4	211.38	208.95	2.43
15	1	03S 38W 04BCC 01	NP	1	1	I	0	2	TO	4	218.13	216.94	1.19
16	2	03S 38W 04BCC 01	NP	1	1	I	0	1	TO	4	218.12	216.94	1.18
17	1	03S 38W 21BCB 01	NP	0	1	U	0	1	TO	4	245.21	246.9	-1.69
18	1	03S 38W 25BBB 01	NP	1	1	I	0	1	TO	4	229.89	229.26	0.63
19	1	03S 39W 04CCC 01	RDM	1	1	I	0	2	TO	4	64.48	64.13	0.35
20	1	03S 39W 20DAC 01	RDM	1	1	I	1	2	TO	4	141.38	140.72	0.66
21	1	03S 39W 24DDD 01	NP	1	1	I	0	1	TO	4	226.54	225.85	0.69
22	2	03S 39W 24DDD 01	NP	1	1	I	0	2	TO	4	226.56	225.85	0.71
23	3	03S 39W 24DDD 01	NP	1	1	I	0	1	TO	4	226.55	225.85	0.7
24	1	03S 39W 32BDB 01	RDM	0	1	I	0	2	TO	4	156.23	155.41	0.82
25	1	03S 40W 29ABC 02	RDM	1	1	I	0	2	QA	2	11.16	11.05	0.11
26	1	03S 40W 35AAC 01	RDM	1	1	I	0	2	TO	4	99.66	98.84	0.82
27	1	03S 41W 33ABB 01	NC	0	1	I	0	2	TO	4	158.92	158.49	0.43
28	2	03S 41W 33ABB 01	NC	0	1	I	0	2	TO	4	158.93	158.49	0.44
29	1	04S 37W 17AAC 01	RDM	1	1	I	0	2	TO	4	202.64	200.16	2.48
30	1	04S 37W 25DCA 01	RDM	1	1	I	0	2	TO	4	158.37	157.56	0.81
31	1	04S 38W 04BAC 01	DRL	0	1	I	0	2	TO	4	225.01	223.57	1.44
32	1	04S 38W 20CCC 01	DRL	1	1	U	0	2	TO	4	161.55	160.7	0.85
33	2	04S 38W 20CCC 01	DRL	1	1	U	0	1	TO	4	161.55	160.7	0.85
34	1	04S 38W 21ADC 01	DRL	1	1	I	1	1	TO	4	191.26	189.16	2.1
35	1	04S 39W 15CCA 01	JMH	1	1	I	0	2	TO	4	144.3	143.69	0.61
36	1	04S 40W 22BCB 01	JMA	1	1	S	0	2	TO	4	127.73	127.17	0.56
37	1	04S 41W 16DAA 01	JMA	1	1	I	0	2	QA	2	17	16.79	0.21
38	1	04S 41W 23AAA 01	JMA	1	1	I	0	2	TO	4	124	123.65	0.35
39	1	04S 41W 25BCB 02	JMA	1	1	S	0	2	TO	4	146.5	146.15	0.35
40	1	04S 42W 02BCC 01	NC	0	1	I	0	2	TO	4	215.37	213.91	1.46
41	2	04S 42W 02BCC 01	NC	0	1	I	0	1	TO	4	215.36	213.91	1.45
42	1	04S 42W 16CCD 01	NC	1	1	U	0	2	TO	4	93.14	91.36	1.78
43	1	05S 37W 15DBB 01	RDM	1	1	I	0	2	TO	4	150.01	148.66	1.35
44	1	05S 38W 13BAD 01	NP	1	1	I	1	2	TO	4	82.18	81.6	0.58
45	1	05S 38W 22ACB 01	DRL	1	1	I	0	2	TO	4	102.86	100.63	2.23
46	1	05S 39W 06DAA 01	BBW	1	1	I	0	2	TO	4	218.44	216.88	1.56
47	1	05S 39W 11CBC 01	JMH	1	1	I	1	2	TO	4	157.47	156.15	1.32
48	1	05S 39W 25CDA 01	JMH	1	1	I	1	2	TO	4	139.03	137.89	1.14
49	1	05S 40W 14BCD 01	BBW	1	1	I	0	2	TO	4	230.73	229.39	1.34
50	1	05S 40W 18ADB 01	JMA	1	1	I	0	2	TO	4	234.21	232.04	2.17
51	2	05S 40W 18ADB 01	JMA	1	1	I	0	2	TO	4	239.4	232.04	7.36
52	1	05S 40W 27BBA 01	BBW	1	1	I	0	2	TO	4	216.07	212.05	4.02
53	2	05S 40W 27BBA 01	BBW	1	1	I	0	2	TO	4	216.07	212.05	4.02
54	1	05S 41W 34CBB 01	BBW	1	1	I	0	2	TO	4	204.96	203.94	1.02
55	1	05S 42W 14DCC 01	JMA	1	1	I	0	2	TO	4	138.74	136.88	1.86
56	1	21S 31W 26CCC 01	DRL	1	1	I	0	2	QUTO	4	75.76	75.07	0.69
57	1	21S 32W 20CBD 01	DRL	1	1	I	0	2	QUTO	4	125.84	122.9	2.94
58	2	21S 32W 20CBD 01	DRL	1	1	I	0	2	QUTO	4	125.85	122.9	2.95
59	1	21S 32W 26DAA 01	DRL	1	1	I	0	2	QUTO	4	112.27	112.98	-0.71
60	1	21S 33W 29BBC 01	DRL	1	1	I	0	2	QUTO	4	88.49	85.35	3.14
61	1	21S 34W 14DBB 01	DRL	1	1	I	0	2	KN	1	103.69	100.15	3.54
62	2	21S 34W 14DBB 01	DRL	1	1	I	0	2	KN	1	103.76	100.15	3.61
63	1	22S 27W 14ADC 01	JMH	0	1	I	0	0	KJ	1	175.71	171.77	3.94
64	2	22S 27W 14ADC 01	JMH	0	1	I	0	0	KJ	1	175.73	171.77	3.96
65	3	22S 27W 14ADC 01	JMH	0	1	I	0	0	KJ	1	175.44	171.77	3.67

Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
66	1	22S 31W 08CCC 01	NP	1	1	I	0	2	QUTO	4	111.46	110.39	1.07
67	2	22S 31W 08CCC 01	NP	1	1	I	0	2	QUTO	4	111.48	110.39	1.09
68	1	22S 32W 08ACB 01	NP	0	1	I	0	2	QUTO	4	113.35	111.69	1.66
69	2	22S 32W 08ACB 01	NP	0	1	I	0	2	QUTO	4	113.25	111.69	1.56
70	1	22S 32W 21CDC 01	NP	1	1	I	1	1	QUTO	4	154.72	151.69	3.03
71	2	22S 32W 21CDC 01	NP	1	1	I	1	0	QUTO	4	154.7	151.69	3.01
72	1	22S 33W 36BCCC 01	NP	1	1	I	0	1	QUTO	4	136.5	131.48	5.02
73	2	22S 33W 36BCCC 01	NP	1	1	I	0	2	QUTO	4	136.49	131.48	5.01
74	1	22S 34W 08BCB 01	DRL	1	1	U	0	2	KN	1	133.53	133.8	-0.27
75	2	22S 34W 08BCB 01	DRL	1	1	U	0	2	KN	1	133.54	133.8	-0.26
76	1	22S 34W 10AAA 01	DRL	1	1	U	0	2	QUTO	4	106.6	106.29	0.31
77	1	22S 34W 18CDD 01	DRL	0	1	I	0	2	QUTO	4	144.55	141.17	3.38
78	1	22S 34W 26CCC 01	NP	1	1	U	0	2	QUTO	4	169.04	167.38	1.66
79	2	22S 34W 26CCC 01	NP	1	1	U	0	2	QUTO	4	169.04	167.38	1.66
80	1	23S 27W 22DAB 01	JMH	1	1	I	1	2	QUTO	4	73.18	72.42	0.76
81	1	23S 28W 22DCD 01	JMH	1	1	I	0	2	QUTO	4	73.83	73.41	0.42
82	1	23S 28W 34DDC 01	JMH	1	1	I	0	2	QUTO	4	96.71	96.12	0.59
83	1	23S 29W 30BBB 01	BBW	1	1	I	1	2	QUTO	4	80.25	79.86	0.39
84	1	23S 29W 34CDD 01	BBW	1	1	I	1	2	TO	4	93.22	97.62	-4.4
85	2	23S 29W 34CDD 01	BBW	1	1	I	1	2	TO	4	93.22	97.62	-4.4
86	1	23S 30W 04ACC 01	BBW	1	1	I	0	2	QUTO	4	73.03	72.32	0.71
87	1	23S 30W 19CCB 01	BBW	1	1	I	0	2	QUTO	4	92.5	92.09	0.41
88	1	23S 31W 03DCD 01	JMH	1	1	I	1	2	QUTO	4	116.58	116.1	0.48
89	1	23S 31W 28CDD 02	JMH	1	1	I	1	2	QUTO	4	151.09	-9999	-9999
90	1	23S 32W 26ACC 01	NP	1	1	I	1	2	TO	4	171.33	168.6	2.73
91	2	23S 32W 26ACC 01	NP	1	1	I	1	1	TO	4	171.26	168.6	2.66
92	1	23S 32W 31CBD 01	NP	1	1	I	0	2	QUTO	4	90	77.17	12.83
93	2	23S 32W 31CBD 01	NP	1	1	I	0	2	QUTO	4	89.99	77.17	12.82
94	3	23S 32W 31CBD 01	DRL	1	1	I	0	2	QUTO	4	55.69	77.17	-21.48
95	4	23S 32W 31CBD 01	DRL	1	1	I	0	2	QUTO	4	55.7	77.17	-21.47
96	1	23S 33W 26ABB 01	NP	1	1	I	0	2	QUTO	4	104.36	91.26	13.1
97	2	23S 33W 26ABB 01	NP	1	1	I	0	2	QUTO	4	104.3	91.26	13.04
98	1	23S 33W 28CDC 01	NP	1	1	U	0	2	QUTO	4	90.98	76.87	14.11
99	2	23S 33W 28CDC 01	NP	1	1	U	0	2	QUTO	4	90.97	76.87	14.1
100	1	23S 33W 34ABC 01	NP	1	1	I	0	2	QUTO	4	96.45	83.8	12.65
101	2	23S 33W 34ABC 01	NP	1	1	I	0	2	QUTO	4	96.48	83.8	12.68
102	1	23S 34W 10ACB 01	NP	1	1	I	0	2	QUTO	4	155.74	145.49	10.25
103	2	23S 34W 10ACB 01	NP	1	1	I	0	0	QUTO	4	155.75	145.49	10.26
104	1	23S 34W 17CCC 01	NP	1	1	I	0	2	QUTO	4	116.1	107.02	9.08
105	2	23S 34W 17CCC 01	NP	1	1	I	0	2	QUTO	4	116.1	107.02	9.08
106	1	23S 34W 21DDC 01	DRL	1	1	U	0	2	QUTO	4	108.55	98.34	10.21
107	2	23S 34W 21DDC 01	DRL	1	1	U	0	2	QUTO	4	108.56	98.34	10.22
108	3	23S 34W 21DDC 01	DRL	1	1	U	0	2	QUTO	4	108.57	98.34	10.23
109	1	24S 31W 27CCB 01	JMH	1	1	H	1	2	QUTO	4	147.34	143.49	3.85
110	2	24S 31W 27CCB 01	JMH	1	1	H	1	2	QUTO	4	147.34	143.49	3.85
111	1	24S 32W 10ACA 01	JMH	1	1	I	1	1	QUTO	4	83.44	80.98	2.46
112	2	24S 32W 10ACA 01	JMH	1	1	I	1	1	QUTO	4	83.29	80.98	2.31
113	3	24S 32W 10ACA 01	JMH	1	1	I	1	1	QUTO	4	83.01	80.98	2.03
114	1	24S 32W 25CBB 02	BBW	1	1	I	1	2	QA	2	19.08	11.89	7.19
115	2	24S 32W 25CBB 02	BBW	1	1	I	1	1	QA	2	19.07	11.89	7.18
116	1	24S 32W 36ACB 01	BBW	1	1	I	1	2	TO	4	16.65	9.44	7.21
117	2	24S 32W 36ACB 01	BBW	1	1	I	1	2	TO	4	16.65	9.44	7.21
118	1	24S 33W 09CCD 01	DRL	1	1	U	0	2	QUTO	4	56.99	47.14	9.85
119	2	24S 33W 09CCD 01	DRL	1	1	U	0	2	QUTO	4	57	47.14	9.86
120	1	24S 33W 09CCD 03	DRL	1	1	U	0	2	KD	1	67.74	60.35	7.39
121	2	24S 33W 09CCD 03	DRL	1	1	U	0	2	KD	1	67.74	60.35	7.39
122	1	24S 33W 09CCD 02	DRL	1	1	U	0	2	QA	2	20.78	12.18	8.6
123	2	24S 33W 09CCD 02	DRL	1	1	U	0	2	QA	2	20.79	12.18	8.61
124	1	24S 33W 18BDB 02	NC	1	1	U	0	2	KD	1	110.07	110.53	-0.46
125	2	24S 33W 18BDB 02	NC	1	1	U	0	2	KD	1	110.07	110.53	-0.46
126	1	24S 33W 18BDB 01	NC	1	1	U	0	2	KD	1	78.14	70.25	7.89
127	2	24S 33W 18BDB 01	NC	1	1	U	0	2	KD	1	78.12	70.25	7.87
128	1	24S 33W 19DBB 02	NC	1	1	U	0	2	KD	1	156.74	161.43	-4.69
129	2	24S 33W 19DBB 02	NC	1	1	U	0	2	KD	1	156.74	161.43	-4.69
130	1	24S 33W 19DBB 01	NC	1	1	U	0	2	KD	1	138.29	129.84	8.45

2003 appendix A

Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
131	2	24S 33W 19DBB 01	NC	1	1	U	0	2	KD	1	138.3	129.84	8.46
132	1	24S 33W 22DCA 01	RDM	1	1	I	1	2	QUTO	4	122.17	117.25	4.92
133	2	24S 33W 22DCA 01	RDM	1	1	I	1	2	QUTO	4	122.19	117.25	4.94
134	1	24S 33W 28DAA 01	NP	1	1	I	0	2	QUTO	4	117.88	113.2	4.68
135	2	24S 33W 28DAA 01	NP	1	1	I	0	2	QUTO	4	117.88	113.2	4.68
136	1	24S 33W 34CAC 01	NP	1	1	I	0	2	QUTO	4	152.86	148.42	4.44
137	2	24S 33W 34CAC 01	NP	1	1	I	0	2	QUTO	4	152.84	148.42	4.42
138	1	24S 34W 01BCBB 01	NC	1	1	I	0	2	QUTO	4	52.91	42.39	10.52
139	2	24S 34W 01BCBB 01	NC	1	1	I	0	2	QUTO	4	52.91	42.39	10.52
140	3	24S 34W 01BCBB 01	NC	1	1	I	0	2	QUTO	4	52.91	42.39	10.52
141	1	24S 34W 17DCA 01	BBW	1	1	I	1	2	QUTO	4	70.82	65.67	5.15
142	2	24S 34W 17DCA 01	BBW	1	1	I	1	2	QUTO	4	70.82	65.67	5.15
143	1	25S 32W 22DBC 01	RDM	1	1	I	0	2	QUTO	4	135.64	131.62	4.02
144	1	25S 32W 31DDC 01	BBW	1	1	I	1	2	QUTO	4	164.05	155.87	8.18
145	2	25S 32W 31DDC 01	BBW	1	1	I	1	2	QUTO	4	164.05	155.87	8.18
146	1	25S 32W 35ADB 01	BBW	1	1	I	1	2	QUTO	4	140.13	136.39	3.74
147	1	25S 33W 05ABD 01	RDM	1	1	I	0	2	QUTO	4	144.75	144.48	0.27
148	2	25S 33W 05ABD 01	RDM	1	1	I	0	2	QUTO	4	144.52	144.48	0.04
149	1	25S 33W 09ABD 01	NP	1	1	I	0	2	QUTO	4	158.21	153.47	4.74
150	2	25S 33W 09ABD 01	NP	1	1	I	0	1	QUTO	4	158.19	153.47	4.72
151	1	25S 33W 15DAC 01	NP	1	1	I	0	2	QUTO	4	179.57	175.09	4.48
152	2	25S 33W 15DAC 01	NP	1	1	I	0	2	QUTO	4	179.57	175.09	4.48
153	1	25S 33W 16DCC 01	NP	1	1	U	0	2	QUTO	4	97.77	95.75	2.02
154	2	25S 33W 16DCC 01	NP	1	1	U	0	2	QUTO	4	97.77	95.75	2.02
155	1	25S 34W 06AAA 01	BBW	1	0	U	0	2	QUTO	4	163.04	157.56	5.48
156	1	25S 34W 10ABB 01	NC	1	1	U	0	2	QUTO	4	121.08	118	3.08
157	2	25S 34W 10ABB 01	NC	1	1	U	0	2	QUTO	4	121.08	118	3.08
158	1	26S 31W 01DDA 01	JMH	1	1	I	1	2	QUTO	4	143.08	139.59	3.49
159	1	26S 31W 06BBBB 01	BBW	1	1	I	1	2	QUTO	4	129.2	125.76	3.44
160	1	26S 31W 31CDC 01	BBW	1	1	I	1	2	QUTO	4	196.04	188.91	7.13
161	2	26S 31W 31CDC 01	BBW	1	1	I	1	2	QUTO	4	196.04	188.91	7.13
162	1	26S 32W 22ABB 01	BBW	1	1	I	1	2	QUTO	4	175.83	172.84	2.99
163	1	26S 33W 10CCD 01	NP	1	1	I	0	2	QUTO	4	176.19	168.24	7.95
164	2	26S 33W 10CCD 01	NP	1	1	I	0	2	QUTO	4	176.19	168.24	7.95
165	1	26S 33W 17DBD 01	NP	0	1	I	1	2	TO	4	177.68	172.44	5.24
166	1	26S 34W 05ADC 01	NC	1	1	I	0	2	TO	4	193.79	187	6.79
167	2	26S 34W 05ADC 01	NC	1	1	I	0	2	TO	4	193.8	187	6.8
168	1	26S 34W 21BBD 01	JMA	1	1	I	0	2	QUTO	4	203.79	197.79	6
169	2	26S 34W 21BBD 01	JMA	1	1	I	0	2	QUTO	4	203.8	197.79	6.01
170	1	26S 22W 21DCD 01	NP	1	1	I	0	2	TOKD	5	39.33	37.49	1.84
171	2	26S 22W 21DCD 01	NP	1	1	I	0	2	TOKD	5	39.33	37.49	1.84
172	1	26S 23W 02ABB 01	DRL	0	1	I	0	2	KD	1	77.63	76.08	1.55
173	2	26S 23W 02ABB 01	DRL	0	1	I	0	2	KD	1	77.63	76.08	1.55
174	1	26S 23W 10DAD 01	DRL	0	1	U	0	2	KD	1	185.27	184.55	0.72
175	2	26S 23W 10DAD 01	DRL	0	1	U	0	2	KD	1	185.28	184.55	0.73
176	1	26S 24W 29DDD 01	NP	1	1	U	0	2	TO	4	155.71	149.71	6
177	2	26S 24W 29DDD 01	NP	1	1	U	0	2	TO	4	155.7	149.71	5.99
178	1	26S 24W 31DDA 01	NP	1	1	U	0	2	QA	2	21.28	14.05	7.23
179	2	26S 24W 31DDA 01	NP	1	1	U	0	1	QA	2	21.26	14.05	7.21
180	1	26S 24W 33CDA 01	NP	1	1	U	0	2	TO	4	46.9	40.56	6.34
181	2	26S 24W 33CDA 01	NP	1	1	U	0	2	TO	4	46.9	40.56	6.34
182	1	26S 25W 16DCC 01	BBW	1	1	I	1	2	TO	4	146	143.72	2.28
183	1	26S 26W 18CCB 01	JMA	1	1	I	0	2	QATO	3	21.74	17.82	3.92
184	1	26S 26W 32DCC 01	JMH	1	0	S	0	2	TO	4	110.94	108.1	2.84
185	1	26S 26W 36DCC 01	JMH	1	1	I	0	2	TO	4	54.82	52.54	2.28
186	1	25S 25W 32CDD 01	BBW	1	1	I	1	2	KD	1	207.93	217.75	-9.82
187	2	25S 25W 32CDD 01	BBW	1	1	I	1	0	KD	1	207.91	217.75	-9.84
188	3	25S 25W 32CDD 01	BBW	1	1	I	1	2	KD	1	207.94	217.75	-9.81
189	1	25S 25W 32DAD 01	BBW	1	1	I	1	2	QUTO	4	76.23	75.72	0.51
190	1	25S 26W 25CDD 01	BBW	1	1	I	1	2	TO	4	80.79	80.12	0.67
191	1	25S 22W 20AAA 01	NP	1	1	U	0	2	TO	4	55.04	55.1	-0.06
192	2	25S 22W 20AAA 01	NP	1	1	U	0	2	TO	4	55.04	55.1	-0.06
193	1	25S 22W 27CCD 01	NP	1	1	H	0	2	TOKD	5	40.99	40.35	0.64
194	2	25S 22W 27CCD 01	NP	1	1	H	0	2	TOKD	5	40.98	40.35	0.63
195	1	25S 23W 11CCC 01	DRL	1	1	U	0	2	KD	1	73.6	72.8	0.8

Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
196	1	25S 23W 12BBB 01	DRL	1	1	U	0	2	KD	1	169.9	166.09	3.81
197	2	25S 23W 12BBB 01	DRL	1	1	U	0	2	KD	1	169.89	166.09	3.8
198	1	26S 21W 25CCC 01	NP	1	1	I	1	2	QA	2	10.02	9.56	0.46
199	2	26S 21W 25CCC 01	NP	1	1	I	1	2	QA	2	10.02	9.56	0.46
200	1	27S 21W 10DBB 01	NP	1	1	I	1	2	QAQU	3	7.63	6.84	0.79
201	2	27S 21W 10DBB 01	NP	1	1	I	1	2	QAQU	3	7.61	6.84	0.77
202	1	27S 23W 24BCB 01	NP	1	1	I	0	2	KD	1	63.67	63.61	0.06
203	2	27S 23W 24BCB 01	NP	1	1	I	0	2	KD	1	63.67	63.61	0.06
204	1	27S 23W 28AAA 01	JMA	0	1	I	0	1	QUTO	4	71.67	71.38	0.29
205	2	27S 23W 28AAA 01	JMA	0	1	I	0	0	QUTO	4	71.61	71.38	0.23
206	1	27S 23W 36CCC 01	JMA	1	1	I	0	2	TO	4	52.63	51.08	1.55
207	1	27S 24W 03CDD 01	NP	1	1	U	0	2	TO	4	23.97	19.22	4.75
208	1	27S 24W 03BBD 01	NP	1	1	U	0	2	TO	4	29.54	28.34	1.2
209	1	27S 24W 04BBC 01	NP	1	1	U	0	2	TO	4	34.38	25.89	8.49
210	2	27S 24W 04BBC 01	NP	1	1	U	0	2	TO	4	34.37	25.89	8.48
211	1	27S 24W 09AAD 01	NP	1	1	U	0	2	TO	4	33.14	28.92	4.22
212	1	27S 24W 16BDB 01	NP	1	1	U	0	2	TO	4	88.95	84.77	4.18
213	1	27S 24W 26DAA 01	JMA	1	1	I	0	2	TO	4	101.9	100.25	1.65
214	1	27S 25W 09ACA 01	JMH	1	1	I	0	2	TO	4	78.11	76.48	1.63
215	1	27S 25W 25BBB 01	NP	1	1	I	0	2	TO	4	127.56	126.5	1.06
216	2	27S 25W 25BBB 01	NP	1	1	I	0	2	TO	4	127.56	126.5	1.06
217	1	28S 21W 10DDD 01	JMA	1	1	I	0	2	QUTO	4	50.24	48.8	1.44
218	1	28S 21W 23DBC 01	JMA	1	1	I	0	2	TO	4	82.95	81.95	1
219	1	28S 21W 25ABB 01	JMA	1	1	I	0	2	QUTO	4	77.3	75.98	1.32
220	1	28S 22W 05ADD 01	JMA	1	1	I	0	2	QAQU	3	22.05	21.55	0.5
221	1	28S 22W 12CAC 01	JMA	1	1	I	0	2	TO	4	67.13	66.77	0.36
222	1	28S 22W 32BAB 01	JMA	1	1	I	0	2	TO	4	129.64	128.86	0.78
223	1	28S 23W 18BAB 01	DRL	1	1	I	0	2	QUTO	4	146.73	145.82	0.91
224	1	28S 23W 24ABB 01	DRL	1	1	I	0	1	QUTO	4	100.29	99.88	0.41
225	1	28S 24W 08DCC 01	DRL	1	1	I	0	2	QUTO	4	150.74	149.63	1.11
226	1	28S 24W 22CDA 01	DRL	1	1	I	0	2	QUTO	4	115.74	114.74	1
227	1	28S 24W 35CAB 01	DRL	1	1	I	1	2	QUTO	4	110.93	110.7	0.23
228	1	28S 25W 06ABB 01	NC	1	1	I	0	2	QUTO	4	160.54	159.48	1.06
229	1	28S 25W 19BBB 01	NC	1	1	I	0	2	TO	4	159.18	156.4	2.78
230	1	28S 26W 06ABB 01	NC	1	1	I	0	2	TO	4	179.8	178.15	1.65
231	1	28S 26W 13CAA 01	NC	1	1	U	0	2	QUTO	4	153.64	151.48	2.16
232	1	29S 21W 05BBB 01	JMA	1	1	I	1	2	TO	4	104.18	103.59	0.59
233	1	29S 21W 20CAD 01	JMA	1	1	I	0	2	QUTO	4	139.41	138.35	1.06
234	1	29S 22W 17DAD 01	JMA	1	1	I	1	2	TO	4	135.3	134.48	0.82
235	1	29S 22W 36ACA 01	JMA	1	1	I	0	2	QUTO	4	141.25	140.59	0.66
236	1	29S 23W 12BAC 01	JMA	0	0	I	0	2	QUTO	4	186.56	188.1	-1.54
237	1	29S 24W 01ABA 01	DRL	1	1	I	0	2	TO	4	152.15	151.02	1.13
238	1	29S 24W 13BCA 01	DRL	1	1	I	0	2	QUTO	4	119.2	118.5	0.7
239	1	29S 24W 18BAA 01	DRL	1	1	I	0	2	TO	4	161.8	161.94	-0.14
240	1	29S 25W 03ADA 01	NC	1	1	I	1	2	TO	4	184.91	182.93	1.98
241	1	29S 25W 10BBBC 01	NC	1	1	I	0	2	QUTO	4	168.89	168.09	0.8
242	1	29S 26W 29ABB 01	NP	1	1	I	0	2	QUTO	4	110.35	105.02	5.33
243	2	29S 26W 29ABB 01	NP	1	1	I	0	2	QUTO	4	110.36	105.02	5.34
244	1	29S 26W 36BBB 01	NC	1	1	I	1	2	TO	4	36.81	34.16	2.65
245	1	28S 37W 10ADB 01	JMH	1	1	I	1	2	QUTO	4	252.93	249.12	3.81
246	1	28S 38W 12BCB 02	RDM	1	1	I	0	1	QUTO	.	252.2	247.4	4.8
247	1	28S 38W 33BDB 01	RDM	0	1	U	0	1	TO	4	247.8	244.71	3.09
248	1	27S 35W 25BDC 01	NC	1	1	I	0	2	TO	4	289.26	284.65	4.61
249	2	27S 35W 25BDC 01	NC	1	1	I	0	2	TO	4	289.26	284.65	4.61
250	1	27S 36W 01ADB 01	BBW	1	0	I	1	0	QUTO	4	285.99	281.94	4.05
251	2	27S 36W 01ADB 01	BBW	1	0	I	1	0	QUTO	4	286	281.94	4.06
252	1	27S 36W 21DCC 01	JMH	1	1	I	1	2	QUTO	4	322.32	318.58	3.74
253	1	27S 37W 16AAD 01	JMH	1	1	I	0	2	TOKJ	5	237.19	235.33	1.86
254	1	27S 37W 21BDD 01	JMH	0	1	I	1	0	TOKJ	5	230.49	224.04	6.45
255	2	27S 37W 21BDD 01	JMH	0	1	I	1	0	TOKJ	5	227.9	224.04	3.86
256	3	27S 37W 21BDD 01	JMH	0	1	I	1	0	TOKJ	5	230.34	224.04	6.3
257	4	27S 37W 21BDD 01	JMH	0	1	I	1	0	TOKJ	5	228.48	224.04	4.44
258	1	27S 38W 12ADC 01	RDM	1	1	I	1	2	QUTO	4	213.73	208.9	4.83
259	1	27S 35W 17ADD 01	JMH	1	1	I	1	2	QUTO	4	303.9	299.11	4.79
260	1	28S 35W 03DBB 01	JMH	1	1	I	1	0	TO	4	324.6	317.47	7.13

Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
261	2	28S 35W 03DBB 01	JMH	1	1	I	1	2	TO	4	328.8	317.47	11.33
262	3	28S 35W 03DBB 01	JMH	1	1	I	1	2	TO	4	328.8	317.47	11.33
263	1	28S 35W 36ABC 01	DRL	1	1	U	0	1	QUTO	4	347.7	347.09	0.61
264	1	28S 36W 18ABC 01	JMH	1	1	I	1	1	TOKJ	5	258.56	251.66	6.9
265	2	28S 36W 18ABC 01	JMH	1	1	I	1	1	TOKJ	5	258.68	251.66	7.02
266	1	28S 36W 24AAD 01	JMH	1	1	I	1	2	QUTO	4	304.48	304.41	0.07
267	1	28S 37W 02BBB 04	JMH	1	1	I	1	2	TOKJ	5	265.52	262.2	3.32
268	1	26S 28W 06DDB 01	JMH	1	1	I	0	2	QAQU	3	19.09	15.31	3.78
269	1	26S 28W 10ACB 02	JMA	0	0	I	0	2	QA	2	37.67	33.55	4.12
270	1	26S 30W 01ABC 01	JMH	1	1	I	0	2	QUTO	4	90.64	84.59	6.05
271	1	26S 30W 24DDD 01	BBW	1	1	I	0	2	QUTO	4	144.19	139.89	4.3
272	2	26S 30W 24DDD 01	BBW	1	1	I	0	2	QUTO	4	144.19	139.89	4.3
273	1	25S 27W 33ABB 01	JMH	1	1	U	0	2	QUTO	4	146.1	145.1	1
274	1	27S 27W 07ADC 01	JMA	1	1	I	0	2	QUTO	4	126.75	127.4	-0.65
275	1	27S 27W 10CDB 01	JMA	1	1	I	0	2	QUTO	4	169.58	166.93	2.65
276	1	28S 27W 03BBB 01	NC	1	1	I	0	2	QUTO	4	201.17	199.49	1.68
277	1	28S 29W 16ACC 01	JMH	1	1	U	0	2	QUTO	4	175.47	174.5	0.97
278	1	28S 30W 10DDD 01	BBW	1	0	I	0	0	QUTO	4	202.23	194.29	7.94
279	2	28S 30W 10DDD 01	BBW	1	0	I	0	0	QUTO	4	202.2	194.29	7.91
280	3	28S 30W 10DDD 01	BBW	1	0	I	0	0	QUTO	4	202.15	194.29	7.86
281	1	28S 30W 17BBA 01	BBW	0	1	I	1	0	TO	4	209.15	203.74	5.41
282	1	28S 30W 24BAB 01	BBW	1	1	I	1	2	QUTO	4	193.08	189.73	3.35
283	1	27S 28W 05AAA 01	JMH	1	1	I	0	2	QUTO	4	143.38	134.63	8.75
284	2	27S 28W 05AAA 01	JMH	1	1	I	0	2	QUTO	4	143.39	134.63	8.76
285	3	27S 28W 05AAA 01	JMH	1	1	I	0	2	QUTO	4	139.85	134.63	5.22
286	1	27S 28W 30CCA 01	JMH	1	1	I	0	2	QUTO	4	143.75	137.21	6.54
287	1	27S 29W 27CAA 01	JMH	1	1	I	0	2	QUTO	4	156.73	149.7	7.03
288	2	27S 29W 27CAA 01	JMH	1	1	I	0	2	QUTO	4	156.74	149.7	7.04
289	1	27S 30W 08BBB 01	JMH	0	0	I	0	2	QUTO	4	155.25	151.51	3.74
290	2	27S 30W 08BBB 01	JMH	0	0	I	0	2	QUTO	4	154.3	151.51	2.79
291	1	27S 30W 23BBC 01	BBW	1	1	I	0	2	QUTO	4	168.98	161.79	7.19
292	1	27S 30W 34CCC 01	BBW	1	1	I	0	2	QUTO	4	191.28	187.1	4.18
293	1	25S 29W 07BCB 01	JMH	1	1	I	0	2	QUTO	4	171.49	168.61	2.88
294	1	25S 29W 14ABB 01	JMH	1	1	I	0	2	QUTO	4	160.6	156.05	4.55
295	1	25S 30W 20BCB 01	JMH	1	1	I	0	2	QAQUTO	3	19.59	14.14	5.45
296	1	24S 29W 16DCA 01	BBW	1	1	I	0	2	QUTO	4	125.78	123.28	2.5
297	1	24S 29W 18CCB 01	BBW	1	1	I	1	2	QUTO	4	147.69	145.69	2
298	1	24S 30W 15CCC 02	BBW	1	1	I	0	2	QUTO	4	163.65	160.69	2.96
299	1	24S 27W 08CCC 01	BBW	1	1	I	1	2	QUTO	4	87.7	85.68	2.02
300	1	24S 27W 14ABB 01	JMH	1	1	I	0	2	QUTO	4	65.73	65.1	0.63
301	2	24S 27W 14ABB 01	JMH	1	1	I	0	2	QUTO	4	65.73	65.1	0.63
302	1	24S 27W 29BCC 01	BBW	1	1	I	1	2	QUTO	4	102	99.6	2.4
303	1	24S 27W 31CDD 01	BBW	1	1	I	1	2	QUTO	4	103.19	101.31	1.88
304	1	24S 28W 28BBA 01	JMH	1	1	I	0	2	QUTO	4	122.86	121.16	1.7
305	1	24S 28W 31DD 01	JMH	1	1	I	0	2	QUTO	4	153.41	145.58	7.83
306	2	24S 28W 31DD 01	JMH	1	1	I	0	2	QUTO	4	153.41	145.58	7.83
307	1	26S 27W 12CDD 01	JMA	1	0	S	0	2	QUTO	4	46.05	41.42	4.63
308	1	26S 27W 27CDD 01	JMA	1	0	U	0	2	QUTO	4	84.54	81.68	2.86
309	1	29S 27W 30BCC 01	DRL	1	0	I	0	2	QUTO	4	160.33	158.92	1.41
310	1	29S 28W 28CDC 01	DRL	1	0	I	0	2	TO	4	161.48	155.36	6.12
311	1	29S 29W 27BCB 01	JMH	0	1	I	0	0	QUTO	4	171.1	168.14	2.96
312	2	29S 29W 27BCB 01	JMH	0	1	I	0	0	QUTO	4	166.3	168.14	-1.84
313	3	29S 29W 27BCB 01	JMH	0	1	I	0	0	QUTO	4	167.27	168.14	-0.87
314	4	29S 29W 27BCB 01	JMH	0	1	I	0	0	QUTO	4	166.47	168.14	-1.67
315	1	29S 30W 08CCB 01	BBW	1	1	I	0	2	QUTO	4	216.09	214.41	1.68
316	1	29S 30W 22BBC 01	BBW	1	1	I	1	2	QUTO	4	240.82	236.22	4.6
317	1	23S 42W 19CBB 01	JMA	1	1	I	0	2	QAQU	3	25.79	24.23	1.56
318	1	23S 42W 26DCA 01	JMA	1	1	I	0	2	QA	2	27.47	26.44	1.03
319	1	23S 42W 27DDB 01	JMA	1	1	I	0	2	QA	2	22.85	22.14	0.71
320	1	23S 42W 34CBB 01	RDM	1	1	I	1	2	QA	2	11.12	10.58	0.54
321	1	24S 39W 19CBC 01	NC	1	1	I	0	2	QA	2	9.83	9.09	0.74
322	1	24S 39W 22CCB 01	NC	1	1	I	0	2	QA	2	12.28	11.71	0.57
323	1	24S 39W 35CBA 01	NC	1	1	I	1	2	QU	4	15.04	14.64	0.4
324	1	24S 39W 35BAC 01	NC	1	1	I	0	2	QA	2	8.6	8.17	0.43
325	1	24S 40W 07CBB 01	JMA	1	1	I	0	2	QA	2	15.52	14.68	0.84

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Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
326	1	24S 40W 17BBB 01	NC	1	1	I	0	2	QA	2	15.77	14.43	1.34
327	1	24S 40W 23AAB 01	NC	1	0	U	0	2	QA	2	26.55	25.47	1.08
328	1	24S 40W 31BBB 01	JMA	1	1	S	0	2	QU	4	61.64	61.21	0.43
329	1	24S 41W 01DAD 01	JMA	1	1	U	0	2	QAQU	3	25.31	23.35	1.96
330	1	24S 42W 28DDD 01	JMA	1	1	S	0	2	KJ	1	170.98	171.69	-0.71
331	1	24S 43W 14CBB 01	JMA	1	1	S	0	2	KJ	1	112.98	113.75	-0.77
332	1	23S 43W 21ABA 01	JMA	1	1	U	0	2	QA	2	14.42	13.42	1
333	1	25S 39W 02CAD 01	NC	0	0	S	0	2	QUTO	4	29.71	29.45	0.26
334	2	25S 39W 02CAD 01	NC	0	0	S	0	2	QUTO	4	29.71	29.45	0.26
335	3	25S 39W 02CAD 01	NC	0	0	S	0	2	QUTO	4	29.7	29.45	0.25
336	1	25S 39W 23BDD 01	NC	1	1	U	0	2	QUTO	4	87.03	86.17	0.86
337	1	25S 40W 01CA 01	JMA	1	1	S	0	2	QU	4	49.01	48.66	0.35
338	1	25S 40W 26BBB 01	NC	0	1	H	0	2	KJ	1	233.21	230.08	3.13
339	2	25S 40W 26BBB 01	NC	0	1	H	0	1	KJ	1	233.2	230.08	3.12
340	1	26S 41W 20BCD 01	RDM	1	1	U	0	2	QUTO	4	51.45	50.55	0.9
341	1	26S 42W 10BB 02	RDM	1	1	I	1	2	QUTO	4	149.84	144.16	5.68
342	2	26S 42W 10BB 02	RDM	1	1	I	1	2	QUTO	4	149.87	144.16	5.71
343	1	26S 42W 17CBB 01	RDM	1	1	I	0	2	QUTOKJ	5	211.27	208.05	3.22
344	1	26S 42W 22DCC 02	RDM	1	1	I	0	2	TO	4	228.84	219.48	9.36
345	2	26S 42W 22DCC 02	RDM	1	1	I	0	0	TO	4	228.1	219.48	8.62
346	1	26S 43W 25DCC 01	RDM	1	1	I	0	2	QUTOKJ	5	259.63	255.09	4.54
347	1	25S 43W 03ABB 01	JMA	1	1	U	0	2	KJ	1	271.18	270.9	0.28
348	1	25S 43W 25CCD 01	RDM	1	1	I	0	2	QUTO	4	182	177.45	4.55
349	1	23S 43W 23BCB 01	RDM	1	1	I	0	2	QA	2	22.14	20.81	1.33
350	2	23S 43W 23BCB 01	RDM	1	1	I	0	0	QA	2	21.2	20.81	0.39
351	1	23S 43W 25CBD 02	RDM	1	1	I	0	2	QA	2	9.3	8.53	0.77
352	1	23S 43W 26BCC 01	RDM	1	1	I	0	2	QA	2	5.35	8.3	-2.95
353	1	21S 39W 07CBA 01	DRL	1	1	H	0	2	TO	4	185.42	185.5	-0.08
354	1	23S 40W 29DDB 01	NC	0	1	S	0	2	KD	1	321.52	321.29	0.23
355	1	27S 31W 24CDC 01	JMH	1	1	I	0	2	QUTO	4	200.55	194.96	5.59
356	1	27S 31W 31BCC 01	BBW	1	1	I	1	2	QUTO	4	235.08	235.08	0
357	2	27S 31W 31BCC 01	BBW	1	1	I	1	1	QUTO	4	235.09	235.08	0.01
358	1	27S 32W 06CBB 01	RDM	1	1	I	0	2	QUTO	4	233.28	223.69	9.59
359	2	27S 32W 06CBB 01	RDM	1	1	I	0	2	QUTO	4	233.3	223.69	9.61
360	1	27S 32W 19CCD 01	DRL	1	1	I	0	2	QUTO	4	274.5	266.44	8.06
361	1	27S 33W 19CDC 01	JMA	1	1	U	0	2	TO	4	286.42	284.44	1.98
362	1	27S 34W 16DDD 02	NC	1	1	I	0	2	TO	4	253.69	248.48	5.21
363	2	27S 34W 16DDD 02	NC	1	1	I	0	2	TO	4	253.71	248.48	5.23
364	1	28S 31W 35CCB 01	JMH	1	1	I	1	2	QUTO	4	252.69	248.84	3.85
365	1	28S 32W 17CDD 01	DRL	1	1	I	0	2	TO	4	344.26	340.1	4.16
366	1	28S 32W 24BCC 01	BBW	0	1	I	1	1	QUTO	4	243.2	240.82	2.38
367	1	28S 33W 20ACD 01	JMA	1	1	I	0	2	TO	4	389.04	385.21	3.83
368	1	27S 34W 28DAA 02	NC	1	1	I	0	2	TO	4	307.18	302.9	4.28
369	2	27S 34W 28DAA 02	NC	1	1	I	0	2	TO	4	307.19	302.9	4.29
370	1	29S 31W 09CBB 01	JMH	1	1	I	0	2	QUTO	4	269.98	266.45	3.53
371	2	29S 31W 09CBB 01	JMH	1	1	I	0	2	QUTO	4	269.97	266.45	3.52
372	1	29S 32W 04AAA 01	DRL	1	1	I	0	2	TO	4	308.74	304.35	4.39
373	1	29S 32W 19CCC 01	DRL	0	1	I	0	2	QUTO	4	337.65	334.97	2.68
374	2	29S 32W 19CCC 01	DRL	0	1	I	0	2	QUTO	4	337.65	334.97	2.68
375	1	29S 33W 01AAB 01	DRL	0	1	I	0	2	QUTO	4	374.19	370.47	3.72
376	1	29S 33W 28BCB 01	DRL	1	1	I	0	2	QUTO	4	351.3	348.44	2.86
377	1	29S 33W 34DDD 01	DRL	1	1	U	0	2	TO	4	361.48	358.75	2.73
378	1	29S 34W 11ADD 02	JMA	0	1	I	0	2	TO	4	349.39	346.5	2.89
379	1	30S 31W 26ABB 01	JMH	1	1	I	0	2	TO	4	275.34	270.99	4.35
380	1	30S 32W 22BBB 01	DRL	1	1	U	0	2	TO	4	328.83	312.7	16.13
381	2	30S 32W 22BBB 01	DRL	1	1	U	0	2	TO	4	328.83	312.7	16.13
382	1	30S 32W 35BBA 01	DRL	1	1	I	0	2	QUTO	4	273.4	278.2	-4.8
383	2	30S 32W 35BBA 01	DRL	1	1	I	0	2	QUTO	4	273.4	278.2	-4.8
384	1	30S 34W 05BBB 01	NC	1	0	I	0	2	QUTO	4	336.9	333.78	3.12
385	2	30S 34W 05BBB 01	NC	1	0	I	0	2	QUTO	4	336.89	333.78	3.11
386	1	30S 34W 15BAA 01	NC	1	1	Z	0	2	QUTO	4	322.22	318.5	3.72
387	2	30S 34W 15BAA 01	NC	1	1	Z	0	2	QUTO	4	322.23	318.5	3.73
388	1	22S 24W 26DDA 01	DRL	1	1	S	0	1	KD	1	160.7	158.97	1.73
389	1	22S 24W 35DAC 01	DRL	1	0	S	0	2	KD	1	125.32	118.57	6.75
390	1	22S 22W 13CCC 01	NC	1	1	U	0	2	QA	2	36.25	32.46	3.79

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Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
391	2	22S 22W 13CCC 01	NC	1	1	U	0	2	QA	2	36.25	32.46	3.79
392	1	22S 24W 14BBC 01	NC	1	0	I	0	2	KD	1	269.68	262.63	7.05
393	2	22S 24W 14BBC 01	NC	1	0	I	0	2	KD	1	269.68	262.63	7.05
394	1	22S 24W 15BDA 01	NC	1	1	I	0	2	KD	1	269.88	263.09	6.79
395	2	22S 24W 15BDA 01	NC	1	1	I	0	2	KD	1	269.88	263.09	6.79
396	1	23S 22W 07DAA 01	NP	1	1	U	0	2	KD	1	102.02	96.65	5.37
397	2	23S 22W 07DAA 01	NP	1	1	U	0	2	KD	1	102.01	96.65	5.36
398	1	23S 23W 04DCA 01	NP	1	1	I	0	2	KD	1	38.77	33.78	4.99
399	2	23S 23W 04DCA 01	NP	1	1	I	0	1	KD	1	38.78	33.78	5
400	1	23S 23W 04AAD 01	NP	1	1	I	1	2	KD	1	40.99	35.6	5.39
401	2	23S 23W 04AAD 01	NP	1	1	I	1	1	KD	1	40.98	35.6	5.38
402	1	23S 23W 12ABD 01	NP	0	0	I	0	0	KD	1	80.26	72.55	7.71
403	2	23S 23W 12ABD 01	NP	0	0	I	0	1	KD	1	80.2	72.55	7.65
404	1	23S 24W 11DAA 01	DRL	0	0	S	0	0	KD	1	144.91	136.6	8.31
405	2	23S 24W 11DAA 01	DRL	0	0	S	0	0	KD	1	144.92	136.6	8.32
406	1	23S 26W 07CCC 01	BBW	1	1	I	0	2	KD	1	322.16	319.26	2.9
407	1	24S 21W 20CBB 01	NP	1	1	I	0	2	TOKD	5	73.17	73.16	0.01
408	2	24S 21W 20CBB 01	NP	1	1	I	0	2	TOKD	5	73.17	73.16	0.01
409	1	24S 23W 03CCC 01	DRL	1	1	I	0	2	TO	4	64.41	63.4	1.01
410	1	24S 23W 06AAB 01	DRL	1	0	I	0	2	KD	1	155.2	153.65	1.55
411	1	24S 24W 02CCC 01	DRL	1	1	I	0	2	TO	4	73.58	71.99	1.59
412	1	24S 24W 20CCC 01	BBW	1	1	I	1	2	TO	4	63.68	63.22	0.46
413	1	24S 25W 22BAB 01	BBW	1	1	I	1	1	TO	4	85.83	85.76	0.07
414	2	24S 25W 22BAB 01	BBW	1	1	I	1	2	TO	4	85.83	85.76	0.07
415	1	23S 26W 20CCC 01	BBW	1	1	I	0	2	TO	4	45.15	46.24	-1.09
416	1	23S 26W 26AAD 01	BBW	1	1	S	0	2	TO	4	69.5	69.11	0.39
417	1	23S 26W 31CDD 01	JMH	1	1	I	0	2	TO	4	68.67	68.2	0.47
418	1	22S 24W 25DDC 01	RM	1	1	S	0	2	KD	1	145.62	-9999	-9999
419	1	25S 36W 14B 01	JMH	1	1	I	1	2	QUTO	4	103.27	98.74	4.53
420	2	25S 36W 14B 01	JMH	1	1	I	1	2	QUTO	4	103.27	98.74	4.53
421	1	25S 36W 28CBD 01	JMH	1	1	I	1	2	QUTO	4	126.76	113.92	12.84
422	2	25S 36W 28CBD 01	JMH	1	1	I	1	2	QUTO	4	126.77	113.92	12.85
423	1	25S 36W 35CCA 01	JMH	1	1	I	0	1	QUTO	4	146.94	142.2	4.74
424	2	25S 36W 35CCA 01	JMH	1	1	I	0	1	QUTO	4	145.95	142.2	3.75
425	3	25S 36W 35CCA 01	JMH	1	1	I	0	1	QUTO	4	147.05	142.2	4.85
426	1	25S 37W 15ABA 02	JMH	1	1	U	0	2	QA	2	10.08	9.27	0.81
427	1	25S 38W 08CAA 01	NC	1	1	U	0	2	QUTOKJ	5	43.45	43	0.45
428	2	25S 38W 08CAA 01	NC	1	1	U	0	0	QUTOKJ	5	43.41	43	0.41
429	1	25S 38W 20ACC 01	NC	1	1	U	0	2	QUTOKJ	5	68.33	68.39	-0.06
430	1	23S 36W 32BBB 01	JMA	1	1	I	0	2	TO	4	242.88	240.2	2.68
431	1	23S 36W 35BBB 01	NP	1	1	I	1	2	TO	4	211.87	211.23	0.64
432	2	23S 36W 35BBB 01	NP	1	1	I	1	2	TO	4	211.87	211.23	0.64
433	1	23S 37W 04ABC 01	DRL	1	1	I	0	2	TO	4	192.24	190.53	1.71
434	1	22S 37W 34BBC 01	DRL	1	1	I	0	2	TO	4	135.47	135.48	-0.01
435	1	22S 35W 23CDD 01	DRL	1	1	U	0	2	TO	4	130.73	131.35	-0.62
436	2	22S 35W 23CDD 01	DRL	1	1	U	0	2	TO	4	130.73	131.35	-0.62
437	1	26S 35W 27AAC 01	DRL	0	1	I	1	0	QUTO	4	253.65	240.82	12.83
438	2	26S 35W 27AAC 01	JMA	0	1	I	1	0	QUTO	4	253.65	240.82	12.83
439	3	26S 35W 27AAC 01	JMA	0	1	I	1	0	QUTO	4	253.57	240.82	12.75
440	1	26S 35W 29BBD 01	JMA	1	0	I	1	2	TO	4	243.08	236.63	6.45
441	2	26S 35W 29BBD 01	JMA	1	0	I	1	1	TO	4	247.79	236.63	11.16
442	1	26S 36W 22CCA 01	BBW	1	1	I	0	2	TO	4	225.37	222.14	3.23
443	1	26S 37W 06ACB 01	JMH	1	0	S	0	2	QUTO	4	29.1	28.31	0.79
444	1	26S 37W 23BBC 01	JMH	1	1	I	1	2	QUTO	4	208.92	205.2	3.72
445	1	23S 35W 05ACC 01	DRL	0	1	I	0	2	TO	4	151.59	151.58	0.01
446	2	23S 35W 05ACC 01	DRL	0	1	I	0	1	TO	4	151.53	151.58	-0.05
447	1	23S 35W 12CCC 02	NP	1	1	I	0	2	QUTO	4	124.65	125.12	-0.47
448	1	23S 35W 16BBC 01	NP	1	1	I	1	2	TO	4	129.4	125.54	3.86
449	2	23S 35W 16BBC 01	NP	1	1	I	1	2	TO	4	129.4	125.54	3.86
450	1	24S 35W 09CCC 01	BBW	1	1	U	0	2	QUTO	4	45.44	39.21	6.23
451	2	24S 35W 09CCC 01	BBW	1	1	U	0	2	QUTO	4	45.44	39.21	6.23
452	1	24S 35W 24BCB 01	BBW	1	1	I	1	2	QAQUTO	3	36.28	32.51	3.77
453	1	24S 36W 23CBB 02	BBW	1	1	I	1	2	QUTO	4	33.97	31.78	2.19
454	1	23S 35W 24BBB 02	NP	1	1	I	0	2	QUTO	4	111.05	111.3	-0.25
455	1	23S 35W 25BBB 03	NP	0	1	I	0	2	QUTO	4	89.66	79.73	9.93

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Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
456	2	23S 35W 25BBB 03	NP	0	1	I	0	1	QUTO	4	89.65	79.73	9.92
457	3	23S 35W 25BBB 03	NP	0	1	I	0	2	QUTO	4	89.62	79.73	9.89
458	1	23S 36W 04CBB 01	DRL	1	1	I	0	2	TO	4	143.48	143.72	-0.24
459	1	25S 35W 02BAA 01	BBW	1	1	U	0	2	QUTO	4	139.68	133.16	6.52
460	2	25S 35W 02BAA 01	BBW	1	1	U	0	0	QUTO	4	139	133.16	5.84
461	3	25S 35W 02BAA 01	BBW	1	1	U	0	2	QUTO	4	139.68	133.16	6.52
462	1	25S 35W 04BDD 01	BBW	1	1	I	1	2	QUTO	4	103.36	97.14	6.22
463	1	25S 35W 17AAA 01	BBW	1	1	I	1	2	QUTO	4	148.12	142.91	5.21
464	1	25S 35W 26BAB 01	BBW	1	1	I	0	2	QUTO	4	209.94	202.99	6.95
465	1	30S 27W 27BBB 01	DRL	1	1	I	0	2	QUTO	4	56.28	52.99	3.29
466	1	30S 28W 17ABB 01	DRL	0	1	I	0	2	QUTO	4	182.34	178.42	3.92
467	1	30S 29W 28BBB 01	JMH	1	1	I	0	2	QUTO	4	215.33	212.3	3.03
468	1	30S 30W 06CCC 01	JMH	1	1	U	0	2	QUTO	4	244.98	240.61	4.37
469	1	30S 30W 28ABB 01	BBW	1	1	I	1	2	QUTO	4	232.45	227.87	4.58
470	2	30S 30W 28ABB 01	BBW	1	1	I	1	2	QUTO	4	232.45	227.87	4.58
471	1	30S 26W 04CBB 01	NP	1	1	I	0	2	QUTO	4	84.54	80.77	3.77
472	2	30S 26W 04CBB 01	NP	1	1	I	0	2	QUTO	4	84.54	80.77	3.77
473	1	30S 26W 13ABB 01	NC	1	1	S	0	2	QUTO	4	68.66	68.63	0.03
474	1	30S 26W 32DDD 01	NP	1	1	I	0	2	QUTO	4	20.52	18.65	1.87
475	2	30S 26W 32DDD 01	NP	1	1	I	0	2	QUTO	4	20.53	18.65	1.88
476	3	30S 26W 32DDD 01	NP	1	1	I	0	1	QUTO	4	20.4	18.65	1.75
477	1	30S 27W 20ABA 01	DRL	1	1	I	0	2	QUTO	4	94.66	91.08	3.58
478	2	30S 27W 20ABA 01	DRL	1	1	I	0	2	QUTO	4	94.67	91.08	3.59
479	1	30S 27W 23ABB 01	DRL	1	1	I	1	2	QUTO	4	77.7	74.66	3.04
480	1	31S 26W 30BBB 01	NP	1	1	U	0	2	QUTO	4	105.23	103.88	1.35
481	2	31S 26W 30BBB 01	NP	1	1	U	0	2	QUTO	4	105.22	103.88	1.34
482	1	31S 27W 20AAA 02	NP	1	1	U	0	2	QUTO	4	59.55	48.47	11.08
483	2	31S 27W 20AAA 02	NP	1	1	U	0	1	QUTO	4	59.56	48.47	11.09
484	1	31S 28W 02CCC 01	NP	1	1	I	0	2	QUTO	4	151.44	147.93	3.51
485	2	31S 28W 02CCC 01	NP	1	1	I	0	2	QUTO	4	151.44	147.93	3.51
486	1	31S 28W 10BCB 02	NP	1	1	I	0	2	QUTO	4	164.46	160.99	3.47
487	2	31S 28W 10BCB 02	NP	1	1	I	0	2	QUTO	4	164.45	160.99	3.46
488	1	31S 28W 26ABB 01	NP	1	1	I	0	2	QUTO	4	62.15	59.09	3.06
489	2	31S 28W 26ABB 01	NP	1	1	I	0	1	QUTO	4	62.16	59.09	3.07
490	1	31S 29W 02DBB 01	DRL	1	1	I	0	2	QUTO	4	200.84	196.55	4.29
491	1	31S 29W 25AAA 02	DRL	1	1	I	0	2	QUTO	4	208.21	203.68	4.53
492	2	31S 29W 25AAA 02	DRL	1	1	I	0	2	QUTO	4	208.2	203.68	4.52
493	1	31S 29W 30AAA 01	JMH	1	1	I	1	2	QUTO	4	196.54	193.75	2.79
494	1	31S 30W 16BBC 01	BBW	1	1	I	0	2	QUTO	4	239.96	233.32	6.64
495	2	31S 30W 16BBC 01	BBW	1	1	I	0	2	QUTO	4	239.96	233.32	6.64
496	1	32S 28W 04ADD 01	NP	0	1	H	0	1	QUTO	4	83.84	80.65	3.19
497	2	32S 28W 04ADD 01	NP	0	1	H	0	0	QUTO	4	83.89	80.65	3.24
498	1	32S 29W 27AAB 02	DRL	1	1	U	0	2	QUTO	4	166.81	164.94	1.87
499	1	32S 30W 09CCC 01	DRL	1	1	I	0	2	QUTO	4	229.86	227.01	2.85
500	1	33S 28W 29BCB 01	NP	1	1	I	1	2	TO	4	18.43	17.32	1.11
501	2	33S 28W 29BCB 01	NP	1	1	I	1	2	TO	4	18.39	17.32	1.07
502	1	33S 29W 36AAB 01	NP	1	1	I	0	2	QUTO	4	92.08	92.49	-0.41
503	2	33S 29W 36AAB 01	NP	1	1	I	0	2	QUTO	4	92.08	92.49	-0.41
504	1	34S 28W 05BDA 01	NP	1	1	U	0	2	QU	4	26.73	27.74	-1.01
505	1	34S 30W 22CBC 01	NP	1	1	I	1	2	TO	4	212.21	211.08	1.13
506	2	34S 30W 22CBC 01	NP	1	1	I	1	2	TO	4	212.2	211.08	1.12
507	1	35S 30W 10CDA 01	RDM	1	0	I	1	2	QA	2	26.73	25.76	0.97
508	1	18S 21W 25AAB 01	NC	1	1	I	0	2	QA	2	26.46	25.06	1.4
509	1	18S 21W 31CAA 01	NC	1	1	U	0	2	QA	2	28.54	28.24	0.3
510	1	18S 24W 36ADB 01	NC	1	0	I	0	2	QA	2	32.88	32.53	0.35
511	1	18S 25W 33BBC 01	BBW	1	1	U	0	2	QA	2	19.55	17.4	2.15
512	2	18S 25W 33BBC 01	BBW	1	1	U	0	2	QA	2	19.55	17.4	2.15
513	1	18S 26W 06BAB 02	JMH	1	1	U	0	2	QA	2	6.05	5.84	0.21
514	1	19S 23W 01CCB 01	NC	1	1	I	1	2	KD	1	90.54	87.78	2.76
515	1	19S 23W 08CBB 01	NC	1	1	U	0	2	QA	2	19.78	18.8	0.98
516	1	20S 22W 20CCC 01	NC	1	1	U	0	2	QA	2	37.93	37.07	0.86
517	1	20S 22W 35BCC 01	NC	1	1	I	0	2	QA	2	38.35	37.21	1.14
518	1	20S 26W 07BDC 01	JMH	1	1	I	0	2	QA	2	22.86	21.06	1.8
519	1	16S 24W 15ABB 01	BBW	1	1	I	0	2	TO	4	27.24	26.95	0.29
520	1	16S 26W 24DDA 01	JMH	1	0	H	0	2	TO	4	58.77	57.78	0.99

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Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
521	2	16S 26W 24DDA 01	JMH	1	0	H	0	2	TO	4	58.77	57.78	0.99
522	1	32S 31W 03DAA 01	BBW	1	1	I	1	2	QUTO	4	234.78	230.68	4.1
523	1	32S 31W 08BBB 01	JMH	1	1	I	1	2	QUTO	4	242.91	240.68	2.23
524	1	32S 31W 26CAA 01	DRL	1	1	I	0	2	QUTO	4	247.26	243.86	3.4
525	1	32S 32W 14BBB 02	JMH	1	1	I	0	2	QUTOKD	5	255.17	251.65	3.52
526	1	32S 32W 19BAB 01	DRL	1	1	I	0	2	QUTO	4	243.42	240.34	3.08
527	1	32S 33W 32DBD 01	JMA	1	1	I	0	2	QUTO	4	185.85	182.65	3.2
528	1	32S 34W 10DAA 01	NC	0	1	I	0	2	QUTO	4	259.57	257.48	2.09
529	2	32S 34W 10DAA 01	NC	0	1	I	0	0	QUTO	4	259.59	257.48	2.11
530	1	31S 33W 06CBD 01	JMA	1	1	U	0	2	QUTO	4	283.09	277.06	6.03
531	2	31S 33W 06CBD 01	JMA	1	1	U	0	2	QUTO	4	283.07	277.06	6.01
532	1	31S 33W 20DBB 01	JMA	1	1	I	0	2	QUTO	4	241.6	238.4	3.2
533	1	33S 31W 09AAB 01	BBW	1	1	I	1	2	TO	4	230.76	227.44	3.32
534	1	33S 31W 20ACA 01	BBW	1	1	I	1	2	QUTO	4	214.29	211.73	2.56
535	1	33S 32W 02AAC 01	JMH	1	1	I	0	2	QUTO	4	229.93	227.89	2.04
536	1	33S 32W 28CDD 02	JMA	1	1	U	0	2	QUTO	4	62.83	62.45	0.38
537	1	33S 33W 12AAD 01	JMA	1	1	I	0	2	QUTO	4	23.79	21.98	1.81
538	1	33S 33W 20BCC 01	JMA	1	1	I	0	2	TO	4	219.41	217.8	1.61
539	1	33S 33W 25DCC 01	JMA	1	1	I	0	2	TO	4	211.87	211.07	0.8
540	1	33S 34W 17DCC 01	NC	1	1	I	0	2	TO	4	161.06	157.4	3.66
541	2	33S 34W 17DCC 01	NC	1	1	I	0	1	TO	4	161.07	157.4	3.67
542	1	31S 31W 03CCC 01	JMH	1	1	U	0	2	QUTO	4	257.02	253.58	3.44
543	1	31S 32W 01ABC 01	BBW	1	1	I	1	2	QUTO	4	269.33	268.14	1.19
544	1	34S 31W 01CAA 01	DRL	1	0	U	0	2	TO	4	227.84	225.68	2.16
545	1	34S 31W 30BBB 01	BBW	1	1	U	0	2	TO	4	219.04	218.55	0.49
546	1	34S 32W 29BAA 01	BBW	1	1	I	0	2	TO	4	183.69	181.47	2.22
547	1	34S 32W 35ADA 01	JMH	1	1	I	0	2	QUTO	4	200.27	199.79	0.48
548	1	34S 33W 07CCB 01	JMA	1	1	I	0	2	QUTO	4	160.58	157.08	3.5
549	1	34S 34W 16DAA 01	NC	1	1	I	0	2	QUTO	4	189.4	183.41	5.99
550	2	34S 34W 16DAA 01	NC	1	1	I	0	2	QUTO	4	189.4	183.41	5.99
551	1	34S 34W 26BCA 01	JMA	1	1	I	0	2	QUTO	4	163.69	154.73	8.96
552	2	34S 34W 26BCA 01	JMA	1	1	I	0	2	QUTO	4	163.69	154.73	8.96
553	1	31S 32W 31BBB 01	DRL	1	1	I	0	2	TO	4	246.75	242.78	3.97
554	1	35S 31W 10AAC 01	JMH	1	1	I	1	2	TO	4	200.7	199.23	1.47
555	2	35S 31W 10AAC 01	JMH	1	1	I	1	1	TO	4	200.6	199.23	1.37
556	1	35S 32W 06CBB 01	JMH	1	1	I	1	2	TO	4	181.94	186.25	-4.31
557	2	35S 32W 06CBB 01	JMH	1	1	I	1	2	TO	4	181.94	186.25	-4.31
558	3	35S 32W 06CBB 01	JMH	1	1	I	1	2	TO	4	181.94	186.25	-4.31
559	1	35S 33W 16BCA 01	BBW	1	1	I	0	2	QUTO	4	146.57	146.88	-0.31
560	2	35S 33W 16BCA 01	BBW	1	1	I	0	1	QUTO	4	146.55	146.88	-0.33
561	1	35S 34W 10BBB 01	NC	1	1	I	1	2	QUTO	4	104.35	101.4	2.95
562	2	35S 34W 10BBB 01	NC	1	1	I	1	2	QUTO	4	104.36	101.4	2.96
563	1	09S 42W 14AAA 01	JMA	1	1	U	0	2	TO	4	191.16	187.22	3.94
564	1	09S 42W 35ABB 01	JMA	1	1	I	0	2	TO	4	172.33	168.62	3.71
565	1	10S 37W 23ABB 01	JMA	0	1	I	0	0	TO	4	212.22	211.28	0.94
566	2	10S 37W 23ABB 01	JMA	0	1	I	0	0	TO	4	212.23	211.28	0.95
567	3	10S 37W 23ABB 01	JMA	0	1	I	0	0	TO	4	212.25	211.28	0.97
568	1	10S 40W 10ADC 01	JMH	1	1	I	0	2	QATO	3	21.32	19.93	1.39
569	1	10S 41W 15CAD 01	JMH	1	1	I	1	2	QATO	3	32.47	31.24	1.23
570	1	10S 42W 20ABB 01	JMA	1	0	I	0	2	TO	4	133.62	131.02	2.6
571	1	10S 42W 24BAB 01	JMA	1	1	I	0	2	TO	4	109.81	109.24	0.57
572	1	06S 37W 07BBA 01	NP	1	1	I	0	2	TO	4	8.95	8.53	0.42
573	1	06S 37W 16CDD 01	RDM	1	1	I	0	2	TO	4	176.49	174.3	2.19
574	1	06S 37W 19ABB 01	RDM	0	1	I	0	2	TO	4	162.82	160.93	1.89
575	1	06S 38W 09ABD 01	DRL	1	1	I	0	2	TO	4	167.16	165.42	1.74
576	1	06S 38W 18DBD 01	DRL	1	1	I	0	2	TO	4	141.34	139.24	2.1
577	1	06S 39W 09DDD 01	JMH	1	0	U	0	2	TO	4	154.09	153.63	0.46
578	1	06S 40W 10AAC 01	JMH	1	1	I	1	2	TO	4	171.77	169.76	2.01
579	1	06S 40W 13CBC 01	JMH	1	1	I	1	2	TO	4	158.9	157.54	1.36
580	1	06S 40W 30DCC 01	JMH	1	1	I	1	2	TO	4	177.52	175.69	1.83
581	1	06S 41W 19DBD 01	JMA	1	1	I	0	2	TO	4	199.14	197.52	1.62
582	1	06S 41W 27DBD 01	JMH	0	1	I	1	2	TO	4	174.19	172.39	1.8
583	1	06S 42W 02AAA 01	JMA	1	1	U	0	2	TO	4	206.98	205.81	1.17
584	1	06S 42W 22DCC 01	JMA	1	1	I	0	2	TO	4	211.67	210.04	1.63
585	1	06S 42W 30ADA 01	JMA	0	1	I	0	2	TO	4	218.85	215.89	2.96

Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
586	1	07S 37W 04BBC 01	RDM	0	1	I	0	2	TO	4	149.48	147.55	1.93
587	1	07S 37W 05CCB 01	RDM	0	1	I	0	2	TO	4	150.01	148.35	1.66
588	1	07S 38W 28DAA 01	NC	1	1	I	1	2	TO	4	156.54	155.04	1.5
589	1	07S 39W 01DCD 01	DRL	1	1	I	0	2	TO	4	139.49	137.75	1.74
590	1	07S 39W 09BBB 01	BBW	1	1	I	0	2	TO	4	124.17	122.29	1.88
591	1	07S 39W 24BAA 01	DRL	1	1	I	0	2	TO	4	158.82	155.8	3.02
592	1	07S 40W 06ADB 01	JMH	1	1	I	1	2	TO	4	177.33	175.36	1.97
593	1	07S 40W 29BBA 01	JMH	1	1	I	0	2	TO	4	151.4	149.56	1.84
594	1	07S 40W 35BBB 01	JMH	1	1	I	1	2	TO	4	134.92	132.57	2.35
595	1	07S 40W 36BAB 01	JMH	1	1	U	0	2	TO	4	143.22	141.52	1.7
596	1	07S 41W 07BCB 01	JMA	1	1	I	0	2	TO	4	211.28	209.89	1.39
597	1	07S 41W 28DBB 01	BBW	1	1	I	1	2	TO	4	141.05	139.28	1.77
598	1	07S 42W 07DAA 01	JMA	1	1	I	0	2	TO	4	201.72	200.19	1.53
599	1	07S 42W 17CCC 01	JMA	1	0	U	0	2	TO	4	153.4	152.15	1.25
600	1	07S 42W 27AAB 01	JMA	1	1	I	0	2	TO	4	179.58	178.1	1.48
601	1	08S 37W 03ADB 01	RDM	0	1	I	0	2	TO	4	167.28	166.18	1.1
602	1	08S 37W 21CCC 01	NP	0	1	I	0	2	TO	4	148.85	145.92	2.93
603	2	08S 37W 21CCC 01	NP	0	1	I	0	2	TO	4	148.85	145.92	2.93
604	1	08S 37W 32ABB 01	NP	1	1	I	0	2	TO	4	105.77	103.27	2.5
605	2	08S 37W 32ABB 01	NP	1	1	I	0	2	TO	4	105.77	103.27	2.5
606	1	08S 38W 17CDD 01	NC	1	1	I	0	2	TO	4	176.11	174.34	1.77
607	1	08S 38W 24AAB 01	NP	1	1	I	0	2	TO	4	128.16	126.76	1.4
608	2	08S 38W 24AAB 01	NP	1	1	I	0	2	TO	4	128.17	126.76	1.41
609	1	08S 39W 15CCC 01	NC	0	1	I	1	2	TO	4	175.5	172.96	2.54
610	1	08S 40W 12DBA 01	BBW	1	1	U	0	2	TO	4	173.77	172.26	1.51
611	1	08S 40W 17CDB 01	BBW	1	1	I	0	2	TO	4	146.48	143.77	2.71
612	1	08S 40W 25AAC 01	BBW	1	1	U	0	2	TO	4	189.45	187.73	1.72
613	1	08S 41W 17CBA 01	JMH	1	1	I	0	2	TO	4	159.27	159.04	0.23
614	2	08S 41W 17CBA 01	JMH	1	1	I	0	2	TO	4	158.26	159.04	-0.78
615	3	08S 41W 17CBA 01	JMH	1	1	I	0	2	TO	4	159.26	159.04	0.22
616	1	08S 41W 25BBC 01	BBW	1	1	I	1	2	TO	4	133.31	131.86	1.45
617	1	08S 42W 15DDB 01	JMA	1	1	I	0	2	TO	4	139.99	137.57	2.42
618	1	08S 42W 31DCD 01	JMA	1	1	U	0	2	TO	4	97.33	95.69	1.64
619	1	09S 37W 07DDB 01	NP	1	1	I	0	1	TO	4	94.33	93.47	0.86
620	2	09S 37W 07DDB 01	NP	1	1	I	0	2	TO	4	94.33	93.47	0.86
621	3	09S 37W 07DDB 01	NP	1	1	I	0	2	TO	4	94.35	93.47	0.88
622	4	09S 37W 07DDB 01	NP	1	1	I	0	1	TO	4	94.8	93.47	1.33
623	1	09S 38W 13BCC 01	NP	1	1	I	0	2	TO	4	81.57	80.09	1.48
624	2	09S 38W 13BCC 01	NP	1	1	I	0	2	TO	4	81.58	80.09	1.49
625	1	09S 39W 01DBA 01	NC	0	1	I	0	2	TO	4	155.66	153.93	1.73
626	1	09S 39W 02BAB 01	NC	0	0	I	1	2	TO	4	187.49	185.69	1.8
627	1	09S 39W 10CCB 01	NC	0	0	I	0	2	TO	4	163.12	160.48	2.64
628	1	09S 39W 19CCC 01	JMH	1	1	I	1	2	TO	4	150.29	146.59	3.7
629	2	09S 39W 19CCC 01	JMH	1	1	I	1	0	TO	4	149.5	146.59	2.91
630	1	09S 40W 13CDC 01	JMH	1	1	I	0	2	TO	4	174.01	169.9	4.11
631	1	09S 40W 29BBB 01	JMH	1	1	U	0	1	TO	4	172.37	172.66	-0.29
632	1	09S 41W 05DCC 01	BBW	1	1	I	0	1	TO	4	189.69	186.23	3.46
633	1	09S 41W 14BBC 01	JMH	1	1	I	1	2	TO	4	202.48	196.61	5.87
634	1	09S 41W 34BAB 01	JMH	1	0	I	0	1	TO	4	166.9	163.26	3.64
635	1	31S 35W 15BAA 01	NC	1	1	U	0	2	QUTO	4	317.61	-9999	-9999
636	2	31S 35W 15BAA 01	NC	1	1	U	0	2	QUTO	4	317.61	-9999	-9999
637	1	31S 36W 02CDD 01	NC	1	1	I	0	2	QUTO	4	196.53	195.77	0.76
638	2	31S 36W 02CDD 01	NC	1	1	I	0	2	QUTO	4	196.53	195.77	0.76
639	1	32S 35W 08DDD 01	NC	1	1	I	0	2	QUTO	4	201.98	198.81	3.17
640	2	32S 35W 08DDD 01	NC	1	1	I	0	2	QUTO	4	201.98	198.81	3.17
641	1	33S 35W 23CBB 01	RDM	1	1	I	0	2	TO	4	208.01	195.31	12.7
642	2	33S 35W 23CBB 01	RDM	1	1	I	0	1	TO	4	208.03	195.31	12.72
643	3	33S 35W 23CBB 01	RDM	1	1	I	0	2	TO	4	207.94	195.31	12.63
644	1	33S 37W 17CCC 01	JMA	0	0	I	0	2	QUTO	4	146.79	142.85	3.94
645	1	33S 37W 28CAC 01	JMA	1	1	I	0	2	QUTO	4	152.3	151.42	0.88
646	1	33S 37W 35ACD 01	JMA	1	1	I	0	2	QUTO	4	183.09	192.76	-9.67
647	2	33S 37W 35ACD 01	JMA	1	1	I	0	2	QUTO	4	183.1	192.76	-9.66
648	1	33S 38W 06AAB 01	JMA	1	1	I	0	2	QUTO	4	99.29	99.09	0.2
649	1	33S 38W 10ACC 01	JMA	1	1	I	0	2	QUTO	4	186.5	180.29	6.21
650	1	33S 38W 33CAA 01	JMA	1	1	I	0	2	QUTO	4	221.64	214.09	7.55

Rows	Rerun	KGS ID	Measurer	A	B	C	D	E	F	G	'03 Depth	'02 Depth	'03-'02
651	2	33S 38W 33CAA 01	JMA	1	1	I	0	2	QUTO	4	221.65	214.09	7.56
652	1	32S 35W 32DCD 01	NC	1	1	I	0	2	QUTO	4	207.05	196.07	10.98
653	2	32S 35W 32DCD 01	NC	1	1	I	0	2	QUTO	4	207.05	196.07	10.98
654	1	32S 36W 03DDC 01	NC	1	1	Z	0	2	QUTO	4	268.66	257.82	10.84
655	2	32S 36W 03DDC 01	NC	1	1	Z	0	2	QUTO	4	268.66	257.82	10.84
656	1	32S 36W 21AAC 01	NC	1	1	I	0	2	TO	4	210.07	206.81	3.26
657	2	32S 36W 21AAC 01	NC	1	1	I	0	2	TO	4	210.07	206.81	3.26
658	1	32S 37W 10DCC 01	NC	1	1	I	0	2	QUTO	4	181.2	180.01	1.19
659	2	32S 37W 10DCC 01	NC	1	1	I	0	1	QUTO	4	181.19	180.01	1.18
660	1	32S 37W 26BAC 01	NC	1	1	I	0	2	QUTO	4	141.08	138.78	2.3
661	2	32S 37W 26BAC 01	NC	1	1	I	0	2	QUTO	4	141.08	138.78	2.3
662	1	32S 38W 11CBB 01	NC	1	1	I	0	2	QUTO	4	194.02	190.1	3.92
663	2	32S 38W 11CBB 01	NC	1	1	I	0	2	QUTO	4	194.02	190.1	3.92
664	1	32S 39W 14DDD 01	NC	1	0	I	0	2	QUTO	4	100.78	88.98	11.8
665	2	32S 39W 14DDD 01	NC	1	0	I	0	2	QUTO	4	100.78	88.98	11.8
666	1	31S 37W 09BBC 01	NC	1	1	I	0	2	QUTO	4	272.53	267.65	4.88
667	2	31S 37W 09BBC 01	NC	1	1	I	0	2	QUTO	4	272.53	267.65	4.88
668	1	31S 37W 13BDD 01	NC	1	1	I	0	2	QUTO	4	272.5	267.74	4.76
669	2	31S 37W 13BDD 01	NC	1	1	I	0	1	QUTO	4	272.48	267.74	4.74
670	1	34S 35W 26ACC 01	NC	1	1	I	0	2	TO	4	207.9	191.55	16.35
671	2	34S 35W 26ACC 01	NC	1	1	I	0	1	TO	4	207.89	191.55	16.34
672	3	34S 35W 26ACC 01	NC	1	1	I	0	2	TO	4	207.9	191.55	16.35
673	1	34S 36W 10CAC 01	JMA	1	1	I	0	2	TO	4	208.97	201.07	7.9
674	1	34S 36W 21DBD 01	JMA	0	1	I	0	2	TO	4	208.72	206.29	2.43
675	1	34S 37W 27ABC 02	JMA	1	1	I	0	2	QUTO	4	158.35	155.26	3.09
676	1	34S 37W 29BBD 01	JMA	1	1	I	0	2	TO	4	191.7	185.62	6.08
677	1	34S 37W 35AAD 01	JMA	1	1	I	0	2	TO	4	161	153.73	7.27
678	1	34S 38W 02ADC 01	JMA	1	1	I	1	1	TO	4	198.23	189.96	8.27
679	1	34S 39W 02CCA 01	JMA	1	1	U	0	2	QUTO	4	107.43	107.29	0.14
680	1	34S 39W 15CAD 01	JMA	1	1	U	0	2	QUTO	4	151.35	149.67	1.68
681	1	31S 37W 22BCC 01	NC	1	1	I	0	2	QUTO	4	279.86	279.94	-0.08
682	1	31S 37W 30DDB 01	NC	1	1	I	0	2	TO	4	290.47	281.66	8.81
683	2	31S 37W 30DDB 01	NC	1	1	I	0	2	TO	4	290.48	281.66	8.82
684	1	31S 38W 17ADB 01	NC	1	1	I	0	2	QUTO	4	266.75	263.4	3.35
685	1	31S 39W 03DCB 01	NC	1	1	I	0	2	QUTO	4	208.52	205.8	2.72
686	1	31S 39W 25ABB 01	NC	1	1	U	0	2	TO	4	195.47	194.89	0.58
687	2	31S 39W 25ABB 01	NC	1	1	U	0	2	TO	4	195.65	194.89	0.76
688	1	35S 35W 15BCC 01	JMA	1	1	I	0	2	TO	4	151.5	146.23	5.27
689	2	35S 35W 15BCC 01	JMA	1	1	I	0	2	TO	4	151.5	146.23	5.27
690	1	35S 36W 01AAA 01	JMA	1	1	I	0	2	QUTO	4	173.6	167.93	5.67
691	1	35S 37W 16BCC 01	JMA	1	1	I	0	2	TO	4	174.98	169.78	5.2
692	1	35S 39W 10CAD 01	JMA	1	1	I	0	2	QUTO	4	222.3	227.59	-5.29
693	2	35S 39W 10CAD 01	JMA	1	1	I	0	2	QUTO	4	222.3	227.59	-5.29
694	1	11S 42W 08DDC 01	JMA	1	1	I	0	2	TO	4	115.14	114.63	0.51
695	1	11S 42W 10AAD 01	JMA	1	1	I	0	2	TO	4	132.55	131.77	0.78

Appendix A key to variables (columns):

A Well Access
B Weighted Tape
C Well Use
D Oil on Water
E Chalk Cut Quality
F Aquifer Code
G Aquifer Group

See page 6 for values within each variable

SUPPLEMENT TO PRELIMINARY REPORT ON STATISTICAL QUALITY CONTROL FOR YEAR 2003 WATER WELL MEASUREMENTS

ANALYSIS OF DWR WATER WELL MEASUREMENTS

Report to the Director
Kansas Geological Survey
University of Kansas

by
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Open-file Report 2003-8
January 30, 2003

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February 19, 2003

SUPPLEMENT TO PRELIMINARY REPORT ON STATISTICAL QUALITY CONTROL FOR YEAR 2003 WATER WELL MEASUREMENTS

ANALYSIS OF DWR OBSERVATION WELL MEASUREMENTS

John C. Davis
Mathematical Geology Section

February 19, 2003

Introduction

In 2003, field crews from the Division of Water Resources (DWR) were equipped with devices for digitally capturing observation well measurements in the field. Although lacking the on-screen navigation capabilities of lap-top computers running the WaterWitch software used by KGS personnel, the DWR's Personal Digital Assistants (PDA's) and attached GPS devices possess the same data-collection functionality. The PDA software, called *WaterBug*, is a subset of WaterWitch and produces records that are similar in format.

For the first time, information has been collected by DWR personnel that is comparable to that routinely gathered by KGS field operators and which can be used to statistically assess the significance of extraneous influences on the water level measurements. This supplement to OFR2003-8 provides a statistical quality control analysis similar to that performed annually on KGS measurements of observation wells. The initial data base of DWR measurements contained 805 rows representing 787 observation wells. Of these, 26 observation wells could not be used because there was no measurement of depth to water for 2002, and hence no annual change in water level, variable **'03–'02**. The usable data base therefore contains 761 wells. Nine of these wells failed a preliminary threshold screening that checks for extreme values of **'03–'02**. Of these, three wells reported previous year's depths to water that were significantly deeper than expected from past trends, resulting in values of **'03–'02** that are extreme and negative. Depths to water in the other six wells are much deeper in 2003 than expected from past trends so that **'03–'02** is extreme and positive. However, these may reflect true depletions over the past year, which has been exceptionally dry in western Kansas. Under KGS operating procedures, these nine wells would have been remeasured in a subsequent quality control step and the remeasurements used for statistical analyses. The original measurements, listed below, are included in analyses that follow.

Well Location	**'03-'02**
22S 17W 05BBC 02	-23.12
18S 38W 23BAB 01	-10.93
28S 08W 26ABC 01	-10.23

Well Location	'03-'02
29S 43W 33CDB 01	23.13
29S 37W 29BBA 01	20.35
27S 39W 27BBA 01	19.71
09S 28W 15CBA 01	17.67
27S 42W 17CCC 01	16.95
01S 29W 03DDB 01	12.82

Statistical Procedures

The measurements of 761 wells made by DWR are included in the statistical analysis, which is an unbalanced analysis of variance (ANOVA) procedure designed to estimate the influence of different well characteristics and procedural differences on variable **'03-'02**. The same variables have been recorded for each DWR well as for KGS wells. However, the variable **Well Use** contains the additional categories N = industrial, and P = public, and the variable **Aquifer Code** does not include the category KN = Cretaceous Niobrara aquifer. Of course, all of the categories of **Measurer** are different.

The statistical model fitted to the DWR measurements includes all exogenous variables recorded during the quality control study that might add to the variability in the response, **'03-'02**, plus the variables **Well Use** and **Aquifer Code**. In contrast to the KGS measurement program, the exogenous variable **Weighted Tape** contributed significantly to the total variance. As expected there also was a significant operator effect measured by the variable **Measurer**. The only other significant contribution to total variance came from **Aquifer Code**.

Analysis of Variance table for DWR model

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob>F
Model	35	1095.5336	31.3010	5.4018	<0.0001
Measurer	12	609.5943	50.7995	8.7667	<0.0001**
Well Access	1	5.9545	5.9545	1.0276	0.3111ns
Weighted Tape	1	26.4051	26.4051	4.5569	0.0331*
Well Use	6	46.8101	7.8017	1.3464	0.2341ns
Oil on Water	1	3.2523	3.2523	0.5613	0.4540ns
Chalk Cut Quality	2	24.0394	12.0197	2.0743	0.1264ns
Aquifer Code	12	225.1937	18.7661	3.2386	0.0001**
Error	725	4201.0792	5.7946		
Total	760	5296.6128			

ns Not significant * Significant ** Highly significant

RSquare 0.21

Because this is possibly the only year that statistical quality control data will be collected from DWR wells, additional analyses such as those routinely run on KGS wells grouped by aquifer type were not performed.

One way to improve the statistical results of the measurement program is to discard wells in which exogenous variables make unusually high contributions to the total variance, arguing that the readings from such wells are atypical and likely erroneous. In addition to the nine wells flagged in the initial examination, there are 14 more wells which were rated "poor" on **Well Access** and "no weight used" on **Weighted Tape**. Based on prior experience by KGS measurers, these wells should be considered for replacement by DWR.

Well Location	**'03-'02**
26S 16W 18CAC 01	4.1
30S 35W 19BCD 01	9.63
28S 09W 01BCC 01	-0.45
17S 28W 15BBC 01	1.85
17S 28W 26ABB 01	0.39
17S 28W 34CBB 01	0.09
17S 30W 20BBB 01	6.22
35S 41W 16CCD 01	-9.7
28S 13W 02DDC 01	0.22
25S 10W 19ABD 01	3.62
17S 32W 16BBB 01	3.33
20S 33W 36CAD 01	5.58
24S 11W 17DDB 01	1.44
30S 40W 33CCB 01	0.76

Importance of contributing variables

We can determine the relative contributions of each category of the contributing variables by examining the least-squares means (averages) of **'03-'02** for a specified state of a variable, while holding all other variables at their average value. (In statistical terms, these averages are referred to as the *expected values* of the variables.) A positive value indicates the average depth to water in a well is greater in 2003 than in 2002 (the water level has declined from last year's measurement). That is, the elevation of the water level in the well is lower than it was previously. The following list gives the least-squares means for the complete data set.

Operator

Level	**Original Least Sq Mean**
CLS	-0.0271
DB	-0.9453
DH	0.6120

DLZ	-1.4325
DR	0.0777
DWA	5.0135
JL	0.1949
JU	0.6065
MB	-0.0227
NC	0.6822
PHD	-0.5294
SB	-1.1658
TPM	0.1158

Well Access

Level	Original Least Sq Mean
0	0.4739
1	0.0168

Weighted Tape

Level	Original Least Sq Mean
0	-0.1486
1	0.6339

Well Use

Level	Original Least Sq Mean
H	1.8506
I	0.7929
N	-0.1158
P	0.2027
S	-0.0395
U	0.2889
Z	-1.1726

Oil on Water

Level	Original Least Sq Mean
0	0.1346
1	0.3561

Chalk Cut

Level	Original Least Sq Mean
0	0.2454
1	1.5661
2	0.8253

Geologic Unit

Level	Original Least Sq Mean
KD	2.9412
KJ	-3.5505
QA	0.6372
QAQU	-1.6738
QATO	-0.1933
QUKD	5.7966
QUQA	0.7897
QUTO	-0.8935
QUTOKD	-0.3862
QUTOKJ	-0.1226
TO	0.4594
TOKD	-1.6424

Summary of the Analysis of Variance

DWR Year 2003 measurements show significant or highly significant variations attributable to **Measurer** and **Weighted Tape** in addition to differences between the aquifer being tapped by the well. The standard deviation of variable **'03-'02** of DWR wells is 2.64 ft., which is less than the standard deviation of variable **'03-'02** of KGS wells (3.86 ft.). The median decline in water level from 2002 to 2003 in DWR wells is 1.21 ft., in constrast to the median decline in water level from 2002 to 2003 in KGS wells which is 2.50 ft.

The significant differences between measurers are mostly attributable to operator **DWA** (who tended to produce deeper than expected measurements) and **DWZ** (who tended to produce shallower than expected measurements). In addition, operators **DB**, **PHD**, and **SB** all tended to produce values that were shallower than expected, although not so extreme as **DWZ**.

The ANOVA equation can be used to create an expected value and residual (difference between observed and expected value) for each well. The distribution of residuals should be approximately normal. Examination of the residual outliers will reveal any well measurements which cannot be explained by extreme combinations of the different sources of variation. The residual plot is more peaked than normal and skewed toward negative values. As a consequence, outliers or extreme values are those measurements which differ from their expected values by an amount that is greater for positive residuals

than for negative residuals. The approximate upper and lower limits are +10 ft. and -5 ft. Nineteen wells have been identified by this process. These wells show changes in water level between 2002 and 2003 that are outside the range expected. These well measurements may be correct and reflect unusual changes in aquifer level; the wrong wells may have been measured in one year or the other; or changes in well construction or other factors may have altered the measurability of a well. The 19 wells, with their residuals, are:

Well ID	Residual, ft.
01S 29W 03DDB 01	11.28
13S 27W 16CA 02	-5.49
29S 37W 29BBA 01	14.64
30S 32W 22BBB 01	13.04
16S 40W 15ACC 01	-6.99
28S 08W 26ABC 01	-12.26
35S 41W 16CCD 01	-9.04
22S 17W 05BBC 02	-22.09
09S 28W 15CBA 01	15.75
27S 39W 27BBA 01	13.60
27S 42W 17CCC 01	10.47
28S 41W 02CCC 01	-7.66
29S 42W 27DAD 01	-4.47
29S 43W 33CDB 01	14.38
30S 42W 12ACC 01	-6.21
30S 43W 36BB 01	-4.53
06S 35W 26ACB 01	-6.15
10S 31W 29AAB 01	-6.07
18S 38W 23BAB 01	-11.25

A positive residual indicates that the 2003 water level is lower than predicted in a well with a declining water level, or is not as high as predicted in a well with an increasing water level. A negative residual indicates that the 2003 water level has declined less than predicted in a well with a declining water level, or has risen more than predicted in a well with a rising water table. These wells, along with wells previously identified by other criteria and DWR wells showing anomalous geostatistical characteristics (identified in Olea and Davis, 2003) should be scrutinized closely during the next field measurement season to determine if they should be replaced in the network.