Memo

Stantec

To:	Flood Control District of Maricopa County	From:	Stantec Consulting Inc. Pat Ellison, PE
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	Phoenix, AZ		Phoenix, AZ
File:	Stantec #181300035	Date:	August 28, 2009

Reference: Salt River Hydraulic Master Plan
Manning's Roughness Sensitivity Model

An HEC-RAS model was developed to determine how the impact of variations in the Manning's roughness coefficient (n-value) would affect the resulting water surface elevations for the existing physical conditions. Two additional geometries and plans were developed. Within one plan (*SR HMP - n value +0.01*), the geometry was modified by increasing all Manning's roughness coefficients by a value of 0.01. Within another plan (*SR HMP - n value -0.01*), the geometry was modified by decreasing all Manning's roughness coefficients by a value of 0.01.

Manning's n-value sensitivity HEC-RAS simulations were conducted utilizing the existing 100-year Post-Roosevelt Dam Modifications peak discharges. The results from simulations performed using the higher Manning's roughness coefficients resulted in higher water surface elevations, ranging from no increase (two locations, RM 226.61, and RM 216.34) up to a maximum increase of 3.96' (RM 226.49). Excluding the two cross sections where no increase was noticed, the next lowest water surface elevation increase was 0.33'. Overall an average increase of 2.35 feet is realized with the higher Manning's roughness coefficient.

The results from simulations performed using the lower Manning's roughness coefficients resulted in lower water surface elevations, ranging from no decrease (two locations, RM 226.61, and RM 216.34), up to a maximum decrease of 3.75' (RM 223.08). Excluding the two cross sections where no decrease was noticed, the next lowest water surface elevation decrease was 0.26' (RM 216.42). Overall an average decrease of 2.30 feet is obtained when utilizing the lower Manning's roughness coefficient.

Attachment A depicts the water surface elevation profiles of the existing 100-year Post-Roosevelt Dam Modifications (*100-yr post WSE*), and the two 100-year Post-Roosevelt Dam Modifications with Manning's roughness coefficients increased (*n +0.01)* and decreased (*n -0.01)* by 0.01, along with top of levee elevations, and minimum channel elevations.

Reference: Salt River Hydraulic Master Plan
Manning's Roughness Sensitivity Model

Attachment B contains in tabular format the water surface elevations of the three aforementioned water surface elevation profiles along with the resulting water surface elevation differences for each change in Manning's roughness coefficient.

Attachment C contains the CD with the hydraulic model used for the sensitivity analysis.

Increasing and decreasing all the Manning's roughness coefficients by a value of 0.01, has shown that relatively modest variations in the coefficients does have a significant affect on water surface elevations.

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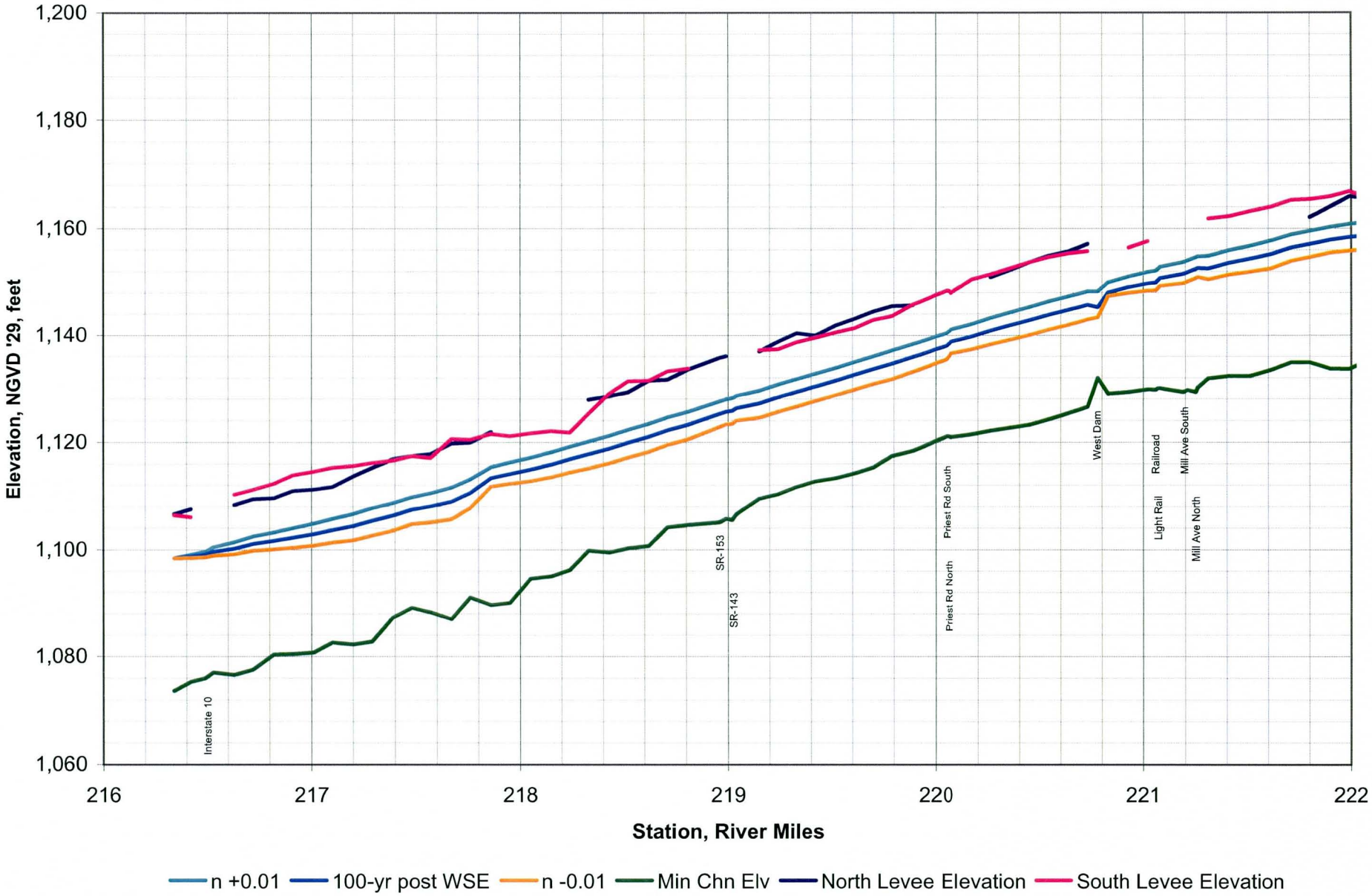
Date Signed 9-28-2009
ARIZONA U.S.A.
Expires 9/30/2009

ATTACHMENT A

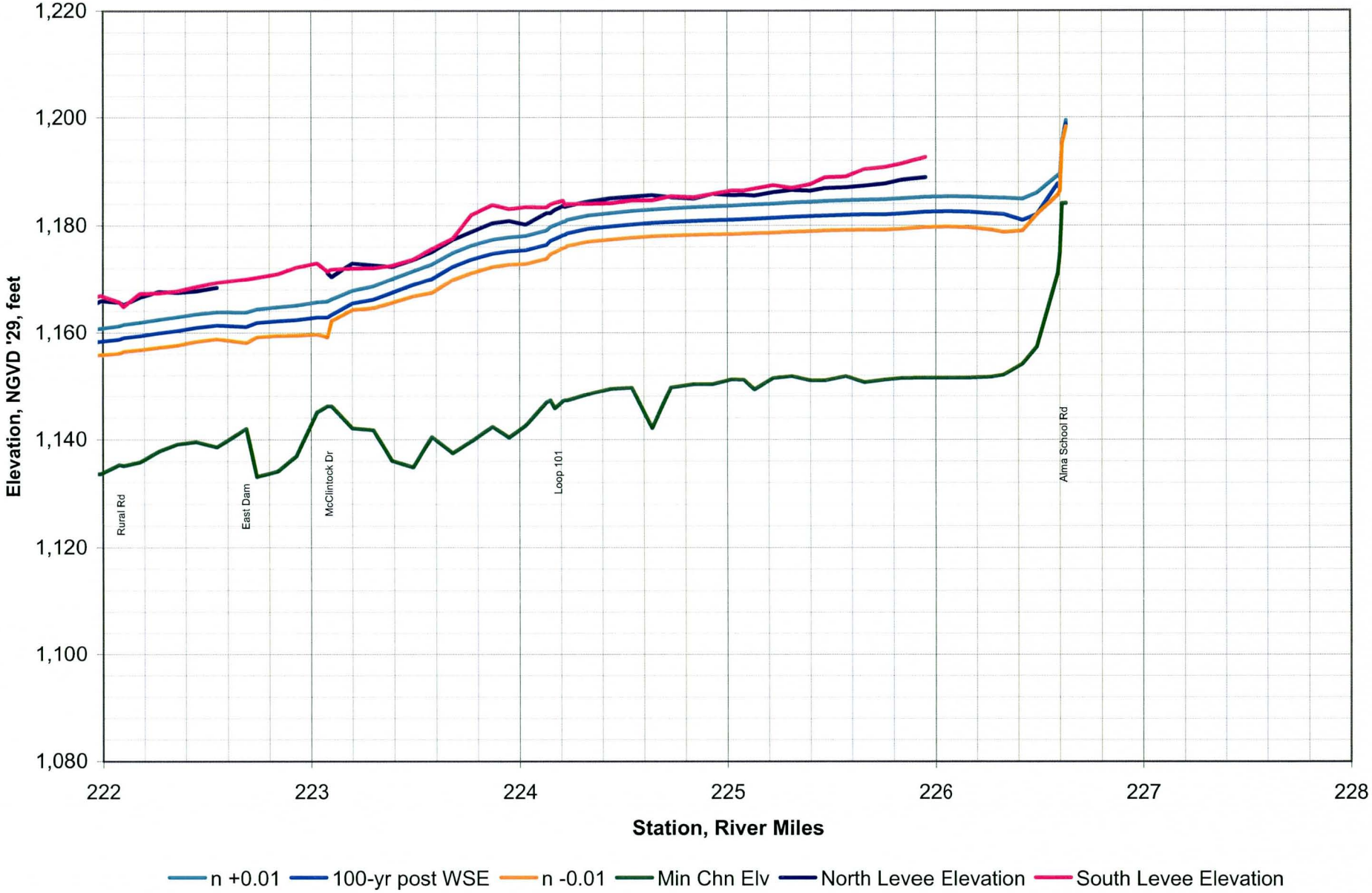
WATER SURFACE ELEVATION PROFILES

Manning's Roughness Sensitivity, +/- 0.01 adjustment
Existing Conditions 100-Year Water Surface Profile Comparison



8/3/2009

Manning's Roughness Sensitivity, +/- 0.01 adjustment
Existing Conditions 100-Year Water Surface Profile Comparison



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ATTACHMENT B

WATER SURFACE ELEVATION DATA

Attachment B - Water Surface Elevations

River Sta *river mile*	100-year Post WSE *feet*	100-year Post WSE (n +0.01) *feet*	100-year Post WSE (n -0.01) *feet*	WSE Differences by adjustment 100-year Post WSE (n +0.01) *feet*	WSE Differences by adjustment 100-year Post WSE (n -0.01) *feet*
226.63	1198.83	1199.41	1198.3	0.58	-0.53
226.61	1195.17	1195.17	1195.17	0	0
226.6	1186.76	1188.86	1186.36	2.1	-0.4
226.59	1187.74	1189.21	1185.62	1.47	-2.12
226.49	1182.05	1186.01	1182.05	3.96	0
226.42	1180.97	1184.92	1179	3.95	-1.97
226.33	1182.08	1185.11	1178.75	3.03	-3.33
226.27	1182.24	1185.13	1179.17	2.89	-3.07
226.16	1182.54	1185.31	1179.63	2.77	-2.91
226.06	1182.6	1185.34	1179.74	2.74	-2.86
225.95	1182.52	1185.25	1179.67	2.73	-2.85
225.84	1182.24	1185	1179.36	2.76	-2.88
225.76	1182.06	1184.81	1179.18	2.75	-2.88
225.66	1182.03	1184.75	1179.2	2.72	-2.83
225.57	1181.95	1184.65	1179.14	2.7	-2.81
225.47	1181.83	1184.52	1179.04	2.69	-2.79
225.4	1181.72	1184.4	1178.93	2.68	-2.79
225.31	1181.59	1184.25	1178.83	2.66	-2.76
225.22	1181.41	1184.05	1178.67	2.64	-2.74
225.13	1181.27	1183.9	1178.57	2.63	-2.7
225.08	1181.16	1183.79	1178.46	2.63	-2.7
225.02	1181.08	1183.69	1178.4	2.61	-2.68
224.93	1180.97	1183.55	1178.33	2.58	-2.64
224.84	1180.87	1183.43	1178.26	2.56	-2.61
224.73	1180.68	1183.2	1178.12	2.52	-2.56
224.64	1180.5	1182.99	1177.98	2.49	-2.52
224.54	1180.21	1182.69	1177.72	2.48	-2.49
224.44	1179.85	1182.33	1177.38	2.48	-2.47
224.33	1179.4	1181.86	1176.96	2.46	-2.44
224.23	1178.58	1181.07	1176.17	2.49	-2.41
224.22	1178.29	1180.79	1175.86	2.5	-2.43
224.21	1178.22	1180.72	1175.79	2.5	-2.43
224.17	1177.51	1180.07	1175.01	2.56	-2.5
224.15	1177.17	1179.77	1174.63	2.6	-2.54
224.13	1176.41	1179.09	1173.77	2.68	-2.64
224.03	1175.4	1178.08	1172.8	2.68	-2.6
223.95	1175.19	1177.82	1172.65	2.63	-2.54
223.87	1174.73	1177.37	1172.21	2.64	-2.52
223.77	1173.62	1176.27	1171.09	2.65	-2.53
223.68	1172.27	1174.88	1169.81	2.61	-2.46
223.58	1169.98	1172.72	1167.39	2.74	-2.59
223.49	1168.89	1171.44	1166.75	2.55	-2.14
223.39	1167.44	1169.95	1165.55	2.51	-1.89
223.3	1166.18	1168.66	1164.57	2.48	-1.61

Attachment B - Water Surface Elevations

River Sta *river mile*	100-year Post WSE *feet*	100-year Post WSE (n +0.01) *feet*	100-year Post WSE (n -0.01) *feet*	WSE Differences by adjustment 100-year Post WSE (n +0.01) *feet*	WSE Differences by adjustment 100-year Post WSE (n -0.01) *feet*
223.2	1165.46	1167.81	1164.24	2.35	-1.22
223.1	1163.37	1166.22	1162.21	2.85	-1.16
223.08	1162.88	1165.81	1159.13	2.93	-3.75
223.03	1162.88	1165.68	1159.66	2.8	-3.22
222.93	1162.38	1165.09	1159.42	2.71	-2.96
222.84	1162.15	1164.75	1159.37	2.6	-2.78
222.74	1161.84	1164.39	1159.13	2.55	-2.71
222.69	1161.09	1163.8	1158.05	2.71	-3.04
222.55	1161.39	1163.86	1158.79	2.47	-2.6
222.45	1160.93	1163.43	1158.27	2.5	-2.66
222.36	1160.35	1162.91	1157.6	2.56	-2.75
222.27	1159.9	1162.43	1157.19	2.53	-2.71
222.18	1159.39	1161.91	1156.73	2.52	-2.66
222.1	1159.04	1161.52	1156.43	2.48	-2.61
222.08	1158.73	1161.23	1156.08	2.5	-2.65
221.99	1158.38	1160.82	1155.83	2.44	-2.55
221.9	1157.91	1160.29	1155.46	2.38	-2.45
221.8	1157.12	1159.53	1154.62	2.41	-2.5
221.71	1156.45	1158.89	1153.92	2.44	-2.53
221.61	1155.21	1157.71	1152.54	2.5	-2.67
221.51	1154.37	1156.77	1151.93	2.4	-2.44
221.41	1153.63	1155.96	1151.39	2.33	-2.24
221.31	1152.57	1154.92	1150.5	2.35	-2.07
221.26	1152.67	1154.82	1150.92	2.15	-1.75
221.25	1152.48	1154.65	1150.73	2.17	-1.75
221.21	1151.86	1154.07	1150.11	2.21	-1.75
221.19	1151.54	1153.76	1149.76	2.22	-1.78
221.08	1150.76	1152.88	1149.27	2.12	-1.49
221.07	1150.36	1152.54	1148.81	2.18	-1.55
221.065	1150.17	1152.35	1148.63	2.18	-1.54
221.06	1149.94	1152.16	1148.37	2.22	-1.57
221.02	1149.76	1151.9	1148.33	2.14	-1.43
220.93	1149.03	1151.06	1147.94	2.03	-1.09
220.83	1148.05	1149.97	1147.37	1.92	-0.68
220.78	1145.3	1148.24	1143.35	2.94	-1.95
220.73	1145.75	1148.24	1142.97	2.49	-2.78
220.64	1144.8	1147.31	1141.94	2.51	-2.86
220.54	1143.85	1146.35	1141.01	2.5	-2.84
220.45	1142.86	1145.34	1140.04	2.48	-2.82
220.35	1141.85	1144.29	1139.13	2.44	-2.72
220.26	1140.87	1143.25	1138.3	2.38	-2.57
220.17	1139.78	1142.13	1137.34	2.35	-2.44
220.07	1138.77	1141.05	1136.55	2.28	-2.22
220.063	1138.44	1140.77	1136.06	2.33	-2.38

Attachment B - Water Surface Elevations

River Sta *river mile*	100-year Post WSE *feet*	100-year Post WSE (n +0.01) *feet*	100-year Post WSE (n -0.01) *feet*	WSE Differences by adjustment 100-year Post WSE (n +0.01) *feet*	WSE Differences by adjustment 100-year Post WSE (n -0.01) *feet*
220.06	1138.43	1140.75	1136.06	2.32	-2.37
220.05	1138.08	1140.46	1135.51	2.38	-2.57
219.89	1135.91	1138.35	1133.14	2.44	-2.77
219.79	1134.69	1137.15	1131.78	2.46	-2.91
219.7	1133.64	1136.05	1130.86	2.41	-2.78
219.61	1132.59	1134.98	1129.83	2.39	-2.76
219.52	1131.52	1133.9	1128.83	2.38	-2.69
219.42	1130.41	1132.79	1127.68	2.38	-2.73
219.33	1129.37	1131.76	1126.65	2.39	-2.72
219.24	1128.35	1130.75	1125.66	2.4	-2.69
219.15	1127.23	1129.62	1124.59	2.39	-2.64
219.04	1126.36	1128.65	1124.04	2.29	-2.32
219.02	1125.87	1128.19	1123.44	2.32	-2.43
218.99	1125.68	1127.97	1123.34	2.29	-2.34
218.96	1125.29	1127.59	1122.86	2.3	-2.43
218.81	1123.29	1125.68	1120.59	2.39	-2.7
218.71	1122.23	1124.61	1119.57	2.38	-2.66
218.62	1121.04	1123.44	1118.27	2.4	-2.77
218.52	1119.93	1122.32	1117.2	2.39	-2.73
218.43	1118.84	1121.22	1116.15	2.38	-2.69
218.33	1117.82	1120.18	1115.19	2.36	-2.63
218.24	1116.9	1119.21	1114.44	2.31	-2.46
218.15	1115.88	1118.18	1113.54	2.3	-2.34
218.05	1114.95	1117.19	1112.83	2.24	-2.12
217.95	1114.15	1116.3	1112.33	2.15	-1.82
217.86	1113.36	1115.41	1111.81	2.05	-1.55
217.76	1110.55	1113.13	1107.72	2.58	-2.83
217.67	1108.95	1111.56	1105.65	2.61	-3.3
217.57	1108.06	1110.52	1105.1	2.46	-2.96
217.48	1107.41	1109.75	1104.77	2.34	-2.64
217.39	1106.33	1108.68	1103.53	2.35	-2.8
217.29	1105.38	1107.68	1102.64	2.3	-2.74
217.2	1104.37	1106.6	1101.76	2.23	-2.61
217.1	1103.65	1105.72	1101.34	2.07	-2.31
217.01	1102.88	1104.82	1100.77	1.94	-2.11
216.91	1102.23	1103.99	1100.39	1.76	-1.84
216.82	1101.64	1103.2	1100.07	1.56	-1.57
216.72	1101.1	1102.47	1099.79	1.37	-1.31
216.63	1100.22	1101.37	1099.15	1.15	-1.07
216.53	1099.62	1100.46	1098.9	0.84	-0.72
216.49	1099.04	1099.63	1098.56	0.59	-0.48
216.42	1098.72	1099.05	1098.46	0.33	-0.26
216.34	1098.4	1098.4	1098.4	0	0