# Manual

Retrieval, Processing and Final Storage in the LVBD of Hydrometeorological Data from the Lake Victoria Monitoring Network

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# Table of Contents

I	Intro	duction	7
1.1	Gene	ral	7
1.2	0ver\	view of the Contents of the Manual	7
1.3	Manu	ial Version	8
2	Deta	iled Outline of the Data Trajectory	9
2.1	Gene	ral	9
2.2	Hard	ware	9
2.3	Softw	vare	10
2.4	Comp	prehensive Data Trajectory	11
3	Rem	aining Hardware and Software Installation	13
3.1	Insta	llation of SC532 Interface	13
3.2	Insta	llation of PC208W Datalogger Support Software	13
4	Reco	mmended Directory Structure	14
4.1	Gene	ral	14
4.2	PC20	8W Files	14
4.3	MS A	ccess Database Files	15
5	PC20	08W Datalogger Support Software	17
5.1	Intro	duction	17
5.2	StgM	odule Component	17
	5.2.1 5.2.2 5.2.3 5.2.4 5.2.5	Introduction Connecting Storage Module to PC Retrieving Raw Data Files Pointers Erasing Data Files	
5.3	Repo	rt Component	24
	5.3.1 5.3.2	Introduction Hydro Station	

		5.3.2.1	General	
		5.3.2.2	Hourly Hydrograph	
		5.3.2.3	Summarized Daily Water Level Information	
		5.3.2.1	Hydro Station Performance Information	
	5.3.3	Met Sta	ation	
		5.3.3.1 5.3.3.2 5.3.3.3 5.3.3.4 5.3.3.5	General Hyetograph Summarized Hourly Meteorological Information Summarized Daily Meteorological Information Met Station Performance Information	
6	Proc	essing	in MS Access and Final Storage in the LVBD	40
6.1	Gene	ral		40
6.2	MS A	ccess D	atabase "LVBD_FinalProcessing"	41
6.3	Impo	rting AS	SCII Files Generated by Report into MS Access	42
6.4	Trans	ferring	New Data Sets From Auxiliary to LVBD Format Table	49
6.5	Арре	nding th	ne Fully Processed New Data Sets to LVBD	52

# List of Figures

Figure 1:	Hardware Components Involved in Data Acquisition Process	9
Figure 2:	Software Components and File Formats Involved in	
	Data Acquisition Process	10
Figure 3:	Recommended Directory Structure for PC208W and Related 'Work' Files	14
Figure 4:	Recommended Directory Structure for MS Access Database Files	15
Figure 5:	Final Data Processing Steps in MS Access	40

# List of Tables

Table 1:	Comprehensive Data Trajectory	12
Table 2:	Various Files and their Function Used by Report in the	
	Processing of Hydro Data	24
Table 3:	Various Files and their Function Used by Report in the	
	Processing of Met Data	32
Table 4:	Database Objects and their Function in the MS Access	
	Database "LVBD_FinalProcessing"	41
Table 5:	Designated Input and Output Tables for each Pre-Defined Append Query	49
Table 6:	LVBD Destination Objects	54

# Annexes

- Annex 1: Consecutive Steps in Connecting Storage Module SM192 to PC.
- Annex 2: Consecutive Steps in Retrieving Raw Data Files form SM192 Storage Module to PC.
- Annex 3: Consecutive Steps in Processing Raw Data Files in Report.
- Annex 4: Consecutive Steps in Final Processing of Report Output Files in MS Access and Appending Fully Processed New Data Sets to LVBD.
- Annex 5: General Design of the Append Queries for Final Processing of the Report Output Files in MS
- Access.

Annex 6: Design of the ID Converter Table.

# Introduction

# 1.1 General

The Lake Victoria Monitoring Network comprises of Automatic Hydro-meteorological Stations equipped with electronic instruments for data acquisition and storage. Measurements are initially pre-processed and stored on site in a digital storage and control module, commonly referred to as datalogger.

Periodically, the accumulated raw data are transferred from datalogger to a computer at the office of the hydrometeorological service. This is accomplished with the help of a portable data retrieval unit, which can serve several stations during a single inspection tour. In order to enhance sustainability of the network, a visiting frequency of 1 month is proposed. Consequently, data should arrive at the office of the hydro-meteorological service with a delay of maximum one month.

After transfer of the collected hydro-meteorological information from retrieval unit to PC, the newly imported data should be processed, checked on consistency and possible measurement errors, and stored in a dedicated table in the Lake Victoria Basin Database (LVBD), regarded as their final destination.

The first segment of the data trajectory, i.e. transfer of measurements form logger to retrieval unit, is covered in two previously issued manuals:

- Manual for Installation, Operation and Maintenance of Automatic Water Level Recording Stations;
- Manual for Installation, Operation and Maintenance of Automatic Meteorological Stations.

The second part of the data track is dealt with in this manual. It covers in detail all steps involved in transferring the accumulated hydro-climatological measurements from the retrieval unit to final storage in the LVBD in MS Access. This includes:

- installation and setup of involved hardware components;
- transfer of raw data from retrieval unit to PC in a preliminary data and file format;
- separation of individual parameters from preliminary data file to comma separated ASCII file, and first, visual data quality check;
- import of pre-processed ASCII file into MS Access;
- rearrangement of newly imported data to final table structure using pre-defined queries, as well as a second, computer operated quality check;
- appending new data to LVDB.

This manual deals with data originating from both Automatic Weather Stations (AWS) and Automatic Water Level Recording Stations (AWLRS). Since a substantial number of steps in the data trajectory apply identically to both type of stations, no separate paragraphs for hydrometric and meteorologic information have been included for the majority of processing actions. Only when the required operations for AWS and AWLRS are significantly different, special station specific paragraphs have been prepared. The reader is requested to disregard the texts not applicable for his or her situation.

# 1.2 Overview of the Contents of the Manual

This manual describes in detail all steps and operations involved in transferring the accumulated raw data from retrieval unit to PC208W software on PC, processing the new information and subsequently storing it in the LVBD in MS Access.

In order to provide the user with the complete picture of the information flow from sensor to database, chapter 2 presents a detailed outline of the comprehensive data trajectory, as well as all software and hardware components involved, and their role.

Chapter 3 focuses on the instructions for installing the hardware and software components that remained to be set up.

A 'recommended directory structure' aimed at obtaining uniformity in the location of the concerned files on hard drive is discussed in chapter 4.

Chapter 5 deals in detail with retrieving the raw data from the storage module to PC, and the initial processing of this new information to a comma separated ASCII format, separated per parameter.

Finally, chapter 6 presents the instructions for importing the pre-processed new data set into MS Access, performing a final processing round, and storing the data values into their final destination in the LVBD.

#### 1.3 Manual Version

The current manual represents version 1.1. Since the project aims at preparing a set of automated modules for performing a number of the steps discussed in this manual, it is expected that updated, amended and extended editions will be issued in the future.

# Detailed Outline of Data Trajectory

# 2.1 General

This chapter gives an overview of the complete track a measurement value has to go from sensor to final storage in the Lake Victoria Basin Database (LVBD). It presents the various hardware and software components involved in this process, together with their interconnection. Furthermore, it lists sequentially all user actions that play a role in the data trajectory.

# 2.2 Hardware

Figure 1 presents all hardware components involved in the route from sensor to PC in the hydro-meteorological data acquisition process



Figure 1: Hardware components involved in data acquisition process.

The various hydro-climatological parameters are measured using electronic sensors. Depending on the nature of a parameter, its value is represented by either a voltage or a sum of pulses.

The datalogger measures the voltages and/or counts the pulses, and transfers them to intelligible figures in standard units, like for example degrees Celsius for temperature or mm of rainfall for precipitation. Other tasks of the datalogger are to activate the various sensors at pre-defined intervals, and store the measurements in its memory.

The CR10KD keyboard display is used to communicate with the datalogger on site. For instance, in case the user wants to invoke manual data transfer this is accomplished by connecting the CR10KD to storage module and logger, and typing in the proper commands.

The SM192 storage module is used to transfer the accumulated raw data from datalogger on site to Personal

Computer at the office. It uses of a specific storage format which can not be read by normal PCs.

The role of the SC532 Interface is to convert this specific storage module format into a RS232 compatible one. The latter is part of the communication standard for IBM compatible PCs.

Data processing, rearrangement and final storage in the LVBD is accomplished on PC.

## 2.3 Software

Figure 2 presents the various software packages and programs, as well as the concerned file formats, playing a role in the data acquisition, processing and storage process.



Figure 2: Software components and file formats involved in data acquisition process.

The datalogger works under a specific Campbell Scientific operating system and is controlled by either the METSTAT or HYDROSTN datalogger program, for meteorological and hydrometrical stations respectively. These programs are specifically created by GCP/RAF/304/JPN for the sensor configuration and data requirements in the Lake Victoria Monitoring Network. Once they work satisfactorily (as they have proved to do after extensive testing at the Project Office), the two programs require no further user intervention.

As indicated in paragraph 2.2, data is transferred from datalogger to PC with help of the SM192 storage module. This module uses a specific Campbell Scientific data format, which is extremely condensed in order to make optimal use of its memory.

The next steps are performed in PC208W Datalogger Support Software. This concerns a package developed by

Campbell Scientific for communication between datalogger and PC. It consists of 8 modules of which only two are directly needed in the data trajectory.

The StgModule component retrieves files from the SM192 Storage Module. All data is kept in the same structure and sequence as in the datalogger. The entire contents of each single SM192 file is stored in a corresponding ASCII file on PC.

The Report component, often referred to as Split, is used to restructure and separate these ASCII files according to the required file/table structure of the user, transfer the Julian dates to months and days, and store the result in a comma separated ASCII file. The latter format is preferred to import external data into MS Access.

Final data processing is accomplished in MS Access in a number of pre-defined tables and queries. Lastly, the measurements are appended to the appropriate tables in the MS Access based Lake Victoria Basin Database.

## 2.4 Comprehensive Data Trajectory

In order to arrive at a complete understanding of the interconnections between the various hardware and software elements that play a role in the data flow, table 1 presents a comprehensive overview of the entire data route, from initial measurement to final dissemination. It shows the place and function of the respective hardware and software items, and their interrelation. It furthermore lists in a sequential order all necessary user actions.

Not all steps described in table 1 are covered in this manual. They have been presented for the sake of completeness and to come to full insight in the whole data trajectory. Issues treated elsewhere include step 1 and 2, which are covered by the operation manuals for both AWS and AWLRS, and step 8 and 9, which will be dealt with in a future version of this manual or in a separate document.

Consequently, as already indicated in paragraph 1.1, the current version (1.1) of this manual covers in detail step 3 to 7.

Table	1:	Com	breher	nsive	Data	Traiectory	1
10000	•••	00111	0101101	10110	Data	majectory	

Step	Operation	Hardware Involved	Software Involved	User Action
1	<ul> <li>Periodic automatic measurement of hydro-meteorologic paremeters</li> <li>pre-processing and storage in the datalogger's RAM</li> </ul>	Sensors + Datalogger	<ul> <li>Campbell Scientific Datalogger Operating System (OS)</li> <li>METSTAT or HYDROSTN datalogger program</li> </ul>	None
2	Transfer of accumulated measurements from logger's RAM to portable SM192 Storage Module; each single transfer exercise results in a separate data file	Datalogger + SM192 Storage Module + CR10KD Keyboard Display	<ul> <li>Campbell Scientific Datalogger Operating System (0S)</li> <li>METSTAT or HYDROSTN datalogger program</li> </ul>	<ul> <li>Connect SM192 to datalogger</li> <li>Type in proper keyboard commands</li> <li>The user can choose between automatic or manually invoked data transfer</li> </ul>
3	Transfer of data files from SM192 Storage Module to PC	SM192 Storage Module + SC532 Interface + PC	Stg <u>M</u> odule component of PC208W datalogger support software	<ul> <li>Connect SM192 to SC532</li> <li>Activate Stg<u>M</u>odule Software</li> <li>Establish connection between PC and SM192</li> <li>Invoke data transfer</li> </ul>
4	Separating and/or rearranging individual hydro-meteorological parameters from a complete, original data file	PC	<u>Report (Split) component of</u> PC208W datalogger support software	<ul> <li>Activate <u>Report software</u></li> <li>Open a ppropriate pre-defined parameter file</li> <li>Select input data file</li> <li>Run Split</li> <li>First, visual data quality check</li> </ul>
5	Exporting separated/rearranged hydro- meteorological parameters to comma separated ASCII file	PC	<u>R</u> eport (Split) component of PC208W datalogger support software	<ul> <li>Activate <u>Report software</u></li> <li>Open appropriate pre-defined paremeter file</li> <li>Select input data file</li> <li>Select and define output data file</li> <li>Run Split</li> </ul>
6	<ul> <li>Importing comma separated ASCII file into MS Access and restructuring data to LVBD format</li> <li>Initial (automatic) quality control</li> </ul>	PC	MS Access (predefined tables and query)	<ul> <li>Activate MS Access</li> <li>Open appropriate database file</li> <li>Import ASCII file in predefined table</li> <li>Activate predefined query to restructure data format</li> </ul>
7	Final Storage in the LVBD	PC	MS Access (predefined tables, LVBD)	<ul> <li>Copy contents of above mentioned query results to the clip board</li> <li>Open appropriate LVBD file</li> <li>Open appropriate table</li> <li>Add data using paste -append</li> </ul>
8	Further quality control of newlyadded data	PC	MS Access (LVBD)	<ul> <li>Open appropriate LVBD file</li> <li>Open appropriate table</li> <li>Run pre-defined data-quality- control queries</li> </ul>
9	Back-up and data dissemination	PC + modem + telephone	Windows Explorer CD -Write software E -mail software	The various user actions involved in this step will be discussed and elaborated in a separate document.

# Hardware and Software Installation

#### 3.1 Installation of SC532 Interface

Provided a PC has already been set up successfully, only one hardware item remains to be installed: the SC532 Interface. The function of this device is to connect IBM compatible computers to certain Campbell Scientific peripherals, in this case the SM192 storage module, and convert their contents into RS232 format. The SC532 has a 9-pin connector for linkage with the storage module and uses a 25-pin slot to connect to PC. It is powered by an AC adapter.

Installation of the SC532 Interface is a straight forward process. Connect the SC532 to PC using the supplied '25 to 9' computer cable. The 9-pin end should be connected to the PC's serial port 1 or 2, while the 25-pin is to be plugged into the SC532.

Connect the 9-pin connector on the SC532 to the SM192 Storage Module using the blue, specific Campbell Scientific SC12 storage module cable. Since the SC532 Interface runs on 110V, use a 220 - 110 transformer between mains and the SC532 while in East Africa.

All hardware components are now installed. Make sure power is supplied to the SC532.

#### 3.2 Installation of PC208W Datalogger Support Software

PC208W Datalogger Support Software requires Windows 95 or higher. There needs to be at least 10Mb of free hard disk space for software installation.

Insert the PC208W floppy disk labeled 1/4 in drive A. In Windows 95, select RUN from the Start button. Type in A:\ SETUP and click the OK button. Follow the instructions given on the screen.

It is recommended to use the following Working Directory name: C:/CAMPBELL/PC208W.

# Recommended Directory Structure

## 4.1 General

For standardization and instruction purposes, this chapter proposes a Recommended Directory Structure. The user is free to modify this if another system would better suit his or her particular computer organization. However, the instructions presented in this manual are based on the proposed structure. Modification of it will require corresponding adjustment of commands concerning file locations.

## 4.2 PC208W Files

Figure 3 presents the Recommended Directory Structure for all files related to PC208W Datalogger Support Software. A subdivision has been made between the PC208W program files and the ones actually used in the data processing, the 'work' files.



Figure 3: Recommended Directory Structure for PC208W and related 'work' files..

The above proposition calls for the creation of a main folder called CAMPBELL on the C drive. This will consist of two sub-folders named FILES and PC208W. The datalogger support software PC208W should be installed in the latter one, see paragraph 3.2.

The FILES folder will be sub-divided into three parts: INPUT, OUTPUT and PARAMETER.

The INPUT sub-folder is destined for all data files retrieved from the SM192 storage module. By default these files are give a DAT extension.

The OUTPUT sub-folder is allocated for all processed, comma separated ASCII files, with TXT extension. They result from the separation and file restructuring exercise in Report (a.k.a. Split).

The PARAMETR sub-folder will be used to store all predefined Split files, having a PAR extension.

Use of the above mentioned files is discussed in chapter 5. The proposed structure is again illustrated in the following Windows Explorer screen.



For the creation of the various folders, use the appropriate Windows Explorer commands.

#### 4.3 MS Access Database Files

Figure 4 presents the Recommended Directory Structure for storage of all data files in MS Access format .



Figure 4: Recommended Directory Structure for all data MS Access database files.

It has proofed beneficial to comply to the MS DOS file naming convention when dealing with database files. It is for this reason that directory names are limited to 8 characters.

It is proposed to create a main database folder called MYDBASE on the C drive. This will consists of two sub-folders called LVBD and PRE\_LVBD. The former will be used to store the Lake Victoria Basin Database files, while the latter is destined to contain the files imported from PC208W for final processing in MS Access, prior to being appended to the appropriate LVBD data tables.

For the creation of the proposed directory structure, use the appropriate Windows Explorer commands. Once more, the structure is illustrated in the below screen.



# PC208W Datalogger Support Software

#### 5.1 Introduction

PC208W Datalogger Support Software is a Windows based software package specifically developed by Campbell Scientific for communication between datalogger and PC. It consists of a help module and 7 independent datalogger support components. Among them software for setting up a network of PC connected stations, and on-line datalogger communication; modules which will not be used in this particular Lake Victoria application.

Smooth flow of data from datalogger to Lake Victoria Basin Database is accomplished with the help of the following two PC208W units: StgModule and Report. The first serves to transfer raw data files from storage module to PC, while the second is used to separate the various hydrometeorological parameters and re-arrange the data structure. Both modules will be discussed in the below presented paragraphs.

The coming text does, however, not cover all aspects of the two employed PC208W components. Only the subjects which are considered useful in the data down-loading process are discussed. The user is referred to the respective Campbell Scientific Instruction Manuals, as well as the on-line help, in case of need of more information.

# 5.2 StgModule Component

#### 5.2.1 Introduction

On-line information flow from datalogger to PC is not yet feasible in the East African environment due to the unavailability of telephone connections at station site. Instead, the project has opted for the portable SM192 Storage Module to transfer the accumulated raw data from the logger's RAM to personal computer. This storage device can contain up to almost 100,000 data values as well as a maximum of 8 datalogger programs. Communication between storage module and PC is enabled through the StgModule software, discussed in this paragraph.

#### 5.2.2 Connecting Storage Module to PC

IThis paragraph presents the instructions for establishing communication between SM192 and PC.

Step A1: Connect the SM192 Storage Module to the SC532 Interface using the blue SC12 cable. Step A2: Make sure the SC532 Interface is powered.

Step A3: Double click the PC208W Datalogger Support Software Icon, presented below.



The following toolbar appears:

5 PC208W	2.2 - Datalo	gger Support	Software				_ 🗆 ×
T	<b>8</b> 7 <b>-</b>	12⊙	<b>****</b>	REPORT	<b>A</b>	3	<u> </u>
<u>S</u> etup	<u>C</u> onnect	S <u>t</u> atus	<u>P</u> rogram	<u>R</u> eport	⊻iew	Stg <u>M</u> odule	<u>H</u> elp

Step A4: Click the StgModule tab. A window alike the one presented below shows up.

The menu-bar contains four different items: File, Options, Data and Help. Just beneath this line 3 different tabs

are found, named CSM1/MCR1, SM192/SM716 and PCCard, each dealing with a different storage medium. Since the Lake Victoria Monitoring Network is equipped with the SM192 unit, click the SM192/SM716 tab at the top-mid of the screen to activate its specific communication software. Disregard the other two tabs.

Step A5: Click the SM192/SM716 tab at the top-mid of the SMS window.

The resulting window is divided into two halves: a status box on the right and a task specific sub- screen on the left.

CSM1/MCR1	SM192/SM716	PC Card
Programs Program Status Prog 1 Prog 2 Prog 3 Prog 4 Prog 5 Prog 6 Prog 7 Prog 8	StatusBox Module Pointers Free Space Storage Ref. Po Display Pointer DumpPointer Module Values- Good RAM Chip Battery Error Count Programs	B binter
Clear Store Read	Status Advanced	/ Update Status 🖉 Abort

At the bottom-left of the latter, four different tabs are found: Setup, Programs, Data and Erase.

Step A6: Click the tab labeled 'Setup' to select the appropriate communication settings. The below screen appears.

COM Port Setup Port COM1 COM2 COM3 COM4 Via Datalogger Target Address G1 G3 G5 G7 C2 C4 C6 C8	StatusBox       Module Pointers       Free Space       Storage Ref. Pointer       Display Pointer       DumpPointer       Module Values       Good RAM Chips       Battery       Error Count       Programs       Switch Settings
Setup (Programs (Data (Erase /	Connect Update Status 🖉 Abort

Step A7: Select the COM Port settings corresponding to the serial port used by the "9 to 25" computer cable connecting the SC532 Interface (see paragraph 3.1). In most cases this will be either COM1 or COM2.

Step A8: Set Baud Rate at 19200. This is a measure of the communication speed between PC and Storage Module. In case frequent communication problems are experienced, lower the Baud Rate and see if this solves the problem.

Step A9: Click the "Connect" button to connect SM192 to PC.

If communication is successfully established, a window similar to the one below appears. Note that the status box is no longer empty and is now containing information on the module's memory.

CSM1/MCR1 COM Port Setup Port COM1 COM2 COM2 19200	SM192/SM716     PC Card       StatusBox     Module Pointers       Free Space     87547       Storage Ref. Pointer     8886       Display Pointer     8886       DumpPointer     2       Module Values     6
Target Address ©1 O3 O5 O7 C2 O4 C6 O8	Battery OK Error Count D Programs 1 Switch Settings 76800/9600 Baud Ring Mode ASCII mode Address 1
\Setup/Programs/Data/Erase/	Disconnect Update Status Ø Abort

PC and Storage Module are now connected. The user can proceed with retrieving data files or other SM192 related operations.

For ease of reference, the above presented steps are listed in Annex 1.

#### 5.2.3 Retrieving Raw Data Files

This paragraph presents the user instructions for retrieving raw data files from the SM192 Storage Module and storing them at a desired location on the PC's hard drive.

Step B1: Connect SM192 to PC and establish communication. See instructions in paragraph 5.2.2.

Step B2: Click the "Data" tab at the bottom-left. The below window appears.

Note that switching between the various task-specific sub screens (Setup, Programs, Data and Erase) has no influence on the contents of the Status Box.

Step B3: Mark the "Comma separated" option in the File Format select box. Import of comma separated ASCII files into MS Access has proven to be flawless and trouble free.

CSM1/MCR1	SM192/SM716 PC Card
File Format © <u>C</u> omma separated © <u>A</u> SCII with Array ID's © As <u>S</u> tored	StatusBox Module Pointers Free Space 87547 Storage Ref. Pointer 8886 Display Pointer 8886 DumpPointer 2
Auto Name Control  Auto Increment Name  Append to Current File  Name File	Module ValuesGood RAM Chips6BatteryOKError Count0Programs1
Show Module Directory	Switch Settings 76800/9600 Baud Ring Mode ASCII mode Address 1
Get <u>A</u> ll Get <u>N</u> ew Get <u>O</u> ne	Status/Advanced/
etup (Programs) Data (Erase /	Disconnect Update Status      Abo

Step B4: Mark the "Auto Increment Name" option in the Auto Name Control select box. Each retrieved data file will get a name according to the format "DATAXXX.DAT" in which XXX is a number which automatically increments when a new file is down loaded.

Step B5: Click the file name in the File Naming Options location (in the current example this is DATA024.DAT). A box similar to Windows Explorer appears which allows the user to navigate to the location where he or she wants to store the retrieved data files. See the window below.

CSM1/MCR1	SM192/SM716	PC Card
File Format © <u>C</u> omma separated © <u>A</u> SCII with Array ID's © As <u>S</u> tored File Naming Options DATA024.DAT	StatusBox Module Pointers Free Space Storage Ref. Pointer Display Pointer DumpPointer Module Values	87547 8886 8886 2
Auto Name Con       Next Datafile Name         Auto Increme       Append to Cu         New Name fo       Gata024.dat         Show Module Dii       data001.dat         Get All       Get         Setup (Programs) Data       Save file as type:	Eolders: c:\campbell\files\i C:\ campbell c:\ campbell c:\ campbell ciles ci	? × OK Cancel N <u>e</u> twork ■ <u>R</u> ead only

If the user has opted for the Recommended Directory Structure (see paragraph 4.2), data files captured from the SM192 should be stored in the following folder:

#### C:\CAMPBELL\FILES\INPUT

Step B6: Click the "Get New" button. This option collects all "new" data files from the SM192, i.e. all files not yet retrieved in a previous down load operation. Each single SM192 data file is stored in an individual DAT file on the hard drive.

For ease of reference, the above presented steps are listed in Annex 2.

#### 5.2.4 Pointers

The Module Pointers area of the Status Box lists four different parameters, i.e. Free Space, Storage Ref. Pointer, Display Pointer and Dump Pointer. Each of which is briefly discussed below:

Free Space:	As implicated by its name, Free Space concerns the number of free data locations in the
	SM192.
Storage Ref. Pointer:	The Storage Reference Pointer (SRP) points to the SM192 location where the next data

Storage Ref. Pointer: The Storage Reference Pointer (SRP) points to the SM192 location where the next data value will be written.

Display Pointer: The Display Pointer points to the location which holds the first value which will be output in response to the 'Get One' or 'Get New' data button in the Data Control Section of the software.

The pointer can be set to any desired location by using the Display Pointer position box in the Advanced section of the data control status box, either by typing in the required loca tion or clicking on the green arrow to move the pointer to successive filemarks.

This option is used to re-down load data from the SM192 which has already been retrieved in a previous operation. This can be useful in case of data loss.

Dump Pointer: The Dump Pointer is an internal pointer used for keeping track of the current 'start-ofdump' for module to module data dumps. It indicates the first location from where new data should be collected. It is a function of the software to move this pointer after each successful data collection.

Especially the Display Pointer is useful if data is lost or corrupted during processing on PC. By manually setting back the Display Pointer (see above and the on-line help for the appropriate instructions), data files can be re-retrieved and re-processed, provided they still exist on the SM192 Storage Module.

#### 5.2.5 Erasing Data Files

The user can decide to erase the information stored on the SM192. This applies both to data files and datalogger programs. However, since the storage module is put by default in ring mode, there is no need to erase data at any time. The moment the module is full, it starts overwriting the eldest information in the unit with new one, in this way never restricting 'new' information to be recorded.

If the user would decide that periodic cleaning of the storage module serves his or her purposes, for example to avoid confusion between two different field visits, the below text presents instructions how to do this.

To activate the Erase Control screen, click the "Erase" tab at the bottom-left of the SMS Window. The below presented screen will appear.

CSM1/MCR1	SM192/SM716 PC Card
Erase Data This option restores programs after erasing data and programs.	StatusBox Module Pointers Free Space 87547 Storage Ref. Pointer 8886 Display Pointer 8886 DumpPointer 7718
Erase Data and Programs This option erases all data and programs.	Module Values Good RAM Chips 6 Battery OK Error Count 0 Programs 1
Erase and Test Module This option erases and tests the Module, and takes some time.	Switch Settings 76800/9600 Baud Ring Mode ASCII mode Address 1
etup (Programs (Data) Erase/	Obsconnect Update Status Ø Abor

The Erase Control box contains three different options, each having self-explanatory names. Since it is advised to leave an uncorrupted version of the applicable datalogger program at all times in program location 8 of the storage module, the recommended option is number 1: Erase Data. No further user interactions are required.

# 5.3 Report Component

#### 5.3.1 Introduction

The Report module, often referred to as Split, is used to separate individual hydro-meteorological parameters from the raw data file and put them into a format used in the various 'target' databases. It essentially performs the following operation: it reads an input file, splits and re-arranges it using a predefined parameter file, and stores the result in an output file.

Since the raw data files for hydro and meteorological stations are significantly different, user instructions for the two stations are discussed in separate paragraphs.

#### 5.3.2 Hydro Station

#### 5.3.2.1 General

As its essential activity, the Hydro Station is programmed to measure water level at a 15 minutes interval. In addition to this, it monitors two station performance indicators on a daily basis: program signature and battery voltage. The HYDROSTN datalogger program transfer these measurements into three different information products, i.e.:

- hydrograph with a time step of 1 hour;
- summary information on a daily basis including average, maximum and minimum water level, as well as standard deviation of the 15 minutes measurements with respect to the daily average; the latter as a measure of the daily fluctuation;
- station performance information on a daily basis: as an indicator of the functioning of datalogger and power unit.

Due to the logger's memory configuration, all three information items are written to the same storage area in the datalogger's RAM in the order of their time of recording, and consequently retrieved as a single, rather unorganized data file, through the SM192, on PC. The function of the Report module is now to separate and re-arrange the scattered recordings into consistent individual data blocks per information product, that can be appended to the existing databases without too much further processing.

Report performs this operation using so called parameter files. Each information product is generated from the single raw data file with a specific pre-defined parameter file, and stored into an individual output file on the hard drive. At the same time the output data is presented on screen for a first visual quality check.

Table 2: Various	files and their funct	ion used by Report in the processing of Hydro Station recordings.	
Input File	Parameter File	Function	Output File
data0XX.dat	hydrohr.par	to extract hourly hydrograph information from data file	hydhrXX.txt
data0XX.dat	hydroday.par	to extract daily summary water level information from data file	hyddayXX.txt
data0XX.dat	hydroprf.par	to extract station performance information from data file	not applicable

Each of these three data products is dealt with more in detail in the next three sub paragraphs.

#### 5.3.2.2 Hourly Hydrograph

The following text describes the procedures for composing a hydrograph with a time step of one hour from a raw data file, and storing the result in an output file in proper format for final processing.

Step C1 Activate Report by clicking the Report tab on the PC208W toolbar. The below screen appears.

Input File(s)	<u>[</u>	<u>)</u> utput File			
Input Data File		File Info			
Browse		Auto Dete	ct	■ Offs	ets
Start Condition					
					- -
Stop Condition					<b></b>
					7
					A
Select					
					*
					-
.1					

Step C2: Choose Open from the File menu to activate a pre-defined parameter file, as indicated in the following window.

Edit Labels <u>R</u> un <u>H</u> elp Nam			
<u>N</u> ew Open	it File		
Save			
– Save <u>A</u> s	Eile Info		
E <u>x</u> it	Auto Detect	•	Offsets
1 C:\CAMPBELL\FILES\PARAMETR\HYDROHR.PAR			
2 C:\CAMPBELL\FILES\PARAMETR\HYDRODAY.PAR			A
3 C:\CAMPBELL\FILES\PARAMETR\HYDROPRF.PAR			
			A
			<b>T</b>
Copy			
			×
Select			
			<b>A</b>
			<b></b>
J./			

Step C3: Navigate to the location on hard drive which contains the parameter files. This is "C:\CAMPBELL\FILES\ PARAMETR" if the Recommended Directory Structure is used. Highlight the file "hydrohr.par", as shown on the window below. Click OK.

Split Version 1.2 <u>File Edit Labels Run H</u> elp Input File(s) Qut	put File
Input Data File       Open         Browse       File name:         Start Condition       hydrohr.par         Stop Condition       hydrohr.par         Stop Condition       hydrohr.par         Copy       methour.par         Select       List files of type:         Parameter Files       v	Folders:   c:\campbell\files\parametr   G:\   C:\   Cancel   Cancel   Metwork
Line Clears all settings for a new Parameter file. Prompts to save curre	nt file.

The title bar on the Split window now indicates the name of the open parameter file.

Step C4: Activate the Input File(s) sub-window and select the Input Data File. To this end click "Browse" in the Input Data File box and navigate to the location on hard disk which contains the data files. This is pictured in the following screen. Highlight the appropriate file and click OK.

ile <u>E</u> dit <u>L</u> abels <u>R</u> un <u>H</u> elp	,			
I <u>n</u> put File(s)	<u>D</u> utj	out File		
Input Data File Browse C:\CAMPBELL\F	ILES\INPUT\DATA	File Info Auto Detect		Offsets
State Condition     Select Input       Stop Condition     File name:       Stop Condition     data015.d       Copy     data001.d       1[400]     data007.d       Select     data015.d       2,3,Edate(4;3),5,6     data017.d	File	Eolders: c:\campbell\file: c:\ c:\ c:\ c: c: c: c: c: c: c: c: c: c: c: c: c:	s\input	OK Cancel N <u>e</u> twork
List files of Data files	type: (*.DAT)	Dri <u>v</u> es:	•	

Step C5: Switch to the Output File sub-window by clicking its tab at the top-mid of the current Split screen. The below window pops up.

l <u>n</u> pi	ut File(s)	ĭ	<u>O</u> utpul	t File	]		
Output Data File Browse	C:\CAMPBE	LL\FIL	File Format	Dlumn Widths	Report C Fil C Pri C No	e	Other
Report and Colu	ımn Headings						
Report Headin	ig WLF	R-Station: Hydro	graph				
Column#	1	2	3	4	5	6	7
Element/Field#	2	3	Edate(4;3)	5	6		
Filename	DATA015.DAT	DATA015.DAT	DATA015.DAT	DATA015.DAT	DATA015.DAT		
Line 1	Stn-ID	Year	Date	Time	avg-H		
Line 2	[-]	[-]	[DDMM]	[hhmm]	[cm]		
Line 3							
Decimal							
							2
							1
Time Series Hea	ading L				Inse	rt Delete	

Step C6: Select location for, and give a name to, the resulting Output file. To this end click "Browse" in the Output Data box. Navigate to the desired folder on the hard drive and type in an output file name according to the following convention:

#### hydhrXX.txt

in which XX is the serial number of the input data file. For instance "hydhr15.txt" when originating from "data015. dat". Click OK. This process is presented in the below window.

Dutput Data File Brows Screen I Report and Report He	File <u>n</u> ame hydhr15.t	: xt	Folder c:\car c:\car c: c:\car c: car car car car car car car car car car	Eolders: c:\campbell\files\output			Other
Element/Fie	List files o	of <u>t</u> ype:	Dri <u>v</u> es	:			
Filename	Output fi	es (*.PRN)	■ □ c	: micron	•		
Line 1 -	зини	теа	Date	rine	avy-n		
Line 2	[•]	[-]	[DDMM]	[hhmm]	[cm]		
Line 3							
Decimal							
•	_						

Step C7: Finalize the routine by selecting Go from the Run menu. The results, as presented on screen, are shown below.

[-]	[-]	[DDMM]	[hhmm]	avg-n [cm]			
12	1998	28	1300	182.6		 	
12	1998	28	1400	188.6			
12	1998	28	1500	190.3			
12	1998	28	1600	195.5			
12	1998	28	1700	196.7			
12	1998	28	1800	198.1			
12	1998	28	1900	198.4			
12	1998	28	2000	199.1			
12	1998	28	2100	198.2			
12	1998	28	2200	198			
12	1998	28	2300	197.9			
12	1998	28	2400	197.7			
12	1998	38	100	197.2			
12	1998	38	200	196.9			
12	1998	38	300	196.5			
12	1998	38	400	195.5			
12	1998	38	500	192.3			
ading fi	les com	pleted.					

For every hour, the following information is generated: Station-ID, Year, Date, Time and Average 1-Hour Water Level in cm. The first four items of this list uniquely identify each output array.

The associated output file is in comma separated ASCII format. This is shown below for the output file corresponding to the above screen: file "hydhr15.txt".

📕 Hydhr15.txt - Notepad	
<u>File E</u> dit <u>S</u> earch <u>H</u> elp	
12,1998,2 8,100,103.7	<u> </u>
12,1998,2 8,200,103.2	
12,1998,2 8,300,103.4	
12,1998,2 8,400,103.5	
12,1998,2 8,500,103.2	
12,1998,2 8,600,113.7	
12,1998,2 8,700,128.3	
12,1998,2 8,1200,175.9	
12,1998,2 8,1300,182.0	
12,1998,2 8,1400,188.0	
12,1998,2 8,1500,190.3	
12,1990,2 0,1000,195.5	
12,1770,2 0,1700,170.7	
12,1770,2 0,1000,170.1	
12 1008 2 8 2000 100 1	
12,1998-2 8,2100,198-2	
12,1998,2 8,2288,198	
	-1
र	E 🖉

This concludes the user activities in Report with respect to the hourly hydrograph information.

For ease of reference, the above presented steps are listed in Annex 3.

#### 5.3.2.3 Summarized Daily Water Level Information

Compilation of summarized daily water level information is a similar process as the one described in the previous paragraph. The reader is referred to this text, and Annex 3, for detailed instructions on steps 1 to 5. In this case the parameter file "hydroday.par" should be used.

Steps 6 and 7 are discussed more in detail in the remaining part of this paragraph, although also these steps are essentially analog to the ones discussed in paragraph 5.3.2.2.

Step C1-5: Perform the same actions as presented in the previous paragraph. Use parameter file "hydroday. par".

Step C6: Select location for, and give a name to, the resulting Output file. To this end click "Browse" in the Output Data box. Navigate to the desired folder on the hard drive and type in an output file name according to the following convention:

#### hyddayXX.txt

in which XX is the serial number of the input data file. For instance "hydday15.txt" when originating from "data015. dat". Click OK. This process is presented in the below window.

Output Data File Browse	C:\CAN	riie <u>n</u> ame: hydday15.txt	×	Folders: c:\campb arc:\ arc:\ arcan	ell\files\outpi pbell s iput	ut	OK Cancel <u>e</u> twork
Report Head Column# Element/Field	ding [ 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	.ist files of <u>typ</u> Output files (*	e: .PRN) 💌	Dri <u>v</u> es:	cron	•	
Filename	DATA015.DA		IIDATA015.DAI	DATA015.DAT	DATA015.DAT	DATAUT5.DA	пратають.
Line 1	Stn-ID	Year	Day	avg-H	max-H	min-H	std-H
Line 2 Line 3	[·]	[-]	[DDMM]	[cm]	[cm]	[cm]	[cm]
Time Series H	eading				Inse	ert Delet	e Add

Step C7: Finalize the routine by selecting Go from the Run menu. The results, as presented on screen, are analogue to the window below.

[-]	[-]	Date [DDMM]	avg-H [cm]	max-H [cm]	min-H [cm]	std-H [cm]	
12	1998	28	161.9	199.1	103.2	24.6	 
12	1998	38	154.2	197.2	124.6	21.3	
12	1998	48	119.6	124.8	103.9	11.6	
12	1998	58	102.6	110.6	99.6	15.7	
12	1998	68	101.7	115.9	95.2	19.6	
12	1998	78	105.2	114.2	100.9	18.2	
12	1998	88	103.2	110.8	100.5	12.5	
ading fi	iles com	pleted.					

For every day the Hydro Station has been operational, the following information is generated: Station-ID, Year, Date, Average Daily Water Level, Maximum and Minimum Daily Water Level, and lastly the Daily Standard Deviation of the 15 minutes Water Level Recordings.

The three first parameters make sure that each array is uniquely identified.

The associated output file is in comma separated ASCII format. This is shown below for the output file corresponding to the above screen: "hydday15.txt".

hydday15.txt - Notepad	
jile <u>E</u> dit <u>S</u> earch <u>H</u> elp	
2,1998,2 8,161.9,199.1,103.2,24.6	A
2,1998,3 8,154.2,197.2,124.6,21.3	
2,1998,4 8,119.6,124.8,103.9,11.6	
2,1998,5 8,102.6,110.6,99.6,15.7	
2,1998,6 8,101.7,115.9,95.2,19.6	
2,1998,7 8,105.2,114.2,100.9,18.2	
2,1998,8 8,103.2,110.8,100.5,12.5	

This concludes the user activities in Report with respect to the Summarized Daily Water Level information.

#### 5.3.2.4 Hydro Station Performance Information

It is up to the user to decide whether or not to archive datalogger performance information of the various Hydro Stations. Although this information can be used to, for example, analyze station power consumption in the past, there seems to be little reason to keep this data if the station has proved to work satisfactorily during a previous recording period.

It is for this reason that the Project has decided not to make any provisions (i.e. pre-defined tables and/or queries) for storing station specific datalogger performance information in an MS Access database.

If the user considers it beneficial for the operation of his/her office to archive the concerned performance indicators, he or she is invited to create an appropriate database for this purpose.

#### 5.3.3 Met Station

#### 5.3.3.1 General

The Automatic Meteorological Stations are equipped with 6 sensors for monitoring a selected set of climatological parameters at a five minutes interval. At the same time the system periodically records two performance indicators: battery voltage and program signature.

The METSTAT datalogger program transfers these measurements into four different information groups, i.e.:

- hyetograph with a 5 minutes time step;
- summary meteorological information on an hourly basis, including average hourly values for air temperature, relative humidity, wind speed and direction, as well as cumulative one-hour solar radiation;
- summary meteorological information on a daily basis, including average, maximum and minimum air temperature; average daily values for relative humidity, wind speed and direction; as well as cumulative oneday rainfall and solar radiation;
- station performance information on a daily basis as an indicator of the functioning of datalogger and power supply.

Due to the logger's memory configuration, all four information products are written to the same storage area in the system's RAM in the order of their time of recording, and consequently retrieved as one single, rather unorganized data file, through SM192, on PC. The role of the Report module is now to separate and reorganize the scattered recordings into consistent individual data blocks per information product.

Report performs this task using so called parameter files. Each of the four information products is extracted from the single data file using a pre-defined dedicated parameter file and stored into an individual output file on the hard drive. At the same time the output data is presented on screen for a first visual quality check.

Table 3 presents the various files involved. XX stands for the data file's serial number.

Table 3: Various	files and their funct	ion used by Report in the processing of Met Station recordings.	
Input File	Parameter File	Function	Output File
data0XX.dat	metrain.par	to extract (5 minutes) hyetograph information from data file to	metrnXX.
data0XX.dat	methour.par	extract 1 hour summary information from data file	txtmethrXX.
data0XX.dat	metday.par	to extract 1 day summary information from data file	txtmetdayXX.
data0XX.dat	metperf.par	to extract station performance information from data file	txtmetprfXX.txt

Each of the four above identified information products is dealt with more in detail in the next four sub paragraphs.

#### 5.3.3.2 Hyetograph

Only in case of a rainfall event, a cumulative 5 minutes rainfall value is written to the logger's RAM at the end of the interval. In contrast, when the rain gage is not measuring precipitation, the data values (thus zeros) are not recorded. Consequently, the hyetograph information product consists of a single time series of total 5 minutes precipitation in which each storm immediately follows a previous one. Gaps in the recorded time series indicate dry periods.

Compilation of hyetograph information is a similar process as the one described in paragraph 5.3.2.2. The reader is referred to this text, and Annex 3, for detailed instructions on steps 1 to 5. In this case the parameter file "metrain. par" should be used.

Steps 6 and 7 are discussed more in detail in the remaining part of this paragraph, although also these steps are essentially analog to the ones discussed in paragraph 5.3.2.2.

Step C1-5: Perform the same actions as presented in the previous paragraph. Use parameter file "metrain.par".

Step C6:In the File name text box of the Select Output File sub-screen, type in the name of the output file. Apply the following naming format:

#### metrnXX.txt

in which XX is the serial number of the input data file. For instance "metrn16.txt" if originating from "data016.dat". Click OK. This process is presented in the below window.

Inp Output Data File Browse Screen Disp Report and Colu Report Headir	ut File(s) F	ile <u>n</u> ame: netrn16.txt	×	Eolders: c:\campl c:\ can can can file can	bell\files\outpu npbell 's Itput		OK Cancel I <u>e</u> twork
Column#		ist files of <u>t</u> yp Dutput files (*	e: .PRN) 🔻	Dri <u>v</u> es:	icron	-	
Element/Field#	2			,			
Filename	DATA016.DAT	DATA016.DAT	DATA016.DAT	DATA016.DAT	DATA016.DAT		
Line 1	Stn_ID	Year	Date	Time	Rain		
Line 2			[DDMM]	[HHMM]	[mm]		
Line 3							
Decimal							
Time Series He	ading				Insert	Delete	e Add

Step C7: Finalize the routine by selecting Go from the Run menu. The results, as presented on screen, are similar to the window below.

Stn_ID	Year	Date [DDMM]	Time [HHMM]	Rain [mm]		
12	1998	17 6	1425	.2		
12	1998	17 6	1430	1.1		
12	1998	17 6	1435	2.5		
12	1998	17 6	1440	1.3		
12	1998	17 6	1445	.8		
12	1998	17 6	1450	.6		
12	1998	17 6	1455	.5		
12	1998	17 6	1500	.7		
12	1998	17 6	1505	.5		
12	1998	17 6	1510	1.5		
12	1998	17 6	1515	.3		
12	1998	17 6	1520	.2		
12	1998	17 6	1525	.1		
12	1998	17 6	1530	.1		
12	1998	17 6	1535	.1		
12	1998	17 6	1540	.1		
12	1998	17 6	1545	.1		
ading file	es comple	eted.				
es Read	142	7				

For every five minutes interval for which rainfall is recorded, the following information is generated: station-ID, year, date and time, and cumulative five minutes rainfall.

The first four parameters guarantee that each array is uniquely identified.

The associated output file is in comma separated ASCII format. This is shown below for the output file corresponding to the above screen: "metrn16.txt".

📕 metrn16.txt - Notepad	_ 🗆 ×
<u>File E</u> dit <u>S</u> earch <u>H</u> elp	
12,1998,15 6,925,.1	
12,1998,17 6,1410,.6	
12,1998,17 6,1415,.6	
12,1998,17 6,1420,.5	
12,1998,17 6,1425,.2	
12,1998,17 6,1430,1.1	
12,1998,17 6,1435,2.5	
12,1998,17 6,1440,1.3	
12,1998,17 6,1445,.8	
12,1998,17 0,1515,.3	
12,1998,17 0,1520,.2	
12,1998,17 0,1525,.1	
12,1998,17 0,1238,1	
12,1990,17 0,1202,.1	
12,1990,17 0,1240,.1	
12,1770,17 0,1242,.1	
	-
1	

This concludes the user activities in Report with respect to the Hyetograph information product.on in which each storm immediately follows a previous one. Gaps in the recorded time series indicate dry periods.

#### 5.3.3.3 Summarized Hourly Meteorological Information

Compilation of hourly meteorological information is a similar process as the one described in paragraph 5.3.2.2. The reader is referred to this text, and Annex 3, for detailed instructions on steps 1 to 5. In this case the parameter file "methour.par" should be used.

Steps 6 and 7 are discussed more in detail in the remaining part of this paragraph, although also these steps are essentially analog to the ones discussed in paragraph 5.3.2.2.

Step C1-5: Perform the same actions as presented in the previous paragraph. Use parameter file "methour.par".

Step C6: In the File name text box of the Select Output File sub-screen, type in the name of the output file. Apply the following naming format:

methrXX.txt, in which XX is the serial number of the input data file. For instance "methr16.txt" if originating from "data016.dat". Click OK. This process is presented in the below window.

Dutput Data File Browse ✓ Screen D Report and C Report Hea	isplay Column Head	File <u>n</u> ame: methr16.txt		Eolders: c:\campbe a c:\ a camp a files a outp	ell\files\out bell out	put	OK Cancel
Column# Element/Fie	1	List files of tv	De:	Drives:			
Filename	DATA01	Output files	*.PRN) 🔻	C: mic	ron	<b>•</b>	
Line 1	Stn-ID						
Line 2			[MMDD]	[HHMM]	[C]	[kPa]	[kPa]
Line 3							
Decimal							Þ
Decimal							

Step C7: Complete the routine by selecting Go from the Run menu. The results, as presented on screen, are similar to the window below.

m-ID	Year	Date [MMDD]	Time [HHMM]	Avg-Tmp [C]	Avg-VP [kPa]	Avg-VPD [kPa]	Tot_Sol [MJ/M2]	Avg_Wsp [M/S]	
12	1998	6 16	2200	22.55	1.938	.795	0	.872	
12	1998	6 16	2300	22.53	1.925	.805	0	.804	
12	1998	6 16	2400	22.22	1.949	.73	0	.57	
12	1998	6 17	100	22.21	1.933	.744	0	.711	
12	1998	6 17	200	22.66	1.973	.778	0	.597	
12	1998	6 17	300	23.67	2.029	.895	0	.913	
12	1998	6 17	400	23.82	2.124	.828	0	1.757	
12	1998	6 17	500	23.01	2.056	.754	0	2.668	
12	1998	6 17	600	23.34	2.16	.706	0	1.348	
12	1998	6 17	700	23.72	2	.934	.011	1.384	
12	1998	6 17	800	24.01	1.96	1.025	.178	1.591	
12	1998	6 17	900	24.23	2.051	.974	.429	1.192	
12	1998	6 17	1000	25.17	2.12	1.08	1.35	1.22	
12	1998	6 17	1100	26.19	2.096	1.302	2.31	1.595	
12	1998	6 17	1200	26.48	2.146	1.311	2.083	1.785	
12	1998	6 17	1300	27.03	2.146	1.426	2.833	1.793	
12	1998	6 17	1400	27.2	2.147	1.459	2.746	1.801	
ling fi	les com	pleted.							
s Read	1	427							

For every full hour the Met Station has been operational, the following information is generated: station-ID, year, date and time; average one-hour air temperature, vapor pressure, vapor pressure deficit and wind speed; total one-hour solar radiation.

The associated output file is in comma separated ASCII format. This is shown below for the output file corresponding to the above screen: "methr16.txt".

🧮 methr16.txt - Notepad	
<u>File Edit Search H</u> elp	
12,1998,5 4,1500,25.3,2.469,.756,1.348,.878	
12,1998,5 4,1600,24.83,2.491,.645,.946,1.073	
12,1998,5 4,1700,25.07,2.494,.686,.938,.873	
12,1998,5 4,1800,25.29,2.388,.835,.815,.907	
12,1998,5 4,1900,22.69,2.376,.382,.036,.527	
12,1998,5 4,2000,21.49,2.341,.221,0,.523	
12,1998,5 4,2100,20.76,2.327,.122,0,.481	
12,1998,5 4,2200,20.56,2.339,.08,0,.22	
12,1998,5 4,2300,20.67,2.287,.15,0,.338	
12,1998,5 4,2400,20.71,2.227,.214,0,.54	
12,1998,5 5,100,20.49,2.15,.259,0,.503	
12,1998,5 5,200,20.35,2.141,.246,0,.458	
12,1998,5 5,300,20.35,2.168,.22,0,.403	
12,1998,5 5,400,20.07,2.245,.102,0,.438	
12,1998,5 5,500,20.08,2.171,.178,0,.375	
12,1998,5 5,600,20.1,2.246,.106,0,.302	
12,1998,5 5,700,20.11,2.311,.042,.008,.308	
12,1998,5 5,800,20.75,2.321,.127,.051,1.672	
12,1998,5 5,900,20.69,2.299,.141,.051,2.591	
12,1998,5 5,1000,21.22,2.37,.15,.074,2.076	
12,1998,5 5,1100,21.19,2.227,.289,.194,1.374	
12,1998,5 5,1200,21.73,2.29,.31,.721,1.187	
	<b>_</b>

This concludes the user activities in Report with respect to the hourly meteorological information.

#### 5.3.3.4 Summarized Daily Meteorological Information

Compilation of daily meteorological information is a similar process as the one described in paragraph 5.3.2.2. The reader is referred to this text, and Annex 3, for detailed instructions on steps 1 to 5. In this case the parameter file "metday.par" should be used.

Steps 6 and 7 are discussed more in detail in the remaining part of this paragraph, although also these steps are essentially analog to the ones discussed in paragraph 5.3.2.2.

Step C1-5: Perform the same actions as presented in the previous paragraph. Use parameter file "metday.par".

Step C6: in the File name text box of the Select Output File sub-screen, type in the name of the output file. Apply the following naming format:

metdayXX.txt in which XX is the serial number of the input data file. For instance "metday16.txt" if originating from "data016.dat". Click OK. This process is presented in the below window.

Dutput Data File Browse Screen Disp Report and Col Report Headi	lay umn He	'ile <u>n</u> ame: metday16.txt	A	Eolders: c:\camp c:\ car car car file car	bell\files\outp npbell ?s utput	put	OK Cancel N <u>e</u> twork
Column#	1 1	.ist files of <u>t</u> y	pe:	Dri <u>v</u> es:			
Filename		Output files (	(*.PRN) 💌	🗐 c: n	nicron	<b>•</b>	
Line 1	Stn-ID	rear	Date	avg_1	max_1	min_1	avg_vP
			[MM DD]	[C]	[C]	[C]	[kPa]
Line 2							
Line 2 Line 3							
Line 2 Line 3 Decimal						-	
Line 2 Line 3 Decimal							

Step C7: Complete the routine by selecting Go from the Run menu. The results, as presented on screen, are similar to the window below.

tn-ID	Year	Date	avg_T	max_T	min_T	avg_VP	avg_VPD	Rain	SolRad
W_spd	W_dir	W_std							
		[MM DD]	[0]	[0]	[0]	[kPa]	[kPa]	լոոյ	[MJ/M2]
.512	319.2	74							
12	1998	69	22.37	28.84	17.53	2.08	.683	0	19.26
.666	351	84.1						_	
12	1998	6 10	22.91	25.37	20.21	2.162	.639	0	8.58
1.314	203.1	61.14	~ ~ ~ ~	~~ ~ ~			005		
12	1998	6 11	24.04	28.04	17.5	2.075	.935	.3	20.73
1.37	230.4	83.9		07.0	<u>.</u>	0.005	0.00		10 77
1 2 4	1998	6 12	23.93	27.9	21.22	2.025	.969	U	19.77
1.24	260.6	(10	<b>.</b>	20 50	00.00	0 100	0.50		20.10
1 461	1990	6 13	24.33	20.00	20.67	2.108	.958	U	20.16
1.401	230.1	60.09	24.26	20 71	20 54	2 002	076		20.25
1 212	228 1	67 24	24.20	20.71	20.34	2.003	.970	0	20.23
1.313	1998	6 15	22 92	28 44	18 66	2 054	782	17	20.3
1.296	247.8	72.9	20.72	20.44	10.00	2.004	.,05	±• /	20.0
12	1998	6 16	23.89	28.84	19.27	2.031	. 97	Ο	21.28
1.237	249.4	63.13	20.02	20101		2.001	• • •	Ŭ	
ading f:	iles com	pleted.							
,									

For every day the Met Station has been operational, the following information is generated: station-ID, year and date; average, maximum and minimum daily air temperature; average vapor pressure and vapor pressure deficit; total daily rainfall and solar radiation; average daily wind speed and direction, as well as standard deviation of the wind direction.

The first three parameters uniquely identify each output array.

The associated output file is in comma separated ASCII format. This is shown below for the output file corresponding to the above screen: "metday16.txt".

📱 metday16.txt - Notepad 📃	
<u>File Edit S</u> earch <u>H</u> elp	
12,1998,5 4,22.86,25.76,20.41,2.361,.436,.8,10.38,.873,338.1,69.15	
12,1998,5 5,21.25,24.42,19.06,2.237,.296,6.2,7.77,.788,8.69,72.6	
12,1998,5 0,23.23,28.1,17.80,2.345,.555,0,22.50,.040,281.0,78.9	
12,1998,5 7,23.8,27.89,20.47,2.378,.587,0,14.25,1.198,255.1,84.0 19 1000 E 0 9E 0E 90 09 91 0 9 191 761 7 99 96 001 179 0 00 1	
12,1996,5 6,25.05,26.03,21.6,2.434,.704,.7,23.30,.991,173.6,98.4	
12,1998,5 10,22,26,25,77,18,86,2,381,323,2,5,9,92,556,341,9,77,3	
12.1998.5 11.21.85.27.37.19.4.2.262375.1.2.14.11481.355.8.48.4	
12,1998,5 12,21.17,25.36,17.79,2.211,.321,1.2,12.29,.814,286.1,57.56	
12,1998,5 13,21.91,25.76,18.39,2.232,.417,0,10.85,.494,35.21,72.3	
12,1998,5 14,23.92,28.92,19.07,2.283,.732,.1,20.89,.73,41.12,72	
12,1998,5 15,20.94,25.04,18.12,2.299,.192,49.4,6.997,.521,342.1,73.6	
12,1998,5 16,22.95,28.31,17.72,2.23,.626,.1,23.93,.624,340.2,74.1	
12,1998,5 17,24.3,28.71,20.67,2.382,.677,4.4,18.64,1.569,200.5,87.7	
12,1998,5 18,23.96,27.64,20.47,2.287,.706,2.1,14.76,1.342,222.1,55.28	
12,1998,5 19,24.10,27.44,22.29,2.325,.094,1.4,14.58,1.028,210.3,41.71	
12,1998,5 20,24.31,28.7,20.81,2.431,.033,.9,21.84,1.23,234.4,05.25	
12,1996,5 21,24.34,26.03,19.72,2.362,.092,9.6,21.53,.900,226.6,56.93	
12,1998,5,23,25,32,29,1,21,41,2,244,1,009,0,22,3,813,308,4,83,9	
12.1998.5 24.24.58.29.57.20.34.2.2848521.22.3782.222.59.16	
12,1998,5 25,24.72,29.71,20.14,2.382,.777,0,21.63,.81,221.7,61.99	
	-
1	► //.

This concludes the user activities in Report with respect to the daily meteorological information.

#### 5.3.3.5 Met Station Performance Information

Similar as for the Hydro Station, it is considered up to the user to decide whether or not to archive datalogger performance information of the various Met Stations. Although this information can be used to, for example, analyze station power consumption in the past, there seems to be little reason to keep this data if the station has proved to work satisfactorily during a previous recording period.

It is for this reason that the Project has decided not to make any provisions (i.e. pre-defined tables and/or queries) for storing station specific datalogger performance information in an MS Access database.

If the user considers it beneficial for the operation of his/her office to archive the concerned performance indicators, he or she is invited to create an appropriate database for this purpose.

# Processing in MS Access and Final Storage into the LVBD

# 6.1 General

Final destination of the hydro-meteorological data obtained from the Lake Victoria Monitoring Network is the LVBD: the Lake Victoria Basin Database developed in MS Access. But prior to coming to the final step of adding new measurements to this database, one more intermediate operation has to be performed: importing the ASCII files generated by Report (as described in the previous chapter) into MS Access and restructuring them into a final LVBD format.

Figure 5 shows the remaining part of the data trajectory, i.e. the final processing actions in MS Access.



Figure 5: Final data processing steps in MS Access.

The following paragraphs will present the detailed instructions for performing the tasks indicated in the above figure.

## 6.2 MS Access Database "LVBD Final Processing"

The remaining data processing activities are carried out in a MS Access database called "LVBD\_FinalProcessing. mdb". If the user is applying the recommended directory structure, this file is stored in the sub folder C:\MyDbase\ Pre\_LVBD.

This database contains several pre-defined objects including 11 tables and 5 append queries. Table and query names are listed in table 4 together with a brief description of their function.

As indicated by their numbering, the various database objects listed in table 4 are divided into four different classes.

- Group 1 is formed by the auxiliary tables in which to import the respective comma separated ASCII files generated in Report.
- Class 2 constitutes of a single ID-converter table used to relate the short datalogger IDs to a final official station identifier.
- Group 3 consists of the tables in final LVBD format in which the fully processed new information is kept up to being added to the LVBD.
- Lastly, class 4 is formed by the respective append queries used to generate the LVBD format table from the related auxiliary one.

Table 4	Database objects and their fund	tion in MS Access da	atabase "LVBD_FinalProcessing.mdb".
No.	Object	<b>Type</b> ttable	Function
1.1	HydroDay	table	pre-defined table in which to import comma separated ASCII
			file "hyddayXX.txt" generated by Report (see paragraph 5.3)
1.2	HydroHour	table	ditto for "hydhrXX.txt"
1.3	MetDay	table	ditto for "metdayXX.txt"
1.4	MetHour	table	ditto for "methrXX.txt"
1.5	MetRain	table	ditto for "metrnXX.txt"
2	ID Converter	table	table relating datalogger IDs to Hydromet station number or
			other identifier
3.1	Additional Daily Hydro	table	pre-defined table in LVBD format for storage of fully proc-
	AWLRS		essed daily hydrometric data; from this table the data is ap-
			pended to the appropriate corresponding table in the LVBD
3.2	Additional	table	ditto for hourly hydrometric data
	Hydrographs AWLRS		
3.3	Additional Daily Clim AWS	table	ditto for daily climatological data
3.4	Additional Hourly Clim AWS	table	ditto for hourly climatological data
3.5	Additional Hyetographs AWS	append query	ditto for 5-minutes rainfall series
4.1	Daily Hydro AWLRS	append query	pre-defined append query to transfer the contents of table "hydroDay" into final LVBD format in table "Additional Daily Hydro AWLRS"
4.2	Hydrograph AWLRS	append query	ditto for hydroHour
4.3	Daily Clim AWS	append query	ditto for MetDay
4.4	Hourly Clim AWS	append query	ditto for MetHour
4.5	Hyetograph AWS	append query	ditto for MetRain

The individual database items in a particular object class are subject to similar final processing. For example, the actions for importing ASCII file 'metdayXX.txt" into Access are equivalent to those for "methrXX.txt", "metrnXX.txt", etc., only table and file names differ. The same applies for running the various append queries and adding the fully processed data to the LVBD.

It is because of this fact, and the wish to avoid redundancy, that this manual presents the detailed user instructions for only one member of each object class. The instructions for the remaining members are analog.

## 6.3 Importing ASCII files generated by Report into MS Access

This paragraph presents the user instructions for importing "methrXX.txt" into Access file "LVBD\_FinalProcessing. mdb". Similar commands are applied for importing "metdayXX.txt", "metrnXX.txt", hyddayXX.txt" and "hydhrXX.txt".

Step D1: Open the MS Access file "LVBD\_FinalProcessing.mdb" in folder C:\MyDbase\Pre\_LVBD. If in table view, the following database window appears:



The view shows the 11 pre-defined tables.

Step D2: Highlight the table "MetHour" and click "Open". This results in the next screen.

▦	MetHour : Table						
	Datalogger-ID	Year	MM-DD	Time	Avg-T	Avg-VP	Avg-VPD
►	12	1998	54	1500	25.3	2.469	0.756
	12	1998	54	1600	24.83	2.491	0.645
	12	1998	54	1700	25.07	2.494	0.686
	12	1998	54	1800	25.29	2.388	0.835
	12	1998	54	1900	22.69	2.376	0.382
	12	1998	54	2000	21.49	2.341	0.221
	12	1998	54	2100	20.76	2.327	0.122
	12	1998	54	2200	20.56	2.339	0.08
	12	1998	54	2300	20.67	2.287	0.15
	12	1998	54	2400	20.71	2.227	0.214
	12	1998	55	100	20.49	2.15	0.259
	12	1998	55	200	20.35	2.141	0.246
	12	1998	55	300	20.35	2.168	0.22
	12	1998	55	400	20.07	2.245	0.102
	12	1998	55	500	20.08	2.171	0.178
	12	1998	55	600	20.1	2.246	0.106
	12	1998	55	700	20.11	2.311	0.042
	12	1998	55	800	20.75	2.321	0.127
	12	1998	55	900	20.69	2.299	0.141
	12	1998	55	1000	21.22	2.37	0.15
	12	1998	55	1100	21.19	2.227	0.289
Re		1000	≠_ of 1056	1000	24 72	2.20	

In the above screen, the MetHour table still contains data from a previous transfer exercise. Although primary key setting in the final LVBD tables do not allow for data duplication, it is good policy to delete all records from the auxiliary tables, in this case MetHour, prior to a processing a new data set. To this end, continue with step 3.

Step D3: Select all records by simultaneously keying CTRL and A, or clicking Select All Records in the Edit menu.

The complete record set is now highlighted.

Step D4: Delete all records by choosing Delete Records from the Edit menu, as shown on the next screen, or by pressing the 'Delete' key.

Microsoft Access Edit <u>V</u> iew Insert F	F <u>o</u> rmat <u>R</u> e	cords <u>T</u> ools <u>W</u> indow <u>H</u> elp				
Can't <u>U</u> ndo	Ctrl+Z	🛍 🚿 🗠 👌 👬 🕉	🛙 🝸 🛤 🕨	×	🗗 /a 🛛 📢	
Cut	Ctrl+X					
<u>С</u> ору	Ctrl+C					
Paste	Ctrl+V		- <u>-</u>			
Paste <u>S</u> pecial		Year MM-DD	Time	Avg-T	Avg-VP	Avg-VPD
Paste Appe <u>n</u> d		1998 5 4	1500	25.3	2.469	0.756
Delete	Del	1998 5 4	1600	24.83	2.491	0.645
Delete Record		1998 5 4	1700	25.07	2.494	0.686
Delete Column		1998 5 4	1800	25.29	2.388	0.835
		1998 5 4	1900	22.69	2.376	0.382
Select Record	CHLA	1998 5 4	2000	21.49	2.341	0.221
Select <u>A</u> ll Records	Ltm+A	1998 5 4	2100	20.76	2.327	0.122
<u>F</u> ind	Ctrl+F	1998 5 4	2200	20.56	2.339	0.08
R <u>e</u> place	Ctrl+H	1998 5 4	2300	20.67	2.287	0.15
<u>G</u> o To		1998 5 4	2400	20.71	2.227	0.214
OLE/DDE Lieks		1998 5 5	100	20.49	2.15	0.259
Oterobe cin <u>s</u> s	Þ	1998 5 5	200	20.35	2.141	0.246
<u>Fields</u>	14	1998 5 5	300	20.35	2.168	0.22
	12	1998 5 5	400	20.07	2.245	0.102
	12	1998 5 5	500	20.08	2.171	0.178
	12	1998 5 5	600	20.1	2.246	0.106
	12	1998 5 5	700	20.11	2.311	0.042
	12	1998 5 5	800	20.75	2.321	0.127
	12	1998 5 5	900	20.69	2.299	0.141
	12	1998 5 5	1000	21.22	2.37	0.15
	12	1998 5 5	1100	21.19	2.227	0.289
Record: II		1 ▶ ▶ ▶ ▶ ★ of 1056	4000	24 22	2.00	
ete the current record						

Step D5: Close MetHour.

The auxiliary MetHour table is now empty. No data duplication will occur unless the user imports a certain data set twice. Although this would eventually be refused by MS Access due to 'key violation', it is recommended not to enter this situation. Continue with step 6.

Step D6: In the database window, select Get External Data from the File menu. Choose the sub command Import, as presented below.

-	Ctrl+N	
Open Database	Ctrl+O	
<u>G</u> et External Data <u>C</u> lose	Ctrl+W	Link Tables
Save	Ctrl+S	
Save <u>A</u> s/Export		eports ZZ Macros 🦓 Modules
Database Properties		<u>Open</u>
Page Setup		Design
Print Pre⊻iew Print	Chil+P	New 1
Sond	Sarri	
1 C:\MyDbase\Pre_Lvbd\LVBD_PreProcessing 2 C:\Bart\MyDbase\Temp\datasplit.mdb	.mdb	
E <u>x</u> it		
- MetHour		-

Step D7: In the subsequent window, navigate to the folder containing the Report output files and select the concerned "merhrXX.txt" file. Use the appropriate Windows Explorer operations. If the recommended directory structure is used, "methrXX.txt" is stored in folder C:\CAMPBELL\FILES\OUTPUT. Make sure the 'Files of type:' box below-left is in Text Files. The resulting screen is depicted below.

Import	?
Look in: 🔁 Output 💽 🗈 🗟 📰 🏢 📰 🗾	
≝ hydday15.txt	Import
l≝j hydday16.txt ≝i Hydhr15.txt	Cancel
₩ hydprf15.txt	<u>A</u> dvanced
i≣j metday16.txt methr16.txt	
≝ metprf16.txt	
≝ metrn16.txt	
I Find files that match these criteria:	
File name:     Text or property:	<u>F</u> ind Now
Files of type:       Text Files (*.txt;*.csv;*.tab;*.asc)         Last modified:       any time	Ne <u>w</u> Search
Not all file types are installed by default. To add other file types, run the Setup program, click a Access, Change Option.	Add/Remove, Da
8 file(s) found.	

Step D8: Click Import.

The following Text Import Wizard pops up.

Image: Choose the remain of the best describes your data.         Image: Choose the remain of the best describes your data.         Image: Choose the remain of the best describes your data.         Image: Choose the remain of the best describes your data.         Image: Choose the remain of the best describes your data.         Image: Choose the remain of the best describes your data.         Image: Choose the remain of the best describes your data.         Image: Choose the best describes your data.<	The wizard has decide more correctly description of the format	ded that your data is in a 'Delimited' format. If it isn't, choose the ibes your data. that best describes your data:	format that
Sample data from file: C:\CAMPBELL\FILES\OUTPUT\METHR16.TXT.         1         1       12,1998,5         4       12,1998,5	Delimited - Cha	racters such as comma or tab senarate each field	
Sample data from file: C:\CAMPBELL\FILES\OUTPUT\METHR16.TXT.  1 12,1998,5 4,1500,25.3,2.469,.756,1.348,.878 2 12,1998,5 4,1600,24.83,2.491,.645,.946,1.073 3 12,1998,5 4,1700,25.07,2.494,.686,.938,.873 4 12,1998,5 4,1800,25.29,2.388,.835,.815,.907 5 12,1998,5 4,1900,22.69,2.376,.382,.036,.527 6 12,1998,5 4,2000,21.49,2.341,.221,0,.523 7 12,1998,5 4,2100,20.76,2.327,.122,0,.481 8 12,1998,5 4,2200,20.56,2.339,.08,0,.22	C Fixed Width - F	ïelds are aligned in columns with spaces between each field	
	Sample data from file 1 12, 1998, 5 2 12, 1998, 5 3 12, 1998, 5 4 12, 1998, 5	<pre>c:\CAMPBELL\FILES\OUTPUT\METHR16.TXT. 4,1500,25.3,2.469,.756,1.348,.878 4,1600,24.83,2.491,.645,.946,1.073 4,1700,25.07,2.494,.686,.938,.873 4,1800,25.29,2.388,.835,.815,.907 4,1900,21.69,2.376,.382,.036,.527 4,2000,21.49,2.341,221,0,522</pre>	1
	5 12,1998,5 6 12,1998,5 7 12,1998,5 8 12,1998,5	4,2100,20.76,2.327,.122,0,.481 4,2200,20.56,2.339,.08,0,.22	

The Report output files are comma-separated and thus fall into the category 'delimited'. This has been done on purpose since importing this format into MS Access has proved to be straight forward and flawless. Continue with step 9.

Step D9: Select 'Delimited" and click 'Next'.

The below screen appears, it shows how the imported text will be divided into various columns according to the applied delimiter.

O Tab	C Semicolo	on 💿 Comma	) C Space	O Other:	
First <u>R</u> ow	Contains Field N	lames	T	ext <u>Q</u> ualifier:	{none}
			1	1	
12 1998 12 1998	5 4 1500 5 4 1600	25.3 2.469 24.83 2.491	. 645 . 946	.878 1.073	f
12 1998	5 4 1700	25.07 2.494	.686 .938	.873	-
12 1998	5 4 1800 5 4 1900	25.29 2.388 22 69 2 376	835 815	.907	
12 1999	5 4 2000	21.49 2.341	.221 0	.523	
τς μινιο.					1000

Step D10: Select 'comma' and click 'Next'.

The subsequent window is used to define the output location for the imported data. In this particular case, the new information is appended to the pre-defined auxiliary table MetHour.

C. Ja a New Table	e my data		
C In a Ne <u>w</u> Lable	; ;		
	Additional Daily Hydro Additional Hydrograph Additional Hyetograph HydroDay HydroDay		
12 1998 5 4 12 1998 5 4 12 1998 5 4	150( ID Converter 160( MetDay 170( MetHour	1.348 .878 946 1.073 ▼ 938 .873	
12 1998 5 4 12 1998 5 4 12 1998 5 4	1800 25.29 2.388 1900 22.69 2.376 2000 21.49 2.341	.835 .815 .907 .382 .036 .527 .221 0 .523	
12 1998 5 4			

Step D11: Check "In an Existing Table:" and navigate in the related list box to the MetHour table. Click 'Next'.

This constitutes the final step in importing the 'methrXX.txt' ASCII file in the appropriate pre-defined MS Access

table.

If no importing errors are encountered, the Text Import Wizard finishes the process by presenting the following message.



Step D12: Click OK.

The text file is now imported in its desired location. View the results by opening the MetHour table in the database window. The result is presented below.

								_
	MetHour : Table							JX
	Datalogger-ID	Year	MM-DD	Time	Avg-T	Avg-VP	Avg-VPD	
	12	1998	5 21	2200	23.96	2.38	0.595	
	12	1998	5 21	2300	23.71	2.347	0.585	
	12	1998	5 21	2400	22.77	2.335	0.435	
	12	1998	5 22	100	22.82	2.342	0.436	
	12	1998	5 22	200	22.55	2.356	0.377	
	12	1998	5 22	300	22.56	2.365	0.369	
	12	1998	5 22	400	22.82	2.383	0.396	
	12	1998	5 22	500	23.29	2.445	0.413	
	12	1998	5 22	600	23.76	2.505	0.435	
	12	1998	5 22	700	24.21	2.516	0.504	
	12	1998	5 22	800	24.67	2.367	0.738	
	12	1998	5 22	900	24.02	2.615	0.372	
	12	1998	5 22	1000	25.62	2.491	0.804	
	12	1998	5 22	1100	27.36	2.322	1.318	
	12	1998	5 22	1200	27.82	2.326	1.414	
	12	1998	5 22	1300	28.46	2.347	1.536	
	12	1998	5 22	1400	28.72	2.213	1.728	
	12	1998	5 22	1500	29.22	2.212	1.845	
	12	1998	5 22	1600	28.91	2.167	1.817	
	12	1998	5 22	1700	28.32	2.226	1.625	
	12	1998	5 22	1800	27.45	2.262	1.399	
	42	1000		4000	~ 7	דר ר	0.005	
He	ecora:		dcU1 10					

This step concludes the transfer of the contents of the Report Output file 'methrXX.txt' into the appropriate location for final processing in MS Access.

As already stated at the beginning of this paragraph, the import procedures for 'metdayXX.txt', 'metrnXX.txt', 'hyddayXX.txt' and 'hydhrXX.txt' are analog to the process presented above.

To ingress the above ASCII files into 'LVBD\_FinalProcessing.mdb', the user is requested to change file and table names where and when necessary.

For ease of reference, all steps discussed in this paragraph are again presented, in proper sequence, in Annex 4. This time however without accompanying comments and illustrations.

# 6.4 Transferring new data sets from Auxiliary to LVBD Format Table

After being imported into an auxiliary table in MS Access, the new data sets are subject to the following final processing:

- two separate text fields containing day and month, and year respectively, have to be converted into a single date field;
- short datalogger ID (due to the logger's memory configuration limited to a number below 255) has to be transferred into an official numerical station identifier, for example in case of Hydromet-IDs consisting of 8 digits;
- automatic quality control: checking if the data values are within an expected range;
- adding of 'source' value: indicating the origin of the data set;
- re-arranging column structure to LVBD format.

For each data type, all these actions are automatically performed in one go with a pre-defined append query. When the Queries tab is activated in the database view, 5 pre-created queries appear, as shown in the window below.

III Tables	📰 Queries 🗎	📰 Forms	📳 Reports	🖾 Macros	🐗 Modules
💠 🛿 Daily Clim /	AWS				<u> </u>
🛟 🛿 Daily Hydr	• AWLRS				Desian
🕂 🛿 Hourly Clin	nAWS				
🕂 🛿 Hydrograp	hAWLRS				<u>N</u> ew
🕂 🛿 Hyetograp	hAWS				

Table 5presents the input and output tables for each of the above queries. AWS stands for Automatic Weather Station while AWLRS is the acronym for Automatic Water Level Recording Station.

For reference purposes, the general query design is presented in Annex 5. The function and design of the ID-Converter table, included in the various queries, is discussed in Annex 6.

Table 5: Designated I	nput and Output table for each p	re-defined append query.
Input Table	Query	Output Table
MetHour	Hourly Clim AWS	Additional Hourly Clim AWS
MetDay	Daily Clim AWS	Additional Daily Clim AWS
MetRain	Hyetograph AWS	Additional Hyetograph AWS
HydroHour	Hydrograph AWLRS	Additional Hydrograph AWLRS
HydroDay	Daily Hydro AWLRS	Additional Daily Hydro AWLRS

Continue the data processing exercise by performing step 13.

Step D13: Finalize data processing by activating the appropriate query. For example, highlight the 'Hourly Clim AWS' append query to process the newly imported data set in the MetHour table. Click Open. The results will be stored in table 'Additional Hourly Clim AWS'.

The following message box pops up.

⚠	You are about to run an append query that will modify data in your table.
	Are you sure you want to run this action query?
	Click Help for information on turning off confirmation messages for document deletions.
	Yes <u>N</u> o <u>H</u> elp

Step D14: Click Yes.

A message box similar to the one below follows.

Microsof	t Access 🛛 🕅
	You are about to append 1056 row(s). Once you click Yes, you can't use the Undo command to reverse the changes.
	Are you sure you want to append the selected rows?
	Yes <u>N</u> o

Step D15: Click Yes.

This steps finalizes the data processing. The destination table is by its primary key settings protected against duplicate records. If a certain record would be added for the second time, the following message box shows up. It indicates that the processing operation is carried out but that any double rows will not be added due to 'key violations'. Click Yes to perform the query to process the genuinely new data.

Microsoft Access set 0 field(s) to Null due to type conversion failure and it didn't add 1056 record(s) to the table due to key violations, 0 record(s) due to lock violations, and 0 records due to validation rule violations. Do you want to run the action query anyway? Click Yes to ignore the error(s) and run the query.	⚠	Microsoft Access can't append all the records in the append query.
Do you want to run the action query anyway? Click Yes to ignore the error(s) and run the query.		Microsoft Access set 0 field(s) to Null due to type conversion failure, and it didn't add 1056 record(s) to the table due to key violations, 0 record(s) due to lock violations, and 0 records due to validation rule violations.
Click Yes to ignore the error(s) and run the query.		Do you want to run the action query anyway?
Chall U ale for an evaluation of the contrast of the violations		Click Yes to ignore the error(s) and run the query.
Click Help for an explanation of the causes of the violations.		Click Help for an explanation of the causes of the violations.

In order to visualize the final results, open the 'Additional Hourly Clim AWS' table in database view.

Step D16: Highlight 'Additional Hourly Clim AWS' table and click Open.

This is presented below.

🏢 Tables 🛛 📰 Queries 🗍 🖼 Forms 🗍 📳 Reports 🖉 🖉 Macro	os 📔 🤻 Modules 🗎
III Addition Daily Clim AWS III MetRain	<u>O</u> pen
III Addition Hourly Clim AWS	Design
III Additional Daily Hydro AWLRS	
🏢 Additional Hydrograph AWLRS	New
🏢 Additional Hyetograph AWS	
III HydroDay	
III HydroHour	
III ID Converter	
III MetDay	
III MetHour	
_	

The screen presents the fully processed data set in LVBD format. Note the combined Station-ID, Date, Time and Source fields uniquely identifying each record.

III (	Addition Hourly Cli	im A₩S : Table					
	Station-ID	Date	Time	Source	Avg-T	Avg-RH	Avg-VPD
	9999000	04-May-98	1500	104	25.3	76.56	0.76
	9999000	04-May-98	1600	104	24.8	79.43	0.64
	9999000	04-May-98	1700	104	25.1	78.43	0.69
	9999000	04-May-98	1800	104	25.3	74.09	0.83
	9999000	04-May-98	1900	104	22.7	86.15	0.38
	9999000	04-May-98	2000	104	21.5	91.37	0.22
	9999000	04-May-98	2100	104	20.8	95.02	0.12
	9999000	04-May-98	2200	104	20.6	96.69	0.08
	9999000	04-May-98	2300	104	20.7	93.84	0.15
	9999000	04-May-98	2400	104	20.7	91.23	0.21
	9999000	05-May-98	100	104	20.5	89.25	0.26
	9999000	05-May-98	200	104	20.4	89.69	0.25
	9999000	05-May-98	300	104	20.4	90.79	0.22
	9999000	05-May-98	400	104	20.1	95.65	0.10
	9999000	05-May-98	500	104	20.1	92.42	0.18
	9999000	05-May-98	600	104	20.1	95.49	0.11
	9999000	05-May-98	700	104	20.1	98.22	0.04
	9999000	05-May-98	800	104	20.8	94.81	0.13
	9999000	05-May-98	900	104	20.7	94.22	0.14
	9999000	05-May-98	1000	104	21.2	94.05	0.15
	9999000	05-May-98	1100	104	21.2	88.51	0.29
Re	cord: 🔟 🔳		of 1056	104	717	00.00	

# 6.5 Appending the fully processed new data set to LVBD

Data processing has been finalized in the previous paragraph. What remains is adding the new records to the Lake Victoria Basin Database. Because the new, fully processed data set is already in LVBD format, this operation is easily accomplished by copying the new records to the clipboard, opening the destination file and table in the LVBD, and adding the new information using the 'paste-append' option.

This process is described in the following steps. It builds on the output of step D16 in the preceding paragraph. Continue with step 17 in the open 'Additional Hourly Clim AWS' table.

Step D17: Select all records by simultaneously keying CTRL and A, or clicking Select All Records in the Edit menu.

The complete record set is now highlighted. Proceed with copying the entire data set to the clipboard, as follows.

Step D18: Choose Copy from the Edit menu.

This action is pictured in the below screen.

Can't <u>U</u> ndo	Ctrl+Z	🔒 🚿 🗩	<u></u> ≜↓ Z↓ 🦻 🦉	7 🚧 🕨	× I	🗊 ⁄a • 💦	
Cu <u>t</u>	Ctrl+X						
Сору	Ctrl+C	AVC - T-LI-					
Paste	Ctrl+V	WS: Table		_			
Paste <u>S</u> pecial		Date	Time	Source	Avg-T	Avg-RH	Avg-VPD
Paste Appe <u>n</u> d		04-May-98	1500	104	25.3	76.56	0.76
Delete	Del	04-May-98	1600	104	24.8	79.43	0.64
_ Delete <u>R</u> ecord		04-May-98	1700	104	25.1	78.43	0.69
Delete Colu <u>m</u> n		04-May-98	1800	104	25.3	74.09	0.83
Calcal Daarad		04-May-98	1900	104	22.7	86.15	0.38
Seject necora Select All Records	CHLA	04-May-98	2000	104	21.5	91.37	0.22
Select All Necolds	CuitA	04-May-98	2100	104	20.8	95.02	0.12
Eind	Ctrl+F	04-May-98	2200	104	20.6	96.69	0.08
R <u>e</u> place	Ctrl+H	04-May-98	2300	104	20.7	93.84	0.15
<u>G</u> o To	•	04-May-98	2400	104	20.7	91.23	0.21
TLE/DDE Links		05-May-98	100	104	20.5	89.25	0.26
Object	)	05-May-98	200	104	20.4	89.69	0.25
	0000	05-May-98	300	104	20.4	90.79	0.22
999	9000	05-May-98	400	104	20.1	95.65	0.10
999	9000	05-May-98	500	104	20.1	92.42	0.18
999	9000	05-May-98	600	104	20.1	95.49	0.11
999	9000	05-May-98	700	104	20.1	98.22	0.04
999	9000	05-May-98	800	104	20.8	94.81	0.13
999	9000	05-May-98	900	104	20.7	94.22	0.14
999	9000	05-May-98	1000	104	21.2	94.05	0.15
999	9000	05-May-98	1100	104	21.2	88.51	0.29
	0000	05 14-0.00	4000	404	217	00.00	0.24

In order to improve computing speed, storing data on the clipboard is normally limited to copying a reference to an open source object to this location. However, if this 'origin' table has to be closed, the actual data has to be transferred to the clipboard, which can be a rather lengthy process and may occupy a substantial amount of memory. Since MS Access does not allow two databases to be open at the same time, opening a LVBD destination file and table must be preceded with closing the auxiliary 'LVBD\_PreProcessing". This is the source in the ongoing append exercise, and its closure will provoke actual copying of all supplement records to the clipboard. Continue with step 19.

Step D19: Close the 'Additional Hourly Clim AWS' table. Step D20: Close the 'LVBD\_FinalProcessing' database.

On closing the 'LVBD\_FinalProcessing.mdb' file, the below message box pops up.

Microsof	t Access
	You copied a large amount of data onto the Clipboard.
	When you copy data onto the Clipboard, only the reference to the object is copied. If you close the source document, however, Microsoft Access must paste all the data from its source. This can take time, depending on the amount of data.
	Do you want to save this data on the Clipboard?
	<u>Yes</u> <u>N</u> o

Step D21: Click Yes.

Depending on the type and origin of the copied data, a destination LVBD data table should be opened. Table 6 presents the various data sources and their related 'target' files and tables in the LVBD.

Table 6: LVBD destination objects.		
Source Table in auxiliary database	Destination LVBD file	Destination LVBD table
'LVBD_FinalProcessing'		
Additional Daily Clim AWS	Depending on the country of origin of the AWS data, this is one of the files listed hereunder: - 'Daily Clim Kenya.mdb' - 'Daily Clim Tanzania.mdb' - 'Daily Clim Uganda.mdb'	AWS Daily Clim
Additional Hourly Clim AWS	ditto	AWS Hourly Clim
Additional Hyetograph AWS	ditto	AWS Hyetograph
Additional Daily Hydro AWLRS	'Daily Runoff.mbd'	AWLRS Daily Water Levels
Additional Hydrograph AWLRS	ditto	AWLRS Hydrographs

Step D22: Open the destination LVBD database file. In this example we have arbitrarily selected 'Daily Clim Uganda. mdb'. The following database window shows up, presenting the included tables.

III Tables 🛛 📰 Queries 🛛 🚺	🖫 Forms 🛛 📳 Reports 🛛 🗖 Macros	🦚 Module:
🏢 AWS Daily Clim	🔠 Rainfall Uganda	<u> </u>
III AWS Hourly Clim	🏢 Relative Humidity Uganda	Desia
🛄 AWS Hyetograph	III Source	
💷 Climatological Station File	🎹 Sunshine Uganda	<u>N</u> ew
🎹 Dew Point Temperature Uganda	🏢 Wind Run Uganda	
🏢 Dry Bulb Temperature Uganda		
🎹 Evaporation Uganda		
💷 Maximum Temperature Uganda		
🏢 Minimum Temperature Uganda		
🏢 Radiation Uganda		

Step D23: Open the destination LVBD data table. In the current example this is table 'AWS Hourly Clim".

Step D24: Append the contents of the clipboard into this table by selecting the Paste Append option from the Edit menu. As shown in the screen below.

Can't <u>U</u> ndo	Ctrl+Z				同為	- <b>▶</b> ?	
Cu <u>t</u> <u>C</u> opy Paste	Ctrl+X Ctrl+C Ctrl+V	AWS Hourly Clim :	Table				
Paste <u>Special</u> Paste Appe <u>n</u> d		Station-ID	Date	<b>Time</b> O	Source 0	Avg-T	Avg-RH 0.00
<u>D</u> elete Delete <u>R</u> ecord Delete Colu <u>m</u> n	Del						
Seject Record Select <u>A</u> ll Records	Ctrl+A						
<u>F</u> ind R <u>e</u> place <u>G</u> o To	Ctrl+F Ctrl+H	_					
OLE/DDE Lin <u>k</u> s Object	Þ						
	diation						
				el of 1		-	

he following message box pops up.

Microsof	t Access 🛛 🔀
	You are about to paste 1056 record(s).
_	Are you sure you want to paste these records?
	Yes <u>N</u> o

Step D25: Click Yes.

This step finalizes the append exercise and concludes the data route from sensor to LVBD. The final results are shown in the window below.

The various LVBD tables are protected against duplicate records by their primary key setting. Appending double records is therefore not permitted. However, a possible doubled record will automatically be disregarded and does not corrupt or halt the append process.

Obviously, the append exercise for the other source and destination objects in table 6 is equivalent to the process discussed in this paragraph. In the listed steps, simply substitute the names of the source table, as well as the target LVBD file and table, with the appropriate ones and follow the above provided guide lines.

■ AWS Hourly Clim :	Table					_ [	'
Station-ID	Date	Time	Source	Avg-T	Avg-RH	Avg-VPD	
9999000	04-May-98	1600	104	24.8	79.43	0.64	_
9999000	04-May-98	1700	104	25.1	78.43	0.69	
9999000	04-May-98	1800	104	25.3	74.09	0.83	
9999000	04-May-98	1900	104	22.7	86.15	0.38	
9999000	04-May-98	2000	104	21.5	91.37	0.22	
9999000	04-May-98	2100	104	20.8	95.02	0.12	
9999000	04-May-98	2200	104	20.6	96.69	0.08	
9999000	04-May-98	2300	104	20.7	93.84	0.15	
9999000	04-May-98	2400	104	20.7	91.23	0.21	
▶ 9999000	05-May-98	100	104	20.5	89.25	0.26	
9999000	05-May-98	200	104	20.4	89.69	0.25	
9999000	05-May-98	300	104	20.4	90.79	0.22	
9999000	05-May-98	400	104	20.1	95.65	0.10	
9999000	05-May-98	500	104	20.1	92.42	0.18	
9999000	05-May-98	600	104	20.1	95.49	0.11	
9999000	05-May-98	700	104	20.1	98.22	0.04	
9999000	05-May-98	800	104	20.8	94.81	0.13	
9999000	05-May-98	900	104	20.7	94.22	0.14	
9999000	05-May-98	1000	104	21.2	94.05	0.15	
9999000	05-May-98	1100	104	21.2	88.51	0.29	
9999000	05-May-98	1200	104	21.7	88.08	0.31	
Record: II I		1000 of 1056	104	22.0	01.04	0.74	<u>ب</u> ال

# Annexes

# Annex 1: Consecutive Steps in Connecting Storage Module SM4M/SM192 to PC.

Annex 1: Cor	nsecutive Steps in Connecting Storage Module SM192 to PC.
Step	Action
A1	Connect the SM192 Storage Module to the SC532 Interface using the blue SC12 cable.
A2	Make sure the SC532 Interface is powered.
A3	On PC, double click the PC208W Datalogger Support Software Icon.
A4	Click the StgModule tab.
A5	Click the SM192/SM716 tab at the top-mid of the SMS window.
A6	Click the tab labeled 'Setup' to select the appropriate communication settings.
A7	Select the COM Port settings corresponding to the serial port used by the "9 to 25" computer cable connecting
	the SC532 Interface (see paragraph 3.1). In most cases this will be either COM1 or COM2.
A8	Set Baud Rate at 19200. This is a measure of the communication speed between PC and Storage Module. In case
	frequent communication problems are experienced, lower the Baud Rate and see if this solves the problem.
A9	Click the "Connect" button to connect SM192 to PC.

The above steps are discussed in detail in paragraph 5.2.2 of this manual.

# Annex 2: Consecutive Steps in Retrieving Raw Data Files from SM192 Storage Module

## to PC

Annex 2: Con	secutive Steps in Retrieving Raw Data Files from SM192 Storage Module to PC
Step	Action
B1	Connect SM192 to PC and establish communication. See instructions in paragraph 5.2.2 or Annex 1.
B2	Click the "Data" tab at the bottom-left.
B3	Mark the "Comma separated" option in the File Format select box. Import of comma separated ASCII files into MS Access has proven to be flawless and trouble free.
B4	Mark the "Auto Increment Name" option in the Auto Name Control select box. Each retrieved data file will get a name according to the format "DATAXXX.DAT" in which XXX is a number which automatically increments when a new file is down loaded.
B5	Click the file name in the File Naming Options location. A box similar to Windows Explorer appears which allows the user to navigate to the location where he or she wants to store the retrieved data files.
B6	Click the "Get New" button. This option collects all "new" data files from the SM192, i.e. all files not yet retrieved in a previous down load operation. Each single SM192 data file is stored in an individual DAT file on the hard drive.

The above steps are discussed in detail in paragraph 5.2.3 of this manual.

# Annex 3: Consecutive Steps in Processing Raw Data Files in Report.

Annex 3:Con	secutive Steps in Processing Raw Data Files in Report.
Step	Action
C1	Activate Report by clicking the Report tab on the PC208W toolbar.
C2	Choose Open from the File menu to activate a pre-defined parameter file.
C3	Navigate to the location on hard drive which contains the parameter files. This is "C:\CAMPBELL\FILES\PARA- METR" if the Recommended Directory Structure is used. Highlight the concerned parameter file and click OK.
C4	Activate the Input File(s) sub-window and select the Input Data File. To this end click "Browse" in the Input Data File box and navigate to the location on hard disk which contains the data files. Highlight the appropriate file and click OK.
C5	Switch to the Output File sub-window by clicking its tab at the top-mid of the current Split screen.
C6	Select location for, and give a name to, the resulting Output file. To this end click "Browse" in the Output Data box. Navigate to the desired folder on the hard drive and type in an output file name according to the convention discussed in paragraph 5.3.2.2. Click OK.
C7	Finalize the routine by selecting Go from the Run menu.

The above steps are discussed in detail in the paragraphs 5.3.2 and 5.3.3 of this manual.

# Annex 4: Consecutive Steps in Final Processing of Report Output Files in MS Access and Appending Fully Processed New Data Sets to LVBD.

#### Annex 4: Consecutive Steps in Final Processing of Report Output Files in MS Access and Appending Fully Processed New Data Sets to LVBD. Action Step D1 Open the MS Access file "LVBD\_FinalProcessing.mdb" in folder C:\MyDbase\Pre\_LVBD. D2 Highlight the appropriate auxiliary table and click "Open". See Table 4 in paragraph 6.2 for an overview of the auxiliary tables (Class 1). D3 Select all records by simultaneously keying CTRL and A, or clicking Select All Records in the Edit menu. D4 Delete all records by choosing Delete Records from the Edit menu, or by pressing the 'Delete' key. D5 Close auxiliary table. D6 In the database window, select Get External Data from the File menu. Choose the sub command Import. D7 In the subsequent window, navigate to the folder containing the Report output files and select the concerned one. Use the appropriate Windows Explorer commands. If the recommended directory structure is used, these files are stored in folder C:\CAMPBELL\FILES\OUTPUT. Make sure the 'Files of type:' box below-left is in Text Files. D8 Click Import. D9 Select 'Delimited" and click 'Next'. D10 Select 'comma' and click 'Next'. D11 Check "In an Existing Table:" and navigate in the related list box to the appropriate auxiliary table. Click 'Next'. D12 Click OK. D13 Finalize data processing by activating the appropriate pre-defined append query. See Table 5 in paragraph 6.4 for the required combination of query, input and output file. D14 Click Yes. D15 Click Yes D16 Highlight the concerned 'Additional Data' table and click Open. D17 Select all records by simultaneously keying CTRL and A, or clicking Select All Records in the Edit menu. D18 Choose Copy from the Edit menu. D19 Close the concerned 'Additional Data' table. D20 Close the 'LVBD\_FinalProcessing' database. D21 Click Yes. D22 Open the destination LVBD database file. See Table 6 in paragraph 6.5 for an overview of the various LVBD destination objects. D23 Open the destination LVBD data table. See Table 6 in paragraph 6.5 for an overview of the various LVBD destination objects. D24 Append the contents of the clipboard into this table by selecting the Paste Append option from the Edit menu. D25 Click Yes. This step finalized the final processing and append operation.

The above steps are discussed in detail in the paragraphs 6.3, 6.4 and 6.5 of this manual.

# Annex 5: General Design of the Append Queries for Final Processing of the Report

# Output Files in MS Access.

The function of the pre-defined append queries is to perform the final processing steps in MS Access. This includes:

- two separate text fields containing day and month, and year respectively, are converted into a single date field;
- short datalogger ID (due to the logger's memory configuration limited to a number below 255) is transferred into an official numerical station identifier, in case of Hydromet-IDs consisting of 8 digits;
- automatic quality control: checking if the data values are within an expected range;
- adding of 'source' value: indicating the origin of the data set;
- re-arranging column structure to LVBD format.

The window below presents the design of the "Daily Hydro AWLRS" append query, which uses "HydroDay" as source table and "Additional Daily Hydro AWLRS" as target.



The query employs two tables: ID-Converter and an auxiliary MS Access table, in this case HydroDay. The tables are linked through the Datalogger-ID field.

Field 1 is used to transfer the (short) datalogger ID into a permanent unique station identifier.

Field 2 serves to convert the two fields "Year" and "MM-DD" into a single date.

Field 3 has the function to add a source value to the final data table. The number 104 has been allocated for data stemming from the Lake Victoria Monitoring Network.

Field 4 to 7 contain the actual data values.

Automatic quality control is accomplished by specifying validation rules in the target tables.

The design of the other append queries is analog. Input (auxiliary) and Output table should be changed according to the combinations presented in Table 5 in paragraph 6.2.

The first three fields are identical for all queries, while the remaining fields depend on the data contents of the auxiliary table.

An overview of the various auxiliary tables (Class 1) is given in Table 4 in paragraph 6.2.

## Annex 6: Design of the ID Converter Table

The ID Converter table serves to transfer the datalogger IDs to official station identifiers. Due to memory allocation, the datalogger ID is a short integer between 1 and 254, which does not allow for proper station numbering in a comprehensive hydrometeorological network.

The following screen presents the design of the ID Converter table.

Ⅲ	ID Converter :	Table					
	Field Na	Field Name Data Type		Description			
▶	Datalogger-ID	atalogger-ID Number			Auxiliary datalogger ID assigned by hydrometric authority		
Ŕ	Station-ID Number			Official Station ID assigned by Meteorological Department			
	Station Name		Text	Station or river nam	ie		
	Location		Text	Description of micro location Latitude in decimal degrees Logitude in decimal degrees			
	Latitude		Number				
	Longitude		Number				
	Remarks		Text	Remarks			
_					<b>Y</b>		
				Field P	roperties		
	General Lealure	a					
	Field Size	Integer					
	Format Decimal Places Auto Input Mask						
					A field name can be up to 64 characters long, including spaces		
	Caption	_			Press F1 for help on field names.		
	Default Value						
	Validation Rule     >0 And <254						
				54			
	Indexed	Yes (Dupl	icates OK)				

The first field contains the datalogger ID, while the second stores the corresponding station ID: the official station identifier assigned by the hydrometeorological service. The remaining fields are used for adding station specific information. Their purpose is mainly to avoid confusion while adding records to the ID Converter table.

In data view, this table is shown below. The Uganda situation is presented while a fourth record has been added for the purpose of writing this manual.

	Datalogger-ID	Station-ID	Name	Location	Latitude	Longitude	Remarks
•	1	9033901	Lolui AWS	Police Station / Lolui Islan	-0.129	33.669	Established 10/07/1998
	2	9032901	Bukasa AWS	Mission / Bukasa Island / I	-0.411	32.526	Established 18/07/1998
	3	8934901	Sio AWLRS	At Majanji	0.401	34.029	Established August 1998
	12	9999000	Example	Dummy	0.000	34.000	For Instruction Purposes
*		0					

Add and modify records according to existing network.