

Jacques Cousteau (JAC) NERR Meteorological Metadata
January – December, 2003
First Update: **February 8, 2023**

I. Data Set & Research Descriptors

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2) Entry verification

a) Data Input Procedures:

The 15-minute, 1-hour average, and 24-hour meteorological data were downloaded from each instrument on the weather station to a Campbell Scientific CR10X datalogger. The CDMO Data Logger Program (nerr303.csi and NERR_4.csi) was loaded into the CR10X (10/02 and 11/05/03, respectively) to control the sensor and data collection schedule (see 2b of the Entry Verification section for the data collection schedule). The CR10X then interfaced with the PC208W software supplied by Campbell Scientific.

This software is located on a computer to which the data are uploaded (bi-weekly and then weekly after 11/05/3) via a short haul modem to a computer located at the RSC Marine Science and Environmental Field Station. The data are saved as a raw data file (i.e. nc101002, Nacote Creek October 10, 2002) and backed up to disk and secondary hard drive.

Data was exported from PC208W in a comma-delimited format (.DAT) and opened in Microsoft Excel for pre-processing with an EQWin format macro (EQWinFormat.xls), created by the CDMO. The macro adds header, station code, date and time columns, and reformats data to the appropriate number of decimal places. The pre-processed data file is then ready to be copied into the EQWin weather.eqi file, where it was QA/QC checked and archived into the database. EQWin was used to generate queries, reports and graphs to identify data set outliers (data values falling outside pre determined values for each parameter) and large changes in measured data. Statistical analyses and customized graphs and queries were also generated using EQWin.

Data corrections, missing data and anomalous data were investigated and listed in their respective sections below.

The most common data errors/ anomalies recorded in 2003 were:

- 1) Barometric pressure sample less than 900 millibars (mb)
- 2) Total LiCor (PAR) sample less than 0 millimoles per meter squared (mmol/m^2)
- 3) Precipitation sample greater than 5 millimeters (mm) in 15 minutes

All reported errors were checked against a local meteorological source (NWS, Pomona, NJ) for verification. Negative PAR values were determined to be within the error range of the sensor and were deleted. Other anomalous PAR and BP data (10/31 – 11/5/03) were caused by an operating error. An updated CR10X DLD program with the new PAR sensor variable was not sent until 11/5, making the PAR data during this period invalid. At that time it was further determined that the BP sensor had been mis-wired during that period. Approximately five days of PAR and BP data were deleted (see section 12). When the met station was powered down to replace sensors data are missing and 24-hour average, minimum and maximum values for that calendar day were deleted. All reported precipitation anomalies were checked and determined to be correct.

SWMP technician Glenn Golden and RSC Marine Field Station manager Steven Evert collected, QA/QC checked and compiled 2003 weather data per CDMO procedures. Raw data files were collected weekly and backed up to disc and/or secondary hard drive. Pre-processing macros were run and EQWin databases were created on a dedicated met station computer. All data was backed up to secondary hard drive and disc.

Note: 2003 data collected prior to the NERR_4.csi program (sent to CR10X on 11/5/03) was submitted to the CDMO for transfer to a format suitable to run through EQWin. ALL 2003 DATA WAS PROCESSED USING EQWin SOFTWARE. Gemteck's EQwin version 5 and the CDMO developed Microsoft Excel EQWinFormat.xls macro now replaces the CDMO Weather Data Management Program (WDMP) as the NERR MET database management program and primary QA/QC program.

The Centralized Data Management Office converted all SWMP weather data collected with CR10X program versions prior to version 4.0 which was distributed in October 2003. This was necessary in order to merge the old data format (12 array output) with the new data format found in version 4.0 (3 array output). The new format produces averages, maximums and minimums every fifteen minutes (array 15), every hour (array 60) and every day (array 144) for any sensors hooked up to the CR10X. Specifically, the 150 and 151 fifteen minute data were converted to the new 15 array; the hourly 101, 102, 105 and 106 data were converted to the new 60 array; and the daily 241, 242, 243, 244, 245 and 246 data were converted to the new 144 array. With the new format, the use of 55555's to code for deleted data and 11111's to code for missing data has been abandoned. Hence, all 55555's or 11111's contained in the SWMP weather data collected prior to Version 4.0 of the CR10X program were removed and left blank.

b) Data Collection Schedule

Data are collected in the following formats.

- (1) Sample data points are collected every 15 minutes.
- (2) Hourly averages are collected every 60 minutes.
- (3) Daily average, maximum with time, and minimum with time.

i) 15-minute data are collected instantaneously for Air Temperature (C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), and Wind Direction (degrees). 15-minute Precipitation (mm) and PAR (mmol/m^2) data are totaled from 5-second readings, prior to NERR_4.CSI

ii) 15-minute average, maximum and minimum data are averages of 5-second readings for Air Temperature (oC), Relative Humidity (%), Barometric Pressure (mb) and Wind Speed (m/s) with NERR_4.CSI.

iii) Hourly average, maximum, and minimum data are averages of 5-second readings for Air Temperature (oC), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), and Wind Direction (degrees). Hourly totals for PAR (mmol/m²) and Precipitation (mm) are totals of 15-minute readings.

iv) Daily average, maximum and minimum data are averages of 5-second readings for Air Temperature (oC), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), and Wind Direction (degrees). Daily totals for PAR (mmol/m²) and Precipitation (mm) are totals of 15-minute readings.

c) Error/Anomalous Data Criteria

Air Temp:

- 15 min sample not greater than max for the day
- 15 min sample not less than the min for the day
- 15 min sample not greater than 3.0 C from the previous 15 minutes (WDMP only)
- Max and min temp recorded for the day (WDMP only)
- 1-hour average not greater than 10% above the greatest 15 min sample recorded in the hour (WDMP only)
- Sample not greater than 50 C or less than -30 C (EQWin only)

Relative Humidity:

- Not changed by more than 25% from the previous 15 minutes (WDMP only)
- Max and min humidity recorded for the day (WDMP only)
- 1-hour average not greater than 10% above the greatest 15 min sample recorded in the hour (WDMP only)
- Sample not greater than 100% or less than 0% (EQWin only)

Pressure:

- Pressure not greater than 1040 mb or less than 980 mb (WDMP only)
- Pressure changes greater than 5 mb per hour (WDMP only)
- Maximum and minimum values recorded for the day (WDMP only)
- 1-hour average not greater than 10% above the greatest 15 min sample recorded in the hour (WDMP only)
- Sample not greater than 1060 mb or less than 900 mb (EQWin only)

Wind Speed:

- Wind speed not greater than 65 m/s or less than 0.5 m/s (WDMP only)
- Wind speed not greater than 30 m/s (EQWin only)
- Wind speed not less than 0.5 m/s for 12 consecutive hours (EQWin only)

Wind Direction:

- Wind direction not greater than 360 degrees or less than 0 degrees

Rainfall:

- Precipitation not greater than 5 mm in 15 min
- No precipitation for the month (WDMP only)

Photosynthetically Active Radiation (PAR):

- Sample not greater than 5000 mmol/m² or less than -0.5 mmol/m²

Time:

- 15-minute interval recorded

For all data:

- No duplicate data

3) Research objectives:

The principal objective is to record long-term meteorological data for the JC NERR in order to observe any environmental changes or trends over time. A major component of the JCNERR SWMP program is the monitoring of estuarine water quality. The close coupling between meteorological conditions and estuarine water quality has necessitated the monitoring of atmospheric conditions in the system as well. The meteorological data collected at the Reserve site thus provides valuable information on the atmospheric influences on water quality in the JCNERR system.

4) Research methods:

The Campbell Scientific weather station samples every 5 seconds to produce both hourly and daily averages of measurements of air temperature, relative humidity, barometric pressure, rainfall, wind speed and wind direction. An instantaneous sample is taken every 15 minutes. The CR10X datalogger can store over three weeks of data before it overwrites the data. If the short haul modem link failed and data could not be collected from the datalogger to the computer the data would be downloaded from the CR10X to a laptop computer following procedures in Part D. Section 4.5 of the CDMO Operations Manual. Periodically, sensors on the weather station are inspected for damage or debris. If any is found, it is repaired and/or cleaned. Sensors are removed and sent back to Campbell Scientific for calibration at a minimum of every two years, depending on sensor specifications.

5) Site location and character:

The Jacques Cousteau National Estuarine Research Reserve (JCNERR) at Mullica River/Great Bay is located on the northeast coast of the United States on the Atlantic Ocean. The estuary is near Tuckerton, New Jersey about 14 kilometers north of Atlantic City. The met station is located adjacent to the Nacote Creek, a tributary of the Mullica River. The site is approximately 14.3 kilometers WSW of Little Egg Inlet, the primary saltwater influence of the JC NERR. The met station is located on property owned by the RSC Marine Science and Environmental Field Station in Port Republic, NJ, approximately 1.8 kilometers south of the Chestnut Neck marina on the Mullica River, and 0.4 kilometers northeast of Rt. 9 in Port Republic, NJ.

GPS coordinates:

N 39 degrees, 32 minutes, 06 seconds

W 74 degrees, 27 minutes, 49 seconds

The nearest long term water quality monitoring station is located at Chestnut Neck Marina, approximately 1.8 kilometers north of the met station. Water quality data (currently not included in the JC NERR SWMP program) for Nacote Creek, at a site adjacent to the met station is available by contacting the Richard Stockton College Marine Science and Environmental Station (Steve Evert, 609-652-4486).

The unit is mounted on a 13-meter tower adjacent to Nacote Creek, approximately 20 m from the high tide line. The elevations above the marsh surface are as follows; Barometric pressure - 2.2 m, temperature and relative humidity (2.9 m), PAR (4.5 m), wind (12.5 m), highest point on tower (lightning rod) is 14 m. The

rain gauge is approximately 2.1 m above the surface and 1.5 m north of the tower. The area is sparsely covered with clam shell debris and upland grasses.

Typical weather patterns for the New Jersey Coast include afternoon seabreezes (SW) and near still winds from midnight until shortly after sunrise during the summer months. Major weather events typically include 2-3 day duration periods of ENE winds and significant cold fronts from October through March. These cold fronts typically bring extended periods of increased NW winds commonly reaching 25-40 knots.

6) Data collection period:

The meteorological monitoring program was started in October 2002 at the JCNERR. The Reserve has a long-standing program in the collection of water quality data and other met data are available (Rutgers University Marine Field Station) before 10/02 by contacting the Research Coordinator listed above.

7) Distribution

According to the Ocean and Coastal Resource Management Data Dissemination Policy for the NERRS System-wide Monitoring Program,

NOAA/ERD retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The PI retains the right to be fully credited for having collected and processed the data. Following academic courtesy standards, the PI and NERR site where the data were collected will be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. Manuscripts resulting from the NOAA/OCRM supported research that are produced for publication in open literature, including refereed scientific journals, will acknowledge that the research was conducted under an award from the Estuarine Reserves Division, Office of Ocean and Coastal Resource Management, National Ocean Service, National Oceanic and Atmospheric Administration. The data set enclosed within this package/transmission is only as good as the quality assurance/quality control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

NERR weather data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Section 1 Principal investigators and contact persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page <http://inlet.geol.sc.edu/cdmohome.html>. Data are available in text format and Access data tables.

8) Associated researchers and projects:

The meteorological data collected in the SWMP program of JCNERR are important to assess migration patterns of key species found in the Mullica River-Great Bay Estuary, Little Egg Harbor, and other contiguous waters. Included here are the seasonal movements of striped bass (*Morone saxatilis*), bluefish (*Pomatomus saltatrix*) and summer flounder (*Paralichthys dentatus*). The meteorological data are also important for studies of the population dynamics of shellfish species, notably the hard clam (*Mercenaria mercenaria*) and blue crab (*Callinectes sapidus*). Furthermore, the data are valuable for evaluating environmental conditions that influence benthic communities, both those inhabiting soft sediments and living attached to hard surfaces (i.e., epibenthos). One of the most important areas of study for the coastal bay waters of Little Egg Harbor is that dealing with submerged aquatic vegetation (*Zostera marina* and *Ruppia maritima*). A major concern is the health and vitality of the SAV, and how the beds in the bay are

affected by natural factors (e.g., storms, unusual temperature conditions, reduced dissolved oxygen, etc.) and anthropogenic influences. All of the aforementioned studies are either underway or scheduled for future work.

II. Physical Structure Descriptors

9) Sensor specifications, operating range, accuracy, date of last calibration

LiCor Quantum Sensor #2

Model # LI190SB

Stability: $<\pm 2\%$ change over 1 yr

Operating Temperature: -40 to 65°C

Sensitivity: typically $5\ \mu\text{A}$ per $1000\ \mu\text{moles s}^{-1}\text{ m}^{-2}$

Light spectrum wavelength: 400 to $700\ \text{nm}$

Date of last calibration: March 25, 2003

S/N: Q32195

Wind Monitor #2

Model # 05103

Range: 0 - $60\ \text{m/s}$; 360° mechanical

Date of last calibration: March 19, 2003

S/N: WM56138

Temperature and Relative Humidity #2

Model #: HMP45C

Operating Temperature: -40 - $+60^{\circ}\text{C}$

Temperature Measurement Range: -40 - $+60^{\circ}\text{C}$

Temperature Accuracy: $\pm 0.2\ ^{\circ}\text{C}$ @ 20°C

Relative Humidity Measurement Range: 0 - 100% non-condensing

RH Accuracy: $\pm 2\%$ RH (0 - 90%) and $\pm 3\%$ (90 - 100%)

Uncertainty of calibration: $\pm 1.2\%$ RH

Date of Last calibration: April 11, 2003

S/N: Y1540089

Barometric Sensor #2

Model # CS-105

Operating Range: Pressure - 600 - $1060\ \text{mb}$

Temperature: -40 - $+60^{\circ}\text{C}$

Humidity: non-condensing

Accuracy: ± 0.5 to $6.0\ \text{mb}$ ($+20$ - 60°C)

Stability: $\pm 0.1\ \text{mb}$ per year

Date of Last calibration: April 2, 2003

S/N: Y1430012

Tipping Bucket Rain Gauge #1

Model #: TE 525

Range: $0.1\ \text{mm}$

Accuracy: 1.0% at $<2''/\text{hr}$

Date of Last calibration: August, 2002

10) Coded variable indicator and variable code definitions:

NC=Nacote Creek

JAC=Mullica River/Jacques Cousteau NERR

Station code=jacncmet

11) Data anomalies:

Arrays:

During 2022 all pre-2007 weather data were revisited by the CDMO. Historically those datasets included 15 minute, hourly (60), and daily data arrays (144). As directed by the NERRS Data Management Committee, the CDMO removed the hourly and daily data arrays leaving only the 15 minute data to make the entire NERRS SWMP weather dataset consistent in its reporting. All references to the 60 and 144 arrays were left in the metadata document as they may still provide valuable information, but users should be aware that they are largely no longer relevant. The updated datasets were uploaded to the database and made available through the various data applications at www.nerrsdata.org/get/landing.cfm throughout the fall of 2022.

Comment 1: All outlying precipitation data were checked against the Nacote Creek NERR SWMP Meteorological Monthly Log and historical data from NWS Pomona, New Jersey.

Comment 2: Precipitation data during periods of at or near 0 degrees Celsius may be suspect due to potential freezing of mechanical rain gauge parts.

Comment 3: All barometric pressure data from 10/31/03 @ 16:15 through 11/05/03 @ 13:00 were deleted due to mis-wiring when the sensor was replaced.

Comment 4: All LiCor (PAR) data from 10/31/03 @ 16:15 through 11/05/03 @ 13:00 were deleted due to failure to send the conversion variables to the CR10X program when the sensor was replaced.

Comment 5: All negative Licor data were changed to read 0 mmol/m².

Data corrections:

February 2003

The following precipitation data are correct and were not deleted. See Comment 1.

15 minute Precip on 02/22/03 @ 14:15

May 2003

The following precipitation data are correct and were not deleted. See Comment 1.

15 minute Precip on 05/28/03 @ 14:30

15 minute Precip on 05/28/03 @ 15:15

15 minute Precip on 05/28/03 @ 15:30

15 minute Precip on 05/28/03 @ 15:45

15 minute Precip on 05/28/03 @ 16:00

15 minute Precip on 05/28/03 @ 16:15

June 2003

The following precipitation data are correct and were not deleted. See Comment 1.

15 minute Precip on 06/07/03 @ 13:15

15 minute Precip on 06/13/03 @ 22:15

July 2003

none

August 2003

The following precipitation data are correct and were not deleted. See Comment 1.

15 minute Precip on 08/30/03 @ 18:00

September 2003

None

October 2003

The following barometric pressure data were invalid and deleted. See Comment 3.

All BP data from 10/31/03 @ 16:15 through 11/05/03 @ 13:00

The following PAR data were invalid and deleted. See comment 4.

All Par data from 10/31/03 @ 16:15 through 11/05/03 @ 13:00

November 2003

The following precipitation data are correct and were not deleted. See Comment 1.

15 minute Precip on 11/19/03 @ 19:45

The following barometric pressure data were invalid and deleted. See Comment 3.

All BP data from 10/31/03 @ 16:15 through 11/05/03 @ 13:00.

The following PAR data were invalid and deleted. See Comment 3.

All Par data from 10/31/03 @ 16:15 through 11/05/03 @ 13:00.

Minimum readings for Temperature and Relative Humidity were deleted on 11/1/2003 due to replacement of sensor without powering down the station therefore giving erroneous readings.

MinTemp on 11/1/2003 @ 00:00 and MinRH on 11/1/2003 @ 00:00

12) Missing data:

Arrays:

During 2022 all pre-2007 weather data were revisited by the CDMO. Historically those datasets included 15 minute, hourly (60), and daily data arrays (144). As directed by the NERRS Data Management Committee, the CDMO removed the hourly and daily data arrays leaving only the 15 minute data to make the entire NERRS SWMP weather dataset consistent in its reporting. All references to the 60 and 144 arrays were left in the metadata document as they may still provide valuable information, but users should be aware that they are largely no longer relevant. The updated datasets were uploaded to the database and made available through the various data applications at www.nerrsdata.org/get/landing.cfm throughout the fall of 2022.

November 5, 2003 @ 12:45 the new CR10x program (nerr_4.csi) was loaded and maintenance was performed on the station as a result data are missing from 12:45-16:00 and hourly data at 17:00 and daily data were deleted.

November 24, 2003 the unit was powered down for replacement of the wind sensor.
Data missing from 9:45 – 10:30, 11/24/03. As a result hourly data at 11:00 and daily data were deleted.

13) Other Remarks/notes

Arrays:

During 2022 all pre-2007 weather data were revisited by the CDMO. Historically those datasets included 15 minute, hourly (60), and daily data arrays (144). As directed by the NERRS Data Management Committee, the CDMO removed the hourly and daily data arrays leaving only the 15 minute data to make the entire NERRS SWMP weather dataset consistent in its reporting. All references to the 60 and 144 arrays were left in the metadata document as they may still provide valuable information, but users should be aware that they are largely no longer relevant. The updated datasets were uploaded to the database and made available through the various data applications at www.nerrsdata.org/get/landing.cfm throughout the fall of 2022.

Precipitation:

During the initial years of NERRS SWMP weather data collection the CR10X programming was inconsistent in how precipitation values were recorded. For most reserves, zeros were not recorded when rainfall had not occurred between 2001-2003, instead no rainfall was represented by a blank cell. The CDMO verified which datasets were impacted by this issue for the 2001-2006 datasets and inserted zeros when the metadata indicated that no precipitation occurred and data were not missing for other reasons. In some cases, zero values for precipitation data were evaluated and removed where the metadata confirmed that no rainfall should have been in the dataset. The pre-2007 data did not go through a thorough QAQC process again at that time (in addition to previous QAQC); however, if discrepancies were noticed between what was documented in the metadata and what was in the dataset, additional updates may have been made. The updated datasets were uploaded to the database and made available through the various data applications at www.nerrsdata.org/get/landing.cfm throughout early 2023

LiCor:

Prior to the installation of the new NERR_4.CSI program, all values less than 0 were altered in the raw data to read 0. These values may indicate an incorrect multiplier, calibration problems, or a sensor malfunction. Because these values are changed in the raw data, we cannot confirm that they are all valid data points.

Relative Humidity:

Prior to the installation of the new NERR_4.CSI program, all values over 100% were altered in the raw data to read 100%. These values may indicate super saturated air, calibration problems, or a sensor malfunction. Because these values are changed in the raw data, we cannot confirm that they are all valid data points.

Daily, Monthly, and Annual Precipitation Totals

Jacncmet

Nacote Creek

Date

Daily Precip Totals (mm)

1/2/2003

27.9

1/3/2003

1.5

1/4/2003

21.3

1/6/2003

0.5

1/7/2003

1.8

1/8/2003

0.3

1/9/2003

0.3

1/18/2003

1.3

1/21/2003

0.3

1/30/2003

3.3

1/31/2003

0.8

Monthly Total

(mm)

59.3

2/1/2003

0.5

2/2/2003

11.4

2/3/2003

0.3

2/5/2003

8.4

2/8/2003

6.6

2/9/2003

5.3

2/11/2003

3.3

2/18/2003

9.7

2/19/2003

1.8

2/20/2003
0.3
2/22/2003
6.1
2/23/2003
32.5
2/24/2003
13.5
2/28/2003
1
Monthly Total
(mm)
100.7

3/1/2003
4.8
3/3/2003
6.9
3/6/2003
6.6
3/7/2003
17.3
3/14/2003
1.5
3/17/2003
4.3
3/18/2003
0.5
3/21/2003
13.7
3/22/2003
8.1
3/27/2003
4.1
3/28/2003
0.3
3/30/2003
20.6
3/31/2003
7.9
Monthly Total
(mm)
96.6

4/3/2003
0.3
4/6/2003
0.3
4/9/2003

16.3
4/10/2003
0.3
4/11/2003
18
4/13/2003
11.9
4/14/2003
12.7
4/23/2003
0.5
4/24/2003
7.9
4/27/2003
4.8
4/28/2003
5.3
Monthly Total
(mm)
78.3

5/3/2003
3.3
5/6/2003
1.8
5/7/2003
0.5
5/8/2003
2.5
5/9/2003
0.8
5/10/2003
3.3
5/17/2003
8.9
5/21/2003
0.3
5/22/2003
9.4
5/23/2003
2
5/24/2003
11.7
5/25/2003
2.5
5/26/2003
0.3
5/27/2003
16
5/28/2003

0.8
5/29/2003
57.9
5/30/2003
0.3
Monthly Total
(mm)
122.3

6/1/2003
2.3
6/2/2003
8.4
6/4/2003
0.5
6/5/2003
13
6/6/2003
1
6/8/2003
69.6
6/9/2003
0.3
6/13/2003
7.6
6/14/2003
26.7
6/15/2003
6.1
6/18/2003
0.5
6/19/2003
22.1
6/20/2003
8.1
6/21/2003
3.8
6/22/2003
2.3
6/23/2003
0.3
Monthly Total
(mm)
172.6

7/4/2003
29.5
7/8/2003
2

7/10/2003
0.8
7/11/2003
29.2
7/15/2003
9.1
7/19/2003
0.5
7/23/2003
1.3
7/24/2003
1
Monthly Total
(mm)
73.4

8/6/2003
5.8
8/7/2003
1.5
8/8/2003
13.7
8/10/2003
3.8
8/11/2003
0.3
8/12/2003
0.3
8/17/2003
4.1
8/18/2003
0.8
8/19/2003
0.3
8/23/2003
0.3
8/24/2003
0.3
8/31/2003
20.6
Monthly Total
(mm)
51.8

9/2/2003
3.8
9/3/2003
1.3
9/4/2003

4.3
9/5/2003
8.1
9/13/2003
5.6
9/14/2003
5.6
9/15/2003
0.5
9/16/2003
17.5
9/17/2003
0.5
9/19/2003
6.4
9/24/2003
15
9/29/2003
10.9
Monthly Total
(mm)
79.5

10/5/2003
0.5
10/11/2003
0.3
10/12/2003
1.5
10/13/2003
26.7
10/15/2003
23.9
10/16/2003
5.8
10/18/2003
0.8
10/23/2003
3.3
10/27/2003
3.8
10/28/2003
14.5
10/29/2003
4.1
10/30/2003
40.6
10/31/2003
0.3
Monthly Total

(mm)
126.1

11/5/2003
0.3
11/6/2003
5.8
11/7/2003
16
11/8/2003
0.3
11/13/2003
20.8
11/14/2003
0.3
11/20/2003
40.6
11/21/2003
8.9
11/25/2003
1.8
11/26/2003
0.3
11/29/2003
10.2
Monthly Total
(mm)
105.3

12/6/2003
33.5
12/7/2003
5.1
12/8/2003
0.5
12/12/2003
32.5
12/15/2003
19.6
12/18/2003
12.4
12/25/2003
30.2
12/31/2003
1.5
Monthly Total
(mm)
135.3

Annual Total
1201.2