QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES

TITLE	**COLLECTION OF OPTICAL MONITORING DATA (IMPROVE PROTOCOL)**
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1.0 PURPOSE AND APPLICABILITY

This standard operating procedure (SOP) outlines collection of optical visibility monitoring data from sites operated according to IMPROVE Protocol. Optical monitoring sites include those equipped with an Optec LPV transmissometer and/or Optec NGN nephelometer.

The IMPROVE Program has partitioned visibility-related characteristics and measurements into three groups: optical, scene, and aerosol. This SOP pertains to the optical group and encompasses the following:

- Optical properties pertaining to the ability of the atmosphere to scatter or absorb light passing through it

- Physical properties of the atmosphere described by the atmospheric extinction coefficient (b_{ext}), absorption coefficient (b_{abs}), scattering coefficient (b_{scat}), and scattering phase function, an angular dependence of the scattering

- Optical characteristics integrating the effects of atmospheric aerosols and gases

- Optical extinction measurements made with transmissometers

- Optical scattering measurements made with nephelometers

Data are generally logged on-site by one of four data logging approaches:

- Satellite data collection platforms (DCPs) (Handar 540/570 or Synergetics)

- Campbell Scientific 21XL dataloggers

- Telephone modems

- Primeline strip chart recorders

This SOP serves as a guide to assure high quality data collection from transmissometer and nephelometer stations operated according to IMPROVE Protocol by:

- Assuring complete, error-free data downloads from Wallops Island or directly from the individual stations via telephone modem.

- Assuring complete, error-free data downloads from sites with Campbell Scientific data storage modules.

- Reducing data from strip chart recorders at transmissometer sites.

- Processing data to reformat raw, downloaded data to Level-A validation.

- Reviewing data and examining error files for details regarding monitoring system performance, datalogger problems, or data acquisition problems.

Because most stations are remote, daily data review is critical to the identification and resolution of field problems.

At sites with a DCP or Campbell Scientific datalogger and telephone modem, data are collected daily. At sites with a Campbell Scientific datalogger and storage module, or at sites where back-up strip chart recorders must be used, data are collected at approximately two-week intervals.

Separate technical instructions (TIs) are developed for the following cases:

- TI 4300-4000   *Data Collection via DCP (IMPROVE Protocol)*

- TI 4300-4002   *Nephelometer Data Collection via Telephone Modem (IMPROVE Protocol)*

- TI 4300-4004   *Nephelometer Data Compilation and Review of DCP-Collected Data (IMPROVE Protocol)*

- TI 4300-4006   *Nephelometer Data Collection via Campbell Scientific Data Storage Module (IMPROVE Protocol)*

- TI 4300-4023   *Transmissometer Daily Compilation and Review of DCP-Collected Data (IMPROVE Protocol)*

- TI 4300-4025   *Transmissometer Data Collection via Strip Chart Recorder*

2.0   RESPONSIBILITIES

2.1   PROJECT MANAGER

The project manager shall:

- Review data collection procedures with the data coordinator to identify and correct problems.

- Review editing of instrument constants files with the data coordinator.

- Coordinate with the NESDIS for allocation of DCP assignments.

2.2   DATA COORDINATOR

The data coordinator shall:

- Update all constants files pertaining to data collection and review with the project manager.

- Set up and initiate the automatic data collection program(s).

- Check the status of the automatic data collection and review data daily to assure the integrity of the monitoring systems and to achieve complete, error-free data collection.

- Perform periodic data collection via data storage module or strip chart reduction for sites without DCP or modem communication.

- Provide technical support to the site operator via telephone.

- Enter any information relating to the collection of the data and operation of the specific monitoring system into the site-specific Quality Assurance Database.

- Review Level-A files with the project manager to identify instrument problems.

- Ship supplies, tools, and replacement instrumentation to the site operator.

- Digitize and convert strip chart recorder data into transmissometer format.

2.3   FIELD SPECIALIST

The field specialist shall:

- Train the site operator in strip chart recorder operation and maintenance.

- Provide technical support to the site operator via telephone.

2.4   SITE OPERATOR

The site operator shall:

- Operate and maintain strip chart recorders.

- Document strip chart recorder operation.

- Report instrument collection inconsistencies to the data coordinator or field specialist.

3.0   REQUIRED EQUIPMENT AND MATERIALS

All data collection occurs on IBM-PC compatible systems. Refer to the individual TIs for the monitoring system-specific computer system requirements. Required computer system components are as follows:

- IBM-PC compatible 386/486 computer system with VGA and 80 megabyte hard disk

- Internal or external Hayes compatible modem configured for COM port #2

- Microsoft Windows 3.0/3.1

- Software for collection DCP data via Wallops Island

- Software for processing of optical data collected via DCP

- Software for telephone modem collection

- Campbell Scientific software for processing optical data:

  - TELCOM   Version 1.0 or later

- SPLIT   Version 1.0 or later

- SMCOM Version 1.0 or later

- TERM   Version 1.0 or later

- Campbell Scientific SC532 storage module interface

- NGN_PULL software Version 3.0 or later (ARS)

- Jandel Scientific Sigma Scan software for digitizing strip charts

- Jandel Scientific digitizing table

Information on the Campbell Scientific software is detailed in the *Campbell Scientific PC208 Datalogger Support Software Instruction Manual*.

4.0 METHODS

This section includes two (2) major subsections:

4.1 Optical Monitoring Station Configurations
4.2 Collection of Optical Monitoring Data

These subsections describe the station configurations and data collection methods for each configuration. Collection of optical monitoring data is dependent on the configuration of individual sites. Transmissometer and nephelometer sites are generally configured differently.

4.1 OPTICAL MONITORING STATION CONFIGURATIONS

Optical monitoring stations are configured based on the following:

- Transmissometer stations are generally configured with a DCP and strip chart recorder.

- Nephelometer stations are generally configured with a Campbell Scientific datalogger, telephone modem, storage module, or optionally, a DCP.

4.1.1 <u>Transmissometer Stations</u>

Transmissometers measure the ability of the atmosphere to transmit light. These measured light transmission properties can be represented in terms of the atmospheric extinction coefficient (b_{ext}).

IMPROVE transmissometer sites generally include:

- A transmitter station with shelter, transmitter telescope, transmitter control box, and battery-backed power supply.

- A receiver station with shelter, receiver telescope, receiver computer, battery-backed power supply.

- A data collection platform (DCP).

- An optional strip chart recorder.

- A collocated air temperature and relative humidity sensor (naturally aspirated).

- A solar powered operation (at some sites).

The following data are collected via DCP from transmissometer sites operated according to IMPROVE Protocol:

- Ten-minute average raw transmissometer transmission values that are later converted to atmospheric extinction coefficient.

- Standard deviation of the 10 one-minute raw transmission values that make up the 10-minute average transmission value.

- Hourly, single reading ambient air temperature and relative humidity.

Strip charts serve as the backup logger at transmissometer sites. Strip charts are only used in the event of DCP failure. The strip chart recorder from transmissometer sites operated according to IMPROVE Protocol collects 10-minute average raw transmissometer transmission values that are later converted to atmospheric extinction coefficient.

4.1.2 <u>Nephelometer Stations</u>

Nephelometers measure the ability of the atmosphere to scatter light. These measured light scattering properties can be represented in terms of the atmospheric scattering coefficient (b_{scat}).

IMPROVE nephelometer sites generally include:

- An NGN-2 nephelometer mounted on a three-meter tower along with datalogger and power supply support system.

- A Campbell Scientific 21XL datalogger.

- A Campbell Scientific storage module.

- An optional telephone modem.

- An optional DCP.

- A collocated air temperature and relative humidity sensor (force aspirated).

- A solar powered operation (at some sites).

The following data are collected via telephone modem and storage module from nephelometer sites operated according to IMPROVE protocol:

- Five-minute nephelometer serial data stream

- Five-minute nephelometer analog channels A1 and A2

- Five-minute ambient air temperature and relative humidity

- Hourly codes summarizing the past hour's operation of the nephelometer and support system.

The following data are collected via DCP from nephelometer sites operated according to IMPROVE Protocol:

- Ten-minute nephelometer analog channels A1 and A2

- Hourly codes summarizing the past hour's operation of the nephelometer and support system.

- Last clean air and span calibrations

- Hourly, single-reading ambient air temperature and relative humidity

4.2   COLLECTION OF OPTICAL MONITORING DATA

The method used to collect optical monitoring data depends on the type of site (transmissometer or nephelometer) and the site-specific configuration (telephone modem, storage module, DCP or strip chart). The following subsections describe data collection procedures for the above listed station configurations.

4.2.1 Collection of Transmissometer Data via DCP

Specific transmissometer data collection procedures are detailed in TI 4300-4000, *Data Collection via DCP (IMPROVE Protocol)*. Collection of transmissometer data via DCP includes:

- Updating the current list of sites in the site information file.

- Updating the next time to download data in the Wallops information file.

- Configuring the computer used for automatic data acquisition that downloads the data from Wallops the following day.

- Reviewing all downloaded data file for communication errors or indications of monitoring, logging and data collection problems.

- Initiating data collection programs if automatic data collection failed.

- Executing the STRIP_T program which removes invalid characters and reformats the raw file.

- Executing the APPEND_T program to add the raw data to site-specific Level-A files.

- Resolving identified system inconsistencies according to TI 4110-3300, *Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*.

4.2.2 Collection of Transmissometer Data via Strip Chart Recorder

Strip chart recorder data are only used as a backup logging method at sites where DCP system failures occur, and are only used until the malfunctioning DCP can be repaired or replaced. Specific procedures are detailed in TI 4300-4025, *Transmissometer Data Collection via Strip Chart Recorder*. Collection of transmissometer data via strip chart recorder includes the following:

- Obtaining strip charts.

- Digitizing the strip chart trace.

- Scaling the digitized values to yield raw transmission values.

- Transferring raw transmission data from the strip chart file into the site-specific Level-A file.

- Changing the validity code in the site-specific Level-A file to reflect the use of an alternate datalogger.

4.2.3 Collection of Nephelometer Data via Telephone Modem

Collection of nephelometer data via telephone modem from sites configured with a Campbell Scientific datalogger is handled by the NGN_PULL software. Specific procedures are detailed in TI 4300-4002, *Nephelometer Data Collection via Telephone Modem (IMPROVE Protocol)*. Collection of nephelometer data via modem includes the following:

- Updating the current list of sites.

- Updating the next time to download data.

- Initiating the automatic download timer.

- Polling each telephone modem station daily using the Campbell Scientific TELCOM program for all data since the last download.

- Dividing each downloaded data file into three parts using the Campbell Scientific SPLIT program:

    - Nephelometer serial data, ambient temperature, and relative humidity

    - Nephelometer analog data, ambient temperature, and relative humidity

    - Hourly nephelometer status code and support system status code

- Reformatting and appending each site's nephelometer serial data to site-specific Level-A plottable data files.

- Creating a daily nephelometer log file that contains a summary of the performance of all of the sites downloaded.

- Resolving identified system inconsistencies according to TI 4100-3100, *Routine Site Operator Maintenance Procedures for Optec NGN-2 Nephelometer Systems (IMPROVE Protocol)*.

4.2.4 Collection of Nephelometer Data via DCP

Collection of nephelometer data via DCP is handled by the NGN_PULL software. Specific procedures are detailed in TI 4300-4004, *Nephelometer Data Compilation and Review of DCP-Collected Data (IMPROVE Protocol)*. Collection of nephelometer data via DCP includes the following:

- Updating the current list of sites.

- Extracting each site's data from the stripped daily download file into site-specific daily data files compatible with data obtained via telephone modem.

- Dividing each reformatted data file into three parts using the Campbell Scientific SPLIT program:

    - Nephelometer analog data, ambient temperature, and relative humidity

    - Hourly nephelometer status code and support system status code

- Reformatting and appending each site's nephelometer analog data to site-specific Level-A plottable data files.

- Creating a daily nephelometer log file that contains a summary of the performance of all of the sites downloaded.

- Resolving identified system inconsistencies according to TI 4100-3100, *Routine Site Operator Maintenance Procedures for Optec NGN-2 Nephelometer Systems (IMPROVE Protocol)*.

4.2.5 Collection of Nephelometer Data via Campbell Scientific Storage Module

Collection of nephelometer data via Campbell Scientific storage module is handled by the NGN_PULL software. Specific procedures are detailed in TI 4300-4006, *Nephelometer Data Collection via Campbell Scientific Data Storage Module (IMPROVE Protocol)*. Collection of nephelometer data via storage module includes the following:

- Updating the current list of sites.

- Downloading data from the storage module using the Campbell Scientific SMCOM program into site-specific files compatible with data obtained via telephone modem.

- Dividing each downloaded data file into three parts using the Campbell Scientific SPLIT program:

    - Nephelometer serial data, ambient temperature, and relative humidity

    - Nephelometer analog data, ambient temperature, and relative humidity

    - Hourly nephelometer status code and support system status code

- Reformatting and appending each site's nephelometer serial data to site-specific plottable data files.

- Creating a nephelometer log file that contains a summary of the performance of all of the sites downloaded.

- Resolving identified system inconsistencies according to TI 4100-3100.

5.0 REFERENCES

Campbell Scientific, Inc., 1989, Campbell Scientific PC208 Datalogger Support Software Instruction Manual, February.

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES

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1.0 PURPOSE AND APPLICABILITY

This technical instruction (TI) describes the collection of data logged by data collection platforms (DCPs) at transmissometer, nephelometer, and meteorological sites operated according to IMPROVE Protocol. The purpose of this TI is to assure quality data capture and minimize data loss by:

- Monitoring DCP operating parameters, including: transmission time, DCP battery voltage, signal strength, and transmission frequency deviation.

- Identifying and resolving problems affecting transmissometer and nephelometer systems, meteorological sensors, data acquisition and control systems, and support equipment.

This TI, as referenced from Standard Operating Procedure (SOP) 4300, *Collection of Optical Monitoring Data (IMPROVE Protocol)*, specifically describes:

- General information about data collection via DCP and data acquisition via the National Environmental Satellite Data and Information Service (NESDIS) downlink facility in Camp Springs, Maryland, via the satellite downlink station at Wallops Island, Virginia.

- Automatic and manual data acquisition procedures.

- Daily data handling of DCP data.

- Verification of DCP transmission parameters.

- Procedures for updating the NESDIS Platform Description Tables (PDTs).

Troubleshooting procedures for DCPs are described in TI 4110-3300, *Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*.

2.0 RESPONSIBILITIES

2.1 PROJECT MANAGER

The project manager shall:

- Coordinate with NESDIS for the allocation of DCP assignments for data collection.

- Review data acquired via DCP to detect and resolve problems.

2.2 DATA COORDINATOR

The data coordinator shall:

- Verify that automatic data collection via DCP is successful and perform manual data collection if unsuccessful.

- Review DCP-transmitted data to determine if the DCP and monitoring equipment are functioning properly.

- Provide technical support to the site operator via telephone to assure high quality data capture from the DCP and monitoring equipment.

- Update NESDIS DCP platform description tables (PDTs) via telephone modem.

3.0   REQUIRED EQUIPMENT AND MATERIALS

Equipment and materials generally required for data collection via DCP includes the following:

- IBM-PC compatible 386/486 computer system with VGA and 80 megabyte hard disk

- Internal or external Hayes compatible modem configured for COM port #2

- Crosstalk-4 PC communications software

- WALLOPS4 PC interface software (ARS)

- User Interface Manual (UIM) for the Data Collection System Automatic Processing System (DAPS), Version 1.1

- Wallops Island log book

- Julian calendar

- Plain ASCII text editor such as WordStar

4.0   METHODS

This section includes six (6) major subsections:

4.1 General Information
4.2 Automatic Data Collection
4.3 Manual Data Collection
4.4 DCP Transmission Quality Check
4.5 Daily DCP Data Handling
4.6 Updating NESDIS Platform Description Tables (PDTs)

4.1   GENERAL INFORMATION

Data logged on data collection platforms (DCPs) are processed by several entities before being available for downloading via modem. Monitoring stations with DCPs undergo the following data downloading sequence:

- The DCP logs transmissometer, nephelometer, and/or meteorological data at pre-programmed intervals.

- At three-hour intervals, the DCP transmits the past three hours' data and its internal battery voltage to the GOES satellite.

- The GOES satellite retransmits the data to the NOAA/NESDIS downlink facility at Wallops Island, Virginia.

- The data are made available via the dissemination facility at Camp Springs, Maryland.

- The data are downloaded via telephone modem to ARS.

4.1.1 GOES Satellite System

The following general information summarizes how satellite data collection works:

SATELLITE USE	Use of the Geostationary Orbiting Earth Satellite (GOES) is free to government agencies. Authorization and operation to use the satellite system is directed by the National Environmental Satellite Data and Information Service (NESDIS), a branch of the National Oceanic and Atmospheric Administration (NOAA).
DCP ASSIGNMENTS	NESDIS assigns each DCP a one-minute data transmit time slot every three hours and a unique DCP identification code. Platform Description Tables (PDTs) describe the location and other operational parameters of each DCP. The PDTs must be updated via modem to reflect the status of all operational DCPs.
SATELLITE SYSTEM CAPACITY	Relay of data from DCPs to the downlink facility is a minor portion of the satellite's job. Its primary function is to provide weather-related data and images to aid in weather forecasting.
	Each satellite is capable of utilizing 233 frequencies for a total capacity of over 12,000 DCPs per hour. The data transmission rate is 100 baud (bits per second). The majority of the DCPs in use throughout the United States help support early warning flood monitoring systems.

4.1.2 Data Collection Platforms (DCPs)

DCPs manufactured by Handar and Synergetics are used at IMPROVE optical monitoring sites. Transmissometer sites are generally configured with Handar DCPs and nephelometer sites are generally configured with Synergetics DCPs. Both types of DCPs have the following features:

- Low power, programmable, microprocessor based system

- Analog sensor inputs

- Real-time clock

- GOES compatible radio transmitter

The dissemination facility makes the following data available via telephone modem a short time after the DCP transmits its data:

- Data logged by the DCP

- Transmission date and time

- DCP signal strength and deviation from the specified frequency

- Quality of the DCP transmission

DCP transmission parameters are used to evaluate the performance of the DCP and to resolve DCP-related problems quickly.

4.2   AUTOMATIC DATA COLLECTION

Automatic data collection via DCP includes the following steps:

- Log onto the ARS_NET2 network at a designated DCP data collection computer.

- Type **LOGIN BATCH**. Enter **OH** for project code and **2** (server number for an IMPROVE2 auto pull job).

- Update the DCP data collection identification file "WALDCP.DAT."

- Check the date and time of the next automatic batch job and change if necessary.

- Start the batch software.

- Verify the success of the data collection.

The following detailed procedures describe automatic data collection of DCP data:

LOG ONTO NETWORK	Log onto ARS_NET2 on the data handling computer using your assigned user name and password.
UPDATE THE "WALDCP.DAT" FILE	The "WALDCP.DAT" file includes DCP and site-specific information required to download data via modem. The file includes:

- Site abbreviation

- DCP identification number

- DCP transmission time

- DCP transmission period

An example "WALDCP.DAT" file is provided as Figure 4-1.

Site|Site_id | Ch.|Time|Interval

ACAD,FA42914E,009E,0227,X3
BADL,FA4315A0,038W,0220,X3
BAND,FA4380C2,038W,0227,X3
BIBE,FA4356AA,038W,0224,X3
BRID,FA43A62E,038W,0229,X3
CANY,FA44F466,014W,0218,X3
CHIR,FA450618,014W,0219,X3
GRBA,FA44E710,014W,0217,X3

Format:
Site Abbrv, DCP Iden, DCP Channel and Satellite, Transmit Time and Interval

Figure 4-1. Example "WALDCP.DAT" DCP Definition File for
WALLOPS4 Software.

Update the "WALDCP.DAT" file to include all operational DCPs, using any plain ASCII editor such as WordStar. The WordStar command is **WS F:\USERS\WALLOPS\WALDCP.DAT**.

CHECK THE BATCH JOB DATE AND TIME

The batch software runs the data collection software at a predetermined date and time. The list of programs the batch software is scheduled to run is included in the batch queue. The batch queue may be edited to add or delete scheduled batch jobs. The following procedures detail how to edit the batch queue:

- To examine the batch queue enter **BATCH #Q**.

- To delete a job in the batch queue enter **BATCH #D @XXXX**, where "XXXX" is the number of the batch job.

- To add a new batch job for DCP data collection enter **F:\USERS\WALLOPS\NEWBATCH HH:MM NN/DD/YY**, where "HH" is the hour, "MM" is the minute, "NN" is the month, "DD" is the day, and "YY" is the year the batch job is next scheduled to run.

START THE BATCH SOFTWARE

Start the automatic batch software by entering **LOGIN BATCH**.

The result of a successful batch run is a file with the name "GALYYDDD.DAT" where "YY" is the year and "DDD" is the Julian day.

EXIT THE BATCH SOFTWARE

The batch software must be running to perform automatic data collection. To exit the PS-BATCH software enter **X** at the PS BATCH prompt.

4.3   MANUAL DATA COLLECTION

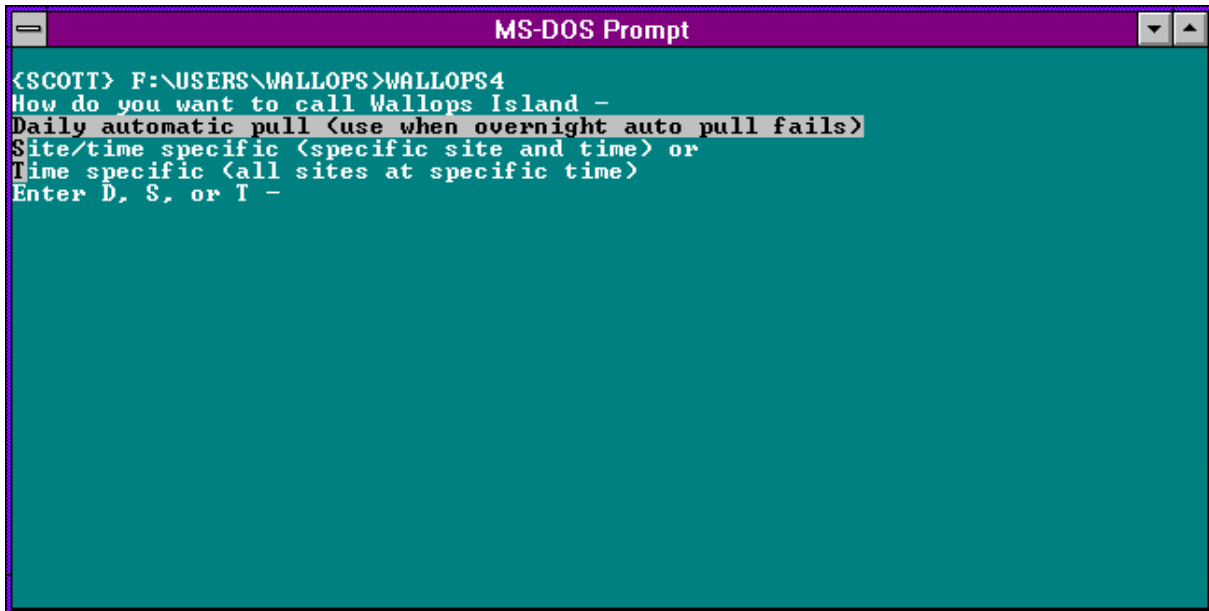Data may be collected manually via telephone modem from the data dissemination facility as follows:

- Log onto the network.

- Run the WALLOPS4 software.

- Enter the site, DCP identification, date, and time at the WALLOPS4 software prompts.

The following procedures detail manual data collection of DCP data:

LOG ONTO NETWORK	Log onto the ARS_NET2 network on the data collection computer using your assigned user name and password.
START THE WALLOPS4 SOFTWARE	The WALLOPS4 software performs all functions of the user interface for manual data collection. To start the WALLOPS4 software, enter **WALLOPS4** at the DOS prompt. Choose one of the following available download options (detailed in Figure 4-2):

- **S** Download one site.

- **D** Download all sites.

- **T** Download all sites at specific beginning and ending time interval.

ENTER THE FILE NAME	If the **D** or **T** option is chosen, enter the file name for the manual data pull using the "GALYYDDD.DAT" format where "YY" is the year and "DDD" is the Julian day.
ENTER THE SITE ABBREVIATION	If **<S>** is chosen, enter the four-character site abbreviation. The site must exist in the "WALDCP.DAT" file. Figure 4-3 shows the WALLOPS4 site entry display.
EXAMINE THE DCP PARAMETERS	Verify that the DCP parameters displayed are correct for DCP data desired. Figure 4-4 shows the parameter verification display.
ENTER THE DATE AND TIME	Enter the date and time of the start of the interval desired. Figure 4-5 shows the date and time entry display. The download will proceed upon entering **Y** at the prompt. Figure 4-6 shows the display during the download process.
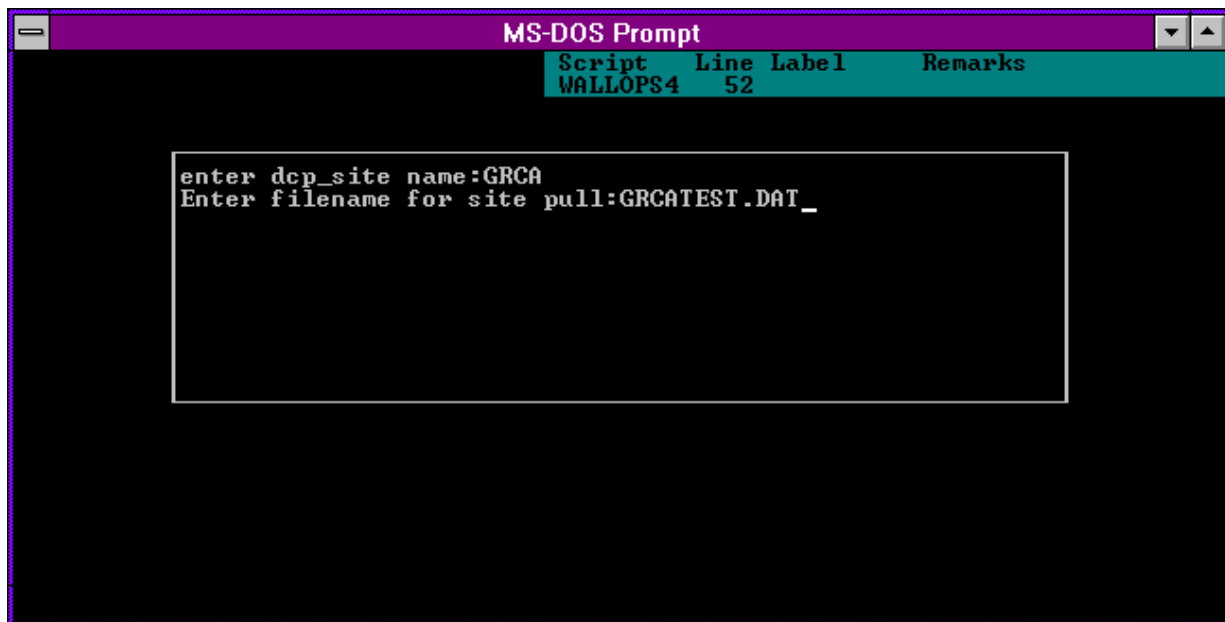
4.4   DCP TRANSMISSION QUALITY CHECK

The data satellite downlink facility analyzes DCP transmissions for transmission strength and quality. The data coordinator should check the downloaded data file for correct DCP operation as follows:

```
=    MS-DOS Prompt                                    ▼ ▲

<SCOTT> F:\USERS\WALLOPS>WALLOPS4
How do you want to call Wallops Island -
Daily automatic pull (use when overnight auto pull fails)
Site/time specific (specific site and time) or
Time specific (all sites at specific time)
Enter D, S, or T -
```
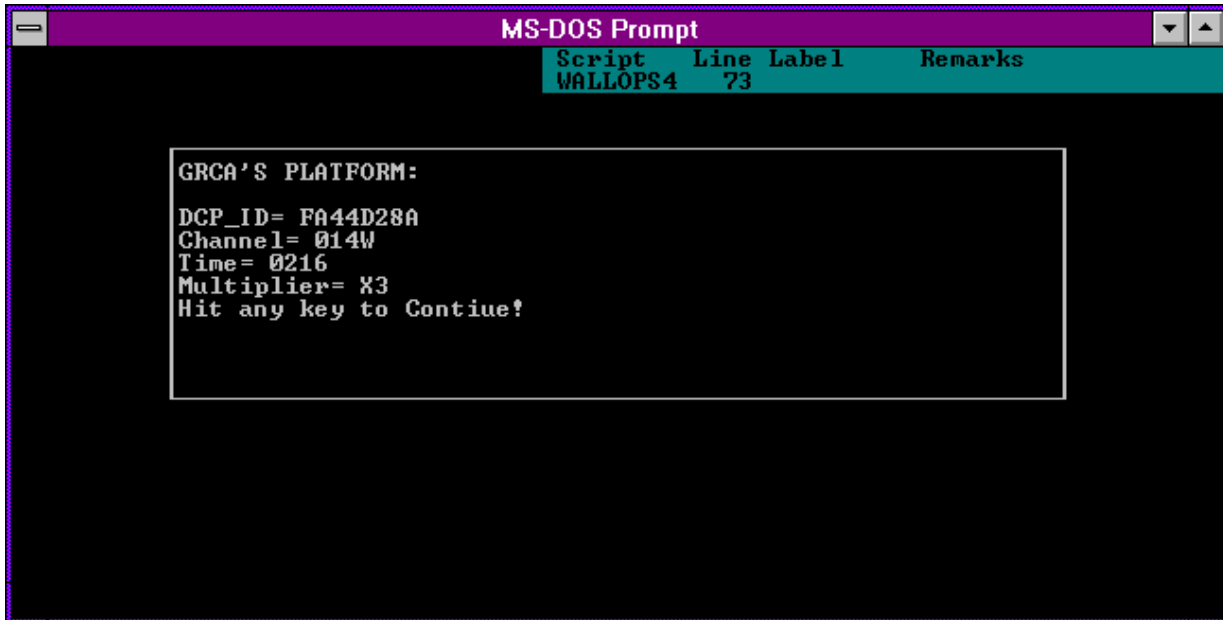
Figure 4-2. Starting WALLOPS4 Software.


```
=    MS-DOS Prompt                                    ▼ ▲
                          Script    Line Label       Remarks
                          WALLOPS4    52


          enter dcp_site name:GRCA
          Enter filename for site pull:GRCATEST.DAT_
```
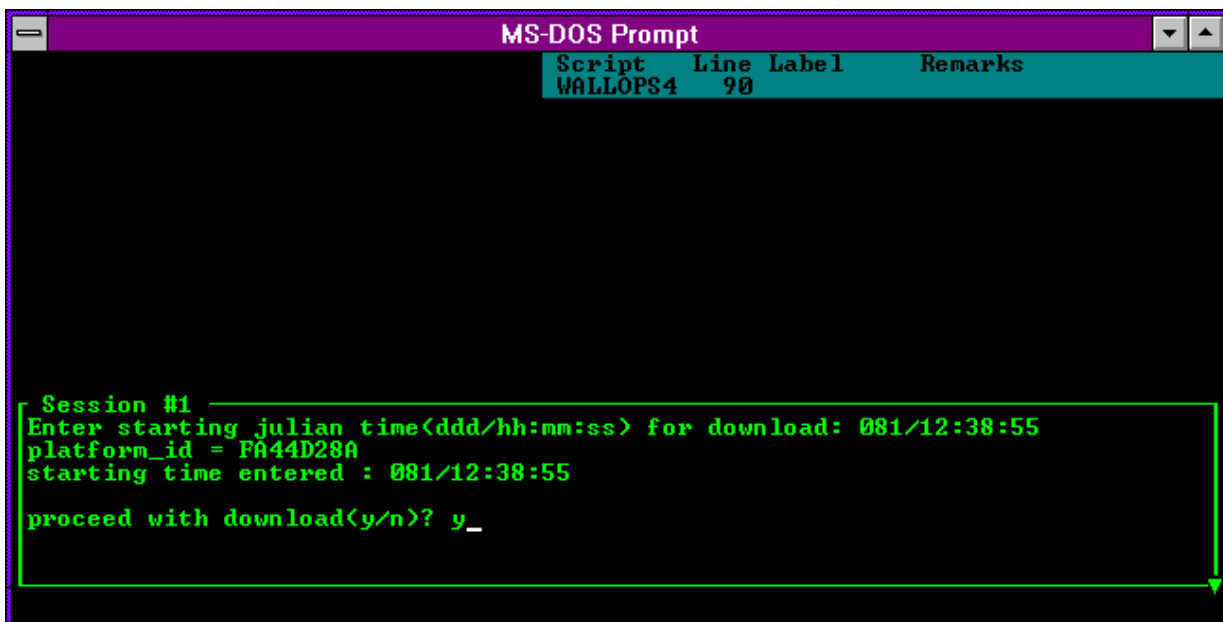
Figure 4-3. Entering Site Abbreviation and File Name in WALLOPS4 Software.

Figure 4-4. Verifying Download Parameters in WALLOPS4 Software.

Figure 4-5. Starting the Download in WALLOPS4 Software.
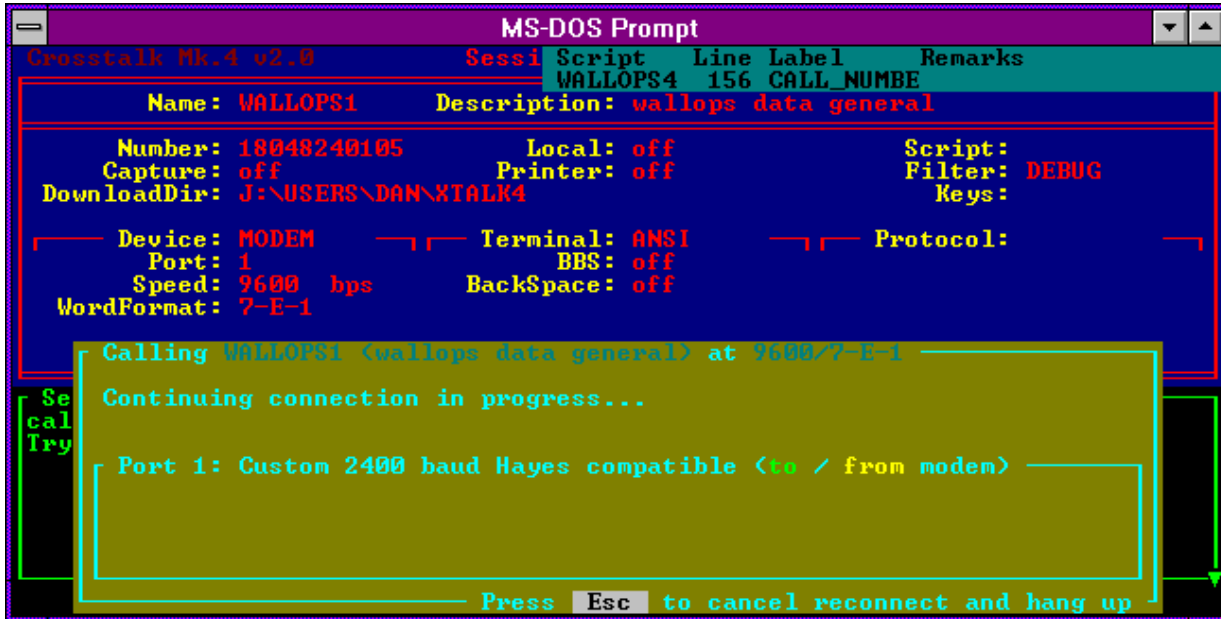
Figure 4-6. Downloading Data Display in WALLOPS4 Software.

- Edit the downloaded data file.

- Check the messages and news information at the beginning of the file.

- Check each DCP data transmission regarding:

    - DCP address.

    - Transmission time (year, Julian day, hour, minute, and second).

    - Failure code.

    - DAMS data quality measurements (signal strength, frequency deviation, modulation index, and modulation quality).

    - DCP transmission channel.

    - Message length.

    - Transmissometer, nephelometer, or meteorological data transmission format.

The following procedures detail the DCP transmission quality check:

EDIT THE DOWNLOADED FILE	Edit the downloaded file using any plain ASCII editor such as WordStar. The WordStar command is **WS FILENAME**. "FILENAME" is the downloaded data file, usually of the format "GALYYDDD.DAT," where "YY" is the year, and "DDD" is the Julian date.
CHECK MESSAGES AND NEWS	The downloaded data file may contain information about data dissemination processes, solar eclipses, data archiving, etc. This information may provide clues to failed DCP transmissions or poor quality data.
CHECK DCP TRANSMISSIONS	Each DCP transmission has associated quality assurance information added to the downloaded data file. Figure 4-7 details the information for a Handar DCP and Figure 4-8 details the information for a Synergetics DCP. Figure 4-9 details the ranges of acceptable values for the DCP transmission information. If any parameter is out of range, refer to TI 4110-3300, *Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*.
CHECK DATA FORMAT	Each type of monitoring station (transmissometer, nephelometer, or meteorological) logs different data and transmits a different data format. Figures 4-7 and 4-8 detail the data transmission formats for transmissometer and nephelometer stations, respectively. If the transmitted data are not in the correct format, refer to TI 4110-3000, *Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol)*, or TI 4100-3100, *Routine Site Operator Maintenance Procedures for NGN-2 Nephelometer Systems (IMPROVE Protocol)*.

```
Example Data                                              Row Description
FA42914E93085112729G38+1HN009EFF00143                    Identification and quality

0501 001 004 0137 090 000 000 000 00.0 13.8              First hourly data
0495 000 004 0138 088 000 000 000 00.0 13.8              Second hourly data
0496 001 003 0138 086 000 000 000 00.0 13.8              Third hourly data


  1    2    3    4    5    6    7    8    9    10          Data column
```

Column   Description
1   Raw transmission average (counts)
2   Receiver computer toggle
3   Standard deviation of the raw transmission (counts)
4   Ambient temperature (°F) (+ 100)
5   Ambient relative humidity (%)
6-9   Not used
10   DCP battery voltage (VDC)

Identification and transmission quality:

Characters	Example	Description
1-8	FA42914E	DCP identification
9-10	93	Year of transmission
11-13	085	Julian date of transmission
14-15	11	Hour of transmission
16-17	27	Minute of transmission
18-19	29	Second of transmission
20	G	Failure code
21-22	38	Signal strength
23-24	+1	Modulation frequency deviation from normal
25	H	Modulation quality
26	N	Modulation index
27-29	009	Satellite channel
30	E	Satellite (East or West)
31-32	FF	IFPD (Intermediate Frequency Presence Detector)
33-37	00143	Message length

Figure 4-7. Handar DCP Transmissometer Data Format.

```
Example Data                                                      Description
FA40643E93085122318G43-1NN002W4C00432# 1   1716                  Identification and quality
# 2    114    173    210    224    383    407    297    302
# 2    383    140    135    140    125    132    138    128
# 2    141    155
# 3    498    498    498    498    498    498    498    498
# 3    498    498    498    498    498    498    498    498
# 3    498    498
# 4    524    423    324
# 5     50     50     50
# 6     -1     -1     -1
# 7    209    209    209
# 8   1020   1020   1020
# 9     96     92    102
#10    960    954    926
#11   1388
```

Data Group

Number	Description
#1	Synergetics operation status
#2	10-minute nephelometer analog A1 readings
#3	10-minute nephelometer analog A2 readings
#4	Nephelometer time when 21X datalogger time is xx:30
#5	Hourly nephelometer code summary
#6	Hourly support code summary
#7	Last clean air calibration (counts) (x10)
#8	Last span calibration (counts) (x10)
#9	Ambient temperature at top of hour (°C) (x10)
#10	Ambient relative humidity at top of hour (%) (x10)
#11	DCP battery voltage (VDC) (x100)

Identification and transmission quality:

Characters	Example	Description
1-8	FA40643E	DCP identification
9-10	93	Year of transmission
11-13	085	Julian date of transmission
14-15	12	Hour of transmission
16-17	23	Minute of transmission
18-19	18	Second of transmission
20	G	Failure code
21-22	43	Signal strength
23-24	-1	Modulation frequency deviation from normal
25	N	Modulation quality
26	N	Modulation index
27-29	002	Satellite channel
30	W	Satellite (East or West)
31-32	4C	IFPD (Intermediate Frequency Presence Detector)
33-37	00432	Message length

Figure 4-8. Synergetics DCP Nephelometer Data Format.

PARAMETER	RANGE	INTERPRETATION
SIGNAL STRENGTH	32 to 57	Signal strength should never exceed 50. Normal strength is 44 to 48. A signal strength less than 43 or greater than 49 indicates a possible malfunction or improper installation. Reliable data can be received with a signal strength as low as 37 if no other signal problems exist.
FREQUENCY	±0 to ±A	50 Hz increments. Reliable data should be possible between -8 and +8 (-449 to +449 Hz). Frequency drift due to temperature (+200 Hz) and Aging (+400 Hz/year) can cause a platform to drift outside the +500 HZ range very quickly. ±250 Hz is a safe range for normal operations.
MODULATION INDEX	N,H,L	N is normal. H (High); messages may be truncated or lost due to loss of demodulator lock. Signal strength readings may indicate too low. L (Low); high error rate, missing messages, and signal strength readings may read too high.
MODULATION QUALITY	N,F,P	N is normal. F indicates malfunction or misalignment, error rate between 10^{-4} and 10^{-6}. P indicates malfunction or misalignment, error rate worse than 10^{-4}.

Figure 4-9. DCP Transmission Quality Description.

4.5 DAILY DCP DATA HANDLING

Daily DCP data handling includes automatic removal of invalid characters from the downloaded file and reformatting the downloaded file into a form usable by processing software. Specifically, DCP data handling includes:

- Updating the "SITEINFO" file.

- Running the STRIP_T program to remove invalid characters and reformat the downloaded data file.

- Examining the stripped file to determine the beginning and ending dates and times for the interval of the file.

- Recording the interval in the Wallops Island log book.

- Examining the "ERROR.DAT" file for incomplete transmissions.

- Examining the "MESSAGE.DAT" file for information included in the header of the downloaded data file.

EDIT AND
UPDATE THE
"SITEINFO"
FILE

The site list information file (SITEINFO) includes information for the current transmissometer and nephelometer sites, including associated DCP ID, site abbreviation, GMT time offset to Local Standard Time (LST), and number of lines in the DCP transmission. The information in the "SITEINFO" file is used by the STRIP_T and APPEND_T programs to define which DCP IDs are valid and to which site they are assigned. The "SITEINFO" file is located in the F:\USERS\WALLOPS directory. The "SITEINFO" file must be updated to reflect changes to DCP-related site configurations. The following procedures describe editing of the "SITEINFO" file:

- Edit the "SITEINFO" file using any plain ASCII editor such as WordStar. The WordStar command is **WS F:\USERS\WALLOPS\SITEINFO**.

- The file format for "SITEINFO" is detailed in Figure 4-10.

- Add, delete, or change the lines in the file to reflect the currently operating DCP-equipped stations.

- Update the number of stations in the first line of "SITEINFO" to reflect the number of stations listed in the file.

- Save the "SITEINFO" file. The WordStar command is **ALT F S**.

```
23
FA42914E,ACADH,4,3,ACADIA,OK,BEXT
FA4315A0,BADLH,7,3,BADLANDS,OK,BEXT
FA4380C2,BANDT,7,3,BANDELIER,OK,BEXT
FA4356AA,BIBEH,6,3,BIGBEND,OK,BEXT
FA43A62E,BRIDH,7,3,BRIDGER,OK,BEXT
FA44220E,BRMEO,7,6,BRYCECANYON,OK,NONE
FA44F466,CANYH,7,3,CANYONLANDS,OK,BEXT
FA450618,CHIRH,7,3,CHIRICAHUA,OK,BEXT
FA441794,GLACT,7,3,GLACIER,OK,BEXT
FA44E710,GRBAH,8,3,GREATBASIN,OK,BEXT
FA44D28A,GRCAH,7,3,GRANDCANYON(SOUTHRIM),OK,BEXT
FA43F652,GRCWH,7,3,GRANDCANYON(IN-CANYON),OK,BEXT
FA42F4A8,GRCMM,7,11,GRANDCANYONMET,OK,NONE
FA437046,GUMOH,6,3,GUADALUPE,OK,BEXT
FA4393B4,MEVEH,7,3,MESAVERDE,OK,BEXT
FA436330,PEFOH,7,3,PETRIFIEDFOREST,OK,BEXT
FA43203A,PINNH,8,3,PINNACLES,OK,BEXT
FA44C1FC,ROMOH,7,3,ROCKYMOUNTAIN,OK,BEXT
FA4306D6,SAGOH,8,3,SANGORGONIO,OK,BEXT
FA42C132,SHENH,4,3,SHENANDOAHLONGPATH,OK,BEXT
FA43B558,YELLH,6,3,YELLOWSTONE,OK,BEXT
FA42D244,YOSEH,8,3,YOSEMITE,OK,BEXT
FA40643E,MACAN,4,14,MAMMOTHCAVESNEPH,OK,NONE
```

Format:
    The first line is the number of DCP definitions in the file.

All other lines:
    DCP Identification
    Site abbreviation and site type
    Hourly offset to GMT
    Number of lines in each transmission
    Site name
    Always OK if active; TEST if not active
    Always b_{ext} if transmissometer; NONE if nephelometer

Site types:
    T Transmissometer sites with Handar AT/RH sensor
    H Transmissometer sites with Rotronics AT/RH sensor
    N Nephelometer sites
    O Bryce Canyon meteorological site

Figure 4-10. Example SITEINFO File for Daily Data Processing.

RUN STRIP_T   The STRIP_T program performs the following functions:

- Strips the downloaded data file of invalid characters.

- Saves the logon and file header information in the "MESSAGE.DAT" file.

- Saves incomplete transmissions in the "ERROR.DAT" file.

- Reformats the downloaded data file and sorts it by transmission date and time (GALYYDDD.TMP file).

    The downloaded data file must be run through STRIP_T before daily data processing of transmissometer or nephelometer data can proceed. The STRIP_T program is started by:

    - Changing to the F:\USERS\WALLOPS directory.

    - Entering **STRIP_T** to start the program.

RECORD START   The stripped downloaded data file is sorted by transmission data
AND END   and time. Examine the first and last transmissions in the
 TIMES   "GALYYDDD.TMP" file and record them in the Wallops Island
                          logbook.

EXAMINE   The "ERROR.DAT" file in F:\USERS\WALLOPS contains
ERROR FILE   incomplete transmissions from the downloaded data file. Examine
                          this file for error messages. If error(s) exist, the data file contains
                          incomplete transmissions that must be corrected.

                          The following procedures describe how to edit the
                          "GALYYDDD.DAT" file that generated an error in the
                          "ERROR.DAT" file:

- Edit the "GALYYDDD.DAT" file using any plain ASCII editor such as WordStar. The WordStar command is **WS F:\USERS\WALLOPS\GALYYDDD.DAT**.

- Each transmissometer data transmission format contains three lines of data following the header line as follows:

        FA44D28A93110141630G51-1NN014WFF00143
        0473 000 004 0136 026 000 000 000 00.0 12.8
        0470 001 005 0135 026 000 000 000 00.0 12.8
        0470 000 003 0139 023 000 000 000 00.0 13.1

- Add, delete, or change the lines in the data file so that the transmission format is complete. For example: the error is "FA44D28A93110011630, 2 lines does not = 3 lines," and the transmission in the "GALYYDDD.DAT" file looks like -

FA44D28A93110141630G51-1NN014WFF00143
0473 000 004 0136 026 000 000 000 00.0 12.8
0470 001 005 0135 026 000 000 000 00.0 12.8

Add a third line with 999's so the transmission looks like -

FA44D28A93110141630G51-1NN014WFF00143
0473 000 004 0136 026 000 000 000 00.0 12.8
0470 001 005 0135 026 000 000 000 00.0 12.8
9999 999 999 9999 999 999 999 999 9999 9999

Once errors are corrected, run STRIP_T again and reexamine the "ERROR.DAT" file. Do not proceed to the next processing stage until the "ERROR.DAT" file is free of errors. (See TI 4300-4023, *Transmissometer Daily Compilation and Review of DCP-Collected Data (IMPROVE Protocol)* or TI 4300-4004, *Nephelometer Data Compilation and Review of DCP-Collected Data (IMPROVE Protocol)*).

EXAMINE
MESSAGE
FILE

The "MESSAGE.DAT" file in F:\USERS\WALLOPS contains the header information from the downloaded data file. Print out a copy of "MESSAGE.DAT" daily and file the printout in the message archive file.

PERFORM
DAILY DATA
COMPILATION
AND REVIEW

Once the primary data collection is complete, the next phase in daily data handling includes compilation and review of the collected data. Refer to the following data-specific TIs:

TI 4300-4004: *Nephelometer Data Compilation and Review of DCP-Collected Data (IMPROVE Protocol)*

TI 4300-4023: *Transmissometer Daily Compilation and Review of DCP-Collected Data (IMPROVE Protocol)*

4.6   UPDATING NESDIS PLATFORM DESCRIPTION TABLES (PDTs)

The NESDIS program information tables must be updated when any change in an operational parameter (location, etc.) occurs. Figure 4-11 details the contents of a typical PDT. Refer to the User Interface Manual (UIM) for the Data Collection System Automatic Processing System (DAPS), Version 1.1 for details on updating PDTs.

5.0   REFERENCES

Integral Systems, Inc., 1990, User Interface Manual (UIM) for the Data Collection System Automatic Processing System (DAPS), Version 1.1, September.

PARAMETER	DESCRIPTION
OWNER_ID	Owner user ID (must be in UDT)

PRIME_TYPE	Primary Type:
	    S: Self-timed
	    I: Interrogate
	    R: Random
	    D: Dual

PRIME_CHAN	Primary CHANNEL: 1 - 266 (must be in CDT)
PRIME_SCD	Primary GOES spacecraft assigned: E: East, W: West
SECND_ADDR	Secondary address or Null

SECND_TYPE	Secondary type:
	    R: Random
	    I: Interrogate, or Null
	    Note: Valid PRIME/SECND types are S/I, S/R

SECND_CHAN	Secondary channel: 0 - 266 (must be in CDT if > 0)
SECND_SCID	Secondary GOES spacecraft assigned: E: East, W: West, or Null

TRIGGER_MODE	Trigger mode:
	    S: Special, T: Test, or Null
	    Note: if not Null then:
	        (a) PRIME_TYPE must be R
	        (b) SECND_ADDR (trigger id) required FIRST_XMT
	        Time of first interrogation for I type platforms in HMMSS format

XMT_PERIOD	Time period between transmissions (S/D) Time period between interrogations (I) in HHMMSS format
XMT_WINDOW	Maximum transmission window size in MMSS (S/D)
XMT_RATE	Data transmission rate in bps (100/300/1200)
MAX_RETRIES	Maximum number of interrogation retries (I)
DATA_FORMAT	DCPRS data format: A: ASCII, B: Binary
PRIME_PREAMBLE	DCPRS preamble type: L: Long, S: Short
SECND_PREAMBLE	DCPRS preamble type: L: Long, S: Short, or Null
LOC_CODE	Three-character location code

LOC_REGION	Location category:
	    A: United States, B: Canada,
	    C: South America, O: Other

LOC_NAME	Location name (31 characters)
LATITUDE	Latitude in DDMMSS
LONGITUDE	Longitude in DDMMSS
MIN_ELEVATION	Minimum elevation angle of platform (in DD)

CATEGORY	Platform category:
	    Fixed: Fixed-buoy, D: Drifting-buoy
	    A: Aircraft, S: Ship
	    B: Balloon, L: Land-based
	    O: Other

Figure 4-11. DCP Platform Description Table (PDT) Description.

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES

TITLE	**TRANSMISSOMETER DAILY COMPILATION AND REVIEW OF DCP-COLLECTED DATA (IMPROVE PROTOCOL)**
TYPE	**TECHNICAL INSTRUCTION**
NUMBER	**4300-4023**
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AUTHORIZATIONS		
TITLE	NAME	SIGNATURE
ORIGINATOR	J. Carter Blandford	
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PROGRAM MANAGER	David L. Dietrich	
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OTHER		

REVISION HISTORY			
REVISION NO.	CHANGE DESCRIPTION	DATE	AUTHORIZATIONS
0.1	Minor text modifications	June 1996	

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1.0   PURPOSE AND APPLICABILITY

The purpose of this technical instruction (TI) is to describe the daily compilation and review of DCP transmissometer and meteorological data from an Optec LPV-2 transmissometer station operated according to IMPROVE Protocol. The primary purpose of daily compilation and review is to assure quality data capture and minimize data loss by:

- Extracting each site's DCP transmissometer and meteorological data from the stripped daily data file downloaded from the NOAA/NESS data dissemination facility at Wallops Island, Virginia. This file is obtained according to Standard Operating Procedure (SOP) 4300, *Collection of Optical Monitoring Data (IMPROVE Protocol)* and TI 4300-4000, *Data Collection via DCP (IMPROVE Protocol)*.

- Reformatting and appending the data to site-specific Level-A plottable data files.

Because most stations are remote and have limited operator visits, early identification of system problems during daily data review is critical to initiating timely corrective actions that minimize data loss.

This TI is a guide to:

- Updating the following transmissometer control files:

    -    "SITEINFO," the DCP site description file.

    -    "XXXX_L," the site-specific lamp calibration files.

    -    "TPROCESS.CON," the data processing control file.

- Operation of the APPEND_T program.

- File formats of the transmissometer constants files, stripped downloaded data file, and site-specific Level-A plottable files.

2.0   RESPONSIBILITIES

2.1   PROJECT MANAGER

The project manager shall:

- Review editing of transmissometer constants files with the data coordinator.

- Review the daily transmissometer data compilation to Level-A files with the data coordinator to assure timely and accurate daily processing.

2.2   DATA COORDINATOR

The data coordinator shall:

- Update all transmissometer constants files and review with the project manager.

- Manually initiate the daily data append program.

- Review the Level-A files to identify instrument problems with the project manager.

3.0   REQUIRED EQUIPMENT AND MATERIALS

Transmissometer data compilation procedures require the following computer hardware and software:

- IBM-PC compatible 386/486 computer system with VGA and 80 megabyte hard disk

- Internal or external Hayes compatible modem configured for COM port #2

- APPEND_T software (ARS)

- Plain ASCII text editor such as WordStar

4.0   METHODS

Transmissometer data collected via DCP are processed daily to reformat and append the data to site-specific Level-A files. The Level-A files may then be reviewed and plotted. Review of transmissometer data is detailed in TI 4400-5000, *Transmissometer Data Reduction and Validation (IMPROVE Protocol)*.

Automatic and manual collection of DCP data is handled in accordance with TI 4300-4000, *Data Collection via DCP (IMPROVE Protocol)*. Daily processing of DCP transmissometer data consists of the following steps:

- Updating the "SITEINFO" file containing the list of currently operating sites.

- Updating the site-specific lamp calibration files, "XXXX_L" (where "XXXX" is the site abbreviation).

- Executing the APPEND_T program.

The following procedures detail the steps for daily processing of transmissometer data:

LOGON TO NETWORK	Logon to network on the transmissometer data handling computer using your assigned user name and password.
UPDATING THE "SITEINFO" FILE	The site list information file "SITEINFO" includes the currently operating transmissometer and nephelometer sites with their associated DCP ID, site abbreviation, GMT time offset to Local Standard Time (LST), and number of lines in the DCP transmission. Information in the "SITEINFO" file is used by the STRIP_T and APPEND_T programs to define which DCP IDs are valid and to which site they are assigned. The "SITEINFO" file is located on the network in the "F:\USERS\WALLOPS" directory. The "SITEINFO" file must be updated to reflect changes to DCP-related site configurations. The following procedures describe editing of the "SITEINFO" file:

- Edit the "SITEINFO" file using any plain ASCII editor such as WordStar. The file format for "SITEINFO" is detailed in Figure 4-1. The WordStar command is **WS F:\USERS\WALLOPS\SITEINFO**.

- Add, delete, or change the lines in the file to reflect the currently operating DCP-equipped stations.

- Update the number of stations in the first line of "SITEINFO" to reflect the number of stations listed in the file.

- Save the "SITEINFO" file. The WordStar command is **Alt-F S**.

UPDATING THE
SITE-SPECIFIC
LAMP FILES

The site-specific lamp files include the following site-specific information:

- Lamp installation and removal dates and times

- Lamp serial numbers and calibration numbers

- Path distance and Rayleigh coefficient

- Lamp calibration curve set information

The information in the lamp files is required to calculate the atmospheric extinction coefficient (b_{ext}) from the raw transmission values collected via DCP. The lamp files must be edited with the most current information available regarding lamps. Each site has its own lamp file with file name "XXXX_L," where "XXXX" is the site abbreviation. The following procedures detail the steps for editing individual lamp files:

- Locate lamp files that are on the network in the "F:\USERS\SITE.CON" directory.

- Edit an individual lamp file using any plain ASCII editor. The WordStar command is **WS F:\USERS\SITE.CON\XXXX_L**, where "XXXX" is the site abbreviation. The file format for lamp files is detailed in Figure 4-2.

- Edit the fields in the lamp file to reflect current information regarding the site. Commas must be included between fields.

- Save the lamp file. The WordStar command is **Alt-F S**.

Line Number	SITEINFO File Contents
1	14
2	FA42914E,ACADH,4,3,ACADIA,OK,BEXT
3	FA4315A0,BADLH,7,3,BADLANDS,OK,BEXT
4	FA4380C2,BANDT,7,3,BANDELIER,OK,BEXT
5	FA4356AA,BIBEH,6,3,BIG BEND,OK,BEXT
6	FA43A62E,BRIDH,7,3,BRIDGER,OK,BEXT
7	FA44220E,BRMEO,7,6,BRYCE CANYON,OK,NONE
8	FA44F466,CANYH,7,3,CANYONLANDS,OK,BEXT
9	FA450618,CHIRH,7,3,CHIRICAHUA,OK,BEXT
10	FA441794,GLACT,7,3,GLACIER,OK,BEXT
11	FA44E710,GRBAH,8,3,GREAT BASIN,OK,BEXT
12	FA44D28A,GRCAH,7,3,GRAND CANYON (SOUTH RIM),OK,BEXT
13	FA43F652,GRCWH,7,3,GRAND CANYON (IN-CANYON),OK,BEXT
14	FA42F4A8,GRCMM,7,11,GRAND CANYON MET,OK,NONE
15	FA437046,GUMOH,6,3,GUADALUPE,OK,BEXT

Line Number Descriptions
1   Number of sites described in this file
2-   One line per site in the format described below

SITEINFO Line Format

DCP ID, site abbreviation and type, GMT time offset to LST, number of data lines per transmission, expanded name, status, type of data

Field	Description
DCP ID	8-Character DCP identification tag.
Site abbreviation and type	4-Character site abbreviation plus 1-character site type: T = Transmissometer with Handar AT/RH sensor H = Transmissometer with Rotronics AT/RH sensor N = Nephelometer O = Bryce Canyon meteorological station M = Grand Canyon Tonto Plateau meteorological station
GMT time offset to LST	Number of hours between Greenwich Mean Time (GMT) (the time programmed into the DCP) and Local Standard Time (LST) (the time used to tag the data).
Number of data lines	Each transmission should contain x number of data lines (not counting the DCP ID header line).
Expanded name	This appears at the top of the raw data plots.
Status	OK or TEST to indicate whether to process the data from this DCP (OK = no, TEST = yes).
Type of data	For transmissometers, this is always b_{ext}, otherwise it is NONE.

There should be one line for every DCP-configured site.

Figure 4-1. Example "SITEINFO" File and Description.

Line Number Contents of XXXX_L File

```
1              GRAND CANYON NATIONAL PARK (SOUTH RIM, GRCA)

2              CONSTANTS FILE

3              WESTERN

4              02/24/93

5                             INST LAMP  CAL  ON/  LAMP   LAMP                    LAMP CAL

6              YYMMDD  JD  HRMM  NUM  NUM  NUM  OFF   FACTOR  OFFSET DISTANCE RAYLEIGH Curve Set COMMENT

7              !!!!!!--!!!--!!!!--!!!--!!!!--!!!--!!!--!!!!!!!---!!!!--!!!!!!!!---!!!!!!!--!!!!!!!----------

8              861201, 335,   0, 001, 1005, 609, ON,    -99,     0, 5.7904, 0.00935,      5,

9              870217,  48, 1200, 001, 1005, 609, ON,    -99,     0, 5.7904, 0.00935,      3, +500 HRS OF OPERATION

10             870401,  91,  500, 001, 1006, -99, ON,    -99,     0, 5.7904, 0.00935,      5,

11             870618, 169, 1200, 001, 1006, -99, ON,    -99,     0, 5.7904, 0.00935,      3, +500 HRS OF OPERATION

12             870707, 188,  500, 002, 1007, 224, ON,    -99,     0, 5.7904, 0.00935,      5,

13             870717, 198,  500, 002, 1007, 224, OFF,   -99,     0, 5.7904, 0.00935,      5,

14             870728, 209,  400, 002, 1007, 224, ON,    -99,     0, 5.7904, 0.00935,      5,

15             871106, 310,  500, 007, 1008, 217, ON,    -99,     0, 5.7904, 0.00935,      5,
```

Line Number	Description
1	Site name
2	Information
3	WESTERN or EASTERN
4	Date this file was last edited
5-7	Headers
8-	Lamp calibration information

Field	Description
YYMMDD	Year, month and day
JJJ	Julian date
HRMN	Hour and minute
INST NUM	Instrument number
LAMP NUM	Lamp number
CAL NUM	Calibration number or -99 for invalid lamp
ON/OFF	Lamp status during this interval
LAMP FACTOR	Lamp correction factor in percent per 500 hours or -99 for default
LAMP OFFSET	Number of hours the lamp has been used prior to this installation
DISTANCE	Path distance in kilometers
RAYLEIGH	Rayleigh coefficient in km^{-1}
LAMP CAL CURVE SET	Lamp calibration curve set (defined in TPROCESS.CON file) to use with this lamp
COMMENT	Comment concerning this line in the file

Important: The fields must be separated by a comma! (No commas in the comment field).

Figure 4-2. Example Lamp Calibration File (XXXX_L).

UPDATING "TPROCESS.CON" FILE

The "TPROCESS.CON" file contains information that is used during seasonal processing of transmissometer data. Information in the file may also be used to calculate a corrected b_{ext} value in the Level-A files as raw data are appended using the APPEND_T program. The "TPROCESS.CON" file should be updated when a site is installed, removed, or when calibration parameters change. The following procedures detail the steps for editing the "TPROCESS.CON" file:

- Locate the "TPROCESS.CON" file on the network in the "F:\USERS\SITE.CON" directory.

- Edit the file using any plain ASCII editor. The file format for "TPROCESS.CON" is detailed in Figure 4-3. The WordStar command is **WS F:\USERS\SITE.CON\TPROCESS.CON**.

- Edit the fields in "TPROCESS.CON" to reflect current information regarding the site. Commas must be included between fields.

- Save the "TPROCESS.CON" file. The WordStar command is **Alt-F S**.

RUNNING THE APPEND_T PROGRAM

The APPEND_T program extracts individual transmissometer data from the daily stripped DCP download file and appends the site-specific Level-A files. During the append process, extinction is calculated from raw transmission values and is included in the site-specific files. The following procedures detail the steps to appending daily data:

- Run the APPEND_T program.

- Enter the name of the daily stripped download file. The file name will be of the form "GALYYJJJ.TMP," where "YY" is the year and "JJJ" is Julian date.

- The program will append the data to site-specific Level-A files with file names of the form "XXXX_T," where "XXXX" is the site abbreviation.

- The APPEND_T program screen will be continuously updated with the status of the append process.

REVIEW THE SITE-SPECIFIC LEVEL-A FILES

The data in the site-specific Level-A files may be reviewed and plotted in accordance with TI 4400-5000, *Transmissometer Data Reduction and Validation (IMPROVE Protocol)*. Figure 4-4 details the file format for the site-specific Level-A files.

<u>Line</u>   <u>Contents of TPROCESS.CON</u>

```
1     TPROCESS.CON
2     Transmissometer Data Processing Constants File
3     Last Updated:
4     02/27/93
5     Last Update by: Jim
6
7     Lamp Calibration Uncertainty Curves, (Power Y=a0*hrs^a1)
8     Number of curve sets, COMMENT
9     Curve set number,curve name,a0,a1,r, COMMENT
10    -------------------------------------------------
11    1,<--- This is the number of curve sets
12    ***********************************
13    High lamp voltage - last bin removed
14    implemented 01/07/93
15    for processing Spring 91 - Summer 92
16    ***********************************
17    1,MEAN, 0.058466,0.684934,0.999970
18    1,UPPER,0.059746,0.764626,0.999694
19    1,LOWER,0.168204,0.331265,0.951433
20    ------------------------------------------------------------------------------------
21        | Constant b_ext Filters |      |      |      |Cal.  |Uncal |Cal  |           |Relative
22        |  First | Second        |WX    |WX    |WX    |Lamp  |Lamp  |Num  |Temperature|Humidity
23    Site|Thresh Num|Thresh Num   |Uncer |Delta |Max   |Uncer |Uncer |Uncer|Min Max Del|Min  Max  Delta
24    ------------------------------------------------------------------------------------
25    ACAD, -0.001, 10,  0.050,  3,   0.018,0.010,   -0.050, 0.005,   0.02,   0.005,   -50, 60, 10,  1,100,30
26    BADL, -0.001, 10,  0.050,  3,   0.018,0.010,   -0.050, 0.005,   0.02,   0.005,   -50, 60, 10,  1,100,30
27    BAND, -0.001, 10,  0.050,  3,   0.018,0.010,   -0.050, 0.005,   0.02,   0.005,   -50, 60, 10,  1,100,30
```

Line Number	Description
1-10	Information about this file
11	Number of curve sets listed below in this file
12-16	Description of the first curve set
17-19	Coefficients for the first curve set
	*Repeat lines 12-16 and 17-19 for the number of curve sets defined in line 11.
20-24	Field headers
25-	Site-specific data processing constants

Field	Description
Site	Site abbreviation
Constant b_{ext} Filters	When there are NUM or more of the same b_{ext} value greater than THRESH, they are invalidated during seasonal processing.
WX Uncertainty Cutoff	Uncertainty cutoff used in the weather removal algorithm (km^{-1}).
WX Delta Cutoff	Delta cutoff used in the weather removal algorithm (km^{-1}).
WX Maximum Cutoff	Maximum cutoff used in the weather removal algorithm (km^{-1}).
Lamp Uncertainties	Not used.
Calibration Number Uncertainty	Percent uncertainty in the calibration number.
Temperature MIN/MAX/DELTA	Minimum and maximum acceptable temperatures (°C). Temperature variations of more than DELTA are recorded in an error file during seasonal processing.
Relative Humidity MIN/MAX/DELTA	Minimum and maximum acceptable relative humidity values (%). Relative humidity variations of more than DELTA are recorded in an error file during seasonal processing.

Figure 4-3. Example "TPROCESS.FILE" and Description.

```
Field: Site  YYMMDD  JJJ  HHMM  b_ext   Raw   SD   AT   RH   Code
       GRCA  921201   336   000    6     461    7   28   14    9
       GRCA  921201   336   100    6     460    5   30   13    9
       GRCA  921201   336   200    6     461    7   29   12    9
       GRCA  921201   336   300    6     460    7   33    5    9
       GRCA  921201   336   400    7     457    7   28   23    0
       GRCA  921201   336   500    8     454    5   31   11    0
       GRCA  921201   336   600    6     460    9   36    3    9
       GRCA  921201   336   700    7     458    7   34    6    0
```

Field	Description
Site	4-Character site abbreviation
YYMMDD	Year, month and day
JJJ	Julian date
HHMM	Hour and minute
b_{ext}	b_{ext} (km^{-1} x 1000)
Raw	Mean of the 10 1-minute raw transmission values
SD	Standard deviation of the 10 1-minute raw transmission values
AT	Ambient air temperature (F°)
RH	Ambient relative humidity (%)
Code	b_{ext} validity code:

0 = Valid
1 = Operator error
2 = Instrument malfunction or removed
3 = Data reduced from alternate data logger
6 = b_{ext} overrange
9 = b_{ext} less than Rayleigh
A = Alignment problem
L = Lamp suspect
S = Suspect data

Code 0,2,6,8 and 9 may be placed by the APPEND_T program. These codes may later be updated during processing.

Figure 4-4. Example Level-A Transmissometer File and Description.

QUALITY ASSURANCE/QUALITY CONTROL DOCUMENTATION SERIES

TITLE	**TRANSMISSOMETER DATA COLLECTION VIA STRIP CHART RECORDER**
TYPE	**TECHNICAL INSTRUCTION**
NUMBER	**4300-4025**
DATE	**JANUARY 1994**

AUTHORIZATIONS		
TITLE	NAME	SIGNATURE
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PROJECT MANAGER	James H. Wagner	
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REVISION HISTORY			
REVISION NO.	CHANGE DESCRIPTION	DATE	AUTHORIZATIONS

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LIST OF FIGURES

1.0   PURPOSE AND APPLICABILITY

The purpose of this technical instruction (TI) is to describe procedures necessary for the collection of transmissometer data via strip chart recorder.   The primary purpose of transmissometer data collection via strip chart recorder is to assure continued data capture and minimize data loss when the primary data collection method (i.e. data collection platform (DCP)), fails. This secondary or backup data collection process includes:

- Performing operational and preventative maintenance checks, as needed, on the strip chart recorder to assure proper operational condition

- Verifying proper transmissometer operation

- Verifying proper strip chart recorder control, switch, and button settings

- Identifying data points on strip chart recorder paper for conversion to data base file

- Operation of digitizing tablet for data measurement

This TI is referenced from SOP 4300, Collection Of Optical Monitoring Data (IMPROVE Protocol), and serves as a guideline to facilitate the following:

- Strip chart recorder operation verification

- Transmissometer system operation verification

- Documentation of data parameters on strip chart recorder paper

- Documentation of data parameters on transmissometer log sheets

- Removal and shipment of strip chart recorder paper

- Digitizing strip chart recorder data

- Conversion of digitized data into site-specific transmissometer data files

Due to variation in the site configuration of IMPROVE Protocol sites, portions of this technical instruction may not apply to every transmissometer station.

2.0   RESPONSIBILITIES

2.1   PROJECT MANAGER

The project manager shall:

- Coordinate with the field specialist and data coordinator concerning the desired strip chart recorder instrument settings for collection of transmissometer data when the primary data collection method (DCP) fails.

- Oversee and review converted strip chart recorder data for accuracy and completeness prior to the data being entered into site-specific transmissometer data files.

2.2 FIELD SPECIALIST

The field specialist shall:

- Train the site operator in all phases of strip chart recorder maintenance and operation procedures.

- Provide technical support to the site operator via telephone to assure proper transmissometer data collection from the strip chart recorder.

- Document all technical support provided to the site operator.

- Resolve problems reported by the site operator.

2.3 DATA ANALYST

The data analyst shall:

- Identify possible DCP malfunction and contact the site operator to verify proper transmissometer and strip chart recorder operation.

- Provide technical support to the site operator via telephone, to assure proper transmissometer data collection from the strip chart recorder.

- Document all technical support provided to the site operator.

- Resolve problems reported by the site operator.

- Review documentation completed by the site operator for accuracy and completeness.

- Ship supplies, tools, and replacement instrumentation necessary for instrument problem resolution to the site operator.

- Enter all correspondence with site operators and the results of all performed procedures into site-specific timelines.

- Digitize the strip chart's transmissometer data.

- Convert digitized data into transmissometer format.

- Enter converted digitized transmissometer data into site-specific data files.

2.4 SITE OPERATOR

The site operator shall:

- Perform all procedures described in this TI.

- Thoroughly document all transmissometer and strip chart recorder operation verification information on the Transmissometer Site Operator Log Sheet and mail the log sheet to the data coordinator.

- Report any noted inconsistencies immediately to the data analyst or field specialist.

3.0   REQUIRED EQUIPMENT AND MATERIALS

The equipment generally required for collection of transmissometer data via strip chart recorder includes:

- Primeline 6723 strip chart recorder

- Strip chart recorder paper (Chart No. ZM1-01-12-15M)

- Strip chart recorder pens (red and black)

- Digitizing tablet with power supply, cable, and digitizing mouse

- Medium Phillips-head screwdriver

- Non-stick tape

- ARS strip chart recorder data conversion software

- Pen or pencil

- Primeline 6723 instruction manual

4.0   METHODS

This section includes three (3) major subsections:

   4.1 Strip Chart Recorder Operation Verification
   4.2 Transmissometer System Operation Verification
   4.3 Digitizing and Converting Strip Chart Recorder Data

The procedures described in these sections refer to specific instrument components. Detailed schematic diagrams and instrument component descriptions are provided for reference in TI 4110-3350, Transmissometer Monitoring System Diagrams and Component Descriptions. Many of the procedures described in Section 4.1 refer to routine maintenance procedures that are detailed in TI 4110-3100, Routine Site Operator Maintenance Procedures for LPV-2 Transmissometer Systems (IMPROVE Protocol). Many of the procedures described in Section 4.2 refer to transmissometer system operation verification procedures that are detailed in TI 4110-3300, Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol).

4.1   STRIP CHART RECORDER OPERATION VERIFICATION

This subsection describes verification checks on the strip chart recorder and describes procedures for documentation on the strip chart recorder paper.

The strip chart recorder is the backup data collection instrument for transmissometer data. At most sites the strip chart recorder operates only when there are problems with the data collection platform (DCP). When data is not transmitted by the DCP, the site operator is notified and requested to verify proper strip chart recorder operation. Refer to Figure 4-1, Strip Chart Component Diagram, for the location of the following items:

CHART PAPER MAGAZINE   The entire chart paper magazine is removable, enabling easy paper installation. Blank paper is stored at the back of the magazine, while paper with recorded data folds into a storage area at the front.

CHART PAPER   Check to make sure that there is an adequate supply of chart paper remaining. A red line will appear on the right side of the chart paper when there is less than two days remaining on the chart. If unsure that there is at least a week of chart paper remaining, install a new roll of strip chart paper. Instructions for installation of chart paper can be found in the Primeline 6723 instruction manual, pages 2-8 through 2-10. By hand, advance the paper a few sheets before loading the magazine to make sure that the paper is feeding correctly.

CHART PENS   Check to make sure that the pens are leaving a bold trace and track freely across the chart paper. The pens should be replaced when the trace becomes weak or intermittent. Chart recorder pens slip into holders, as described on page 2-10 of the Primeline 6723 instruction manual. It is important that the pens be inserted securely into the mounts. Note that the pen positions, as they mark on the chart paper, are offset slightly. This is important when looking at the strip chart data.

PEN LIFTERS   Pen lifters raise the pens off the chart paper to prohibit recording or to make installation of new pens easier.

IMPORTANT -- pen lifters should be in the fully down position for routine operation.

EVENT MARKERS   Event markers are momentary-on push buttons, that when depressed, make a "tick" mark on the strip chart paper. These tick marks are used to accurately record events such as field operator servicing visits. Tick marks on the strip chart paper should always have a time and date written next to them. When making tick marks, depress the event markers 4 or 5 times rapidly to make a good, positive mark.

RANGE SWITCHES   Range switches should be set to the values listed on the strip chart settings sticker. For most locations, CHA should be set to the **10-volt** position and CHB to the **50-volt** position. The 50-volt setting is a combination of the "10-VOLT" push-button and the "ZERO CONTROL" knob pulled out to the **X5** position.
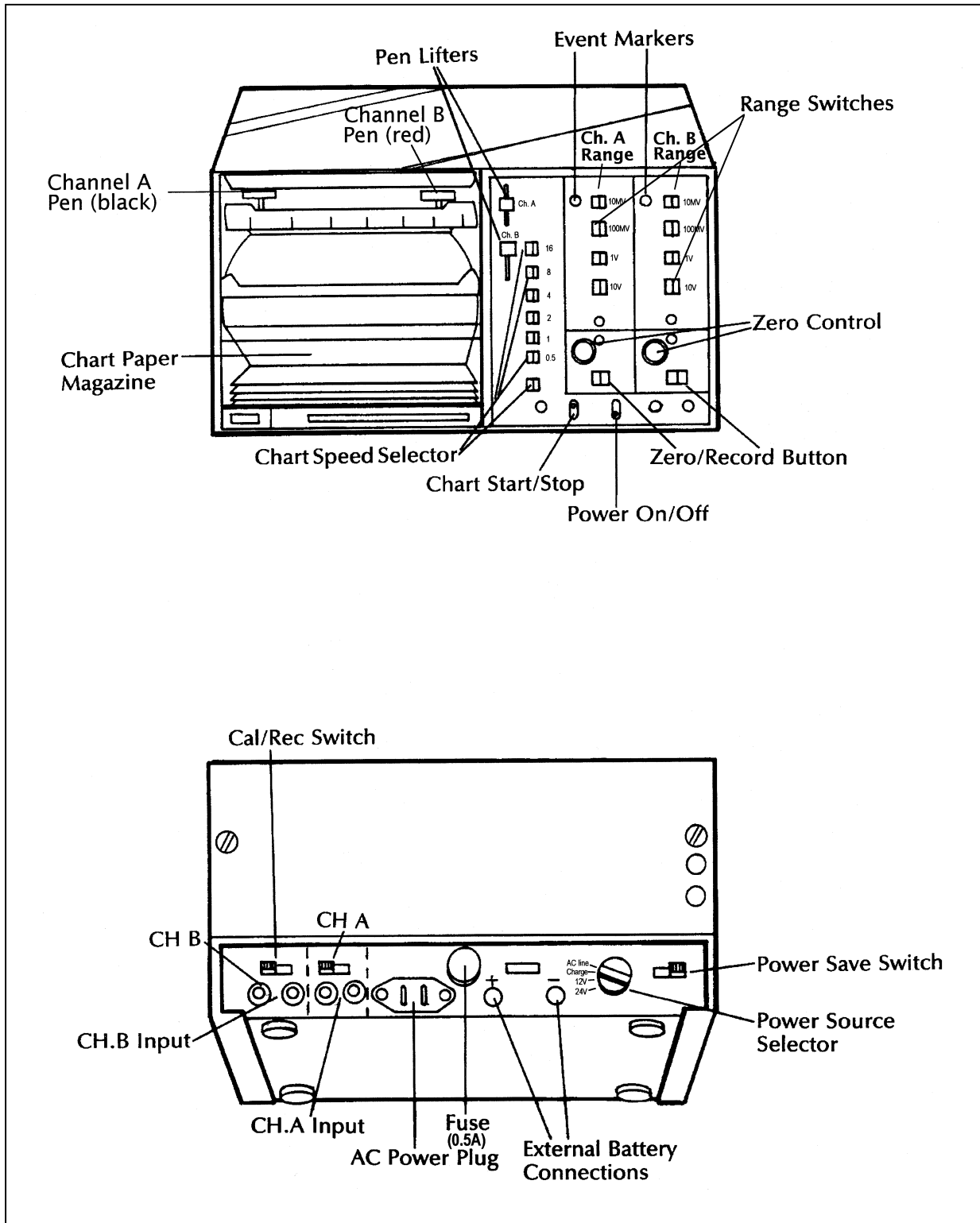
Figure 4-1. Strip Chart Component Diagram.

ZERO
CONTROL
KNOB

The "ZERO CONTROL" knob provides the following functions:

1)   It positions the pens to the correct **zero** position on the chart paper. (The **zero** position can only be adjusted when the "ZERO/RECORD" button is in the **zero** position.)

2)   It expands the range settings by a factor of five. For example, a range switch setting of **10** becomes **50-volts** full scale when the "ZERO CONTROL" knob is pulled out.

ZERO
RECORD
BUTTON

The "ZERO/RECORD" button adjusts the pens to their correct **zero** position when used in conjunction with the "ZERO CONTROL" knob.

IMPORTANT -- the button must be in its record position for routine operation.

POWER
ON/OFF
SWITCH

The power "ON/OFF" switch controls the supply of power to the recorder regardless of the power supply used.

CHART
START/STOP
SWITCH

This switch stops movement of the chart paper. It does not inhibit the pens from changing position as input voltages change. With the slow chart speed used in the transmissometer monitoring system, it is possible to write strip chart documentation on the "moving" chart paper. This switch should remain in the **start** position when the strip chart recorder is operational.

IMPORTANT -- no data will be recorded when the switch is in the **stop** position.

CHART
SPEED
SELECTOR

The speed at which the chart paper passes the recording pens is selected by these switches. The speed is determined by a combination of the setting chosen from the upper six switches, and the setting of the lower switch. These switches should remain in the positions listed on the strip chart settings sticker. For routine monitoring, the button marked "0.5" should be depressed and the bottom button should be in the **out** or **CM/HR** position.

CHA INPUT

The analog voltage representing the transmissometer extinction signal inputs the strip chart recorder at CHA on the back panel. The banana jacks on the strip chart cable are labeled: the CHA positive lead connects to the plug marked "+" and the negative lead connects to "-".

CHB INPUT

The analog voltage, representing toggle state (on or off), inputs the strip chart recorder at CHB on the back panel.

CAL/REC
SWITCH

The "CAL/REC" (calibrate/record) switch puts the recorder in either the "TEST" or "OPERATE" mode. If the switch is placed in the **CAL** position, an internally-generated 50-millivolt voltage is sent to the channel. This known reference voltage is used to check or verify correct recorder operation. For routine monitoring, the switch should remain in the **record** position.

IMPORTANT -- no data is recorded when the switch is in the **CAL** position.

FUSE	The fuse contained within the fuse holder is used only when the recorder is operated from AC power. Spare fuses are supplied with the servicing equipment.
EXTERNAL BATTERY CONNECTOR	If DC battery power is used to operate the strip chart recorder, the power jacks connect at the position labeled "EXT battery" on the back panel. Care must be taken to observe correct polarity.
POWER SOURCE SELECTOR	The power source switch selector position must match the type of power supplied. When battery power is used, the switch must be set to 12-volts, not 24-volts. When the AC power is used, the switch must be set to **AC line**.
POWER SAVE SWITCH	The power save switch reduces power consumption when only one channel of data (CHA) is to be collected. If the pen on Channel B fails to respond to signals or changes in control switch settings, check the position of the switch. This switch must remain in the **off** position.

4.1.1 Documentation on Strip Chart Recorder Paper

When the data collection platform (DCP) is not operating or is operating improperly, the strip chart recorder becomes the only source of data from the transmissometer. Once proper strip chart recorder operation is verified, the following information must be recorded on the chart paper at each site visit:

- Event markers or "ticks"

- Date and time

- Location

- Operator name

- Receiver computer display value

- Toggle "on" or "off"

- Other information such as:

    - Pens zeroed

    - Replacement pens/paper

    - Computer reset

    - Alignment off/corrected

    - System timing off/corrected

The transmissometer receiver computer outputs its A1 channel and toggle readings to the strip chart recorder. During normal operation, the receiver computer A1 switch is in the **C** (raw reading) position and the strip chart recorder Channel A (black pen) range setting is in the **10-volt** position. In order to get better resolution of data readings on the strip chart paper when the DCP is not operating, the receiver computer A1 switch should be in the **B** (b_{ext}) position and the strip chart recorder Channel A range setting should be in the **1-volt** position. See Figure 4-2, Example of Strip Chart Data, for an example of b_{ext} readings on strip chart paper with Channel A range setting on 1-volt.

It is very important that the documentation on the strip chart recorder paper is thorough (especially the date, time, and current reading), and that the transmissometer data is being "transferred" to the proper position on the chart paper. For example, an b_{ext} reading of .028 should be easily distinguishable from a b_{ext} reading of .030 on the strip chart paper.

4.1.2 Removal of Strip Chart Recorder Paper and Shipment to ARS

When removing the strip chart paper, record the location, date, and time of last data on the outside of the chart paper. The same information should be written at the beginning of the roll of chart paper when installing. The procedure for changing chart paper is described on pages 2-8 through 2-10 of the Primeline 6723 Strip Chart Recorder Manufacturer's Instruction Manual.

Once the strip chart paper has been document and removed from the recorder, it should be mailed to Air Resource Specialists, Inc. (ARS) with corresponding transmissometer log sheet documentation. The correct mailing address for ARS is:

> Air Resource Specialists, Inc.
> 1901 Sharp Point Drive, Suite E
> Fort Collins, Colorado 80525

Call ARS immediately if any problem arises with strip chart recorder operation, documentation, chart paper replacement, or shipment of chart paper and log sheets. Primary contacts at ARS are:

> Carter Blandford
> Dave Beichley
> Jim Wagner

ARS may be reached at the following telephone numbers:

> Regular: (303) 484-7941
> FAX: (303) 484-3423

4.2 TRANSMISSOMETER SYSTEM OPERATION VERIFICATION

This subsection describes verification checks on the transmissometer system log sheet documentation procedures.
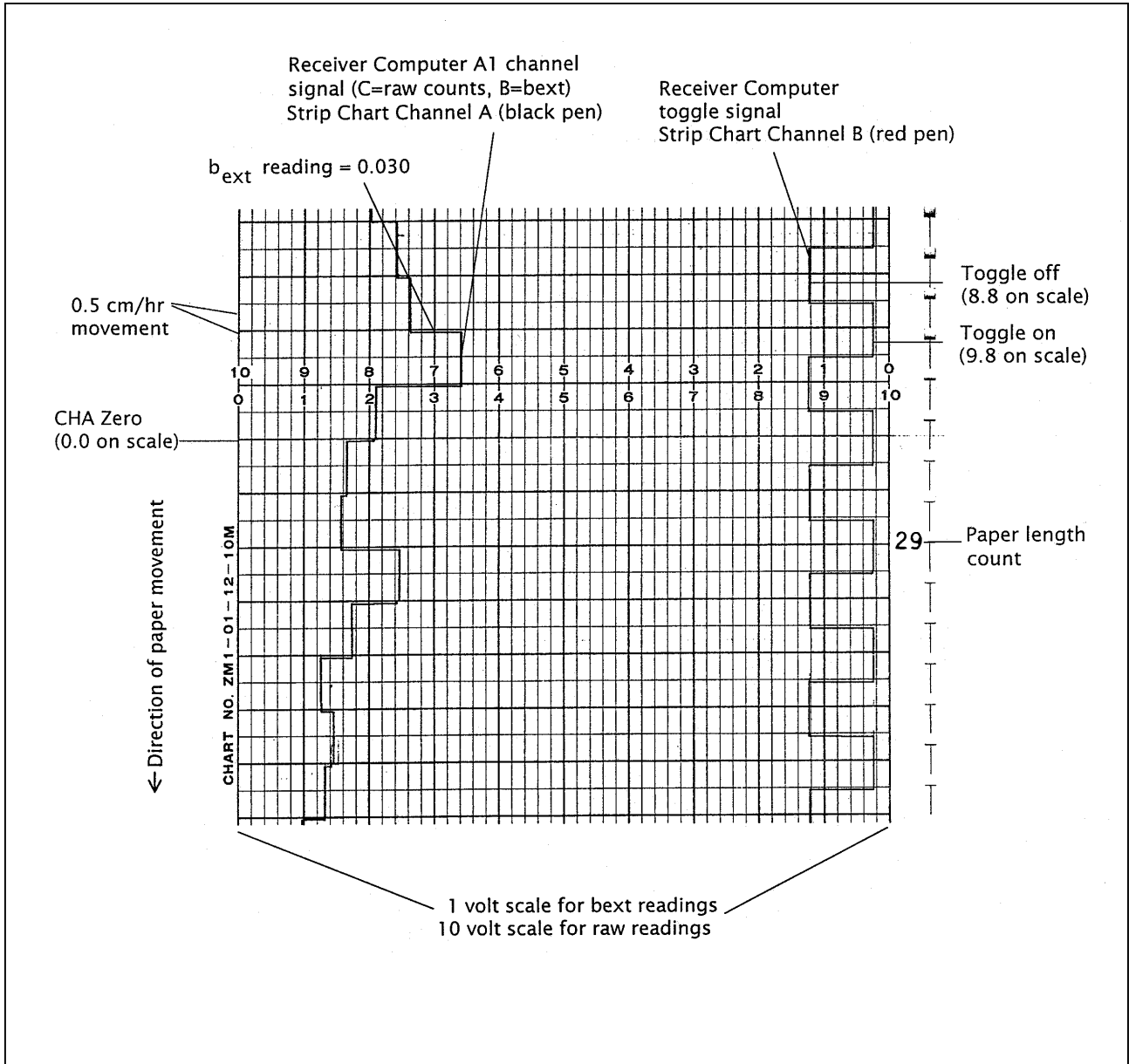
Figure 4-2. Example of Strip Chart Data.

For data collected from the strip chart recorder to be considered valid, the transmissometer system operation must also be verified. Frequent site visits (twice a week instead of weekly) are necessary for weather and visibility comparisons with the transmissometer data. When the DCP is not transmitting data from the transmissometer station, there is no air temperature or relative humidity data to relate the transmissometer readings with.

The site operator must verify proper transmissometer system operation by documenting the following on the site operator log sheets:

- System timing - lamp "on" and "off" times and receiver display update time

- Toggle operation

- Receiver computer display reading accuracy (does the reading make sense?)

- Current and recent weather and visibility conditions

- Receiver computer switch settings

- Lamp number and lamp voltage readings

- Optical cleanliness (shelter windows and telescopes)

- Alignment location/correction

- Power supply and/or deep-cycle battery operation/maintenance

- Solar panel and regulator operation

The above documentation and operation verification information is referred to in TI 4110-3100, Routine Site Operator Maintenance Procedures for LPV-2 Transmissometer Systems (IMPROVE Protocol), and in TI 4110-3300, Troubleshooting and Emergency Maintenance Procedures for Optec LPV-2 Transmissometer Systems (IMPROVE Protocol).

4.3 DIGITIZING AND CONVERTING STRIP CHART RECORDER DATA

This subsection describes procedures for identifying data points, date and time reference points on strip chart recorder paper, and procedures for converting strip chart data into site-specific transmissometer Level-A data files.

When the strip chart paper containing data to be converted is received at ARS (along with the associated transmissometer log sheets), the data analyst must identify the beginning date, time, and data reading on the strip chart paper with the help of site operator documentation on both the chart paper and log sheets. Once the start date, time, and data reading is identified, the strip chart paper can be attached (using non-stick tape) to the digitizing tablet for data identification. The data analyst uses the digitizing tablet to scan the data points on the strip chart paper and input the data into an ASCII/TEXT file on the ARS computer network system.

For the data analyst to convert the strip chart data into valid transmissometer data, the following information is needed:

- Strip chart Channel A range setting (1-volt or 10-volt)

- Lamp number from transmissometer transmitter for data in question

- Calibration number for lamp being used

- Site path distance (km) of site using the strip chart data

By using the above information and ARS strip chart data conversion software, the digitized data can be converted into raw readings and b_{ext} readings that can be manually entered into the site-specific Level-A (XXXX_T) file. Refer to TI 4300-4023, Transmissometer Daily Compilation and Review of DCP-Collected Data, for an example and description of a Level-A transmissometer file.

To scan the data points on the strip chart paper, perform the following:

- Use the digitizing tablet's mouse to locate the boundaries of the strip chart paper's length (identifying the "x" scale - time in 24-hour format).

- Use the digitizing tablet's mouse to locate the boundaries of the strip chart paper's width (identifying the "y" scale - 1-volt or 10-volt).

- Using the digitizing tablet's mouse, click on each hours' data reading by following the black pen marks opposite the red pen toggle marks (a one-hour reading for each toggle change). (See Figure 4-2).

The result of this scan will be the First Stage digitized ASCII/TEXT file (see Figure 4-3). Once the raw numbers have been identified, they can be associated with a specific date, time, and b_{ext} reading using the documentation information provided by the site operator on the strip chart paper. Using ARS strip chart data conversion software, the First Stage ASCII/TEXT file can then be converted to a Second Stage ASCII/TEXT file with date, time, b_{ext}, and raw readings (must use calibration number and site path distance to calculate a raw reading from the b_{ext} reading). See Figure 4-4 for an example of a Second Stage ASCII/TEXT file.

Before the b_{ext} and raw readings can be manually inserted into the site-specific Level-A (XXXX_T) file, they must be rounded off to the nearest whole number (see Figure 4-5). Once the b_{ext} and raw readings numbers have been rounded off, the digitized strip chart data can be manually inserted into the proper Level-A file using any plain ASCII editor. To manually insert the final strip chart data file into the Level-A file, perform the following:

- Locate the missing data period in the Level-A file (site-specific Level-A data files are in F:\USERS\TRANS\XXXX_T, where XXXX is the site abbreviation).

- Insert columns 3 and 4 from the final ASCII/TEXT file (see Figure 4-5) into the proper column positions and into the correct date and time positions of the XXXX_T file.

- Manually insert a code of 3 (data reduced from strip chart recorder) into the code column of the XXXX_T file for every strip chart reduced data entry.

	1	2	3	4	5	6	7
1	13.44725	3.89400	13.00000	--			
2	14.51350	3.95009	--	--			
3	15.44824	3.96600	--	--			
4	16.53336	4.00692	--	--			
5	17.47107	4.00158	--	--			
6	18.45543	4.00393	--	--			
7	19.52918	3.52553	--	--			
8	20.52801	2.85970	--	--			
9	21.53478	**********	--	--			
10	22.44322	***********	--	--			
11	23.45813	***********	23.00000	--			
12	24.51312	***********	--	2.00000			
13	25.55793	***********	--	--			
14	26.50285	***********	--	--			
15	27.51361	0.42116	--	--			
16	28.55919	***********	--	--			
17	29.53740	***********	--	--			
18	30.55167	***********	--	--			
19	31.46562	***********	--	--			
20	32.47193	3.79105	--	--			
21	33.49115	2.36362	--	--			
22	34.46910	3.01281	--	--			
23	35.50277	***********	--	--			
24	36.44289	3.72777	--	--			
25	37.49520	1.51310	--	--			
26	38.52862	***********	--	--			
27	39.41033	***********	--	--			
28	40.44518	***********	--	--			
29	41.53187	0.42877	--	--			
30	42.51135	2.92060	--	--			
31	43.49480	1.79701	--	--			
32	44.57633	0.22858	--	--			
33	45.49841	3.01188	--	--			
34	46.50510	3.23649	--	--			
35	47.50374	3.48245	23.00000	--			
36	48.43491	3.61505	--	3.00000			
37	49.39043	3.63485	--	--			
38	50.44734	3.64868	--	--			
39	51.45123	3.69311	--	--			
40	52.45694	***********	--	--			
41	53.50633	3.03475	--	--			
42	54.48326	2.96301	--	--			
43	55.44315	3.48316	--	--			

KEY

Column 1 = X value (hour measurement) going length-wise on strip chart paper

Column 2 = Y value (b_{ext} or raw reading measurement) going width-wise on strip chart paper

Column 3 = Hour scale (24-hour format)

Column 4 = Day scale (0-23 hours equals one day)

Figure 4-3. Example of First Stage ASCII/TEXT File From Strip Chart Paper.

	1	2	3	4	5	6	7
1	13.4473	3.8940	13	12/04/92	15.93	389.00	
2	14.5135	3.9501	14	12/04/92	13.55	395.00	
3	15.4482	3.9660	15	12/04/92	12.77	397.00	
4	16.5334	4.0069	16	12/04/92	11.21	401.00	
5	17.4711	4.0016	17	12/04/92	11.60	400.00	
6	18.4554	4.0039	18	12/04/92	11.60	400.00	
7	19.5292	3.5255	19	12/04/92	31.02	353.00	
8	20.5280	2.8597	20	12/04/92	63.73	286.00	
9	21.5348	0.0394	21	12/04/92	727.19	4.00	
10	22.4432	0.0472	22	12/04/92	692.51	5.00	
11	23.4581	0.0491	23	12/04/92	692.51	5.00	
12	24.5131	0.0439	0	12/05/92	727.19	4.00	
13	25.5579	0.0388	1	12/05/92	727.19	4.00	
14	26.5029	0.0545	2	12/05/92	692.51	5.00	
15	27.5136	0.4212	3	12/05/92	361.81	42.00	
16	28.5592	0.0684	4	12/05/92	640.23	7.00	
17	29.5374	0.0602	5	12/05/92	664.18	6.00	
18	30.5517	0.0557	6	12/05/92	664.18	6.00	
19	31.4656	0.0677	7	12/05/92	640.23	7.00	
20	32.4719	3.7911	8	12/05/92	19.98	379.00	
21	33.4912	2.3636	9	12/05/92	93.59	236.00	
22	34.4691	3.0128	10	12/05/92	55.78	301.00	
23	35.5028	0.0542	11	12/05/92	692.51	5.00	
24	36.4429	3.7278	12	12/05/92	22.46	373.00	
25	37.4952	1.5131	13	12/05/92	162.98	151.00	
26	38.5286	0.0748	14	12/05/92	640.23	7.00	
27	39.4103	0.0704	15	12/05/92	640.23	7.00	
28	40.4452	0.0677	16	12/05/92	640.23	7.00	
29	41.5319	0.4288	17	12/05/92	358.16	43.00	
30	42.5114	2.9206	18	12/05/92	60.50	292.00	
31	43.4948	1.7970	19	12/05/92	135.68	180.00	
32	44.5763	0.2286	20	12/05/92	455.38	23.00	
33	45.4984	3.0119	21	12/05/92	55.78	301.00	
34	46.5051	3.2365	22	12/05/92	44.34	324.00	
35	47.5037	3.4825	23	12/05/92	33.24	348.00	
36	48.4349	3.6151	0	12/06/92	27.11	362.00	
37	49.3904	3.6349	1	12/06/92	26.68	363.00	
38	50.4473	3.6487	2	12/06/92	25.83	365.00	
39	51.4512	3.6931	3	12/06/92	24.13	369.00	
40	52.4569	0.0501	4	12/06/92	692.51	5.00	
41	53.5063	3.0348	5	12/06/92	57.75	303.00	
42	54.4833	2.9630	6	12/06/92	58.39	296.00	
43	55.4432	3.4832	7	12/06/92	33.24	348.00	

KEY

Column 1 = Value (hour measurement) going length-wise on strip chart paper

Column 2 = Y value (b_{ext} or raw reading measurement) going width-wise on strip chart paper

Column 3 = Hour scale (24-hour format)

Column 4 = Date identification (month/date/year)

Column 5 = b_{ext} reading (calculated using calibration number, site path distance, and raw reading

Column 6 = Raw reading (calculated using calibration number, site path distance, and b_{ext} reading)

Figure 4-4. Example of Second Stage ASCII/TEXT File From Strip Chart Paper.

1	2	3	4
0	12/03/92	27	369
1	12/03/92	27	368
2	12/03/92	28	366
3	12/03/92	28	365
4	12/03/92	28	267
5	12/03/92	28	366
6	12/03/92	28	367
7	12/03/92	28	367
8	12/03/92	27	369
9	12/03/92	26	371
10	12/03/92	25	374
11	12/03/92	23	377
12	12/03/92	23	378
13	12/03/92	21	382
14	12/03/92	20	385
15	12/03/92	20	386
16	12/03/92	20	386
17	12/03/92	20	384
18	12/03/92	20	384
19	12/03/92	20	385
20	12/03/92	23	377
21	12/03/92	24	375
22	12/03/92	25	374
23	12/03/92	24	375
0	12/04/92	24	375
1	12/04/92	24	375
2	12/04/92	24	375
3	12/04/92	24	376
4	12/04/92	23	378
5	12/04/92	22	380
6	12/04/92	23	379
7	12/04/92	23	377
8	12/04/92	23	379
9	12/04/92	23	379
10	12/04/92	22	381
11	12/04/92	22	381
12	12/04/92	18	389

KEY

Column 1 = Hour scale (24-hour format)

Column 2 = Date identification (month/year)

Column 3 = b_{ext} reading (rounded off to nearest whole number)

Column 4 = Raw reading (counts)

Figure 4-5. Example of Final ASCII\TEXT File From Strip Chart Paper.