From:M. Sam McCown, User Engagement & Services Branch, CSMD, NCDCTo:Thomas R. Karl, Director, NCDCSubject:SCEC Decision: New Maximum Temperature Record for South Carolina

On Monday, October 15, 2012, Hope Mizzell (State Climatologist for South Carolina) convened the State Climate Extremes Committee (SCEC) via teleconference to evaluate the validity of two potential maximum temperature records for the state of South Carolina. Hope requested Sam McCown of the National Climatic Data Center (NCDC) lead the discussion. The SCEC examined the June 29, 2012 maximum temperature readings of 113 degrees Fahrenheit at two Cooperative Observer stations in South Carolina: Johnston 4 SW (GHCND: USC 00384607; COOP 38460705) and Columbia University of South Carolina (GHCND: USC00381944; Coop 38194406). As a result of all SCEC participants having examined a comprehensive report ("South Carolina High Temperature Record Evaluation: NWS Cooperative sites reporting 113 °F, June 29, 2012") prepared by Wes Tyler of the SC State Climatologist's Office and Leonard Vaughan of the National Weather Service prior to the teleconference, a proposal to examine each record independently and to hold separate votes on each was unanimously supported. This report is attached to this Memorandum as Appendix A and is henceforth referred to as the "State Climatologist report."

After discussing the proposed Johnson 4 SW record and noting the lack of adherence to National Weather Service (NWS) standards in both instrument siting, exposure, and in the measuring of the observation, the SCEC voted unanimously (0-5) against accepting this record. However, after discussing the proposed Columbia University of South Carolina record, the SEC voted 4-1 to accept this as a new state record. Even though the same lack of adherence to NWS standard procedures in the measuring of the observation occurred here as did at Johnston 4 SW, the instrument siting and exposure conditions at Columbia Univ of SC were near NWS standards and the same maximum temperature reading of 113 °F occurred on a nearby thermometer maintained by the South Carolina Department of Health and Environmental Control (DHEC). Accordingly, I request that the NCDC Director approve the SCEC's decision regarding the Columbia University of South Carolina observation and recognize the 113 °F temperature which occurred on June 29, 2012 as the new South Carolina state record for maximum temperature.

## **Previous South Carolina Maximum Temperature State Records**

The previous maximum temperature of record in South Carolina was 111 °F established at Blackville on September 4, 1925, at Calhoun Falls on September 8, 1925, and most recently at Camden 2 WSW on June 27, 1954 (recorded as the 7 AM observation on June 28, 1954). Copies of the Special Observers' Meteorological Record for Blackville, Cooperative Observers' Meteorological Record for Calhoun Falls, and the Record of River and Climatological Observations for Camden 2 WSW are available in Appendix C.

The Blackville and Calhoun Falls records occurred during one of the most anomalous months for maximum temperatures and drought ever recorded in the Southeast U.S. The "General Summary" of the South Carolina "Climatological Data" publication for September 1925 states: "Unprecedented heat, with absolute maximum temperature records of all previous months broken, excessively high day temperatures for over three weeks, and monthly rainfall less than half the normal marked the weather of September, conditions that further intensified the record-breaking drought that has prevailed with comparatively little relief since January. All vegetation deteriorated incident to drought, large numbers

of forest trees died, forest fires became more numerous, even in swamp regions, many streams were the lowest of record, with hydro-electric power correspondingly reduced, and scarcity of water in the interior resulted in considerable premature marketing of stock; in fact, the whole countryside has assumed the ordinary mid-fall appearance." The "Temperature" section states: "The monthly mean for the Section, determined from reports of 41 stations was 81.7°, or 7.3° above the normal, and the highest September mean temperature of record. The highest temperature was 111° at Blackville on the 4<sup>th</sup> and at Calhoun Falls on the 8<sup>th</sup>, one degree higher than the previous Section absolute maximum temperature at Chester on July 18, 1887; …"

The 1954 Camden 2 WSW record also occurred during a month with both temperature and precipitation extremes. The June, 1954 South Carolina "Climatological Data" publication states "Extremes of weather characterized the month. Over the state as a whole it was the driest June on record, with an average rainfall of only 1.85 inches. ... All-time high temperature records were broken at many places, while the coolest weather of record for the time of year also occurred at some localities. ... The warmest day was the 27th ; practically every station had a temperature of 100° or higher that afternoon, and readings ranging from 105° to 107° were common. ... the hottest place of all was Camden 2 WSW, with 111°. This equals the all-time high temperature of record for South Carolina, and exceeds by three degrees the previous record for June. Despite these unseasonably high temperatures there were sufficient unseasonably cool days during the month to give the State for the month as a whole an average temperature which was only about one-half degree above normal. Precipitation during the month was quite variable in amount, ... The state average of 1.85 inches was 2.76 inches below normal for the month and was the least rainfall for June since the beginning of record in 1887; the driest June prior to 1954 was in 1905 when the average for the state was 1.95 inches."

## Synopsis of the 2012 Heat Wave

A synopsis of the 2012 heat wave in the Southeast was provided by Leonard Vaughan, Climate Service Program Manager of the National Weather Service Columbia SC and can be found on pages 38 – 46 of the State Climatologist report. According to Mr. Vaughan's analysis, a strong ridge of high pressure built over the Tennessee Valley into the Carolinas on June 29<sup>th</sup> through the 30<sup>th</sup>. The 850 mb temperatures on June 30 were forecast to range from 25 to 26° C (4.3 standard deviations above normal) and the 925 mb temperatures were expected to be 30 to 34° C (up to 5.6 standard deviations above normal). Mr. Vaughan also developed radiosonde histograms for Charleston, Greensboro, and Atlanta which showed that temperatures of 24-26 °C aloft at the 850 mb level have been extremely rare since the stations began in 1948 or 1955.

In addition to the ridge aloft, a thermal trough was expected to develop across the South Carolina Midlands on Friday afternoon, June 29. West of the trough a surface downslope flow would cause additional compressional heating thereby increasing the temperatures across the Midlands. The air mass was also dry for late June.

The result was record high temperatures recorded at Columbia WSO on June 29 and 30, and an all-time maximum temperature at Greer WSO on July 1. Many locations throughout the state recorded temperatures in the range from 105 - 110°F.

## **Evaluation of the Johnston 4 SW Observation**

The Johnston 4 SW Cooperative station is located in a fairly open agricultural area of rolling hills at 16 Cattle Drive in northeastern Edgefield County in west central South Carolina at 33° 46′ 39.0″N, 81° 50′

48.12"W. It is located at a private residence at an elevation of 189.0 meters (620 feet), and observations are taken by Mr. J. Olin Berry. The station has been taking observations at the same location since May 17, 1980 and in the general area since August 9, 1957. It is serviced by the Columbia Office of the National Weather Service, and the observed data are archived indefinitely by the NCDC.

The Johnston cooperative weather station was moved from a location 2.6 miles NNW of Johnston to its present location 4 miles SW of Johnston on May 17, 1980 where it has been since. Equipment includes a standard Cotton Region Shelter containing a NWS maximum mercury thermometer and a NWS Nimbus MMT sensor approximately 90 feet west-northwest of the NWS Cotton Region Shelter. In addition, the station's instrumentation includes a non-official Davis Weather Station placed in use about 25 years ago about 12 feet northwest of the NWS Cotton Region Shelter with a data feed to a computer monitor within the residence. The rain gage is a NWS 8 inch Standard Rain Gage with precipitation values measured to the nearest hundredth of an inch. On February 8, 2011, the reporting procedure was changed from a B-91 form to the use of Weather Coder 3 with the data being transmitted to the Columbia WFO. The observation time was continued as 0700 EST, which it had been since September 23, 1996. On August 6, 2012 (after the proposed record maximum temperature had been observed in June), the observation time was changed from 0700 EST to 0800 EST. The site is climatologically representative of the region, and the thermometer meets or exceeds instrument standards set forth by NOAA. However, the shelter location fails to meet siting standards due to surrounding farm equipment as is explained in detail by the attached State Climatologist report.

The monthly form of "Record of River and Climatological Observations" (WS Form B-91) dynamically generated from the Weather Coder 3 data for June 2012 for Johnston 4 SW is provided in Appendix B.

## **Station Inspections**

Inspections of the Johnston 4 SW station were conducted by Wes Tyler of the SC State Climatology Office and Leonard Vaughan of the Columbia WFO, who visited the observer's residence and evaluated the site for adherence to NWS recommended guidelines for obtaining weather observations and instrument siting requirements. Photographs of the current Johnston station taken during inspections on July 3 and July 26, 2012 are provided on pages 2, 4, 11, and 14 - 17 (images 1- 9) of the State Climatologist report. Pages 3 and 4 of this report summarize the surrounding farm equipment as noted during the July 3 inspection.

The 24 –hour maximum temperature value for Johnston 4 SW recorded at 7:00 AM on June 30, 2012 was 113° F, and this likely occurred on the afternoon of June 29, the previous day. The Davis Weather Station computer stores temperature observations and a review of the maximum temperature reading for June 29 showed a maximum reading of 106.6 °F at 4:00 PM. The MMT option to review past values for the previous 30 days was not engaged, so no comparison could be made.

After inspecting the Cotton Region Shelter on July 3 and finding it in good condition and proper orientation, a comparison was made between a standard NWS maximum mercury thermometer placed inside the shelter and the site's maximum mercury thermometer. At 10:30 AM, the MMT digital display read 88.8°F and the Davis instrument displayed 89.1°F. Within five minutes, both of the maximum mercury thermometers within the shelter were read by three individuals and each indicated an agreed temperature of approximately 94.8° F.

On July 26, Wes Tyler made a return visit to confirm the method used to make the maximum temperature observation and to make additional thermometer comparisons. The SC State Climatology

portable shelter was set up within 10 feet of the Cotton Region Shelter and Mr. Berry was asked to demonstrate his method of making a maximum temperature observation. Mr. Berry informed Mr. Tyler that he visually referenced the end of the mercury column while the thermometer was still in the locked horizontal resting position to obtain the value. He then released the Townsend support to spin the thermometer for resetting. Mr. Tyler informed Mr. Berry that the correct procedure was to release the Townsend support first and read the maximum value from the thermometer's vertical position. This reduces the chance of mercury column separation and parallax error. (NWS instructions regarding Cooperative Station Observations can be found on pages 52-54 of the attached State Climatologist report.)

A series of comparison readings were then made. The temperature at 2:35 PM for the Townsend supported thermometer in the locked and released vertical positions were both 101°F. Within one minute, the NWS Townsend supported mercury thermometer within the State Climatologist's portable shelter from the released vertical position was read as 98.5 F – a difference of 1.5 °F between the NWS Johnston thermometer and the SCO portable one. Additional readings taken at 2:50 PM and 3:00 PM showed an observed difference between the two thermometers of 2.2 °F, rising to 2.5 °F at 3:10 PM. After the portable shelter was moved to an open mowed lawn, comparison readings were made between the SCO portable thermometer and the NWS Johnston thermometer at 3:45 PM (difference of 2.5 °F) and at 4:00 PM (difference of 2.3 °F).

## Comparison with Other Divisional Stations

The State Climatologist report also compared the Johnston 4 SW station with surrounding stations during two previous heat waves including that of August 1983 and August 2007 (see page 18 of the report). During the August 1983 event, Johnston 4 SW observed a maximum of 106° on August 21 (and recorded on August 22). Four stations in the West Central Climate Division recorded higher temperatures during this event: 109°F at Aiken 5 SE, 108°F at Clark Hill 1 W and at Newberry, and 107°F at Saluda. Three stations recorded cooler maximum temperatures: 105°F at Greenwood and Calhoun Falls and 104°F at Little Mountain. Thus, in 1983 the Johnston 4 SW station observations were in the middle of those measured at nearby stations in the same Climate Division.

Twenty three years later in August, 2007, the Johnston 4 SW station recorded the hottest temperature not only in the entire West Central Climate Division at 110° F, but that was also the hottest temperature for that month in the entire state. The remaining stations in the Division recorded 107° F at Saluda, 106°F at Aiken 5 SE and Calhoun Falls, and 105°F at Calhoun Falls 1 W, Greenwood, and Little Mountain.

In June, 2012, the Johnston 4 SW station at 113°F tied as the hottest temperature in the entire state and also once again was the hottest in the West Central Climate Division. As was the case in 2007, other stations in the Division were cooler by several degrees with observers measuring 109°F at Saluda, 108°F at McCormick, 107°F at Little Mountain, 106°F at Calhoun Falls, 104° at Greenwood 8 NE and Newberry, and 100° at Clarks Hill 1 W.

## **Evaluation of the Columbia University of SC Observation**

The Columbia University of South Carolina Cooperative station is located near the Geology Building on the USC campus. This is in Richland County in central South Carolina at 33° 58′ 58.8″N, 81° 00′ 59.76″W. The station is located within a fenced area at an elevation of 73.76 meters (242 feet), and observations are taken by Mr. Mike Leitzke. The station has been taking observations at the same location since May 30, 1973 and in the general area since September 1, 1954. It is serviced by the

Columbia Office of the National Weather Service, and the observed data are archived indefinitely by the NCDC.

The Columbia USC cooperative weather station was moved from a location 1.2 miles SE of the Post Office in Columbia to near its present location on May 30, 1973 where it has remained since. Equipment includes a standard Cotton Region Shelter containing a NWS maximum mercury thermometer and a NWS 8 inch Standard Rain Gage with precipitation values measured to the nearest hundredth of an inch. The State Climatologist report indicates that a diagram dated June 25, 1992 displays a hand drawn schematic of a fenced area containing only the Cotton Region Shelter and a pair of rain gauges. In November of 1998, the SC Department of Health and Environmental Control (DHEC) placed a raised wooden platform supporting multiple environmental sampling units within the fenced area. Current photographs of the station are contained in the State Climatologist report on pages 21 and 22 (Images 10 -13). On February 8, 2011, the reporting procedure was changed from a B-91 form to the use of Weather Coder 3 with data being transmitted to the Columbia WFO. The observation time was continued as 1700 EST, which it has been since the station's beginning. The site is climatologically representative of the region, which is described as being a college campus in an area of rolling hills with an urban area. The thermometer meets or exceeds instrument standards set forth by NOAA.

The monthly form of "Record of River and Climatological Observations" (WS Form B-91) dynamically generated from the Weather Coder 3 data for June 2012 for Columbia USC is provided in Appendix B.

## **Station Inspections**

An inspection of the Columbia USC station was conducted on July 7, 2012 by Wes Tyler of the SC State Climatology Office and by Dr. Cary Mock, Professor of Climatology and shared administrator of observing duties at the site. At 4:05 PM, Wes Tyler placed inside the shelter the same standard NWS maximum mercury thermometer used to compare against the Johnston thermometer. After one hour had passed, both thermometers were read by Dr. Mock and by Mr. Tyler and were identical in displaying 102° F. During the hour, Mr. Tyler and Dr. Mock had made tape measurements from the nearest point of the shelter to the sampling DHEC sampling units within the fenced area. These measurements are included in an explanation of the DHEC Sampling units by April Hiscox and Scott Reynolds and are found within the State Climatologist Report on pages 27 - 36. Additional measurements included the fact that 61 feet northeast of the shelter is an asphalt sidewalk that adjoins Bull Street, and Bates House student dormitories 10 floors high are at an estimated 200 feet south of the shelter. By 5:30 PM, the USC observer has not arrived to take the usual observation, so a note was left by Dr. Mock indicating what the maximum reading had been. Before leaving the fenced area, a stainless steel shovel estimated as 8 inches x 5 inches was found atop the Shelter and was removed.

The 24 –hour maximum temperature value for Columbia USC recorded at 17:00 (5:00 PM) on June 29, 2012 was 113° F, and the temperature at the time of observation was 110 °F. On July 12, Mr. Tyler met Mr. Mike Leitzke, the Columbia USC observer, for an interview to determine how the maximum and minimum temperatures derived from the Townsend-supported NWS standard mercury maximum and alcohol minimum thermometers had been made on June 29. Mr. Leitzke was asked to demonstrate his method of measurement. As was the case in the reading of the Johnston 4 SW maximum temperature, the observer incorrectly visually referenced the end of the mercury column while the thermometer was still in the locked horizontal resting position to obtain the value. He then released the Townsend support to spin the thermometer for resetting. Mr. Tyler informed Mr. Leitzke that the correct procedure was to release the Townsend support first and read the maximum value from the

thermometer's vertical position. In this case, the difference between the horizontal and vertical positions was one degree F.

On July 16, 2012, Mr. Tyler was accompanied by April Hiscox, USC Department of Geography and administrator of the USC NWS Coop site responsibilities, for an explanation of the DHEC sampling units. This was followed on July 18 by a detailed phone conversation with Scott Reynolds, SC DHEC Bureau of Environmental Services, who maintains the instruments. Each of the eight units is described on page 28 of the SC State Climatologist report. A temperature graph for June 29, 2012 taken by the tripodmounted BetaTherm instrument was supplied by April Hiscox on July 18 and it indicated a maximum value of 111.2° F. Five minute-averaged temperatures from a "Bates Reference" thermometer of a R&P Particulate Monitor PM 2.5 (Unit 3) showed a maximum of 112.28 °F at 4:30 PM EDT on June 29 and from the "Bates Duplicate" thermometer of a R&P Particulate Monitor PM 2.5 (Unit 4) showed a maximum of 112.82° F, also at 4:30 PM EDT on June 29. The highest sampled value was 113.2° F, but it is unknown as to which unit or time made the measurement. A visit to compare temperatures between SCO portable shelter and on-site DHEC instruments was made on July 24, and these results are described in pages 31-36 of the State Climatologist report. Unlike the Johnston readings where there were several degrees difference between the thermometers, the USC Columbia maximum value of 100 ° F on this date was similar to the maximum reading by the thermometer within the portable shelter, and the Bates monitors were also similar with the maximum 5-minute averages between 3:30 PM – 5:30 PM EDT being 98.6°F on both. On July 24, the BetaTherm thermometer reached a maximum of 99.9 °F at 18:00 EDT.

#### Conclusion

On Monday, October 15, 2012, the SCEC first voted unanimously (5-0) to reject the 113° F maximum temperature recorded at Johnston 4 SW on June 29, 2012 as the new state record for South Carolina. During a second voting round, the SCEC voted 4-1 to recognize the 113° F maximum temperature recorded at Columbia University of South Carolina on June 29, 2012 as the state record for all-time maximum temperature for South Carolina. The dissenting vote was by Hope Mizzell, SC State Climatologist, who expressed her belief that the discrepancies caused by the error in measuring procedure and in siting requirements was sufficient to invalidate the record. These problems and those at the Johnston 4 SW station are detailed in the "Summary Findings' on the State Climatology report on pages 55 and 56.

#### Acknowledgements

NCDC expresses its thanks for the excellent work from both the South Carolina State Climatologist Office and the Columbia Weather Forecast Office in collecting and analyzing data and supplying a very comprehensive report concerning measurements made at both Johnston 4 SW and at Columbia USC. We especially would like to thank Wes Tyler, Assistant State Climatologist for Service of the SC state Climatology Office and Leonard Vaughan, Climate Service Program Manager of the National Weather Service Office of Columbia, SC for writing the report. In addition, we also would like to thank Wes for conducting several site visits and providing metadata and station photos included in the report.

#### **State Climate Extremes Committee Members:**

Kimberly Campbell, Meteorologist-In-Charge, National Weather Service, Columbia WFO (Voting) Kevin Murray, Public Information Officer, NWS Eastern Region Headquarters (Voting) Dr. Hope Mizzell, South Carolina State Climatologist, SC Department of Natural Resources (Voting)
Dr. Charles E. Konrad II, Director, Southeast Regional Climate Center (Voting)
Wes Tyler, Assistant SC State Climatologist for Service, SC Department of Natural Resources
Leonard Vaughan, Climate Service Program Manager, National Weather Service, Columbia WFO
Sam McCown, User Engagement and Services Branch, National Climatic Data Center (Voting)

## Appendix A



South Carolina State Climatology Office

# South Carolina High Temperature Record Evaluation: NWS Cooperative sites reporting 113 °F, June 29, 2012





Prepared by:

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## Introduction:

On the afternoon of June 29, 2012, the Columbia Office of the National Weather Service was notified by the Johnston 4SW COOP observer, Olin Berry, and the Columbia USC COOP observer, Mike Leitzke, that each site had recorded a maximum temperature of 113 °F. It is the standard practice at Johnston 4SW to make observations of temperature and precipitation at 7 AM\*. Although Mr. Berry did call the Columbia NWS on Friday, June 29, 2012, his official observation was made the following morning, June 30, 2012, at 7 AM and recorded as 113 °F for the 24-hours ending that date. The Columbia USC site makes their official observation daily at 5 PM and the 113 degree value was recorded on June 29, 2012.

The South Carolina State Climatology Office contacted Deke Arndt of the National Climatic Data Center in Asheville, NC for procedures to conduct an impartial evaluation as to the authenticity and acceptance of the possible state record highest temperature. NCDC informed us that the local National Weather Service office should coordinate a joint review effort with the State Climatology Office and present the findings, including a site visit with interviews, histories, photography and any measurements that could support that the site meets the guidelines for standardized observations and expectations for exposure. The draft report would then be distributed to the State Climate Extremes Committee, consisting of representatives from the Eastern Region National Weather Service, the NOAA Regional Climate Centers, the National Climatic Data Center, the Columbia National Weather Service Office and the SC State Climatology Office. Each recipient of the draft would be given an opportunity to respond with any suggestions, questions, challenges or remarks regarding the draft. Once all five parties had reviewed the original draft and discussed the findings, a separate vote would be taken to approve/not approve/not approve with recommendations for changed values for either Johnston or Columbia USC. The committee's final decision would be presented to Tom Karl, Director of the National Climatic Data Center. Dr. Karl's endorsement would make the values official for recordkeeping.

Weather records held by the National Climatic Data Center in Asheville, NC, and within the SC State Climatology Office in Columbia indicate the official highest temperature of record in South Carolina is a shared value of 111 °F at Blackville on September 4, 1925, at Calhoun Falls on September 8, 1925, and at Camden 2WSW on June 28, 1954 (noted in the text records as the 7AM observation of June 29, 1954).

The Blackville observation on September 4, 1925, was surrounded on the same date by the closest numerical values of 110 °F at Garnett, Society Hill and Santuck. The Calhoun Falls observation on September 8, 1925, was surrounded on the same date by the closest numerical values of 106 °F at Newberry and Trenton (Trenton 108 on September 7). The Camden observation in 1954 was surrounded on the same date by the closest numerical values of 108 °F at Society Hill, Aiken, Florence and Marion.

\*It occurred to Wes Tyler on July 11, 2012, that Mr. Berry's Friday, June 29, 2012, observation may have been made from the Townsend supported locked horizontal maximum mercury thermometer position.

## Johnston history and site visit, July 3, 2012:

The US Department of Commerce Substation History indicates that the Johnston, SC, COOP site has made daily weather observations since:

August 1957 – August 1975 Mr. Mark T Boatwright (2.0 mile SSW) August 1975 – November 1976 Mr. Henry S Crouch (1.9 miles SW) November 1976 – August 1979 Mr. John G Shealy (2.7 miles NNW) August 1979 – April 1980 Mr. W R Pennington (2.6 miles NNW) May 1980 to present Mr. Olin Berry (4 Miles SW)

Johnston is located in eastern Edgefield County at the geographical coordinates of 33 ° 47' N by 81 ° 51' W at an elevation of 620 feet above sea level. The landscape is a mostly rural, rolling terrain of farm operations that include pasture land, row crops and peach orchards. The countryside is broken by forested areas that contain hard and softwood species.



### Johnston 4SW (16 Cattle Drive)

On July 3, 2012, Wes Tyler and Leonard Vaughan arrived at the residence of Olin Berry, 16 Cattle Drive, Johnston, SC, at 9:30 AM EDT to evaluate the site to satisfy the NWS recommended guidelines for taking daily weather observations and to interview Olin Berry.

On July 3, 2012, the ground appeared dry and there was visible stress to non-irrigated corn and grasses within the county. Although Johnston's most recent rain (prior to the recorded 113 °F) was 0.03 inches for the 24-hours ending 7 AM on June 25, the next previous rainfalls were noted on June 11 (1.17"), June 12 (0.28") and June 13 (1.05") yielding that three-day total of 2.50".

In addition to the NWS Cotton Region Shelter at the Johnston site, there is a Davis Weather Station (placed in use about 25 years ago) on a tripod provided by the Clemson University Extension Service (approximately 12 feet to the northwest of the NWS COOP shelter) with a data feed to a computer monitor in the residence and a NWS Nimbus MMT sensor approximately 90 feet west-northwest of the NWS Cotton Region Shelter with a digital temperature display in the residence.

Our first task was to inspect the Cotton Region Shelter and to compare the present temperature values by placing a separate and identical standard NWS maximum mercury thermometer on the inside shaded wooden frame "bridge" about one inch above the Townsend support apparatus that secures both the site's maximum mercury thermometer and alcohol-filled minimum thermometer. This secondary NWS maximum mercury thermometer was reset and placed in the shelter at 9:35 AM and left in the shelter for approximately one hour before the values were compared.

The shelter appeared in good condition with no structural weaknesses, wood decay or restrictions to ventilation. A handheld compass was used to determine the orientation. The placement of the shelter was very close to true north (350°) for the front door opening and (170°) south for the rear. The official high temperature observation at Johnston 4SW is made from the NWS maximum mercury thermometer.

An electric wire fence runs along the eastern side (about 8 feet from the shelter) to contain a small herd of cattle in a grass field used for grazing with no obstructions to the eastern horizon. On the south, west and north directions away from the shelter are various farm implements ranging from chemical sprayers, rolls of fence wire, rusting steel tanks, discarded lumber, scrap metal, plumbing parts and an open steel bed parked utility trailer (Images 1, 2, 3). Mature hardwood trees surrounded the temperature shelter on the south, west and north quadrants within a 100 foot distance.

Measurements were made using a 50-foot cloth tape away from the nearest part of the shelter. The unpainted, rusty propane tank (estimated 6 feet in length by 4 feet in diameter) was 10.5 feet to the south of the shelter. A yellowed/clear polypropylene herbicide sprayer (estimated to hold 100 gallons) was 4.5 feet to the southwest of the shelter. An open and empty rusty steel bed utility trailer (estimated 10 feet by 8 feet) was 15 feet to the west-southwest of the shelter. We were told by Mr. Berry that the utility trailer was parked there maybe a week before the 113 degree temperature was observed. A painted (light gray) steel "mister" was 11.5 feet to the northwest of shelter. A large metal out-building was positioned behind the shelter and adjacent to the electric fence wire. From a distant photo image it

was estimated to be 50 feet south of the shelter. The structure is unique in that the exposed southeast facing walls are painted metal (light in color) that begin at ground level and are angled perhaps 20 degrees at the top leaning northwest to an estimated height of 15 feet. The metal covered building (placed in the 1970's) measured 40'X 48' with a 13 foot door.

The MMT sensor is located in an open space (date of placement unknown at this time), quite near a waste/wood burning furnace (placed in 2003) that provides heat and hot water to the home and measured 16.5 feet to the south of that sensor. This furnace was in operation during our visit and operates year round. The unit is estimated to be the size of a large home kitchen refrigerator with an exhaust/smoke stack rising 3 feet above the unit. We were told it produces internal temperatures of up

to 1200 °F. Nearly surrounding the MMT sensor was a knee-high woodpile used to feed the furnace.

Image 1 (right): Steel bed utility trailer (lower left) Polypropylene sprayer (center) Steel propane tank (right middle)

Image 2 (lower left): Shelter, looking south

Image 3 (lower right): Shelter, looking west from pasture







Our interview with Olin Berry was conducted in his home where the temperature values for the MMT and Davis are displayed.

Below are the 24-hour maximum temperature values Mr. Berry recorded by visually reading the NWS maximum mercury thermometers at his "nearest to" 7:00 AM observation:

Friday, June 29, 2012 - 103 °F and reset Saturday, June 30, 2012 - 113 °F and reset Sunday, July 1, 2012 - 111 °F and reset

It should be noted that the maximum temperature value entered on Saturday morning is for the previous 24-hours and is most likely (unless proven otherwise) to have occurred the day before. The observer's handwritten daily observation form displays the date of when the value was read.

The Davis Weather Station computer stores the temperature observations and will allow the user to review each date's highest temperature value and time (EDT). Shown below:

Friday, June 29, 2012 - 106.6 °F at 4:00 PM Saturday, June 30, 2012 - 106.0 °F at 2:30 PM Sunday, July 1, 2012 - 102.6 °F at 2:00 PM

The MMT option to review past values at Johnston 4SW for the past 30 days was not engaged.

At 10:30 AM on July 3, 2012, the Johnston 4SW MMT digital display indicated 88.8 °F while at the same time the Davis instrument displayed 89.1 °F. Within five minutes, both of the NWS mercury-filled maximum thermometers in the Cotton Region Shelter were read in their resting horizontal position by three observers and each thermometer indicated an agreed temperature of 94.8 °F (higher than 94.5°F, but not 95°F).

The nearest NWS COOP sites reporting high temperatures for Friday, June 29, 2012, with approximate distance in miles and direction from Johnston 4SW in parenthesis (from 7AM reports June 30):

| Saluda Filter Plant | 109°F | (13 miles N)   |
|---------------------|-------|----------------|
| McCormick           | 108°F | (34 miles W)   |
| Batesburg           | 106°F | (17 miles ENE) |
| Clarks Hill         | 105°F | (31 miles WSW) |

Nearby airport high temperature observations for Friday, June 29, 2012:KAIK Aiken, SC AP105.8 °F (21 miles S) AWOS IIIKDNL Augusta, GA "Daniel" AP107°F (32 miles SW) ASOSKGRD Greenwood, SC AP105.1°F (35 miles NW) ASOS

## History for Aiken, SC KAIK AP

Friday, June 29, 2012

| Time              | Temp.    | Heat     | Dew              | Humid      | Pressure | Visibility | /Wind Di | rWind Speed | dGust Spee | dPrecipEvent | sConditions |
|-------------------|----------|----------|------------------|------------|----------|------------|----------|-------------|------------|--------------|-------------|
| (LDT)<br>12.15 AM | 78 8 °E  | inuex    | FUIIL<br>64 4 °E | 11y<br>61% | 20 08 in | 10.0 mi    | Calm     | Calm        | _          | Ν/Λ          | Clear       |
| 12.15 AM          | 78.8°F   | _        | 64.4 °E          | 61%        | 29.90 m  | 10.0 mi    | Calm     | Calm        | _          | N/A          | Clear       |
| 12:55 AM          | 77.0°F   | -        | 64.4 °F          | 65%        | 29.90 in | 10.0 mi    | SW       | 4.6 mph     | _          | N/A          | Clear       |
| 1:15 AM           | 77.0 °F  | -        | 64.4 °F          | 65%        | 29.97 in | 10.0 mi    | Calm     | Calm        | -          | N/A          | Clear       |
| 1:35 AM           | 77.0 °F  | -        | 64.4 °F          | 65%        | 29.97 in | 10.0 mi    | SSW      | 3.5 mph     | -          | N/A          | Clear       |
| 1:55 AM           | 75.2 °F  | -        | 64.4 °F          | 69%        | 29.96 in | 10.0 mi    | SW       | 3.5 mph     | -          | N/A          | Clear       |
| 2:15 AM           | 75.2 °F  | -        | 64.4 °F          | 69%        | 29.96 in | 10.0 mi    | SW       | 4.6 mph     | -          | N/A          | Clear       |
| 2:55 AM           | 75.2 °F  | -        | 64.4 °F          | 69%        | 29.95 in | 10.0 mi    | SW       | 4.6 mph     | -          | N/A          | Clear       |
| 3:15 AM           | 75.2 °F  | -        | 64.4 °F          | 69%        | 29.95 in | 10.0 mi    | SW       | 5.8 mph     | -          | N/A          | Clear       |
| 3:35 AM           | 73.4 °F  | -        | 64.4 °F          | 73%        | 29.94 in | 10.0 mi    | SW       | 5.8 mph     | -          | N/A          | Clear       |
| 3:55 AM           | 73.4 °F  | -        | 64.4 °F          | 73%        | 29.93 in | 10.0 mi    | WSW      | 6.9 mph     | -          | ,<br>N/A     | Clear       |
| 4:15 AM           | 73.4 °F  | -        | 64.4 °F          | 73%        | 29.94 in | 10.0 mi    | WSW      | 6.9 mph     | -          | ,<br>N/A     | Clear       |
| 4:35 AM           | 73.4 °F  | -        | 64.4 °F          | 73%        | 29.93 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A          | Clear       |
| 4:55 AM           | 73.4 °F  | -        | 64.4 °F          | 73%        | 29.93 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A          | Clear       |
| 5:15 AM           | 71.6 °F  | -        | 64.4 °F          | 78%        | 29.93 in | 10.0 mi    | WSW      | 6.9 mph     | -          | N/A          | Clear       |
| 5:35 AM           | 71.6 °F  | -        | 64.4 °F          | 78%        | 29.93 in | 10.0 mi    | WSW      | 4.6 mph     | -          | N/A          | Clear       |
| 5:55 AM           | 71.6 °F  | -        | 64.4 °F          | 78%        | 29.94 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A          | Clear       |
| 6:15 AM           | 71.6 °F  | -        | 64.4 °F          | 78%        | 29.94 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A          | Clear       |
| 6:35 AM           | 71.6 °F  | -        | 64.4 °F          | 78%        | 29.95 in | 10.0 mi    | WSW      | 4.6 mph     | -          | N/A          | Clear       |
| 6:55 AM           | 71.6 °F  | -        | 64.4 °F          | 78%        | 29.95 in | 10.0 mi    | WSW      | 4.6 mph     | -          | N/A          | Clear       |
| 7:15 AM           | 71.6 °F  | -        | 64.4 °F          | 78%        | 29.95 in | 10.0 mi    | West     | 4.6 mph     | -          | N/A          | Clear       |
| 7:35 AM           | 75.2 °F  | -        | 66.2 °F          | 73%        | 29.95 in | 10.0 mi    | West     | 4.6 mph     | -          | N/A          | Clear       |
| 7:55 AM           | 77.0 °F  | -        | 66.2 °F          | 69%        | 29.95 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A          | Clear       |
| 8:15 AM           | 78.8 °F  | -        | 68.0 °F          | 69%        | 29.96 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A          | Clear       |
| 8:35 AM           | 80.6 °F  | 83.2 °F  | 68.0 °F          | 65%        | 29.96 in | 10.0 mi    | West     | 6.9 mph     | -          | N/A          | Clear       |
| 8:55 AM           | 82.4 °F  | 85.4 °F  | 68.0 °F          | 62%        | 29.96 in | 10.0 mi    | West     | 5.8 mph     | -          | N/A          | Clear       |
| 9:15 AM           | 82.4 °F  | 85.4 °F  | 68.0 °F          | 62%        | 29.96 in | 10.0 mi    | WNW      | 5.8 mph     | -          | N/A          | Clear       |
| 9:35 AM           | 86.0 °F  | 89.4 °F  | 68.0 °F          | 55%        | 29.96 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A          | Clear       |
| 9:55 AM           | 87.8 °F  | 91.4 °F  | 68.0 °F          | 52%        | 29.95 in | 10.0 mi    | West     | 4.6 mph     | -          | N/A          | Clear       |
| 10:15 AM          | 89.6 °F  | 93.4 °F  | 68.0 °F          | 49%        | 29.95 in | 10.0 mi    | NW       | 3.5 mph     | -          | N/A          | Clear       |
| 10:35 AM          | 91.4 °F  | 94.0 °F  | 66.2 °F          | 43%        | 29.95 in | 10.0 mi    | WNW      | 3.5 mph     | -          | N/A          | Clear       |
| 10:55 AM          | 93.2 °F  | 97.7 °F  | 68.0 °F          | 44%        | 29.95 in | 10.0 mi    | Calm     | Calm        | -          | N/A          | Clear       |
| 11:15 AM          | 95.0 °F  | 99.5 °F  | 68.0 °F          | 41%        | 29.95 in | 10.0 mi    | WNW      | 5.8 mph     | -          | N/A          | Clear       |
| 11:35 AM          | 96.8 °F  | 100.7 °F | 66.2 °F          | 37%        | 29.95 in | 10.0 mi    | NNW      | 6.9 mph     | -          | N/A          | Clear       |
| 11:55 AM          | 98.6 °F  | 101.0 °F | 64.4 °F          | 32%        | 29.95 in | 10.0 mi    | NW       | 6.9 mph     | -          | N/A          | Clear       |
| 12:15 PM          | 98.6 °F  | 101.0 °F | 64.4 °F          | 32%        | 29.95 in | 10.0 mi    | NE       | 4.6 mph     | -          | N/A          | Clear       |
| 12:35 PM          | 100.4 °F | 102.4 °F | 62.6 °F          | 29%        | 29.94 in | 10.0 mi    | NNE      | 6.9 mph     | -          | N/A          | Clear       |
| 12:55 PM          | 102.2 °F | 104.2 °F | 62.6 °F          | 27%        | 29.94 in | 10.0 mi    | NNW      | 5.8 mph     | -          | N/A          | Clear       |
| 1:35 PM           | 104.0 °F | 105.3 °F | 60.8 °F          | 24%        | 29.93 in | 10.0 mi    | ENE      | 5.8 mph     | -          | N/A          | Clear       |
| 1:55 PM           | 104.0 °F | 105.3 °F | 60.8 °F          | 24%        | 29.92 in | 10.0 mi    | NE       | 4.6 mph     | -          | N/A          | Clear       |
| 2:15 PM           | 105.8 °F | 107.5 °F | 60.8 °F          | 23%        | 29.92 in | 10.0 mi    | North    | 8.1 mph     | -          | N/A          | Clear       |
| 2:35 PM           | 105.8 °F | 107.5 °F | 60.8 °F          | 23%        | 29.91 in | 10.0 mi    | ENE      | 10.4 mph    | -          | N/A          | Clear       |
| 2:55 PM           | 105.8 °F | 107.5 °F | 60.8 °F          | 23%        | 29.90 in | 10.0 mi    | North    | 4.6 mph     | -          | N/A          | Clear       |
| 3:15 PM           | 105.8 °F | 107.5 °F | 60.8 °F          | 23%        | 29.90 in | 10.0 mi    | Calm     | Calm        | -          | N/A          | Clear       |
| 3:35 PM           | 105.8 °F | 107.5 °F | 60.8 °F          | 23%        | 29.89 in | 10.0 mi    | SW       | 4.6 mph     | -          | N/A          | Clear       |
| 3:55 PM           | 105.8 °F | 107.5 °F | 60.8 °F          | 23%        | 29.88 in | 10.0 mi    | Calm     | Calm        | -          | N/A          | Clear       |
| 4:15 PM           | 105.8 °F | 107.5 °F | 60.8 °F          | 23%        | 29.88 in | 10.0 mi    | South    | 4.6 mph     | -          | N/A          | Clear       |
| 4:35 PM           | 105.8 °F | 108.3 °F | 62.6 °F          | 24%        | 29.87 in | 10.0 mi    | South    | 4.6 mph     | -          | N/A          | Clear       |
| 4:55 PM           | 105.8 °F | 108.3 °F | 62.6 °F          | 24%        | 29.87 in | 10.0 mi    | South    | 3.5 mph     | -          | N/A          | Clear       |

| Time     | Tomp     | Heat     | Dew     | Humid | Droccure | Vicibility | Wind Di   | rWind Space | dCust Space | DracipEvant | Conditions  |
|----------|----------|----------|---------|-------|----------|------------|-----------|-------------|-------------|-------------|-------------|
| (EDT)    | remp.    | Index    | Point   | ity   | Pressure | VISIDIIIU  | y wind Di | i winu spee | udust speed |             | sconultions |
| 5:15 PM  | 105.8 °F | 108.3 °F | 62.6 °F | 24%   | 29.87 in | 10.0 mi    | West      | 3.5 mph     | -           | N/A         | Clear       |
| 5:55 PM  | 105.8 °F | 108.3 °F | 62.6 °F | 24%   | 29.86 in | 10.0 mi    | Calm      | Calm        | -           | N/A         | Clear       |
| 6:15 PM  | 105.8 °F | 107.5 °F | 60.8 °F | 23%   | 29.85 in | 10.0 mi    | WNW       | 4.6 mph     | -           | N/A         | Clear       |
| 6:35 PM  | 104.0 °F | 107.4 °F | 64.4 °F | 27%   | 29.85 in | 10.0 mi    | South     | 6.9 mph     | -           | N/A         | Clear       |
| 7:15 PM  | 102.2 °F | 110.0 °F | 69.8 °F | 35%   | 29.85 in | 10.0 mi    | South     | 5.8 mph     | -           | N/A         | Clear       |
| 7:35 PM  | 100.4 °F | 106.3 °F | 68.0 °F | 35%   | 29.85 in | 10.0 mi    | South     | 3.5 mph     | -           | N/A         | Clear       |
| 7:55 PM  | 98.6 °F  | 104.1 °F | 68.0 °F | 37%   | 29.85 in | 10.0 mi    | SSW       | 8.1 mph     | -           | N/A         | Clear       |
| 8:15 PM  | 96.8 °F  | 101.8 °F | 68.0 °F | 39%   | 29.85 in | 10.0 mi    | SSW       | 9.2 mph     | -           | N/A         | Clear       |
| 8:35 PM  | 95.0 °F  | 99.5 °F  | 68.0 °F | 41%   | 29.85 in | 10.0 mi    | SSW       | 6.9 mph     | -           | N/A         | Clear       |
| 9:15 PM  | 91.4 °F  | 94.0 °F  | 66.2 °F | 43%   | 29.86 in | 10.0 mi    | SSW       | 5.8 mph     | -           | N/A         | Clear       |
| 9:35 PM  | 89.6 °F  | 92.2 °F  | 66.2 °F | 46%   | 29.86 in | 10.0 mi    | SSW       | 6.9 mph     | -           | N/A         | Clear       |
| 9:55 PM  | 89.6 °F  | 91.1 °F  | 64.4 °F | 43%   | 29.87 in | 10.0 mi    | SW        | 4.6 mph     | -           | N/A         | Clear       |
| 10:15 PM | 87.8 °F  | 89.4 °F  | 64.4 °F | 46%   | 29.88 in | 10.0 mi    | SW        | 4.6 mph     | -           | N/A         | Clear       |
| 10:35 PM | 87.8 °F  | 90.4 °F  | 66.2 °F | 49%   | 29.88 in | 10.0 mi    | Calm      | Calm        | -           | N/A         | Clear       |
| 10:55 PM | 86.0 °F  | 88.2 °F  | 66.2 °F | 51%   | 29.89 in | 10.0 mi    | SW        | 3.5 mph     | -           | N/A         | Clear       |
| 11:15 PM | 86.0 °F  | 89.4 °F  | 68.0 °F | 55%   | 29.88 in | 10.0 mi    | SSW       | 4.6 mph     | -           | N/A         | Clear       |
| 11:35 PM | 82.4 °F  | 85.4 °F  | 68.0 °F | 62%   | 29.89 in | 10.0 mi    | Calm      | Calm        | -           | N/A         | Clear       |
| 11:55 PM | 84.2 °F  | 87.3 °F  | 68.0 °F | 58%   | 29.88 in | 10.0 mi    | Calm      | Calm        | -           | N/A         | Clear       |

# History for Augusta, GA KDNL Daniel AP Friday, June 29, 2012

| Time (EDT) | Temp.    | Heat Index | Dew Point | Humidity | Pressure | Visibility | Wind Dir | Wind Speed | Gust Speed | Prec | Conditions |
|------------|----------|------------|-----------|----------|----------|------------|----------|------------|------------|------|------------|
| 12:53 AM   | 82.0 °F  | 82.4 °F    | 60.1 °F   | 47%      | 29.93 in | 10.0 mi    | SW       | 3.5 mph    | -          | N/A  | Clear      |
| 1:53 AM    | 80.1 °F  | 80.9 °F    | 60.1 °F   | 50%      | 29.92 in | 10.0 mi    | SW       | 3.5 mph    | -          | N/A  | Clear      |
| 2:53 AM    | 80.1 °F  | 81.1 °F    | 61.0 °F   | 52%      | 29.91 in | 10.0 mi    | Calm     | Calm       | -          | N/A  | Clear      |
| 3:53 AM    | 79.0 °F  | -          | 62.1 °F   | 56%      | 29.89 in | 10.0 mi    | Variable | 4.6 mph    | -          | N/A  | Clear      |
| 5:53 AM    | 77.0 °F  | -          | 64.0 °F   | 64%      | 29.90 in | 10.0 mi    | Calm     | Calm       | -          | N/A  | Clear      |
| 6:53 AM    | 77.0 °F  | -          | 64.9 °F   | 66%      | 29.91 in | 10.0 mi    | WNW      | 3.5 mph    | -          | N/A  | Clear      |
| 8:53 AM    | 82.0 °F  | 84.1 °F    | 66.0 °F   | 58%      | 29.92 in | 10.0 mi    | Variable | 4.6 mph    | -          | N/A  | Clear      |
| 9:53 AM    | 86.0 °F  | 87.6 °F    | 64.9 °F   | 49%      | 29.92 in | 10.0 mi    | NW       | 6.9 mph    | -          | N/A  | Clear      |
| 10:53 AM   | 91.0 °F  | 93.0 °F    | 64.9 °F   | 42%      | 29.91 in | 10.0 mi    | Variable | 3.5 mph    | -          | N/A  | Clear      |
| 11:53 AM   | 96.1 °F  | 96.9 °F    | 62.1 °F   | 32%      | 29.91 in | 10.0 mi    | Calm     | Calm       | -          | N/A  | Clear      |
| 12:53 PM   | 100.0 °F | 101.2 °F   | 61.0 °F   | 28%      | 29.90 in | 10.0 mi    | Variable | 3.5 mph    | -          | N/A  | Clear      |
| 1:53 PM    | 102.9 °F | 103.0 °F   | 59.0 °F   | 23%      | 29.88 in | 10.0 mi    | Calm     | Calm       | -          | N/A  | Clear      |
| 2:53 PM    | 102.9 °F | 103.0 °F   | 57.9 °F   | 23%      | 29.86 in | 10.0 mi    | Variable | 3.5 mph    | -          | N/A  | Clear      |
| 3:53 PM    | 105.1 °F | 104.4 °F   | 55.9 °F   | 20%      | 29.83 in | 10.0 mi    | Calm     | Calm       | -          | N/A  | Clear      |
| 4:53 PM    | 106.0 °F | 103.9 °F   | 53.1 °F   | 17%      | 29.82 in | 10.0 mi    | SW       | 3.5 mph    | -          | N/A  | Clear      |
| 5:53 PM    | 106.0 °F | -          | 50.0 °F   | 15%      | 29.81 in | 10.0 mi    | SSW      | 6.9 mph    | -          | N/A  | Clear      |
| 6:53 PM    | 102.9 °F | 103.6 °F   | 60.1 °F   | 24%      | 29.80 in | 10.0 mi    | South    | 8.1 mph    | -          | N/A  | Clear      |
| 7:53 PM    | 99.0 °F  | 100.5 °F   | 63.0 °F   | 30%      | 29.81 in | 10.0 mi    | South    | 9.2 mph    | -          | N/A  | Clear      |
| 8:53 PM    | 96.1 °F  | 97.3 °F    | 63.0 °F   | 33%      | 29.81 in | 10.0 mi    | South    | 6.9 mph    | -          | N/A  | Clear      |
| 9:53 PM    | 93.0 °F  | 94.6 °F    | 64.0 °F   | 38%      | 29.82 in | 10.0 mi    | SSW      | 3.5 mph    | -          | N/A  | Clear      |
| 10:53 PM   | 91.0 °F  | 92.6 °F    | 64.0 °F   | 41%      | 29.83 in | 10.0 mi    | SSW      | 4.6 mph    | -          | N/A  | Clear      |
| 11:53 PM   | 88.0 °F  | 90.3 °F    | 66.0 °F   | 48%      | 29.83 in | 10.0 mi    | SSW      | 5.8 mph    | -          | N/A  | Clear      |

## History for Greenwood, SC KGRD AP

Friday, June 29, 2012

| Time (EDT | ) Temp.  | Heat<br>Index | Dew Poin | t Humidity | Pressure | Visibility | Wind<br>Dir | Wind Speed | Gust<br>Speed | Precip | Conditions |
|-----------|----------|---------------|----------|------------|----------|------------|-------------|------------|---------------|--------|------------|
| 12:56 AM  | 82.0 °F  | 82.4 °F       | 60.1 °F  | 47%        | 29.92 in | 10.0 mi    | WSW         | 4.6 mph    | -             | N/A    | Clear      |
| 1:56 AM   | 78.1 °F  | -             | 60.1 °F  | 54%        | 29.91 in | 10.0 mi    | WSW         | 5.8 mph    | -             | N/A    | Clear      |
| 2:56 AM   | 79.0 °F  | -             | 60.1 °F  | 52%        | 29.90 in | 10.0 mi    | WSW         | 6.9 mph    | -             | N/A    | Clear      |
| 3:56 AM   | 75.9 °F  | -             | 60.1 °F  | 58%        | 29.89 in | 10.0 mi    | WSW         | 3.5 mph    | -             | N/A    | Clear      |
| 4:56 AM   | 70.0 °F  | -             | 62.1 °F  | 76%        | 29.89 in | 10.0 mi    | West        | 3.5 mph    | -             | N/A    | Clear      |
| 5:56 AM   | 69.1 °F  | -             | 62.1 °F  | 78%        | 29.91 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 6:56 AM   | 72.0 °F  | -             | 61.0 °F  | 68%        | 29.91 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 7:56 AM   | 75.9 °F  | -             | 63.0 °F  | 64%        | 29.91 in | 10.0 mi    | West        | 4.6 mph    | -             | N/A    | Clear      |
| 9:56 AM   | 87.1 °F  | 89.9 °F       | 66.9 °F  | 51%        | 29.92 in | 10.0 mi    | WNW         | 3.5 mph    | -             | N/A    | Clear      |
| 10:56 AM  | 93.0 °F  | 95.9 °F       | 66.0 °F  | 41%        | 29.92 in | 10.0 mi    | West        | 4.6 mph    | -             | N/A    | Clear      |
| 11:56 AM  | 100.9 °F | 101.6 °F      | 60.1 °F  | 26%        | 29.91 in | 10.0 mi    | North       | 8.1 mph    | -             | N/A    | Clear      |
| 12:56 PM  | 100.9 °F | 100.5 °F      | 57.9 °F  | 24%        | 29.90 in | 10.0 mi    | North       | 5.8 mph    | -             | N/A    | Clear      |
| 1:56 PM   | 102.0 °F | 102.2 °F      | 59.0 °F  | 24%        | 29.89 in | 10.0 mi    | North       | -          | -             | N/A    | Clear      |
| 2:56 PM   | 104.0 °F | 104.6 °F      | 59.0 °F  | 23%        | 29.87 in | 10.0 mi    | Variable    | e4.6 mph   | -             | N/A    | Clear      |
| 3:56 PM   | 104.0 °F | 103.4 °F      | 57.0 °F  | 21%        | 29.86 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 4:56 PM   | 105.1 °F | 105.7 °F      | 59.0 °F  | 22%        | 29.84 in | 10.0 mi    | NE          | 8.1 mph    | -             | N/A    | Clear      |
| 5:56 PM   | 105.1 °F | 105.0 °F      | 57.9 °F  | 21%        | 29.83 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 6:56 PM   | 102.0 °F | 103.3 °F      | 61.0 °F  | 26%        | 29.81 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 7:56 PM   | 96.1 °F  | 99.9 °F       | 66.9 °F  | 38%        | 29.81 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 8:56 PM   | 88.0 °F  | 89.6 °F       | 64.9 °F  | 46%        | 29.81 in | 10.0 mi    | South       | 3.5 mph    | -             | N/A    | Clear      |
| 9:56 PM   | 82.0 °F  | 84.1 °F       | 66.0 °F  | 58%        | 29.83 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 10:56 PM  | 80.1 °F  | 82.9 °F       | 69.1 °F  | 69%        | 29.85 in | 10.0 mi    | Calm        | Calm       | -             | N/A    | Clear      |
| 11:56 PM  | 80.1 °F  | 82.9 °F       | 69.1 °F  | 69%        | 29.85 in | 10.0 mi    | South       | 4.6 mph    | -             | N/A    | Clear      |

## History for Aiken, SC KAIK AP

Tuesday, July 3, 2012

| Time     | Tomp    | Heat    | Dew     | Lumidity | Droccuro Vicibility | Wind | Wind    | Gust  | Dracin | Conditions |
|----------|---------|---------|---------|----------|---------------------|------|---------|-------|--------|------------|
| (EDT)    | Temp.   | Index   | Point   | Humaity  | Pressure visibility | Dir  | Speed   | Speed | Precip | Conditions |
| 12:15 AM | 82.4 °F | 85.4 °F | 68.0 °F | 62%      | 30.05 in 10.0 mi    | SSW  | 6.9 mph | -     | N/A    | Clear      |
| 12:35 AM | 80.6 °F | 83.2 °F | 68.0 °F | 65%      | 30.06 in 10.0 mi    | SSW  | 3.5 mph | -     | N/A    | Clear      |
| 12:55 AM | 80.6 °F | 83.9 °F | 69.8 °F | 70%      | 30.06 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 1:15 AM  | 80.6 °F | 83.9 °F | 69.8 °F | 70%      | 30.05 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 1:35 AM  | 80.6 °F | 83.9 °F | 69.8 °F | 70%      | 30.05 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 1:55 AM  | 78.8 °F | -       | 69.8 °F | 74%      | 30.05 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 2:15 AM  | 78.8 °F | -       | 69.8 °F | 74%      | 30.05 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 2:35 AM  | 78.8 °F | -       | 69.8 °F | 74%      | 30.05 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 2:55 AM  | 77.0 °F | -       | 69.8 °F | 78%      | 30.04 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 3:35 AM  | 77.0 °F | -       | 69.8 °F | 78%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 3:55 AM  | 75.2 °F | -       | 69.8 °F | 83%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 4:15 AM  | 73.4 °F | -       | 69.8 °F | 88%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 4:35 AM  | 73.4 °F | -       | 69.8 °F | 88%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 4:55 AM  | 73.4 °F | -       | 69.8 °F | 88%      | 30.02 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 5:15 AM  | 73.4 °F | -       | 69.8 °F | 88%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 5:35 AM  | 73.4 °F | -       | 68.0 °F | 83%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 5:55 AM  | 73.4 °F | -       | 68.0 °F | 83%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 6:15 AM  | 71.6 °F | -       | 68.0 °F | 88%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 6:35 AM  | 71.6 °F | -       | 68.0 °F | 88%      | 30.03 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 6:55 AM  | 71.6 °F | -       | 68.0 °F | 88%      | 30.04 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |
| 7:15 AM  | 73.4 °F | -       | 69.8 °F | 88%      | 30.04 in 10.0 mi    | Calm | Calm    | -     | N/A    | Clear      |

| Time       | Temp.   | Heat     | Dew     | Humidity      | Pressure Visibility  | Wind   | Wind     | Gust     | Precip   | Conditions    |
|------------|---------|----------|---------|---------------|----------------------|--------|----------|----------|----------|---------------|
| (EDT)      | remp.   | Index    | Point   | mannancy      | r ressure visibility | Dir    | Speed    | Speed    | riccip   | conditions    |
| 7:35 AM    | 75.2 °F | -        | 69.8 °F | 83%           | 30.05 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 7:55 AM    | 78.8 °F | -        | 71.6 °F | 78%           | 30.05 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 8:15 AM    | 80.6 °F | 84.6 °F  | 71.6 °F | 74%           | 30.05 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 8:35 AM    | 82.4 °F | 87.2 °F  | 71.6 °F | 70%           | 30.05 in 10.0 mi     | WSW    | 3.5 mph  | -        | N/A      | Clear         |
| 9:15 AM    | 86.0 °F | 91.8 °F  | 71.6 °F | 62%           | 30.06 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 9:35 AM    | 87.8 °F | 93.8 °F  | 71.6 °F | 58%           | 30.06 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 9:55 AM    | 89.6 °F | 96.2 °F  | 71.6 °F | 55%           | 30.06 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 10:15 AM   | 91.4 °F | 98.4 °F  | 71.6 °F | 52%           | 30.07 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 10:35 AM   | 91.4 °F | 96.8 °F  | 69.8 °F | 49%           | 30.07 in 10.0 mi     | South  | 3.5 mph  | -        | N/A      | Clear         |
| 10:55 AM   | 93.2 °F | 98.8 °F  | 69.8 °F | 46%           | 30.07 in 10.0 mi     | WSW    | 3.5 mph  | -        | N/A      | Clear         |
| 11:15 AM   | 95.0 °F | 101.3 °F | 69.8 °F | 44%           | 30.07 in 10.0 mi     | West   | 4.6 mph  | -        | N/A      | Sct Clouds    |
| 11:35 AM   | 95.0 °F | 101.3 °F | 69.8 °F | 44%           | 30.07 in 10.0 mi     | West   | 5.8 mph  | -        | N/A      | Mostly Cloudy |
| 11:55 AM   | 95.0 °F | 99.5 °F  | 68.0 °F | 41%           | 30.06 in 10.0 mi     | Calm   | Calm     | -        | ,<br>N/A | Mostly Cloudy |
| 12.00 PM   | 95.0 °F | 101 3 °F | 69.8 °F | 44%           | 30.06 in 10.0 mi     | SSW    | 5.8 mph  | -        | N/A      | Sct Clouds    |
| 12:15 PM   | 95.0 °F | 99.5 °F  | 68.0 °F | 41%           | 30.05 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 12:55 PM   | 95.0 °F | 99.5 °F  | 68.0 °F | 41%           | 30.05 in 10.0 mi     | SW/    | 3 5 mnh  | _        | Ν/Δ      | Clear         |
| 1.15 DM    | 06.8 °E | 101 Q °E | 68 0 °E | 20%           | 30.05 in 10.0 mi     | Calm   | Calm     | _        |          | Sct Clouds    |
| 1.13 FIVI  | 90.8 T  | 101.0 I  | 60.0 T  | JJ/0<br>//10/ | 20.04 in 10.0 mi     | Calm   | Colm     | -        |          | Mostly Cloudy |
|            | 95.0 F  | 39.3 F   |         | 41/0          | 30.04 in 10.0 mi     |        | 4.6 mph  | -        |          | Mostly Cloudy |
| 1:55 PIVI  | 90.8 F  | 101.8 F  |         | 39%           | 30.04 in 10.0 mi     | VVINVV | 4.6 mpn  | -        |          | Nostly Cloudy |
| 2:15 PIVI  | 95.0 F  | 99.5 F   | 08.0 F  | 41%           | 30.03 in 10.0 mi     | South  | 4.6 mpn  | -        | N/A      | Nostly Cloudy |
| 2:35 PIVI  | 95.0 F  | 99.5 F   | 68.0 °F | 41%           | 30.03 in 10.0 mi     | SVV    | 6.9 mpn  | -        | N/A      |               |
| 3:15 PM    | 96.8 °F | 101.8 °F | 68.0 °F | 39%           | 30.01 in 10.0 mi     | ENE    | 6.9 mph  | -        | N/A      | Clear         |
| 3:35 PM    | 95.0 °F | 98.5 °F  | 66.2 °F | 39%           | 30.00 in 10.0 mi     | ESE    | 3.5 mph  | -        | N/A      | Clear         |
| 3:55 PM    | 96.8 °F | 101.8 °F | 68.0 °F | 39%           | 29.98 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 4:15 PM    | 96.8 °F | 100.7 °F | 66.2 °F | 37%           | 29.97 in 10.0 mi     | South  | 3.5 mph  | -        | N/A      | Clear         |
| 4:35 PM    | 96.8 °F | 101.8 °F | 68.0 °F | 39%           | 29.98 in 10.0 mi     | SE     | 5.8 mph  | -        | N/A      | Clear         |
| 4:55 PM    | 89.6 °F | 92.2 °F  | 66.2 °F | 46%           | 29.99 in 10.0 mi     | SW     | 15.0 mph | -        | N/A      | Clear         |
| 5:15 PM    | 89.6 °F | 92.2 °F  | 66.2 °F | 46%           | 30.00 in 10.0 mi     | SSW    | 12.7 mph | 21.9 mph | N/A      | Sct Clouds    |
| 5:35 PM    | 89.6 °F | 92.2 °F  | 66.2 °F | 46%           | 29.99 in 10.0 mi     | SSW    | 15.0 mph | 23.0 mph | N/A      | Sct Clouds    |
| 5:55 PM    | 89.6 °F | 93.4 °F  | 68.0 °F | 49%           | 29.98 in 10.0 mi     | SW     | 11.5 mph | -        | N/A      | Clear         |
| 6:15 PM    | 89.6 °F | 92.2 °F  | 66.2 °F | 46%           | 30.00 in 10.0 mi     | SSW    | 10.4 mph | -        | N/A      | Clear         |
| 6:35 PM    | 86.0 °F | 89.4 °F  | 68.0 °F | 55%           | 30.02 in 10.0 mi     | NE     | 10.4 mph | -        | N/A      | Sct Clouds    |
| 6:55 PM    | 78.8 °F | -        | 68.0 °F | 69%           | 30.04 in 10.0 mi     | NE     | 10.4 mph | -        | N/A      | Mostly Cloudy |
| 7:15 PM    | 78.8 °F | -        | 66.2 °F | 65%           | 30.04 in 10.0 mi     | NNW    | 4.6 mph  | -        | N/A      | Sct Clouds    |
| 7:35 PM    | 80.6 °F | 82.3 °F  | 64.4 °F | 58%           | 30.03 in 10.0 mi     | WNW    | 4.6 mph  | -        | N/A      | Clear         |
| 7:55 PM    | 80.6 °F | 82.7 °F  | 66.2 °F | 61%           | 30.03 in 10.0 mi     | NW     | 8.1 mph  | -        | N/A      | Clear         |
| 8:15 PM    | 80.6 °F | 82.7 °F  | 66.2 °F | 61%           | 30.03 in 10.0 mi     | WNW    | 4.6 mph  | -        | N/A      | Clear         |
| 8:35 PM    | 78.8 °F | -        | 69.8 °F | 74%           | 30.03 in 10.0 mi     | West   | 5.8 mph  | -        | N/A      | Light Rain    |
| 8:55 PM    | 77.0 °F | -        | 69.8 °F | 78%           | 30.03 in 10.0 mi     | WNW    | 3.5 mph  | -        | N/A      | Light Rain    |
| 9:15 PM    | 77.0 °F | -        | 71.6 °F | 83%           | 30.03 in 10.0 mi     | WNW    | 6.9 mph  | -        | N/A      | Clear         |
| 9:35 PM    | 75.2 °F | -        | 71.6 °F | 89%           | 30.05 in 10.0 mi     | NW     | 4.6 mph  | -        | N/A      | Light Drizzle |
| 9:55 PM    | 75.2 °F | -        | 71.6 °F | 89%           | 30.05 in 10.0 mi     | Calm   | Calm     | -        | N/A      | Clear         |
| 10:15 PM   | 75.2 °F | -        | 71.6 °F | 89%           | 30.05 in 10.0 mi     | SW     | 6.9 mph  | -        | ,<br>N/A | Clear         |
| 10:35 PM   | 75.2 °F | -        | 71.6 °F | 89%           | 30.06 in 10.0 mi     | SW     | 6.9 mph  | -        | N/A      | Clear         |
| 10:55 PM   | 77.0 °F | -        | 71.6 °F | 83%           | 30.05 in 10.0 mi     | WSW    | 3.5 mnh  | -        | N/A      | Clear         |
| 11.15 PM   | 75.2 °F | -        | 71.6 °F | 89%           | 30.05 in 10.0 mi     | SW     | 5.8 mnh  | _        | N/A      | Clear         |
| 11.35 PM   | 77 0 °F | -        | 69.8 °F | 78%           | 30.05 in 10.0 mi     | SW     | 6.9 mnh  | _        | N/A      | Clear         |
| 11.55 PM   | 77 0 °F | _        | 69.8 °F | 78%           | 30.06 in 10.0 mi     | SSW/   | 8.1 mnh  | _        | N/A      | Clear         |
| 1111001101 | 77.0 1  |          | 00.01   | ,0,0          | 22.00 11 10.0 111    | 5544   | or mbu   |          | · •//~   | Cicui         |

Return visit to Johnston on July 26, 2012 to confirm method of maximum mercury thermometer temperature observation and make portable shelter thermometer comparison:

I, Wes Tyler arrived at the Johnston, SC residence of Olin Berry at 2:05 PM on Thursday, July 26, 2012. The local conditions were sunny and hot with west winds estimated at 10-15 mph with gusts. The SC State Climatology Office portable shelter (JIM-GEM/Forestry Suppliers Inc.) with Townsend supported NWS maximum mercury thermometer was set up and placed an estimated 10 feet to the NW of the Johnston 4SW Cotton Region Shelter (Images 4, 5, 6, 7). I then requested Mr. Berry take me through his practice of measuring the maximum mercury thermometer temperature reading as he did on June 29, 2012. Mr. Berry informed me that he would visually reference the end of the mercury column in the locked horizontal resting position to obtain the value, then release the Townsend support so the thermometer could be spun to reset. I assumed this as Mr. Berry had reported the 113 degree value on the Friday afternoon of June 29, 2012, and not followed his customary observation time of 7 AM. This was overlooked on the authors' initial investigation visit on July 3, 2012. I advised him that the correct procedure was to always carefully release the Townsend support and read the value from the thermometer's vertical position. This practice eliminates the chance of mercury column separation and "parallax" error. Mr. Berry was unaware of this method.

Mr. Berry and I observed the temperature value at 2:35 PM for the Johnston NWS Townsend supported thermometer in the locked positions and the released vertical position. Each position read 101 °F. Mr. Berry's Taylor magnet reset max/min thermometer hanging on the inside eastern panel displayed 102 °F. Within a minute, the NWS Townsend supported mercury thermometer inside of the SCO portable shelter read 98.5 °F from the vertical position and an additional "backyard" U-tube type pushbutton magnet reset max/min thermometer on the inside read 94.5 °F. The difference between the NWS Johnston thermometer and the NWS SCO thermometer at this observation was 1.5 °F. At this time, I placed an "extra" NWS maximum mercury thermometer on the wooden "bridge" that supports the Townsend apparatus inside the SCO portable shelter.

July 26, 2012 results from analyzing the un-shaded, exposed nearby surface temperatures to the Johnston 4SW Cotton Region Shelter using the Gilson Laser Thermometer, model MA-372:

## At 2:40 PM:

Polyethylene 100 gallon sprayer - 138.4 °F. Rusting steel tank - 135.8 °F Bare ground adjacent to shelter - 128.5 °F Light colored discarded roof covering at foot of shelter - 126.9 °F Green lawn grass - 118.4 °F Black tarp over farm implements estimated 15 feet southwest - 149.0 °F (Image right) The steel utility trailer that had been near the shelter on July 3, 2012, had been moved an estimated 100 feet to the north.

July 26, 2012 comparison of the SCO portable shelter thermometer to the Johnston shelter thermometer:

(All NWS maximum mercury thermometer values read from 2:50 PM in the released vertical position and not reset by centrifuge actions).

### At 2:50 PM:

The SCO portable NWS thermometer read 99.0 °F. The "extra" thermometer read 98.0 °F. The SCO pushbutton read 95.0 °F. The Johnston shelter NWS thermometer read 101.2 °F and the "Taylor" read 103.0 °F. Observed difference in the SCO/Johnston NWS thermometer temperature values: 2.2 °F

### At 3:00 PM:

The SCO portable NWS thermometer read 99.0 °F. The "extra" thermometer read 98.0 °F. The SCO pushbutton read 96 °F.

The Johnston shelter NWS thermometer read 101.2 while the "Taylor" read 103 °F. Observed difference in the SCO/Johnston NWS thermometer temperature values: 2.2 °F At 3:10 PM:

The SCO portable NWS thermometer read 99.0 °F. The "extra" thermometer read 98.5 °F. The SCO pushbutton read 96 °F.

The Johnston shelter NWS thermometer read 101.5 °F and the "Taylor" read 104 °F. Observed difference in the SCO/Johnston NWS thermometer temperature values: 2.5 °F

## At 3:15 PM:

Placed the SCO "extra "maximum mercury thermometer inside the Johnston shelter on the wooden bridge that supports the Townsend apparatus after resetting by downward forcing motion. At the same time, the SCO portable shelter was moved to a shaded area at ground level to let thermometers "cool" to a reset temperature of 96 °F.

## At 3:25 PM:

SCO portable shelter was relocated to the most central open area of Mr. Berry's property. This was a mowed lawn with no obstructions to the west. (Images 8,9)

## At 3:35 PM:

The Johnston shelter NWS thermometer read 101.5 °F and the Taylor read 102.0 °F.

## At 3:45 PM:

The relocated SCO portable NWS thermometer read 99.3°F. The SCO pushbutton read 97.5 °F. The Johnston shelter NWS thermometer read 101.8 °F and the "Taylor" read 102.5 °F.

The SCO "extra" read 100.5 °F.

Observed difference in the SCO/Johnston NWS thermometer temperature values after relocated: 2.5 °F

### At 3:50 PM:

The indoor display for the Davis Instruments thermometer read 96.8 while the NWS MNT read 95.9 °F.

## At 4:00 PM:

The SCO relocated portable shelter NWS thermometer read 99.5 °F. The SCO pushbutton read 97.0 °F. The Johnston shelter NWS thermometer read 101.8°F and the "Taylor" read 101.5 °F. The SCO "extra" read 100.5 °F.

Observed difference in the SCO/Johnston NWS thermometer temperature values: 2.3 °F

The observed 4:00 PM Johnston temperature on July 26, 2012 was 101.8°F, yet the Johnston site reported a July 27, 2012 7 AM 24-hour maximum of 101.

## History for Aiken, SC KAIK AP

July 26, 2012

|            | _                  | Heat     | Dew     | Humidi      | _        |            |          | Wind        |            |            |            |
|------------|--------------------|----------|---------|-------------|----------|------------|----------|-------------|------------|------------|------------|
| Time (EDT) | Temp.              | Index    | Point   | ty          | Pressure | Visibility | Wind Dir | Speed       | Gust Speed | Precip     | Conditions |
| 12:35 AM   | 80.6 °F            | 86.2 °F  | 75.2 °F | 84%         | 29.98 in | 10.0 mi    | South    | 4.6 mph     | -          | N/A        | Clear      |
| 12:55 AM   | 80.6 °F            | 86.2 °F  | 75.2 °F | 84%         | 29.98 in | 10.0 mi    | South    | 3.5 mph     | -          | N/A        | Clear      |
| 1:15 AM    | 80.6 °F            | 86.2 °F  | 75.2 °F | 84%         | 29.97 in | 10.0 mi    | South    | 4.6 mph     | -          | N/A        | Clear      |
| 1:35 AM    | 80.6 °F            | 86.2 °F  | 75.2 °F | 84%         | 29.97 in | 10.0 mi    | South    | 4.6 mph     | -          | N/A        | Clear      |
| 1:55 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.96 in | 10.0 mi    | South    | 3.5 mph     | -          | N/A        | Clear      |
| 2:15 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.96 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 2:35 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.95 in | 10.0 mi    | SSE      | 3.5 mph     | -          | N/A        | Clear      |
| 2:55 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.95 in | 10.0 mi    | South    | 3.5 mph     | -          | N/A        | Clear      |
| 3:15 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.95 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 3:35 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.94 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 3:55 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.93 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 4:15 AM    | 78.8 °F            | -        | 75.2 °F | 89%         | 29.92 in | 10.0 mi    | South    | 3.5 mph     | -          | N/A        | Clear      |
| 4:35 AM    | 77.0 °F            | -        | 75.2 °F | 94%         | 29.92 in | 10.0 mi    | South    | 3.5 mph     | -          | N/A        | Clear      |
| 4:55 AM    | 77.0 °F            | -        | 77.0 °F | 100%        | 29.92 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 5:15 AM    | 77.0 °F            | -        | 75.2 °F | 94%         | 29.92 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 5:35 AM    | 77.0 °F            | -        | 75.2 °F | 94%         | 29.93 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 6:15 AM    | 77.0 °F            | -        | 77.0 °F | 100%        | 29.95 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 6:35 AM    | 77.0 °F            | _        | 77.0 °F | 100%        | 29.95 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 6:55 AM    | 77.0 °F            | -        | 77.0 °F | 100%        | 29.96 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 7:15 AM    | 77.0 °F            | -        | 77.0 °F | 100%        | 29.97 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 7:35 AM    | 77.0 °F            | -        | 77.0 °F | 100%        | 29.98 in | 10.0 mi    | Calm     | Calm        | -          | N/A        | Clear      |
| 8:15 AM    | 80.6 °F            | 86.2 °F  | 75.2 °F | 84%         | 29.99 in | 10.0 mi    | WSW      | 5.8 mph     | -          | N/A        | Clear      |
| 8:35 AM    | 80.6 °F            | 87.1 °F  | 77.0 °F | 89%         | 29.99 in | 10.0 mi    | WSW      | 4.6 mph     | -          | N/A        | Clear      |
| 9:15 AM    | 86.0 °F            | 96.9 °F  | 77.0 °F | 74%         | 30.00 in | 10.0 mi    | West     | 8.1 mph     | -          | N/A        | Clear      |
| 9.35 AM    | 87.8 °F            | 99.7 °F  | 77.0°F  | 70%         | 29 99 in | 10.0 mi    | West     | 6.9 mnh     | _          | N/A        | Clear      |
| 9.55 AM    | 89.6 °F            | 102.2 °F | 77.0°F  | 66%         | -        | 10.0 mi    | West     | 8.1 mnh     | _          | N/A        | Clear      |
| 10·15 AM   | 89.6 °F            | 102.2 °F | 77.0°F  | 66%         | _        | 10.0 mi    | West     | 8.1 mph     | _          | $N/\Delta$ | Clear      |
| 10:35 AM   | 05.0 T             | 102.2 °F | 75.2 °F | 59%         |          | 10.0 mi    | West     | 0.1 mph     | _          | N/A        | Clear      |
| 10:55 AM   | 93.2 °F            | 102.5 T  | 73.4 °F | 52%         | _        | 10.0 mi    | WNW      | 8.1 mnh     | _          | N/A        | Clear      |
| 11.15 AM   | 95.0°F             | 102.4 T  | 71.6°E  | 17%         |          | 10.0 mi    | W/ost    | 5.8 mnh     | 16.1 mnh   | N/A        | Clear      |
| 11:15 AM   | 95.0 °F            | 103.2 °F | 71.6 °F | 47%         | _        | 10.0 mi    | NNW      | 9.2 mnh     | -          | N/A        | Clear      |
| 11:55 AM   | 95.0 °F            | 103.2 °F | 71.6 °F | 47%         |          | 10.0 mi    |          | 8.1 mnh     | _          | N/A        | Clear      |
| 12.35 PM   | 96.8 °F            | 105.2 T  | 71.0 T  | 4770        | _        | 10.0 mi    | W/oct    | 6.9 mnh     | 16.1 mph   |            | Clear      |
| 12:55 DM   | 06.8 °E            | 105.1 °E | 71.0 T  | 1/1%        |          | 10.0 mi    | West     | 11 5 mph    | 10.1 mpn   |            | Clear      |
| 1.15 DM    | 08.6 °E            | 105.1 T  | 60.8 °E | 20%         |          | 10.0 mi    | West     | 12.2 mph    | 18 / mnh   |            | Clear      |
| 1.15 FIVI  | 08.6 °E            | 103.3 T  | 09.0 T  | 12%         |          | 10.0 mi    | West     | 12.0 mph    | 18.4 mph   |            | Clear      |
| 1.55 PIVI  | 90.0 F             | 107.7 °E | 71.0 F  | 42/0        | -        | 10.0 mi    | West     | 11.5 mph    | 10.4 mph   | N/A        | Clear      |
| 2.15 PM    | 00 6 °E            | 107.7 °E | 71.0 T  | 42/0        | -        | 10.0 mi    |          | 12.7 mph    | 16.1 mph   |            | Clear      |
| 2.13 FIVI  | 90.0 F             | 107.7 F  | 71.0 F  | 42/0        | -        | 10.0 mi    | WINVV    | 12.7 mph    | 17.2 mph   | N/A        | Clear      |
| 2.55 FIVI  | 90.0 F             | 107.7 F  | 71.0 F  | 42/0        | -        | 10.0 mi    | VVESL    | 11 E mph    | 16.1 mph   | N/A        | Clear      |
| 2.55 PIVI  | 90.0 Г<br>100 Л °Е | 103.3 F  | 09.0 F  | 59%<br>270/ | -        | 10.0 mi    | Wort     | 11.5 IIIµII | 17.2 mph   | N/A        | Clear      |
| 2.12 FIVI  | 100.4 F            | 107.0 F  | 09.0 F  | 200/        | -        | 10.0 mi    | VVESL    | 10.4 mph    | 17.5 mph   | N/A        | Clear      |
| 5.55 PIVI  | 90.0 F             | 105.5 F  | 09.0 F  | 39%         | -        | 10.0 mi    |          | 10.4 IIIpii | 10.1 mpn   | N/A        | Clear      |
| 4:15 PIVI  | 98.0 F             | 105.5 F  | 09.8 F  | 39%         | -        | 10.0 mi    |          | 9.2 mph     | -          | N/A        | Clear      |
|            | 100.4 F            | 109.5 F  | 71.0 F  | 39%         | -        | 10.0 mi    |          | 9.2 mph     | -          | N/A        | Clear      |
| 4:55 PIVI  | 98.0 F             | 107.7 F  | 71.0 F  | 42%         | -        | 10.0 mi    | VVINVV   | 8.1 mpn     | -          | N/A        | Clear      |
| 5:15 PIVI  | 100.4 °F           | 109.3 F  | 71.6°F  | 39%         | -        | 10.0 mi    |          | 3.5 mpn     | 16.1 mpn   | N/A        | Clear      |
| 5:35 PIVI  | 100.4 F            | 109.3 F  | 71.0 F  | 39%         | -        | 10.0 mi    |          | 6.9 mpn     | -          | N/A        | Clear      |
| 5:55 PIVI  | 98.6 F             | 107.7°F  | 71.6 F  | 42%         | -        | 10.0 mi    | VV IN VV | 5.8 mpn     | 10.4 mpn   | N/A        | Clear      |
| 6:15 PM    | 98.6 °F            | 107.7°F  | /1.6 °F | 42%         | -        | 10.0 mi    | west     | 9.2 mph     | -          | N/A        | Clear      |
| 0:35 PIVI  | 98.6 °F            | 107./°F  | /1.6 °F | 42%         | -        | 10.0 mi    | west     | 8.1 mph     | -          | IN/A       | Clear      |
| 6:55 PIVI  | 96.8 °F            | 105.1 °F | /1.6 °F | 44%         | -        | 10.0 mi    | west     | 6.9 mph     | -          | N/A        | Clear      |
| 7:15 PM    | 96.8 °F            | 103.1 °F | 69.8 °F | 41%         | -        | 10.0 mi    | West     | 8.1 mph     | -          | N/A        | Clear      |
| 7:35 PM    | 95.0 °F            | 101.3 °F | 69.8 °F | 44%         | -        | 10.0 mi    | West     | 4.6 mph     | -          | N/A        | Clear      |
| 7:55 PM    | 95.0 °F            | 101.3 °F | 69.8 °F | 44%         | -        | 10.0 mi    | West     | 3.5 mph     | -          | N/A        | Clear      |
| 8:15 PM    | 93.2 °F            | 100.5 °F | 71.6 °F | 49%         | -        | 10.0 mi    | South    | 5.8 mph     | -          | N/A        | Clear      |

| Time (EDT) | Temp.   | Heat    | Dew<br>Point | Humidi | Pressure | Visibility | Wind Dir | Wind<br>Speed | Gust Spee | dPrecip | Conditions       |
|------------|---------|---------|--------------|--------|----------|------------|----------|---------------|-----------|---------|------------------|
| 8:35 PM    | 91.4 °F | 98.4 °F | 71.6 °F      | 52%    | -        | 10.0 mi    | SW       | 4.6 mph       | -         | N/A     | Clear            |
| 8:55 PM    | 91.4 °F | 98.4 °F | 71.6 °F      | 52%    | -        | 10.0 mi    | SW       | 3.5 mph       | -         | N/A     | Clear            |
| 9:35 PM    | 89.6 °F | 96.2 °F | 71.6 °F      | 55%    | -        | 10.0 mi    | SW       | 8.1 mph       | -         | N/A     | Clear            |
| 9:55 PM    | 89.6 °F | 96.2 °F | 71.6 °F      | 55%    | -        | 10.0 mi    | WSW      | 4.6 mph       | -         | N/A     | Clear            |
| 10:35 PM   | 87.8 °F | 93.8 °F | 71.6 °F      | 58%    | -        | 10.0 mi    | SW       | 5.8 mph       | -         | N/A     | Clear            |
| 10:55 PM   | 87.8 °F | 93.8 °F | 71.6 °F      | 58%    | -        | 10.0 mi    | SW       | 6.9 mph       | -         | N/A     | Clear            |
| 11:15 PM   | 87.8 °F | 95.6 °F | 73.4 °F      | 62%    | -        | 10.0 mi    | WNW      | 3.5 mph       | -         | N/A     | Scattered Clouds |
| 11:35 PM   | 86.0 °F | 91.8 °F | 71.6 °F      | 62%    | -        | 10.0 mi    | WSW      | 3.5 mph       | -         | N/A     | Clear            |





Image 6





Image8



Image 7





## High temperature event of August 1983 for West Central Climate Division

-i

|                   |      |      |        | Tempe  | rature | e (°F I | F)   |      |                      |        | Pre    | cipitat     | t <mark>ion</mark> (i | inche | s)                   |
|-------------------|------|------|--------|--------|--------|---------|------|------|----------------------|--------|--------|-------------|-----------------------|-------|----------------------|
|                   |      | Α    | verage | es     |        | Extre   | emes |      |                      | Totals |        |             | Extremes              |       |                      |
| Station Name      | Max  | Min  | Mean   | Depart | High   | Date    | Low  | Date | Percent<br>Available | Obs    | Depart | Pct<br>Norm | 1-<br>Day<br>Max      | Date  | Percent<br>Available |
| AIKEN 5SE         | 95.6 | 68.1 | 81.9   | 1.8    | 109    | 8/22    | 55   | 8/15 | 100                  | 4.85   | -0.43  | 92          | 1.50                  | 8/4   | 100                  |
| CALHOUN<br>FALLS  | 95.4 | 70.4 | 82.9   | 4.5    | 105    | 8/23+   | 64   | 8/15 | 100                  | 2.15   | -1.57  | 58          | 1.65                  | 8/2   | 100                  |
| CLARK HILL<br>1 W | 95.5 | 69.1 | 82.3   | 2.3    | 108    | 8/22    | 61   | 8/15 | 100                  | 0.94   | -3.26  | 22          | 0.42                  | 8/2   | 100                  |
| GREENWOOD         | 93.9 | 67.1 | 80.5   | 2.9    | 105    | 8/22    | 57   | 8/15 | 100                  | 2.10   | -1.52  | 58          | 0.62                  | 8/2   | 100                  |
| JOHNSTON 4<br>SW  | 93.9 | 68.2 | 81.1   | 3.8    | 106    | 8/22    | 58   | 8/15 | 100                  | 2.63   | -2.34  | 53          | 0.88                  | 8/4   | 100                  |
| LITTLE MTN        | 93.7 | 70.4 | 82.0   | 4.0    | 104    | 8/21    | 60   | 8/14 | 100                  | 3.92   | -0.83  | 83          | 2.55                  | 8/25  | 100                  |
| NEWBERRY          | 95.6 | 69.5 | 82.6   | 4.0    | 108    | 8/21    | 59   | 8/14 | 100                  | 6.50   | 1.62   | 133         | 5.21                  | 8/25  | 100                  |
| SALUDA            | 95.6 | 64.1 | 79.8   | 0.3    | 107    | 8/22    | 54   | 8/15 | 100                  | 1.61   | -2.94  | 35          | 0.47                  | 8/8   | 100                  |

## High temperature event of August 2007 for West Central Climate Division

|                   |      |      |       | Temp   | eratu | re (°F | F <b>F</b> ) |       |           |      | P      | recipit     | ation (in    | ches) |           |  |
|-------------------|------|------|-------|--------|-------|--------|--------------|-------|-----------|------|--------|-------------|--------------|-------|-----------|--|
| Station Name      |      | Av   | erage | s      |       | Extr   | emes         |       | Domoont   |      | Totals | 5           | Extre        | nes   | Domoont   |  |
| Station Mame      | Max  | Min  | Mean  | Depart | High  | Date   | Low          | Date  | Available | Obs  | Depart | Pct<br>Norm | 1-Day<br>Max | Date  | Available |  |
| AIKEN 5SE         | 96.5 | 72.6 | 84.6  | 4.5    | 106   | 8/11   | 68           | 8/4   | 100       | 1.71 | -3.57  | 32          | 0.59         | 8/18  | 100       |  |
| CALHOUN<br>FALLS  | 98.0 | 70.9 | 84.5  | 6.1    | 106   | 8/11   | 61           | 8/5   | 100       | 0.30 | -3.42  | 8           | 0.09         | 8/18  | 96        |  |
| CLARK HILL<br>1 W | 97.6 | 70.6 | 84.1  | 4.1    | 105   | 8/10   | 65           | 8/4   | 100       | 3.86 | -0.34  | 92          | 1.40         | 8/31  | 100       |  |
| GREENWOOD         | 97.9 | 73.4 | 85.6  | 8.0    | 105   | 8/13   | 69           | 8/13+ | 74        | 1.23 | -2.39  | 34          | 0.56         | 8/24  | 93        |  |
| JOHNSTON 4<br>SW  | 99.6 | 64.5 | 82.0  | 4.7    | 110   | 8/11   | 60           | 8/4+  | 100       | 2.94 | -2.03  | 59          | 1.42         | 8/27  | 96        |  |
| LITTLE MTN        | 96.1 | 72.1 | 84.1  | 6.1    | 105   | 8/10   | 65           | 8/4   | 100       | 1.26 | -3.49  | 27          | 0.77         | 8/26  | 100       |  |
| SALUDA            | 98.7 | 71.5 | 85.1  | 5.6    | 107   | 8/11+  | 65           | 8/4   | 100       | 2.60 | -1.95  | 57          | 1.05         | 8/27  | 100       |  |

## Questionable Johnston maximum temperature values from July 10-11, 2012

COLUMBIA AREA TEMPS AND PRECIP...TUESDAY MORNING REPORT UPDATED... NATIONAL WEATHER SERVICE COLUMBIA SC 1230 PM EDT TUE JUL 10 2012 :MAX...HIGH TEMPERATURE LAST 24 HRS MIN...LOW TEMPERATURE LAST 24 HRS :CUR...CURRENT TEMPERATURE PCPN...PRECIPITATION LAST 24 HRS :EVAPORATION IN INCHES AIR TEMP SOIL TEMP SID MAX MIN CUR PCPN MAX MIN CUR EVAP :STATION :...NORTH MIDLANDS... :...NORTH MIDLANDS... :BISHOPVILLE 9 AM :BSPS1 102/ 72/ 77/ 2.12 //// :CEDAR CREEK :BLYS1 101/ 72/ 72/ 0.06 / 90/ 87/ 87/ :CHERAW WATER PLANT:CEWS1 98/ 72/ 73/ 0.00 //// :CHESTERFIELD 11 AM:CTFS1 98/ 71/ 80/ 0.61 / 91/ 84/ 84/ :LONGTOWN :LNTS1 99/ 71/ 76/ 0.00 //// :LAKE WATEREE :WATS1 102/ 73/ 75/ 0.15 //// :LUGOFF 2 NE :LUGS1 99/ 73/ 78/ 0.00 //// :SHAW AFB :SSC 100/ 73/ 74/ 0.14 //// :WINNSBORO :WNBS1 99/ 74/ 74/ 0.01 //// :...SOUTH MIDLANDS... :BAMBERG :BAMS1 101/ 73/ 73/ 0.55 //// :BATESBURG :BATS1 99/ 72/ 73/ 0.50 //// :COLUMBIA METRO APT:CAE 103/ 74/ 76/ 3.29 / 88/ 79/ 79/ :COLUMBIA OWENS APT:CUB 103/ 74/ 75/ 1.37 //// :LITTLE MOUNTAIN :LIMS1 101/ 71/ 84/ 0.00 //// : 10 AM :FLOTILLA ISLAND :LMFS1 97/ 75/ 80/ //// :SANTEE LK. MARION :LMSS1 / 78/ //// :MANNING :MANS1 98/ 70/ 70/ 0.50 //// :MCENTIRE ANG :MMT 100/ 73/ 73/ 1.04 //// :NEWBERRY WKDK :NWYS1 100/ 73/ 73/ 0.07 //// :ORANGEBURG AIRPORT:OGB 99/ 73/ 76/ 0.77 //// :PELION :PLNS1 98/ 71/ 75/ 0.82 //// :SANDHILL :SAHS1 103/ 73/ 73/ 0.26 / 90/ 85/ 85/ 0.48 :SALUDA FLTR PLT :SADS1 101/ 71/ 73/ 0.36 //// :...SOUTH MIDLANDS... : :...CENTRAL SAVANNAH RIVER AREA... :AIKEN :AKIS1 98/ 72/ 73/ 0.11 //// 

 :AIKEN
 :AKISI
 98/
 72/
 73/
 0.11
 77//7

 :AUGUSTA BUSH APT
 :AGS
 100/
 70/
 74/
 T
 ////

 :AUGUSTA DANIEL APT: DNL
 100/
 73/
 75/
 0.79
 ////

 :BARNWELL
 :BNLS1
 101/
 71/
 72/
 0.00
 91/
 79/
 81/
 0.45

 :CLARKS HILL
 :CHDS1
 99/
 72/
 74/
 0.30
 ////

 :JOHNSTON
 :JOHS1
 104/
 71/
 73/
 0.50
 87/
 80/
 81/

 :MCCORMICK
 :MCCS1
 100/
 74/
 74/
 0.00
 ////

 :WAYNESBORO
 :WYNG1
 97/
 73/
 77/
 0.00
 ////

COLUMBIA HYDROLOGIC AREA TEMPERATURES AND PRECIPITATION NATIONAL WEATHER SERVICE COLUMBIA SC 1003 AM EDT WED JUL 11 2012

:MAX...HIGH TEMPERATURE LAST 24 HRS MIN...LOW TEMPERATURE LAST 24 HRS :CUR...CURRENT TEMPERATURE PCPN...PRECIPITATION LAST 24 HRS :EVAPORATION IN INCHES AIR TEMP SOIL TEMP :STATION SID MAX MIN CUR PCPN MAX MIN CUR EVAP :...NORTH MIDLANDS... 

 :BISHOPVILLE
 :BSPS1
 92/
 68/
 74/
 1.52
 ////

 :CEDAR CREEK
 :BLYS1
 92/
 70/
 71/
 0.63
 87/
 85/
 85/

 :CHERAW WATER PLANT:CEWS1
 98/
 71/
 72/
 0.46
 ////

 :LAKE WATEREE
 :WATS1
 98/
 71/
 72/
 M
 ////

 :SHAW AFB
 :SSC
 94/
 71/
 73/
 0.43
 ////

 :...SOUTH MIDLANDS... :BAMBERG :BAMS1 92/ 70/ 70/ 2.03 //// :BATESBURG :BATS1 93/ 69/ 70/ 1.90 //// :COLUMBIA METRO APT:CAE 93/ 72/ 73/ 1.26 / 84/ 77/ 79/ :COLUMBIA OWENS APT:CUB 92/ 72/ 73/ 2.64 //// :FLOTILLA ISLAND :LMFS1 92/ 71/ 73/ //// :SANTEE LK. MARION :LMSS1 74/ 71/ 74/ //// :MANNING :MANS1 98/ 70/ 75/ 0.66 //// :MCENTIRE ANG :MMT 92/ 70/ 72/ 0.72 //// :NEWBERRY WKDK :NWYS1 94/ 69/ 70/ 1.61 //// :ORANGEBURG AIRPORT:OGB 92/ 70/ 71/ 2.13 //// :PELION :PLNS1 97/ 64/ 70/ 1.91 //// :SANDHILL :SAHS1 96/ 69/ 71/ 0.37 / 86/ 82/ 82/ 0.31 :SALUDA FLTR PLT :SADS1 96/ 69/ 71/ 1.23 //// :...SOUTH MIDLANDS... :...CENTRAL SAVANNAH RIVER AREA... :AIKEN :AKIS1 97/ 69/ 69/ 0.16 //// 

 AIREN
 ARISI
 97/
 03/
 09/
 0.16
 ////

 AUGUSTA BUSH APT
 AGS
 98/
 70/
 73/
 0.43
 ////

 AUGUSTA DANIEL APT: DNL
 96/
 71/
 72/
 0.22
 ////

 BARNWELL
 :BNLS1
 95/
 69/
 70/
 0.55
 84/
 75/
 76/
 0.28

 :CLARKS HILL
 :CHDS1
 96/
 70/
 72/
 1.85
 ////

 :JOHNSTON
 :JOHS1
 104/
 69/
 69/
 0.59
 86/
 80/
 80/

 :MCCORMICK
 :MCCS1
 97/
 70/
 70/
 1.86
 ////

 :WAYNESBORO
 :WYNG1
 97/
 70/
 0.74
 ////

 .END

Johnston reported a 104°F maximum on July 10, 2012. 103°F was reported for Columbia Metro AP, Columbia Hamilton-Owens Downtown AP and Sandhill.

Johnston again reported a 104°F maximum on July 11, 2012 The next highest value for that date within 50 miles: Augusta, Ga. KAGS Bush AP - 98 °F, McCormick/Aiken - 97 °F, Clarks Hill/Saluda/Augusta, Ga. KDNL Daniel AP - 96 °F.

## Columbia USC COOP evaluation:

The USC Campus site began observations in September 1954.

Records indicate the initial geographical location was 34.00 ° N by 81° 01′ W at the Geology Building on the USC Campus. A move 210 feet southwest (better exposure) was noted on December 4, 1963 (this being the earliest reference to station name as "Columbia University of South Carolina") and to its present location one-half mile south May 30, 1973. A diagram dated June 25, 1992, displays a hand drawn schematic of the fenced area containing only a Cotton Region Shelter and a pair of rain gages. The terrain was described as rolling hills in an urban city setting. The present geographical coordinates are 33 ° 59′ N by 81 ° 01′ W at an elevation of 242 feet above sea level (Images 10, 11, 12, 13).



Image 10 – USC site viewed west

Image 11 – USC site viewed north



Image 12 – USC site viewed southwest



Image 13 – Aerial view of USC site



Observations on visit to Columbia USC COOP site Saturday July 7, 2012, at 4 PM with Dr. Cary Mock, Professor of Climatology and shared administrator of observing duties at the site:

At 4:05 PM, I, Wes Tyler placed a standard NWS mercury maximum thermometer inside the Cotton Region Shelter (same instrument used to compare Johnston NWS thermometer) just above Townsend support maximum and minimum thermometers on the wooden "bridge" for comparison. Dr. Mock and I then made tape measurements from the nearest point of the shelter to all nearby sampling units within the fenced area. These measurements are included in the DHEC sampling unit's explanation by April Hiscox and Scott Reynolds.

By using a handheld compass it was determined that the USC Cotton Region Shelter was geographically oriented 10° north by 190° south. The shelter was inside a fenced-in area of unirrigated ground cover. A wooden unpainted deck (estimated four feet in width by 40 feet in length and raised about one foot over ground) was positioned eight feet northwest of the shelter at its closest point and supported multiple SC Department of Health and Environmental Control sampling units. To the northeast is an asphalt sidewalk that adjoins Bull Street at a distance of 61 feet. Bates House student dormitories of 10 floors were an estimated 200 feet south of the shelter at their closest point. On the northern side of the DHEC wooden platform are assorted shrubbery/small trees and an abrupt elevation change of an estimated 40 feet down to a railroad track.

At 5:05 PM, both thermometers were read by Dr. Mock and me in the shade of the shelter and were identical in displaying 102°F from the Townsend support's locked horizontal position and "bridge." At 5:30 PM, the USC observer had not arrived for the usual 5:00 PM observation. Dr. Mock left a handwritten note in the shelter saying the maximum temperature had been made at 102 °F and the thermometer had been reset. I did not observe Dr. Mock record the value or reset the thermometer.

Before exiting the fenced area it was discovered that a stainless steel fan/shovel blade (unknown source) was on top of the Cotton Region Shelter. Estimated blade size was 8 inches by 5 inches with about 3 inches of a broken handle. It was photographed, removed from the top of shelter and left on site (Image 14).

| Image 1 | 14 |
|---------|----|
|---------|----|



Nearest ASOS AP site to Columbia USC COOP making detailed observations on June 29, 2012:

## History for Columbia Hamilton-Owens, SC KCUB AP

Friday, June 29, 2012

| Time (FDT) | Temp.    | Heat     | Dew     | Humidity | Pressure | Visibility | Wind Dir | Wind Speed | Gust Speed | Precip Events | Conditions   |
|------------|----------|----------|---------|----------|----------|------------|----------|------------|------------|---------------|--------------|
|            | . c p.   | Index    | Point   |          |          | 1.0.0      |          | tind opeed | easespeed  |               | Contantionis |
| 12:53 AM   | 77.0 °F  | -        | 64.9 °F | 66%      | 29.92 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 1:53 AM    | 75.9 °F  | -        | 64.9 °F | 69%      | 29.91 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 2:53 AM    | 73.9 °F  | -        | 64.9 °F | 73%      | 29.90 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 3:53 AM    | 73.9 °F  | -        | 64.0 °F | 71%      | 29.88 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 4:53 AM    | 72.0 °F  | -        | 64.0 °F | 76%      | 29.88 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 5:53 AM    | 71.1 °F  | -        | 64.9 °F | 81%      | 29.88 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 6:53 AM    | 71.1 °F  | -        | 64.9 °F | 81%      | 29.90 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 7:53 AM    | 75.0 °F  | -        | 64.0 °F | 69%      | 29.90 in | 10.0 mi    | SW       | 3.5 mph    | -          | N/A           | Clear        |
| 8:53 AM    | 81.0 °F  | 82.7 °F  | 64.9 °F | 58%      | 29.90 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 9:53 AM    | 88.0 °F  | 90.3 °F  | 66.0 °F | 48%      | 29.90 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 10:53 AM   | 95.0 °F  | 97.0 °F  | 64.0 °F | 36%      | 29.89 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 11:53 AM   | 100.0 °F | 101.8 °F | 62.1 °F | 29%      | 29.89 in | 10.0 mi    | Variable | 4.6 mph    | -          | N/A           | Clear        |
| 12:53 PM   | 104.0 °F | 104.0 °F | 57.9 °F | 22%      | 29.88 in | 10.0 mi    | Variable | 4.6 mph    | -          | N/A           | Clear        |
| 1:53 PM    | 106.0 °F | 105.1 °F | 55.9 °F | 19%      | 29.86 in | 10.0 mi    | Variable | 3.5 mph    | -          | N/A           | Clear        |
| 2:53 PM    | 107.1 °F | 107.4 °F | 57.9 °F | 20%      | 29.85 in | 10.0 mi    | NW       | 5.8 mph    | -          | N/A           | Clear        |
| 3:53 PM    | 108.0 °F | 106.6 °F | 55.0 °F | 17%      | 29.82 in | 10.0 mi    | Variable | 3.5 mph    | -          | N/A           | Clear        |
| 4:53 PM    | 108.0 °F | 106.6 °F | 55.0 °F | 17%      | 29.81 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 5:53 PM    | 109.0 °F | 108.1 °F | 55.9 °F | 17%      | 29.80 in | 10.0 mi    | Variable | 3.5 mph    | -          | N/A           | Clear        |
| 6:53 PM    | 107.1 °F | 106.7 °F | 55.9 °F | 19%      | 29.79 in | 10.0 mi    | WNW      | 4.6 mph    | -          | N/A           | Clear        |
| 7:53 PM    | 100.9 °F | 102.7 °F | 62.1 °F | 28%      | 29.78 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 8:53 PM    | 95.0 °F  | 99.0 °F  | 66.9 °F | 40%      | 29.79 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 9:53 PM    | 90.0 °F  | 93.6 °F  | 68.0 °F | 48%      | 29.81 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 10:53 PM   | 87.1 °F  | 91.3 °F  | 69.1 °F | 55%      | 29.83 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
| 11:53 PM   | 88.0 °F  | 92.1 °F  | 69.1 °F | 53%      | 29.83 in | 10.0 mi    | Calm     | Calm       | -          | N/A           | Clear        |
|            |          |          |         |          |          |            |          |            |            |               |              |

CLIMATE REPORT - NATIONAL WEATHER SERVICE COLUMBIA SC

THE HAMILTON - OWENS AIRPORT SC CLIMATE SUMMARY FOR JUNE 29 2012

| WEATHER  | ITEM                   | OBSERVED  | TIM  | E<br>F) | RECORI | ) YEAR | NORMAL   | DEPARTUR<br>FROM | E LAST<br>VEAR    |
|----------|------------------------|-----------|------|---------|--------|--------|----------|------------------|-------------------|
|          |                        | VALUE     | (Ш). | 1)      | VADOR  |        | VALUE    | NORMAL           | ILAN              |
| <br>     | ייישבייי.<br>(ה) שמווי | •••••     | •••• | •••     | ••••   |        | •••••    |                  | • • • • • • • • • |
| YESTERD  | )AY                    |           |      |         |        |        |          |                  |                   |
| MAXIMU   | M                      | 110       | 405  | PM      | MM     | MM     | 92       | 18               | 92                |
| MINIMU   | M                      | 71        | 555  | AM      | MM     | MM     | 171      | 0                | 73                |
| AVERAG   | Έ                      | 91        |      |         |        |        | 82       | 9                | 83                |
| PRECIPIT | ATION                  | (IN)      |      |         |        |        |          |                  |                   |
| YESTER   | RDAY                   | 0.00      |      |         | MM     | MM     | 0.18     | -0.18            | 0.01              |
| MONTH    | TO DATE                | S 3.97    |      |         |        |        | 4.73     | -0.76            | 4.24              |
| SINCE    | JUN 1                  | 3.97      |      |         |        |        | 4.73     | -0.76            | 4.24              |
| SINCE    | JAN 1                  | 19.73     |      |         |        |        | 21.55    | -1.82            | 20.75             |
| WIND (MP | Ϋ́Η)                   |           |      |         |        |        |          |                  |                   |
| HIGHES   | T WIND                 | SPEED     | 8    | H       | IGHEST | WIND   | DIRECTIO | DN W             | (270)             |
| HIGHES   | T GUST                 | SPEED     | 13   | H       | IGHEST | GUST   | DIRECTIO | DN W             | (290)             |
| AVERAG   | E WIND                 | SPEED     | 1.4  | 1       |        |        |          |                  |                   |
| SKY COVE | R                      |           |      |         |        |        |          |                  |                   |
| AVERAG   | E SKY (                | COVER 0.0 |      |         |        |        |          |                  |                   |
| WEATHER  | CONDITI                | IONS      |      | 1001    |        |        |          |                  |                   |

THE FOLLOWING WEATHER WAS RECORDED YESTERDAY. NO SIGNIFICANT WEATHER WAS OBSERVED.

## Aerial image of Columbia Hamilton-Owens AP

ASOS



Ground image of Columbia Hamilton-Owens AP ASOS instrumentation array



Return visit to Columbia USC site to confirm method of maximum mercury thermometer temperature observation on July 12, 2012:

I, Wes Tyler, met Mike Leitzke, Columbia USC COOP observer at 4:55 PM at the USC COOP site for an interview on the method of observation he made on June 29, 2012. Mr. Leitzke allowed access to the fenced-in area by unlocking gate. I explained to Mr. Leitzke that I wanted him to go through the procedure of observing the temperatures from the NWS Townsend supported NWS standard mercury maximum and alcohol minimum thermometers as he did on June 29, 2012. Mr. Leitzke opened the front door of the unlocked shelter. He then observed the maximum value from the thermometers horizontal-resting locked position and voiced to me that the maximum was 96°F. The minimum was then read from its resting position but I do not recall the value. At this time he accessed his cell phone and began to forward the values to the local NWS by the weather coder method. I stopped him and said the procedure he used to measure the maximum temperature was not part of the guidelines and demonstrated that the recommended practice for measuring the maximum temperature was to carefully release the Townsend support so that the thermometer could be read in a vertical position. He said that he had always measured the maximum temperature the other way and pointed to a placard inside the shelter with instructions. His interpretation of the instructions was incorrect. The value observed from the "released" Townsend supported mercury thermometer read in the vertical position was an agreed 95 °F. To reset the maximum thermometer he "gently" rotated the thermometer in a clockwise manner. Although this is in part a recommended procedure I explained to him that the rotation to reset must be forcefully done to create enough of a centrifuge to reset the mercury column through the bore constriction to attain the present temperature. I gave a demonstration and the mercury column was reset and the thermometer was replaced to its locked setting. Readings of the maximum temperature from the Townsend supported horizontal locked resting position versus the vertical position can result in a separation of the mercury column. This is a common problem caused by external forcing (jarring) of the shelter and/or thermometer since or from when previously reset.

# Explanation of USC Department of Geography and DHEC monitoring instruments at USC site:

On July 16, 2012 at 2:30 PM, I was accompanied by April Hiscox, USC Department of Geography and administrator of the USC NWS COOP site responsibilities for an explanation to the platform mounted DHEC sampling units and on July 18, I had a more detailed phone conversation on the descriptions of the sampling units with Scott Reynolds, SCDHEC Bureau of Environmental Services who maintains those instruments. DHEC operates units 1-5 that are located on the raised wooden platform that was placed at the site in November of 1998.



Unit 1 is furthest west on the platform.

**Unit # 1** - Described as a Tapered Element Oscillating Microbalance (TEOM) Ambient Particulate Monitor Model #432 SP. This unit has an air conditioning/exhaust system attached to maintain sampling temperatures of between 20-40 °C, painted white metal (in use). Placed September 25, 2006. 17' NW of shelter.

**Unit #2** - Air Quality Monitor AQA013 (total suspended particulates air pollution monitor), unpainted metal (not in use). 11' NNW of shelter.

**Units #3/4** - R&P Particulate monitors PM 2.5, painted white metal (in use). 10.5' N of shelter. "Bates Reference" shown as Unit 3 and "Bates Duplicate" shown as Unit 4.

**Unit #5** - TISCH (total suspended particulates air pollution monitor), unpainted metal (not in use). 17.5" NE of shelter.

**Unit #6** - NWS Tipping Bucket for 5-minute interval rainfall, painted white (in use). 6.5' N of shelter.

Unit #7 - Soil temperature monitoring enclosure, grey fiberglass (not in use). 6' W of shelter.

**Unit #8** - A metal tri-pod tower 8' E of shelter supports temperature, anemometer, and other USC Department of Geography atmospheric monitors, some of which are not in use.

On July 18, I received a temperature graph from April Hiscox for June 29, 2012 taken by the tripodmounted BetaTherm instrument indicating a high value of 44.01°C (111.2°F) occurring at approximately 4:23 PM EDT (Figure 1. "red trace").

# Analysis from the USC Department of Geography BetaTherm instrument graph of June 29, 2012 includes:

At approximately 4:07 PM a temperature value of 41.3°C/106°F was traced. At approximately 4:23 PM a temperature value of 44.0°C/111°F was traced. This is a 5 degree rise in 16 mins?

The dark blue trace values are from a sonic temperature analyzer that is by definition, closer to "virtual" temperature since it is dependent on the speed of sound which is affected by humidity.







On July 18, I was provided with a spreadsheet of averaged temperature values obtained every 5 minutes for the DHEC particulate sampling monitors taken on June 29, 2012 by the Thermo Scientific particulate monitors (Image left).

|           | EST   | Bates Reference (°C) | Bates Reference (°F) | Bates Duplicate (°C) | Bates Duplicate (°F) |
|-----------|-------|----------------------|----------------------|----------------------|----------------------|
| 6/29/2012 | 14:30 | 43.2                 | 109.76               | 43.2                 | 109.76               |
| 6/29/2012 | 14:35 | 43.3                 | 109.94               | 43.3                 | 109.94               |
| 6/29/2012 | 14:40 | 43.3                 | 109.94               | 42.9                 | 109.22               |
| 6/29/2012 | 14:45 | 43                   | 109.4                | 43.2                 | 109.76               |
| 6/29/2012 | 14:50 | 42.9                 | 109.22               | 43                   | 109.4                |
| 6/29/2012 | 14:55 | 42.9                 | 109.22               | 43.3                 | 109.94               |
| 6/29/2012 | 15:00 | 43.7                 | 110.66               | 43.7                 | 110.66               |
| 6/29/2012 | 15:05 | 43.4                 | 110.12               | 43.2                 | 109.76               |
| 6/29/2012 | 15:10 | 43.4                 | 110.12               | 43.1                 | 109.58               |
| 6/29/2012 | 15:15 | 43.1                 | 109.58               | 42.9                 | 109.22               |
| 6/29/2012 | 15:20 | 43.2                 | 109.76               | 43.1                 | 109.58               |
| 6/29/2012 | 15:25 | 43.8                 | 110.84               | 43.9                 | 111.02               |
| 6/29/2012 | 15:30 | 44.6                 | 112.28               | 44.9                 | 112.82               |
| 6/29/2012 | 15:35 | 44.3                 | 111.74               | 44.5                 | 112.1                |
| 6/29/2012 | 15:40 | 44                   | 111.2                | 44                   | 111.2                |
| 6/29/2012 | 15:45 | 43.1                 | 109.58               | 42.8                 | 109.04               |
| 6/29/2012 | 15:50 | 43.3                 | 109.94               | 43.3                 | 109.94               |
| 6/29/2012 | 15:55 | 43.5                 | 110.3                | 43.4                 | 110.12               |
| 6/29/2012 | 16:00 | 43.3                 | 109.94               | 43.3                 | 109.94               |
| 6/29/2012 | 16:05 | 43.4                 | 110.12               | 43.5                 | 110.3                |
| 6/29/2012 | 16:10 | 43.9                 | 111.02               | 43.7                 | 110.66               |
| 6/29/2012 | 16:15 | 43.1                 | 109.58               | 42.9                 | 109.22               |
| 6/29/2012 | 16:20 | 43.4                 | 110.12               | 43.7                 | 110.66               |
| 6/29/2012 | 16:25 | 43.5                 | 110.3                | 43.6                 | 110.48               |
| 6/29/2012 | 16:30 | 43.4                 | 110.12               | 43.6                 | 110.48               |
|           |       |                      |                      |                      |                      |

Highest sampled value 45.1°C/113.2°F (unknown which unit or time)

Highest 5 minute average Unit 1 "Bates Reference" 44.6°C/112.3°F @ 4:30 PM EDT (shown on spreadsheet as 15:30 EST)

Highest 5 minute average Unit 2 "Bates Duplicate" 44.9°C/112.8°F @ 4:30 PM EDT (shown on spreadsheet as 15:30 EST)

Greatest movement/change of 5 minute average temperatures within any 15 minute interval on June 29, 2012 of either "Bates Reference" or "Bates Duplicate" between 14:30 EST and 16:30 EST.

"Bates Duplicate" – 5 minute average temperature ending at: 15:20 EST 43.1°C/109.6°F 15:30 EST 44.9°C/112.8°F (+3.2°F in 15 mins)

15:35 EST 44.5°C/112.1°F 15:45 EST 42.8°C/109.0°F (-3.1°F in 15 mins)

# A visit to compare temperatures between SCO portable shelter and on-site DHEC instruments on July 24, 2012:

I, Wes Tyler, arrived at the Columbia USC site at 3:40 PM.

The SCO portable temperature shelter was set up approximately 12 feet south of USC Cotton Region Shelter just outside of fenced-in area (Images 15, 16). Weather conditions were sunny and hot with a steady northwest wind of an estimated 8-10 mph.

The SCO portable temperature shelter included a NWS maximum mercury Townsend support thermometer, a NWS maximum mercury thermometer placed on the "bridge" over the Townsend support, an expanded scale (indexed 160°F) probe thermometer and a "backyard" U-tube type pushbutton magnet reset max/min mercury thermometer.



Image 15

Image 16



Leonard Vaughan, CAE NWS, arrived at 4:00 PM and assisted in making SCO portable shelter temperature observations every 10 minutes beginning at 16:25 EDT without using any centrifuge methods of resetting:

|       | SCO Poi     | rtable Shelter | <b>Observations July</b> | 24, 2012    |         |        |
|-------|-------------|----------------|--------------------------|-------------|---------|--------|
| Time  | Max Mercury | Townsend       | Max Mercury              | Vortical Ob | V Droho | DD     |
| (EDT) | Townsend    | Vertical Ob    | on "bridge"              | vertical OD | A Probe | PD     |
| 16:25 | 99°F        | 98.5°          | 103.5°F                  | 103°F       | 94.2°F  | 96°F   |
| 16:35 | 99.5°F      | 99°F           | 103.5°F                  | 103°F       | 92.5°F* | 96.3°F |
| 16:45 | 99.2°F      | 99°F           | 103.5°F                  | 103°F       | 93°F    | 96.3°F |
| 16:55 | 99.3°F      | 99°F           | **                       | N/A         | 92.5°F  | 96.3°F |
| 17:05 | 100°F       | 99.8°F         | 98.8°F                   | 98.5°F      | 94°F    | 97°F   |

\*replaced completely inside shelter

\*\*reset bridge thermometer, seemed too high

## <u>Table Key:</u>

Townsend supported NWS max/mercury at offset horizontal rest = Max Mercury Townsend Townsend supported NWS max/mercury released to vertical position = Townsend Vertical Ob. NWS max/mercury thermometer at horizontal rest on "bridge" = Max Mercury on "bridge" Read in vertical position = Vertical Ob. Expanded scale probe = X probe

Pushbutton U tube = PB

Scott Reynolds, DHEC, arrived at the USC COOP site at around 5:05 PM and allowed access to inside of fenced-in area of Cotton Region Shelter and adjacent monitoring instruments.

Using the Gilson Laser thermometer the following temperature observations were made on selected un-shaded exposed surfaces at around 5:10 PM on July 24, 2012:

Top of Particulate monitor (Bates Reference Unit #3) 107.4 °F Wooden unpainted raised platform 128.3 °F Wooden rail 132.0 °F Top of Tapered Element Oscillating Microbalance (TEOM Unit #1) 115.7 °F Top of soil temperature Unit #7 133.3 °F

5:15 PM - At this time USC observer had not arrived so we took the liberty to read the USC Townsend supported maximum/mercury thermometer within the USC Cotton Region Shelter.
Resting in the offset horizontal position 100.2°F
Released in the vertical position 99.8°F.
We did not spin the thermometer to reset.

5:15 PM - Scott Reynolds was able to observe the current temperatures of "Bates Reference" Unit #3 and "Bates Duplicate" Unit #4.

"Bates Reference" Unit #3 36.7°C (98.4°F) "Bates Duplicate" Unit #4 37.3°C (99.1°F)

USC observer Mike Lietzke arrived at around 5:25 PM and made his observation: Value of 100 °F was reported to the NWS from vertical observation of Townsend released maximum mercury thermometer. Then spun to reset.

Below are the 3:30 PM-5:30 PM EDT 5-min average values on July 24, 2012 for the DHEC "Bates Reference" and "Bates Duplicate" monitors:

|           | EST   | Bates Reference (°C) | Bates Reference (°F) | Bates Duplicate (°C) | Bates Duplicate (°F) |
|-----------|-------|----------------------|----------------------|----------------------|----------------------|
| 7/24/2012 | 14:30 | 36.2                 | 97.16                | 36.4                 | 97.52                |
| 7/24/2012 | 14:35 | 36.3                 | 97.34                | 36.4                 | 97.52                |
| 7/24/2012 | 14:40 | 36.4                 | 97.52                | 36.2                 | 97.16                |
| 7/24/2012 | 14:45 | 36.4                 | 97.52                | 36.6                 | 97.88                |
| 7/24/2012 | 14:50 | 36.4                 | 97.52                | 36.7                 | 98.06                |
| 7/24/2012 | 14:55 | 36.2                 | 97.16                | 36.6                 | 97.88                |
| 7/24/2012 | 15:00 | 36.6                 | 97.88                | 36.4                 | 97.52                |
| 7/24/2012 | 15:05 | 36.7                 | 98.06                | 37                   | 98.6                 |
| 7/24/2012 | 15:10 | 36.6                 | 97.88                | 36.6                 | 97.88                |
| 7/24/2012 | 15:15 | 36.4                 | 97.52                | 36.4                 | 97.52                |

| 7/24/2012 | 15:20 | 37   | 98.6  | 36.5 | 97.7  |
|-----------|-------|------|-------|------|-------|
| 7/24/2012 | 15:25 | 36.6 | 97.88 | 36.5 | 97.7  |
| 7/24/2012 | 15:30 | 36.4 | 97.52 | 36.7 | 98.06 |
| 7/24/2012 | 15:35 | 36.5 | 97.7  | 36.7 | 98.06 |
| 7/24/2012 | 15:40 | 36.5 | 97.7  | 36.7 | 98.06 |
| 7/24/2012 | 15:45 | 36.7 | 98.06 | 36.4 | 97.52 |
| 7/24/2012 | 15:50 | 36.7 | 98.06 | 36.8 | 98.24 |
| 7/24/2012 | 15:55 | 36.7 | 98.06 | 36.7 | 98.06 |
| 7/24/2012 | 16:00 | 36.4 | 97.52 | 36.7 | 98.06 |
| 7/24/2012 | 16:05 | 36.8 | 98.24 | 36.4 | 97.52 |
| 7/24/2012 | 16:10 | 36.7 | 98.06 | 36.7 | 98.06 |
| 7/24/2012 | 16:15 | 36.7 | 98.06 | 36.6 | 97.88 |
| 7/24/2012 | 16:20 | 36.4 | 97.52 | 36.4 | 97.52 |
| 7/24/2012 | 16:25 | 36.7 | 98.06 | 37   | 98.6  |
| 7/24/2012 | 16:30 | 36.6 | 97.88 | 36.9 | 98.42 |

Unlike the averages noted on June 29, 2012 under "near calm" conditions at "Bates Reference", it appears that when there is a steady horizontal surface wind, the 5 minute average temperature values are progressively smoother in change.

Greatest movement/change of 5 minute average temperatures within any 15 minute interval on July 24, 2012 of either "Bates Reference" or "Bates Duplicate" between the times of 14:30 PM EST and 16:30 PM EST:

"Bates Reference" – 5 minute average temperature ending at: 15:20 EST 37.0°C/98.6°F 15:30 EST 36.4°C/97.5°F (-1.1 °F in 15 mins)

"Bates Duplicate"– 5 minute average temperature ending at: 15:05 EST 37.0°C/98.6°F 15:15 EST 36.4°C/97.5°F (-1.1 °F in 15 mins) Image 17



It should be noted that the beehive temperature sensor that is attached to the side of both Thermo Scientific particulate monitors is only five inches away from the top of each unit (Image 17).





Scott Reynolds, DHEC, kneeling – "Bates Reference"



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# Ambient temperatures on July 24, 2012 as recorded by the BetaTherm instrument belonging to the USC Department of Geography (Figure 2):

The high value of 37.74°C (99.9°F) was recorded at approximately 18:00 EDT. Of note, at approximately 13:35 EDT, the value of 36.0°C/96.8°F fell to 34.8°C/94.6°F (2.2°F in 10 minutes). During the next 10 minutes, the temperature rose to 36.0°C/96.8°F (2.2°F). At approximately 17:30 EDT, the temperature value rose 1.6°C (2.9°F) from 36.1°C/97.0°F to the 18:00 EDT value of 37.7°C/99.9°F. The temperature fluctuations after the observed peak (18:00 EDT) are significantly smaller than the ones prior to the peak, resulting in a much smoother temperature trace.



Figure 2. USC Department of Geography BetaTherm instrument graph.

## History for Columbia Hamilton-Owens, SC KCUB AP

July 24, 2012

| Time     |         | Heat     | Dew     | Humidi |          |            |          | Wind     | Gust     |         |               |
|----------|---------|----------|---------|--------|----------|------------|----------|----------|----------|---------|---------------|
| (EDT)    | Temp.   | Index    | Point   | ty     | Pressure | Visibility | Wind Dir | Speed    | Speed    | Precip  | Conditions    |
| 12:53 AM | 81.0 °F | 85.8 °F  | 73.0 °F | 77%    | 30.08 in | 10.0 mi    | SSW      | 4.6 mph  | -        | N/A     | Clear         |
| 1:53 AM  | 81.0 °F | 85.8 °F  | 73.0 °F | 77%    | 30.07 in | 10.0 mi    | SW       | 6.9 mph  | -        | N/A     | Clear         |
| 2:53 AM  | 80.1 °F | 84.2 °F  | 73.0 °F | 79%    | 30.05 in | 10.0 mi    | WSW      | 3.5 mph  | -        | N/A     | Clear         |
| 3:53 AM  | 79.0 °F | -        | 73.0 °F | 82%    | 30.04 in | 10.0 mi    | Calm     | Calm     | -        | N/A     | Clear         |
| 4:53 AM  | 79.0 °F | -        | 73.0 °F | 82%    | 30.04 in | 10.0 mi    | WSW      | 4.6 mph  | -        | N/A     | Clear         |
| 5:53 AM  | 78.1 °F | -        | 73.9 °F | 87%    | 30.04 in | 10.0 mi    | Calm     | Calm     | -        | N/A     | Clear         |
| 6:53 AM  | 78.1 °F | -        | 73.0 °F | 84%    | 30.03 in | 10.0 mi    | WSW      | 3.5 mph  | -        | N/A     | Clear         |
| 7:53 AM  | 80.1 °F | 84.2 °F  | 73.0 °F | 79%    | 30.04 in | 10.0 mi    | West     | 5.8 mph  | -        | N/A     | Clear         |
| 8:53 AM  | 82.9 °F | 88.8 °F  | 73.0 °F | 72%    | 30.05 in | 10.0 mi    | West     | 9.2 mph  | -        | N/A     | Clear         |
| 9:53 AM  | 86.0 °F | 93.0 °F  | 73.0 °F | 65%    | 30.03 in | 10.0 mi    | WSW      | 8.1 mph  | -        | N/A     | Clear         |
| 10:53 AM | 90.0 °F | 97.9 °F  | 73.0 °F | 57%    | 30.02 in | 10.0 mi    | Variable | 4.6 mph  | -        | N/A     | Clear         |
| 11:53 AM | 93.0 °F | 104.6 °F | 75.0 °F | 56%    | 29.99 in | 10.0 mi    | WSW      | 6.9 mph  | -        | N/A     | Clear         |
| 12:53 PM | 96.1 °F | 102.9 °F | 70.0 °F | 43%    | 29.98 in | 10.0 mi    | Variable | 5.8 mph  | -        | N/A     | Clear         |
| 1:53 PM  | 97.0 °F | 103.5 °F | 70.0 °F | 41%    | 29.96 in | 10.0 mi    | WNW      | 6.9 mph  | -        | N/A     | Clear         |
| 2:53 PM  | 98.1 °F | 105.0 °F | 70.0 °F | 40%    | 29.94 in | 10.0 mi    | Variable | 6.9 mph  | -        | N/A     | Clear         |
| 3:53 PM  | 98.1 °F | 105.0 °F | 70.0 °F | 40%    | 29.91 in | 10.0 mi    | NW       | 10.4 mph | -        | N/A     | Partly Cloudy |
| 4:53 PM  | 98.1 °F | 106.5 °F | 71.1 °F | 42%    | 29.91 in | 10.0 mi    | NW       | 8.1 mph  | -        | N/A     | Clear         |
| 5:53 PM  | 98.1 °F | 105.0 °F | 70.0 °F | 40%    | 29.90 in | 10.0 mi    | West     | 10.4 mph | 16.1 mph | N/A     | Clear         |
| 6:53 PM  | 97.0 °F | 102.8 °F | 69.1 °F | 40%    | 29.90 in | 10.0 mi    | WNW      | 6.9 mph  | -        | N/A     | Clear         |
| 7:53 PM  | 86.0 °F | 90.1 °F  | 69.1 °F | 57%    | 29.94 in | 10.0 mi    | NE       | 10.4 mph | 23.0 mph | N/A     | Partly Cloudy |
| 8:53 PM  | 82.0 °F | 86.3 °F  | 71.1 °F | 69%    | 29.92 in | 10.0 mi    | Variable | 3.5 mph  | -        | 0.00 in | Partly Cloudy |
| 9:53 PM  | 80.1 °F | 83.8 °F  | 72.0 °F | 76%    | 29.94 in | 10.0 mi    | SW       | 5.8 mph  | -        | N/A     | Sct Clouds    |
| 10:53 PM | 80.1 °F | 84.2 °F  | 73.0 °F | 79%    | 29.93 in | 10.0 mi    | WSW      | 4.6 mph  | -        | N/A     | Clear         |
| 11:53 PM | 79.0 °F | -        | 72.0 °F | 79%    | 29.94 in | 10.0 mi    | SSW      | 3.5 mph  | -        | N/A     | Clear         |

The summary below was provided by Leonard Vaughan, Meteorologist, Climate Service Program Manager, National Weather Service Columbia, SC

## SC Heat Wave Synopsis:

Strong ridge of high pressure built over the Tennessee Valley into the Carolinas on the 29<sup>th</sup> through the 30<sup>th</sup>. The models were forecasting 850 mb temperatures to range from 25 to 26 °F Celsius along with 700 mb temperatures exceeding 10 to 12 °F Celsius. The 850 mb anomaly charts from the NAM/GFS/SREF and GEFS for 00z Saturday June 30<sup>th</sup>, shows standard deviations of 4 to 5 °F across South Carolina for the event. This gives the indication of an extreme event for South Carolina.

Along with the favorable conditions aloft for the event, a thermal trough was expected to develop across the Midlands Friday. West of the trough a surface downslope flow would develop increasing the compressional heating and therefore increase the temperatures across the Midlands. The air mass also remained rather dry for late June with Precipitable Water Values (PW) forecasted to range from 1.0 - 1.5 inches.

This scenario produced some of the highest temperatures ever recorded across the Palmetto State. Records were broken at Columbia on the 29<sup>th</sup> and 30<sup>th</sup> and many locations recorded high temperatures well above the century mark.



## 500 MB Temperature Analysis 00z on the 28th



## 500 MB Temperature Analysis 12z on the 28th

## 500 MB Temperature Analysis 00z on the 29th



## 500 MB Temperature Analysis 00z on the 30th



## 500 MB Temperature Analysis 12z on the 30th





Most of SC is the 3-4 Standard Deviation Area with H8 Temperatures from 25 to 26 °C .



Most of SC is the 3-4 Standard Deviation Area with H8 Temperatures from 24-25 °C.



H8 Temperatures in the 24-26 °C range are "extremely" rare since 1948.

## 72215 Radiosonde Histogram



Radiosonde Histogram for FFC (ATL) H8 Temperatures in the 24-26 °C range are "extremely" rare since 1955.



Radiosonde Histogram for GSO

H8 Temperatures in the 24-26 °C range are "extremely" rare since 1948.



925 mb Forecast Temperature Anomaly from the valid at Saturday 18Z 29 June 2012 from the 00Z 28 June 2012 run of the GEFS. Maximum Value is +5.48 Standard Deviations.



925 mb Forecast Temperature Anomaly from the valid at Saturday 00Z 30 June 2012 from the 06Z 27 June 2012 run of the GEFS. Maximum Value is +5.11 Standard Deviations.



t925 mb Forecast Temperature Anomaly from the valid at Saturday 00Z 30 June 2012 from the 12Z 29 June 2012 run of the GEFS. Maximum Value is +5.64 Standard Deviations.

I grabbed the anomally charts from the WFO CTP/PSU web page for the NAM, GFS, SREF, and GEFS for 00Z Saturday, 30 June. across the Southeast. As you might expect, 850-hPa temperatures are 3-4 standard deviations above normal across much of NC with areas of 5 SD across SC.



The Record Breaking Heatwave that occurred on June 29<sup>th</sup> and 30<sup>th</sup> was an extremely rare event. The 850mb Temperatures that occurred across the area were extremely rare when compared to histograms from ATL, GSO and CHS. There had been very few cases in the past 57 to 64 years. This would include the historic record head event of the 1950s, especially the 1952 event. The "Standard Deviations" for this event were in the 3 to 4 positive range with the highest values around plus 4.33 along the Savannah River Valley and across South-Central Georgia.

The 925mb Temperatures were even more impressive with Standard Deviations between 5 and 5.64 positive range and values in the 30 to 34 degree Celsius range



## State Climate Extremes Committee National Oceanic and Atmospheric Administration

National Climatic Data Center

- Overview
- Operational Details
  - Reports
- Elements Tracked
  - Records
  - Contact

A fully-detailed set of operational guidelines are also available in National Weather Service Instruction 10-1004.

## 1. Purpose

The formation of a State Climate Extremes Committee (SCEC) addresses the consideration of potentially record-setting extreme meteorological elements observed at the statewide level. The purpose of the SCEC is to mirror the activities of the National Climatic Extremes Committee (NCEC), but for observations challenging state records, rather than national ones. The SCEC serves as an advisory panel that will make recommendations regarding state records to the director of the NCDC. With the agreement of the NCDC Director, such records will become officially sanctioned, and recognized by the meteorological and climatological community.

## 2. Scope

The SCEC is to provide counsel and a recommendation regarding the status of an observation of a meteorological element (*e.g.*, maximum temperature) that challenges the existing, official record value for that element for a given state. If such observations also challenge a national record, the involvement of the SCEC will be to render a recommendation regarding the state record only. The case will be forwarded and considered separately by the NCEC.

While many aspects of meteorological elements may be tracked, and record extremes determined, officiating and tracking many of the elements that are of extremely limited

interest or use to the public would unnessicarily burden the SCEC. Therefore, the SCEC has compiled an inital list of elements that are to be tracked. These elements have demonstrated a strong public interest, and the historical data for these elements are readily available for a large number of observation stations across the United States.

## 3. Composition and convening

The SCEC will be an *ad hoc* committee comprised of the following five voting members:

- A representative from the Weather Forecast Office (WFO) holding jurisdiction over the station recording a potential record. The Meteorologist in charge (MIC), or the climate focal point is preferred.
- The State Climatologist (SC) for the state in which the record is being challenged. If the state does not have an SC, the SC from a neighboring state will be asked to serve.
- A representative from the NWS Regional Headquarters. Preferrably this will be the NWS Regional Climate Services Program Manager (CSPM) or the Regional COOP Program Manager.
- A representative from the relevant Regional Climate Center. Preferrably this will be the Regional Climatologist or the RCC Director.
- A representative from NCDC. The NCDC National Partnership Liaison will serve in this capacity.

Additional non-voting members may be asked to participate. This is often the case where the input of a particular subject matter expert is desirable. A quorum of the committee is considered to be three of the five voting members.

The committee may be called by any member, but in general, it will be expected that either the relevant WFO or the SC for the affected state will call for the committee to convene. The committee will dissolve once a recommendation has been reached regarding a challenged record value, or when the challenge has been withdrawn. Recommendations will carry with a simple majority vote. The director of the NCDC renders the final decision regarding any SCEC recommendation, and may override SCEC voting results or send the decision back to the SCEC for further review.

It is expected that most discussion and voting of the committee will take place via either E-mail or teleconference (see Section 4). Occasionally, it may be necessary for the committee to meet in person. If the in-person meeting is to discuss a particular state record, the meeting should occur in the state in question (as a site visit may be necessary). Such a meeting should be arranged by a member based in that state.

## 4. Record Recognition Process

The SCEC will compile a list of the extant records listed in Table 1 for each state of the United States. These records will be reviewed to determine their validity and, if found to be acceptable, will be recommended to the NCDC Director for inclusion in the statewide records data set. As of April, 2010 NCDC has reviewed and updated the statewide extremes tables for all-time maximum and minimum temperature, 24-hr precipitation and snowfall, and all-time greatest snow depth. Remaining tables of the tracked elements will be subsequently updated.

Thereafter, the challenge of an SCEC officially recognized statewide record is expected to follow the following guidelines:

- 1. If the WFO or the SC thinks a statewide record may have been set, a representative from the WFO or SC office (preferably the WFO) should visit the site of the record within 2 days of notification of the record and take the following action.
  - Test equipment to ensure proper working order.
  - Examine and describe exposure and take pictures.
- 2. After the site visit, the WFO representative or SC should send an E-mail to all members of the SCEC (see Section 3) informing them of a challenge to the record. Information/photos from the site visit should be attached to the E-mail.
- 3. At this point, the WFO should transmit a preliminary Record Event Report (RER). The RER should clearly indicate that the record is under review, and final determination will be forthcoming.
- 4. Once the WFO or SC sends the initial SCEC E-mail, they should set up a teleconference call that includes all members of the SCEC.
  - The teleconference should take place within the soonest practical timeframe after the E-mail from the WFO or SC is received.
  - If any member of the SCEC is unavailable, they should notify the committee of their absence. They may provide input via E-mail, but their vote would either be abstained, or cast by their alternate or other proxy acceptable to the committee.
- 5. Each SCEC member will review the validity of the proposed record value, using all tools available to them, prior to the teleconference. They should be prepared to discuss and vote on the validity of the record during the conference call. A second call may be needed if new information is brought to light in the first call.
- 6. The SCEC will vote for or against recommending to the director of the NCDC that the record be updated. A simple majority will carry the vote.
- 7. The director of the NCDC will be informed of the challenge to the record, and will be given the recommendation of the SCEC. The director, or their officially designated proxy, will render an official decision on the record. The decision of the NCDC Director or proxy will be final.

NWS Instruction 10-1004 limited recognition of statewide climate records to those values originating from official NOAA-sanctioned weather stations. However, it has

become evident that limiting the recognition of official climatological records to only official observations (e.g., NOAA weather stations) may result in legitimate meteorological observations being dismissed on non scientific grounds. Therefore, the SCEC has taken the informal stance that a meteorolgical observation being considered for a statewide record may come from any legitimate metorological observation platform, provided the value has first been vetted by either the State Climatologist or a local NWS representative. When evaluating a value that has come from a source external to NOAA's officially sanctioned weather observing network, the SCEC requires that:

- The observation is meteorologically sound and climatologically representative of the climate of the region (*e.g.*, not biased by micro-climatological, anthropogenic, geologic, or combustion factors).
- The observing platform meets or exceeds instrument and siting standards set forth by the WMO, OFCM, and NOAA.
- The instrument/sensor has operational parameters which support the observation. If an observation is beyond the operational envelope of the instrument, the instrument may be forwarded to a standards facility for testing.
- The data collected by the instrument is archived indefinitely, along with any quality control and metadata information pertaining to the data, sensor, platform or network.
- Public access to the data and all accompanying metadata is unrestricted (although the access may be fee-based).

## 5. Erroneous records

If upon future examination, it comes to the attention of a member of an organization represented on the SCEC that an officially recognized statewide record may be in error or otherwise invalid, that member of the SCEC should send an E-mail to the committee, informing them of the questionable record, and including documentation in support of the challenge.

The challenging member should then invite all members to a teleconference, where the record will be discussed and a recommendation regarding validity voted upon.

If a challenge to the validity of an existing official statewide record is made by someone outside the committee structure, the challenge should be directed toward the relevant WFO or SC, who will review the challenge and, if the evidence warrants it, forward the challenge to the committee as per the steps outlined in the previous paragraph. If the NCDC Director or designated proxy determines that a record value should be changed, they have the authority to order the change without involving the SCEC, but are

expected to notify the NCDC National Partnership Liaison of their decision so the SCEC records tables may be updated.

## 6. Public visibility

NCDC, NWS, State Climatologists, and/or the American Association of State Climatologists may wish to publish a table of state records and/or post them on the web. The table may include the officially sanctioned record values, the date on which the records were set, and the stations at which they were set. Web postings may also describe the SCEC mission, the records it tracks, and the steps for reporting potential records or challenging existing records. This SCEC website contains all of the aforementioned information.

## NATIONAL WEATHER SERVICE MANUAL 10-1315 October 5, 2010 Operations and Services Surface Observing Program (Land), NDSPD 10-13 Cooperative Station Observations

#### **APPENDIX B – Air Temperature**

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1. Definitions. The word temperature as used in this appendix refers only to the air temperature. Temperature readings are taken from maximum and minimum thermometers, or from the digital displays of an electronic thermometer.

The minimum temperature is the lowest temperature to have occurred since the minimum thermometer or on the electronic thermometer since it was last read and reset.

The maximum temperature is the highest temperature since the maximum thermometer or electronic thermometer since it was last read and reset.

The current temperature is the temperature at the time the thermometer or electronic thermometer is read. This is read from the maximum thermometer while in a vertical position after it has been whirled.

2. Types of Thermometers. There are two types of temperature sensors approved at cooperative stations; the liquid-in-glass maximum and minimum thermometers (Figure B-1) and the electronic thermometers (seen in background of Figure B-2). Figure B-1 shows the liquid-inglass (LIG) maximum and minimum thermometers in their correct operating or measuring positions. The LIG thermometers are required to be housed within a Cotton Region Shelter (CRS). The CRS is pictured in Figure B-2.



Figure B-1 - Liquid-in-Glass Maximum and Minimum Thermometers

3. Instrument Shelters. Ensure thermometers are enclosed in shelters to reduce the risk of erroneous readings. The sensors are shielded from the sun, rain, snow, and other sources of light, heat, or cold, when they are housed in a shelter. Shelters are designed to allow the maximum possible free flow of air. Ventilation is accomplished by louvers which slope downward from the inside to the outside of the shelter and with a double top. Figure B-2 shows the medium-sized cotton region shelter used most often for liquid-in-glass maximum and minimum thermometers. Liquid-in-glass thermometers are mounted on a horizontal board located in the upper middle part of the shelter. The MMTS shelters are shown behind the cotton region shelter in Figure B-2.

3.1 Shelter Placement.



The ground under the shelter should be typical of the surrounding area. A level, open clearing is desirable so the thermometers are freely ventilated by the flow of air. Do not install on a steep slope or in a sheltered hollow unless it is typical of the area, or unless data from that type of topographic location is desired. When possible, the shelter should be no closer than four times the estimated height of any obstruction (tree. fence, building, etc.). Optimally it should be at least 100 feet from any paved or concrete surface. Under no circumstances should a shelter be placed on the roof of a building as this may result in extreme temperature biases.

4.2 Maximum Thermometer - How It Works. The maximum thermometer has a mercury filled bulb sensing element. It is exposed in a nearly horizontal position (Figure B-1). Graduations at one degree intervals are etched on the stem. The bore is constricted between the graduated portion of the stem and the bulb, as

shown in Figure B-4.

As the temperature rises, some of the expanding mercury in the bulb is forced to pass through the constricted portion into the graduated portion. As soon as the temperature falls, the column of mercury breaks at the constriction leaving the thread of mercury in the graduated portion indicating its highest reading. The thermometer is turned vertical for reading. The top of the

mercury column indicates the highest temperature reached. Once the maximum temperature is read, the max thermometer is spun in its mount to force the mercury in the graduated tube past the constriction until it joins the mercury in the bulb. When joined, the maximum thermometer will indicate the current air temperature.



Figure B-4 - Liquid-in-Glass Maximum Thermometer

4.6 How to Read and Record Temperatures. Thermometers are read and recorded to the nearest whole degree Fahrenheit. Readings are usually recorded on WS Form B-82, and WS Form B-91, or WS Form B-92. Temperatures below zero are recorded with a minus (–) sign to the left of the digits; i.e.,  $-15^{\circ}$ F for  $15^{\circ}$ F below zero. The thermometers should be reset after they are read, as described in Sections 4.6.1, 4.6.2 and Figure B-7.

**Caution:** Stand as far from the thermometers as possible to prevent body heat from changing the readings. This is particularly important in cold weather. The bulbs of the thermometers should not be touched.

4.6.1 Reading and Setting the Maximum Thermometer. The highest temperature occurring since the maximum temperature was previously reset is the reading at the top of the mercury column, taken with the bulb end lowered. Release the support catch on the back of the clamp and carefully lower the bulb end of the thermometer. See Figure B-9.

To reset the maximum thermometer, start with the bulb end lowered and whirl it rapidly, allowing it to spin freely until it comes to rest. Repeat the whirling if necessary until the mercury will not retreat farther into the bulb; i.e., until the column is no longer separated at or below the constriction. See Figure B-10.

Next, move the catch on the support until it touches the longer shaft. Carefully elevate the bulb end of the thermometer until the catch locks the shaft in place on the support. The thermometer is now "set" to indicate the maximum temperature that occurs before it is set again.

## **Summary Findings**

## Johnston 4SW

There were a wide range of same-time temperature values observed by the Johnston Cotton Region Shelter mercury thermometer, the Davis and Nimbus MMTS systems.

### For example:

On July 3 at 10:30 AM, the Nimbus MMT displayed 88.8°F while the Davis displayed 89.1°F (within 0.3 degrees of each other) yet the shelter thermometer read 94.8°F.

The Davis instrument logged a maximum value on June 29, 2012 of 106.6°F.

The nearest highest value reported by a NWS COOP site on June 29, 2012 was Saluda with 109°F (4 degrees less than Johnston).

The nearest AWOS airport highest value reported on June 29, 2012 was 105.8°F at Aiken, SC KAIK AP and the nearest ASOS airport highest value reported was 107°F at Augusta, GA KDNL "Daniel" AP.

Wind speeds recorded at nearby Aiken AP were from the south and generally less than 5 mph after the 2:35 PM observation with periods of calm air through the peak heating of the day.

The reported maximum temperature of 104°F on the morning of July 11, 2012 was suspiciously the same value as the day before and 8 degrees higher than its nearest NWS COOP site of Saluda that reported 96 degrees. This 104°F report suggests that the maximum thermometer was not reset the day before.

On July 26, 2012, it was discovered that the method of making the daily maximum temperature value at Johnston on June 29, 2012 was not made according to the NWS guidelines of viewing the indexed temperature value by releasing the locked Townsend supported NWS maximum mercury thermometer horizontal position to the vertical viewing position. This is a known error that compromises accuracy.

Temperature comparisons using the SCO portable shelter on July 26 with the Johnston Cotton Region Shelter revealed a running temperature difference of between 2.2 and 2.5 degrees during the test. The SCO portable NWS standard thermometer was continuously cooler regardless of being only a few feet away or relocated to a more open area on Mr. Berry's property. Surface winds on this date were quite brisk from the west all during the visit.

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#### Columbia USC

Once again the practice of observing the daily maximum temperature at the USC site was discovered on July 12, 2012 to be outside of the NWS recommended guidelines. The observer, Mike Leitzke, was unaware of the correct method of viewing the Townsend supported maximum mercury thermometers temperature value from the released vertical position.

Continuous temperature recordings by the USC Department of Geography BetaTherm instrument adjacent to the USC shelter on June 29, 2012 indicated a high value of 111.2°F at approximately 4:23 PM EDT. Of interest is that between the approximate times of 4:07 PM EDT and 4:23 PM EDT (a period of 16 minutes) the temperature rose from 106°F to 111°F.

The nearest ASOS surface weather observations at Columbia Hamilton-Owens AP on June 29, 2012 reported a high value of 110°F at 4:05 PM EDT.

SC DHEC particulate monitors that also record temperature reported a high value of 113.2°F but the time could not be determined. By reviewing the 5-minute average values it is likely that the 113.2°F occurred near 4:30 PM EDT.

There were two notable fluctuations in the DHEC 5-minute average temperature observations on June 29, 2012 within any 15-minute interval. The 5-minute average temperature for the 15-minute interval ending at 15:30 EST **rose** 3.2 degrees. The 5-minute average temperature for the 15-minute interval ending at 15:45 EST **fell** 3.1 degrees. This represents a 6.3 degree range in average temperature over 30 minutes. This would suggest that air speeds over nearby and direct sun-exposed surfaces were influencing the sensitivity of the temperature sensor.

Temperature comparisons on July, 24 2012 between the SCO portable shelter, DHEC monitors, USC Department of Geography BetaTherm instrument and the USC COOP shelter revealed the following:

There were also two notable temperature fluctuations in the running USC BetaTherm trace on July 24, 2012. At approximately 13:35 EDT, the temperature was traced at 36.2°F/97.2°F and in 10 minutes **fell** to 34.8°C/94.6°F (a change of 1.4°C/2.6°F). During the following 15 minutes, the temperature **rose** to 36.0°C/96.8°F (a change of 1.2°C/2.2°F).

At 5:15 PM on July 24, 2012, the SCO portable NWS maximum thermometer read 99.0 °F released from the Townsend support and in the vertical position. The USC thermometer read 99.8 °F in the released vertical position and the DHEC monitor "Bates Reference "read 98.4 °F while the "Bates Duplicate" read 99.1 °F. At this observation, NW winds were steady at around 8-10 mph. The SCO portable shelter thermometer and DHEC thermometers were within 0.6°F of each other. The USC shelter thermometer was at least 0.7°F higher. The maximum temperature recorded on this date by the USC BetaTherm was 99.9°F at approximately 6:02 PM.

Numerous monitoring units are near the USC Cotton Region Shelter and may contribute as artificial heat sources, especially on days of light winds or calm air and thus influence the observable temperature.

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| _  |  |   |                      |   |                |                                  |           |           |           |         |           |                     |                    |                     |         |          |                   |                    |              |      |          |                |           |          |          |       |         |          |           |          |  |
|----|--|---|----------------------|---|----------------|----------------------------------|-----------|-----------|-----------|---------|-----------|---------------------|--------------------|---------------------|---------|----------|-------------------|--------------------|--------------|------|----------|----------------|-----------|----------|----------|-------|---------|----------|-----------|----------|--|
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| 2  | 90   | 50                                      | 65                   | 0.00  | -              | <u> </u>                         | ++        | +         | ++        | +       | ++        | ++                  | ++                 | +                   |         | H        | +                 | ++                 | ++           | +    |          | <u> </u>       | -         | -        | <u> </u> | +     | +       | <u> </u> |           | -        |  |
| 3  | 83   | 53                                      | 63                   | 0.00  | -              | <u> </u>                         | H         | +         | ++        | +       | ++        | H                   | ++                 | ++                  |         | H        | +                 | H                  | H            | +    | -        | -              |           | -        | -        | +     | +       | -        | -         | -        |  |
| 4  | 90   | 59                                      | 68                   | 1.38  | -              | -                                |           | Ħ         |           | +       | ++        | ++                  | ++                 | +                   |         |          |                   | H                  | Ħ            | +    |          | <u> </u>       |           |          | -        | +     | +       | -        | -         | -        |  |
| 5  | 83   | 63                                      | 63                   | 0.16  |                | I                                | H         | Ħ         |           | -       | H         | Ħ                   | ++                 | +                   |         | H        |                   | H                  | Ħ            | +    |          | -              |           | -        |          | 1     | +       |          | -         | -        |  |
| 6  | 67   | 60                                      | 63                   | 0.38  |                |                                  | H         | Ħ         |           |         | $\square$ | Ħ                   | +                  |                     |         |          |                   | H                  | Ħ            |      |          |                |           |          |          |       |         |          |           |          |  |
| 7  | 74   | 57                                      | 59                   | 0.04  |                |                                  |           |           |           |         |           |                     |                    |                     |         |          |                   |                    | П            |      |          |                |           |          |          |       |         |          |           |          |  |
| 8  | 83   | 57                                      | 62                   | 0.00  | 1              |                                  |           |           |           |         |           |                     |                    |                     |         |          |                   |                    | Π            |      |          |                |           |          |          |       |         |          |           |          | Present weather fair   |
| 9  | 86   | 58                                      | 59                   | 0.00  |                |                                  |           |           |           |         |           |                     |                    |                     |         |          |                   |                    |              |      |          |                |           |          |          |       |         |          |           |          | present wx fair  |
| 10 | 87   | 58                                      | 70                   | 0.00  |                |                                  |           |           |           |         | 11        | $\square$           | +                  |                     |         |          |                   | Ц.                 | $\square$    |      |          |                |           |          |          |       |         |          |           |          | present wx cloudy  |
| 11 | 79   | 66                                      | 68                   | 1.17  |                |                                  |           |           |           |         |           |                     |                    |                     |         |          |                   |                    |              |      |          |                |           |          |          | 1     |         |          |           |          | Present weather is cloudy  |
| 12 | 79   | 65                                      | 70                   | 0.28  | -              | I                                | 1         | 2 3       | 4 5       | 6 7     | 8         | 9 10                | 11                 | 1 2                 | 3 4     | 5        | 6 7               | 8                  | 9 10         | 11   |          | <u> </u>       | -         | <u> </u> | <u> </u> | +     | +       | <u> </u> | -         | <u> </u> | Present weather is cloudy  |
| 13 | 89   | 65                                      | 65                   | 1.05  |                | <u> </u>                         | ++        | +         |           | -       | ++        | ++                  | +                  | +                   |         | $\vdash$ | +                 | ++                 | ++           | -    | -        | <u> </u>       | -         | -        | <u> </u> | +     | -       | <u> </u> |           | -        |  |
| 14 | 88   | 64                                      | 69                   | 0.00  | -              | <u> </u>                         | ++        | +         | ++        | +       | ++        | ++                  | ++                 | +                   |         | H        | +                 | ++                 | +            | +    | -        | <u> </u>       |           | -        |          | +     | +       | -        |           | <u> </u> | Present weather is fair.   |
| 10 | 84   | 60                                      | 68                   | 0.00  |                | <u> </u>                         | ++        | +         | ++        | +       | ++        | ++                  | ++                 | +                   |         | H        | +                 | ++                 | ++           | +    | -        | <del> </del> _ | -         | -        | <u> </u> | +     | +       | <u> </u> | -         | -        | Flesent weather is fall.   |
| 17 | 83   | 55                                      | 68                   | 0.00  | -              | <u> </u>                         | ++        | +         | ++        | +       | ++        | ++                  | ++                 | +                   |         | H        | +                 | H                  | +            | +    | -        | -              |           | -        | -        | +     | +       | -        |           | -        |  |
| 18 | 85   | 61                                      | 64                   | 0.00  |                | l –                              | H         | ++        | ++        | +       | H         | Ħ                   | ++                 | +                   |         | H        | +                 | H                  | ++           | +    |          | <u> </u>       |           | -        | -        | +     | +       | -        |           | -        |  |
| 19 | 88   | 59                                      | 62                   | 0.00  | 1              | -                                | H         | Ħ         |           | +       | ++        | Ħ                   | ++                 |                     |         | H        | +                 | H                  | Ħ            | +    |          | -              |           |          | -        | -     | 1       |          |           |          |  |
| 20 | 87   | 62                                      | 63                   | 0.00  |                |                                  |           | $\square$ |           |         | H         | Ħ                   |                    |                     |         |          |                   | H                  | Ħ            |      |          |                |           |          |          |       |         |          |           |          |  |
| 21 | 90   | 63                                      | 75                   | 0.00  |                |                                  |           |           |           |         |           |                     |                    |                     |         |          |                   |                    | Π            |      |          |                |           |          |          |       |         |          |           |          | present wx fair  |
| 22 | 93   | 63                                      | 63                   | 0.00  | 1              |                                  | 1         | 2 3       | 4 5       | 6 7     | * 8       | 9 10                | 17                 | 1 2                 | 3 4     | 5        | 6 7               | . 8                | 9 10         | 11   |          |                |           |          |          |       |         |          |           |          | present wx fair  |
| 23 | 95   | 63                                      | 67                   | 0.00  |                |                                  | П         | Π         | T         | T       |           |                     |                    |                     |         |          |                   | П                  | Π            | T    |          |                |           |          |          |       |         |          |           |          | present wx fair with light fog   |
| 24 | 96   | 66                                      | 74                   | 0.00  |                |                                  |           |           | +         |         |           | ++                  | $\square$          |                     |         |          |                   |                    |              | -    |          |                |           |          |          | 1     |         |          |           |          | present wx hazy  |
| 25 | 92   | 62                                      | 62                   | 0.03  | -              | <u> </u>                         | $\square$ | +         | +         | _       | 11        | 11                  | ++                 | +                   |         | 4        | +                 | Ц.                 | 11           |      |          | L              |           |          | L        | -     | 1       | L        |           |          | Present Wx cloudy  |
| 26 | 89   | 62                                      | 70                   | 0.00  |                | -                                | ++        | +         | +         | +       | ++        | ++                  | +                  | +                   |         | $\vdash$ | +                 | +                  | +            | +    |          | -              |           | -        | -        | -     | -       |          | -         | -        | present wx hazy  |
| 27 | 86   | 56                                      | 57                   | 0.00  | -              | <u> </u>                         | $\square$ | +         | +         | +       | ++        | ++                  | +                  | +                   |         | $\vdash$ | +                 | $\vdash$           | +            | +    | -        | -              |           | -        | -        | -     | -       | -        |           | -        |  |
| 28 | 89   | 55                                      | 64                   | 0.00  |                | -                                | ++        | +         | ++        | +       | ++        | ++                  | ++                 | +                   |         | +        | +                 | ++                 | ++           | -    | -        | <u> </u>       | -         | -        |          | +     | +       | <u> </u> | -         | -        |  |
| 29 | 103  | 53                                      | 78                   | 0.00  | -              | <u> </u>                         | ++        | +         | ++        | +       | ++        | ++                  | +                  | +                   |         | +        | +                 | ++                 | +            | +    | -        | -              | -         |          | ├        | +     | +       | -        |           | -        |  |
| 31 | 113  | ,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,, | 12                   | 0.00  |                | 1                                | ++        | +         | +         | +       | ++        | ++                  | +                  | +                   |         | H        | +                 | H                  | Ħ            | +    | -        | -              | -         |          | -        | +     | 1       | -        | -         | -        |  |
| Ê  | 87.53  | 60.93                                   | SUM                  | 5.28  |                | $\sim$                           |           |           | CHEC      | KBA     | R (for    | r wire              | weigh              | nt) NC              | RMA     | CH       | IECK              | BAR                | 2            | _    |          | -              |           | 70       |          | -     |         |          |           |          |  |
| C  | ONDITION                                     | OF RIVER                                | AT GAGE              |   |                |                                  | RE        | ADIN      | G         |         |           |                     | Ĩ                  | DATI                | E       |          |                   |                    |              |      | 8        | 8              | Glaze     | Thun     | Fail     | Dam   | V       | <        | X         | X        |  |
| 1  | Obstrue                                      | ted by rou                              | ugh ice              | E. Ice  | gorge bel      | ow gage                          | -         |           |           |         |           |                     |                    |                     |         |          |                   |                    |              | _    | OBS      | ERVE           | R         | DDV      | 1        |       |         |          |           |          |  |
| E  | <ul> <li>Frozen.</li> <li>Upper s</li> </ul> | but open<br>surface sn                  | at gage<br>nooth ice | F. Sho<br>G. Floa   | ating ice      |                                  | -         |           |           |         |           |                     | -                  |                     |         |          |                   |                    |              | -    | SUP      | ERVIS          | ING C     | FFICE    | -        |       |         |          |           |          | STATION INDEX NO.  |
| 0  | . Ice gor                                    | ge above ;                              | gage                 | H. Poc  | stage          |                                  |           |           |           |         |           |                     |                    | _                   |         |          |                   |                    |              | _    | CAL      | s cc           | LUM       | BIA      |          |       |         |          |           |          | 38-4607-05   |
| _  |  |   |                      |   |                |                                  | _         |           |           |         |           |                     |                    |                     |         |          |                   |                    |              |      |          |                |           |          |          |       |         |          |           | _        |  |

## Appendix B Johnston 4 SW and Columbia USC Cooperative Records: June 2012

| Co.     | lumb                | ia Ur     | niv or   | SC                      |                |                          | (Rive            | er Statio        | on, il d     | afforer    | ין מ     | MON       | н ,      | Jui       | 1                       | 20      | 12     |           | 0        | 03-09         | ORM<br>9) | B-91    |        |          |       |                 |               |            |              | NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRAT |  |  |  |  |  |
|---------|---------------------|-----------|----------|-------------------------|----------------|--------------------------|------------------|------------------|--------------|------------|----------|-----------|----------|-----------|-------------------------|---------|--------|-----------|----------|---------------|-----------|---------|--------|----------|-------|-----------------|---------------|------------|--------------|--|--|--|--|--|--|
| STA     | TE                  |           |          |                         | RIC            | HLANI                    | 0                |                  |              |            | 1        | RIVEF     | \$       |           |                         |         |        |           |          |               |           |         |        |          |       |                 | NATIONAL WEAT |            |              |  |  |  |  |  |  |
| TIME    | E (local)           | OF OBS    | SERVATIO | ON RIVER                | TEM            | PERATU                   | RE               | PREC             |              | TION       |          | STAN      | DARD     | TIME      | IN U                    | ISE     |        |           |          |               |           |         | RE     | =co      | RD    |                 |               |            |              | ATOLOGICAL OBSERVATIONS                      |  |  |  |  |  |
| TYP     | E OF R              | IVER GA   | GE       | ELEVATI                 | ION OF I       | RIVER                    | FLO              | OD ST            | AGE          |            | 1        | NORN      | IAL P    | DOL S     | STAG                    | E       |        |           | ٦,       | his           | for       | m wa    | e dv   | mami     | calls |                 | orate         | d from     | West         | nerCoder 3 data on 2012-12-13 at 05.53 DM #8 |  |  |  |  |  |
| Ť       | TEN                 | PERATU    | JRE      |                         |                |                          |                  |                  | PRE          | CIPITA     | ATIO     | 4         |          |           |                         |         |        |           | -        | W             | /EATH     | IER (   | Observ | ation    | Dav)  | l gen           | R             | IVER STAC  | E            |  |  |  |  |  |  |
|         |                     |           |          | 24 HR AM                | OUNTS          | AT OB                    | Draw             | a straigh        | t line (     | ) (        | hrough   | hours     | precipi  | tation v  | vas ob                  | served, | and a  | wavy fi   | ne       | Mark 1        | 'X' for   | il type | occum  | ing eacl | h day | 8               |               | Casa       |              |  |  |  |  |  |  |
| 24      | 4 HRS E             | NDING     |          | s) ed                   | Inths          | = -                      |                  | (                | ) the        | rough h    | ours p   | recipita  | tion pro | ibably i  | occum                   | ed unot | served | 1         |          |               | 22        |         |        |          | p     | from            | 6             | reading    | ~            |  |  |  |  |  |  |
| ) c     | BSER                | ATION     |          | redth<br>redth          | ts, ice        | as, ha                   | <u> </u>         |                  | A.I          | И.         |          | N         | NOC      |           |                         | P.M.    |        |           | -        |               | oelle     |         | nder   |          | agir  | of oc           | ditio         | at         | denc         |  |  |  |  |  |  |
| ŝL      |                     |           | AT       | Rain,<br>snow<br>fin ar | Snow<br>petter | Snow<br>pellet<br>ice or |                  |                  |              |            |          |           |          |           |                         |         |        |           |          | Fog           | 8         | Glaz    | h      | Hail     | Darr  | Time<br>If diff | Con           | AM         | Ten          | REMARKS                                      |  |  |  |  |  |
| 1       | MAX                 | MIN       | OBSN     | 0.00                    |                |                          | 1 2              | 3 4              | 5 6          | 7 8        | 91       | 0 11      | 1        | 2 3       | 4 5                     | 6 7     | 8 9    | 10 :      | 11       | -             | -         | _       |        | -        |       | -               | -             |            |              | (SPECIAL OBSERVATIONS, ETC.)                 |  |  |  |  |  |
| -       | 91                  | 72        | 84       | 0.66                    |                | 6                        |                  |                  |              |            | +        |           | ++-      | 44        | ++                      | +       | +      | -         |          | -             | _         | _       |        | -        | -     | -               | <u> </u>      |            | _            |  |  |  |  |  |  |
|         | 86                  | 66        | 85       | 0.00                    |                | -                        | $\square$        | $\left  \right $ | ++           | +          | +        | $\square$ | ++-      | ++        | ++                      | +       | +      |           |          | +             | _         |         | _      | -        | -     | -               | -             |            |              |  |  |  |  |  |  |
|         | 90                  | 62        | 90       | 0.00                    |                |                          | $\square$        | $\square$        | +            | +          | -        | $\square$ |          | 11        | ++                      | +       |        |           |          | -             | _         | _       |        | -        | -     | -               | -             |            | -            |  |  |  |  |  |  |
| -       | 90                  | 71        | 86       | 0.25                    |                | -                        | $\square$        | $\square$        | +            | +          | +        | $\square$ | 11       | $\square$ | 11                      | +       | +      | 4         | 11       | $\rightarrow$ | _         | _       | _      | -        |       | -               | <u> </u>      |            |              | Max carried from previous day                |  |  |  |  |  |
|         | 90                  | 68        | 84       | 0.57                    |                |                          |                  | $\square$        | +            | +          | -        | $\square$ | 11       | $\square$ | ++                      | +       |        |           |          | +             | _         | _       | -      |          |       | -               | <u> </u>      |            |              |  |  |  |  |  |  |
|         | 84                  | 63        | 79       | 0.00                    |                |                          |                  |                  | $\downarrow$ | $\square$  | -        | $\square$ | 11       | $\square$ | $\downarrow$            |         |        |           | 11       | -             |           |         | _      |          |       |                 |               |            |              | Max carried from previous day                |  |  |  |  |  |
| 1       | 85                  | 61        | 82       | 0.00                    |                |                          |                  |                  |              |            |          |           |          | $\square$ | $\square$               |         |        |           |          |               |           | _       |        |          |       |                 |               |            |              |  |  |  |  |  |  |
| 8       | 88                  | 62        | 84       | 0.00                    |                |                          |                  |                  |              |            |          |           |          |           |                         |         |        |           |          |               |           |         | 1      | 0        |       |                 |               |            | 2            |  |  |  |  |  |  |
|         | 91                  | 64        | 84       | 0.00                    |                |                          |                  |                  |              |            |          |           |          |           |                         |         |        |           |          |               |           |         | . 1    | (        |       |                 |               |            |              |  |  |  |  |  |  |
| p       | 86                  | 64        | 79       | 0.32                    | i i            |                          |                  |                  |              |            |          |           | П        |           | Π                       |         |        |           |          |               |           |         |        |          |       |                 |               |            |              |  |  |  |  |  |  |
| 1       | 81                  | 71        | 75       | 1.71                    |                |                          | $\square$        |                  |              |            |          | П         | П        | П         | Π                       |         |        |           | П        |               |           |         |        |          |       |                 |               |            |              |  |  |  |  |  |  |
| 2       | 84                  | 71        | 84       | 0.24                    |                |                          | 1 2              | 3 4              | 5 6          | 7 8        | 9 1      | 0 11      | 1        | 2 3       | 4 5                     | 6 7     | 8 9    | 10        | 11       |               |           |         |        |          |       |                 |               |            |              |  |  |  |  |  |  |
| 3       | 92                  | 70        | 90       | 0.02                    |                |                          |                  | Ш                | П            | Т          | Т        | П         | İΤ       | П         | Π                       | П       | Т      |           |          |               |           |         |        |          |       |                 |               |            |              |  |  |  |  |  |  |
| 4       | 90                  | 68        | 85       | 0.00                    | -              |                          |                  |                  | +            |            |          | H         | Ħ        | Ħ         | Ħ                       |         |        | H         | Ħ        |               |           |         |        |          |       |                 |               |            | -            |  |  |  |  |  |  |
| 5       | 90                  | 63        | 87       | 0.00                    |                |                          | $\square$        | $\square$        | ++           |            | +        | Ħ         | Ħ        | Ħ         | Ħ                       | +       |        | H         | H        | -             |           |         |        | <u> </u> |       |                 | -             |            | <u> </u>     |  |  |  |  |  |  |
| 6       | 88                  | 64        | 86       | 0.00                    |                |                          |                  |                  | ++           |            | +        | H         | Ħ        | Ħ         | Ħ                       | +       |        | H         | H        | +             | -         | _       |        | <u> </u> | -     | -               |               |            | -            |  |  |  |  |  |  |
| 7       | 89                  | 61        | 87       | 0.00                    |                | -                        |                  |                  | ++           |            | +        | H         | Ħ        | Ħ         | Ħ                       |         | +      | H         | H        |               |           | -       | -      | -        | -     | -               |               |            | -            |  |  |  |  |  |  |
| 8       | 9.0                 | 62        | 95       | 0.00                    | -              | -                        |                  |                  | ++           | ++         | +        | H         | H        | Ħ         | Ħ                       | +       |        | H         | $\vdash$ | -             | -         | _       | -      | -        | -     | -               | -             |            | -            | -  |  |  |  |  |  |
| 9       | 91                  | 61        | 90       | 0.00                    |                | -                        | H                | +++              | +            | ++         | +        | H         | H        | H         | H                       | +       | +      | H         | H        | -             | -         | _       |        | -        | -     |                 | -             |            | -            |  |  |  |  |  |  |
|         | 02                  | 70        | 00       | 0.00                    |                | -                        |                  | $\left  \right $ | ++           | ++         | +        | ++        | ++       | H         | H                       | +       | +      | H         | $\vdash$ | -+            | -         |         | -      | -        | -     | +               | $\vdash$      |            | -            |  |  |  |  |  |  |
| -       | 05                  | 71        | 00       | 0.00                    | -              |                          |                  |                  | ++           | ++         | +        | H         | ++       | H         | H                       | +       | +      | H         | ++       | -             | -         | _       | 1 1    | -        | -     | -               | -             | -          | -            |  |  |  |  |  |  |
| 2       | 95                  | (1        | 92       | 0.00                    |                | -                        | 1 3              |                  | 5.6          | 7 0        | 0 1      | 0 11      |          | 2 3       | 4.5                     | 6 7     | 8.0    | 10        |          | +             | -         | _       | -      | -        | -     | -               | -             |            | -            |  |  |  |  |  |  |
| 2       | 95                  | 08        | 93       | 0.00                    |                | -                        | 1                |                  | 11           | <u>,</u> , | <b>T</b> |           | tí       | TT        | 11                      | 11      | 1      |           | <u></u>  | +             | -         | _       | 1      | -        | -     | -               | -             |            | -            |  |  |  |  |  |  |
| <u></u> | 90                  | 70        | 30       | 0.00                    |                |                          |                  | $\left  \right $ | +            | +          | +        | +         | ++       | ++        | +                       | +       | +      | $\vdash$  | $\vdash$ | +             | _         | _       | -      | -        | -     | -               | -             |            | -            |  |  |  |  |  |  |
| -       | 96                  | 75        | 88       | 0.00                    |                |                          | $\square$        | $\left  \right $ | +            | +          | +        | +         | ++       | ++        | ++                      | +       | +      | +         | +        | +             | -         | _       | -      | -        | -     | -               | -             |            | -            |  |  |  |  |  |  |
| 2       | 97                  | /1        | 90       | 0.00                    |                | -                        | $\square$        | +++              | +            | +          | +        | ++        | ++       | ++        | ++                      | +       | +      | $\vdash$  |          | -             | _         |         | -      | -        | -     | -               | <u> </u>      |            |              |  |  |  |  |  |  |
| •       | 91                  | 71        | 84       | 0.00                    |                |                          | $\left  \right $ | $\left  \right $ | +            | +          | -        | $\square$ | ++-      | ++        | ++                      | +       | +      | -         |          | +             | _         | _       |        | -        | -     | -               | -             |            | -            |  |  |  |  |  |  |
| 7       | 94                  | 63        | 90       | 0.00                    |                | -                        |                  |                  | +            | +          | -        | $\square$ | ++-      | ++        | ++                      | +       | +      | -         |          | +             | _         | _       | -      | -        |       |                 | -             | -          | -            |  |  |  |  |  |  |
| 8       | 103                 | 62        | 102      | 0.00                    |                | -                        | $\square$        | $\left  \right $ | +            | +          | -        | $\square$ | 11       | $\square$ | 11                      | +       | +      |           |          | +             | _         | _       |        | -        | -     | <u> </u>        | <u> </u>      |            |              |  |  |  |  |  |  |
| 9       | 113                 | 73        | 110      | 0.00                    |                | -                        | $\square$        |                  | +            | +          | +        | $\square$ |          | $\square$ | ++                      |         | +      |           |          | -             | _         |         |        | -        |       | <u> </u>        | -             |            | -            |  |  |  |  |  |  |
| 0       | 111                 | 78        | 109      | 0.00                    |                | -                        | $\square$        | $\square$        | +            | +          | -        | $\square$ | 11       | $\square$ | $\downarrow \downarrow$ | +       |        | $\square$ | 11       | _             |           |         |        | -        |       | -               | <u> </u>      |            |              |  |  |  |  |  |  |
| 1       |                     |           |          |                         |                |                          |                  |                  |              |            |          |           |          | Ш         |                         |         |        |           |          | _             |           |         |        |          |       |                 |               |            |              |  |  |  |  |  |  |
|         | 92                  | 67.2      | SUM      | 3.77                    |                | $\ge$                    |                  | СН               | ECKE         | BAR (      | or wi    | e wei     | ght) N   | ORM       | AL CH                   | HECK    | BAR    | <u>.</u>  | _        |               | E         | 92      | pur    | -        | e Sp  | 5               | <             | $\searrow$ | $\mathbb{N}$ |  |  |  |  |  |  |
| CON     | DITION              | F RIVER   | AT GAGE  |                         |                |                          | REA              | DING             |              | _          | _        |           | DAT      | TE .      | _                       | _       | _      | _         |          | Fog           | 8         | Gla     | H      | Hail     | Dan   | $\checkmark$    | >             | $\sim$     | $\sim$       |  |  |  |  |  |  |
| A. (    | Obstruct            | ed by ror | ugh ice  | E. Ice of               | orge belo      | w gage                   |                  |                  |              |            |          |           |          |           |                         |         |        |           | C        | DBSE          | RVEF      |         |        |          |       |                 |               |            |              |  |  |  |  |  |  |
| B. F    | rozen,              | but open  | at gage  | F. Shore                | e ice          |                          | <u> </u>         |                  |              |            |          |           | -        |           |                         |         |        |           |          | INIV          | VER       | SIT     | Y OI   | r sc     | 2     |                 |               |            |              | ATATION INDEX NO                             |  |  |  |  |  |
| D. 1    | opper si<br>ce goro | e above i | noom ide | H. Pool :               | stage          |                          |                  |                  |              |            |          |           |          |           |                         |         |        |           | s        | SUPE          | KVISI     | NGO     | FFICE  |          |       |                 |               |            |              | STATION INDEX NO.                            |  |  |  |  |  |

#### Appendix C: Blackville and Calhoun Falls Cooperative Records September 1925



#### Camden 2 WSW Cooperative Record June 1954



