Manual

Installation, Operation and Maintenance of the Orpheus Automatic Water Level Recorders in The Nile Basin and Processing of the Retrieved Data

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Information Products for Nile Basin Water Resources Management
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List of Acronyms

Ahr	Ampere hour
AWLR	Automatic Water Level Recorder
AWS	Automatic Weather Station
CTA	Chief Technical Advisor
FAO	Food and Agriculture Organization of the United Nations
FPI	Focal Point Institution
ID	Identification Code
IrDA	Infrared DuoLink Interface Adapter
LVBD	Lake Victoria Basin Database
NBD	Nile Basin Database
NBI	Nile Basin Initiative
NBWR	Nile Basin Water Resources
RAM	Random Access Memory/Readily Available Memory
RH	Relative Humidity
WRME	Water Resources Monitoring Expert

Table of Contents

List of Figures

List of Tables

Introduction

1.1 General

This manual presents detailed instructions for the installation, operation, and maintenance of the "Orpheus" Pressure Transducer Automatic Water Level Recorder (AWLR) installed in the Nile Basin by the FAO Nile Basin Water Resources Project. Manufacturer of the Orpheus is OTT Hydrometrie, based in Germany, which has provided conventional and automatic hydrometric equipment in the basin for over 50 years.

The reader is advised to study this manual carefully before starting any work with the Orpheus. We have worked hard to present the user instructions as concise as possible. Background information on the functioning of the various elements is presented at appropriate occasions.

The hydrometric monitoring network in the Nile Basin consists of a large number of various types of water level recording stations. Using a rating curve, the stage measurements are transferred into discharges, representing essential information for water resources planning, management, and design purposes.

The project is a strong advocate of introducing electronic monitoring equipment in the Nile basin. The use of electronic sensors connected to a datalogger is now well established in the world, and carries many advantages. For example, it facilitates automating data processing, which often forms the main obstacle in database development. Another major benefit is the possibility to acquire a continuous set of sub-daily data values. This provides important additional information on the behavior of often highly variable hydro-climatological parameters.

The project operated an Orpheus AWLR at its office compound for testing and manual preparation purposes. The new equipment did not show any technical problem during the testing period. Based on this experience the project is multiplying the equipment in the basin with the associated necessary training to the users.

1.2 Thalimedes and its Individual Components

Orpheus measures changes in water levels using an electronic sensor, and then stores this data in the logger's non-volatile memory. The records are retrieved using: (a) a laptop PC, or (b) the OTT VOTA data retrieval unit. Orpheus is used as a stand-alone device. The following paragraphs discuss the main components comprising the Orpheus:

Pressure Transducer Integrated with Datalogger: Orpheus consists of a pressure transducer sensor integrated with datalogger (with 128kb storage capacity of upto 52000 measuring values) via a pressure probe cable. Orpheus has been designed for the exact and continuous measurement and recording the level (or depth of water) of both ground water and surface waters. The pressure probe is made up of salt resistant stainless steel and is water tight up to 70 m water column. It is 42 mm in diameter with a length of 520 mm and weighs 0.9 kg. The water level sensor consists of a robust, oil-free, ceramic measuring cell. The datalogger is integrated within the probe body and is pre-protected against damage caused by lightening strikes.

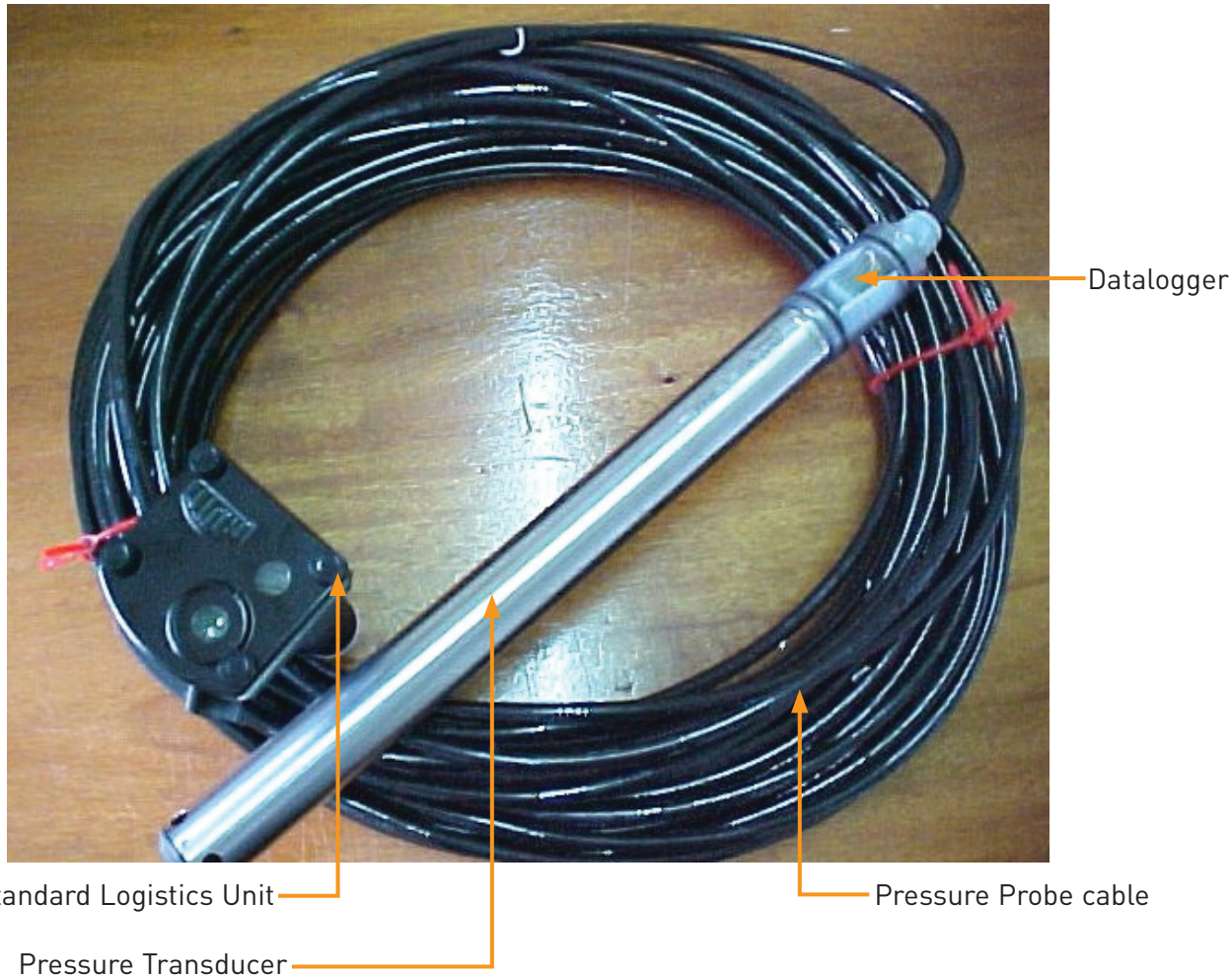


Figure 1: Orpheus with integrated datalogger and standard logistics unit

Standard Logistics Unit: This unit enables communication between the datalogger and the VOTA and/or PC, and provides the power supply of the Orpheus. The standard logistics unit is a plastic housing, which consists of a 6 volts power supply unit, terminal strip for pressure probe cable, an optical interface for data readout, pressure probe cable, cable suspension clamp and a reusable silica-gel cartridge for moisture absorption. The power supply unit needs commonly available 4 x 1.5V type-C batteries.

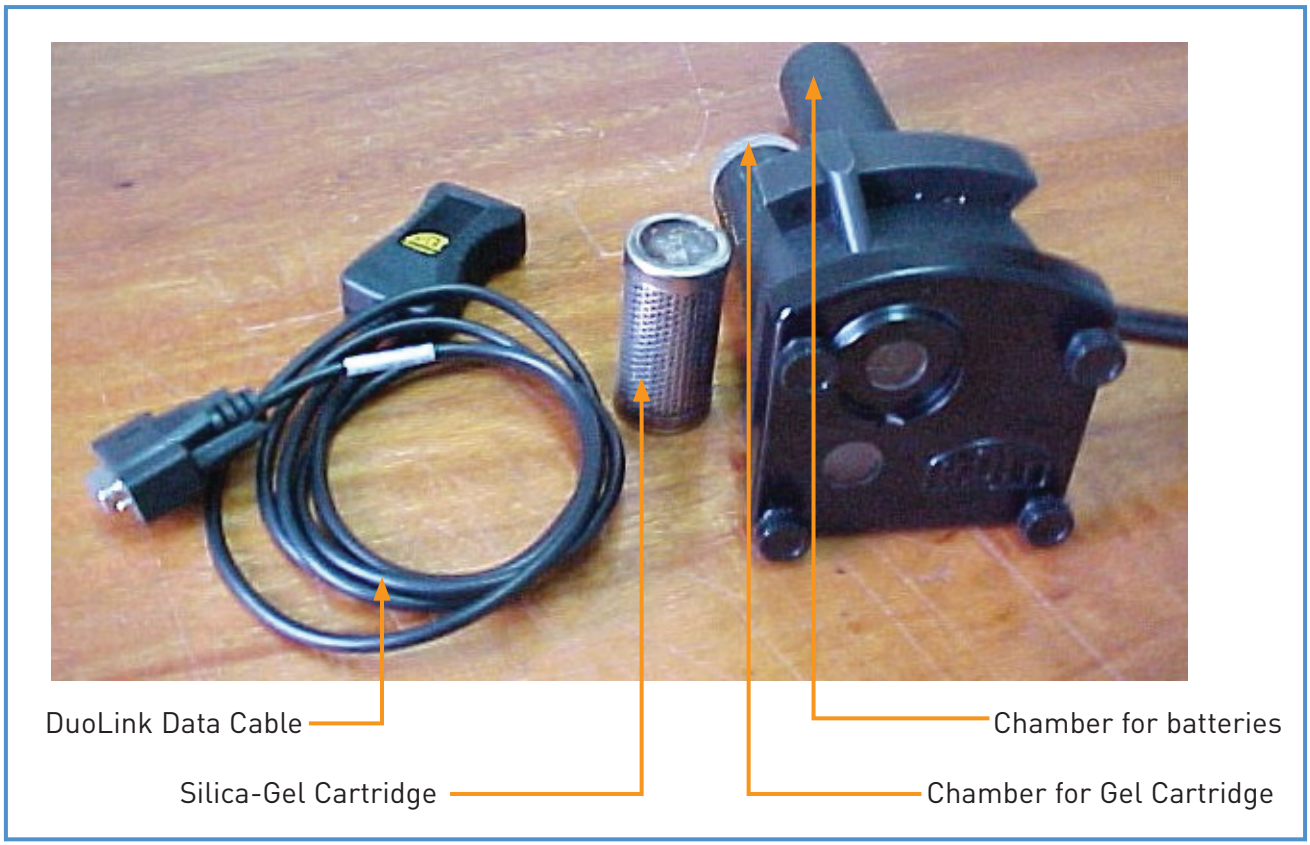


Figure 2: Standard logistics unit with data readout cable

Data Retrieval Unit: Data is retrieved using either a laptop PC or an OTT VOTA. The VOTA is a ruggedized data programming/retrieval unit for use in the field. Its design is based on PC technology, and its software is pre-installed. VOTA is operated by a single knob, 'called 'Jog Shuttle". Figure 4 shows the VOTA.

Figure 3: OTT VOTA programming / retrieval unit

1.3 Overview of the Contents of the Manual

This manual provides all the necessary user-helping information for successful installation, operation, and maintenance of Orpheus Automatic Water Level Recorders (AWLR). It also covers the instructions for data retrieval, data processing, and final storage of the Orpheus recordings into an MS-Access database.

Chapter 2 describes the installation of Orpheus AWLR as a stand-alone device for recording river or lake levels.

Chapter 3 deals with the operation of the Orpheus AWLR including programming and data retrieval when using a PC, while chapter 4 discusses the same issues when using the VOTA unit. This chapter also includes transferring the accumulated raw data from VOTA to PC.

Chapter 5 describes primary data processing in HYDRAS 3: a proprietary software package specifically developed by OTT for this purpose. The process includes converting raw data files into ASCII text files.

Chapter 6 discusses secondary data processing. This includes importing the ASCII data files into the MS Access, and the subsequent final storage in the Nile Basin Database (NBD).

Installation of the Orpheus

2.1 General

Orpheus AWLR is an electronic sensor integrated with a pressure probe/transducer for measuring ground and surface water levels. This pressure transducer is designed for measuring a maximum water column of upto 10 meters above the sensor. Orpheus stores the measured records in its datalogger's non-volatile memory. The measured values are retrieved either using a laptop PC or the supplied PC based OTT VOTA unit. The pressure transducer is installed in a stilling well with the datalogger installed on a secure place away from the water.

While installed in a stilling well, the sensor measures changes in water column above the sensor. The sensor transfers the corresponding pressure into an analog signal, which is transferred via the transducer cable to the datalogger as a measured value.

2.2 Installation of the Orpheus Automatic Water Level Recorder

Installation of the Orpheus AWLR is easy and straightforward and is suited particularly for new measuring sites and for sites where the use of float-operated devices is not feasible. Orpheus is used for measuring ground water as well as surface water. This manual discusses in detail the use of Orpheus for measuring surface water level in several countries of the Nile Basin. The installation procedure for the Orpheus is discussed in the following paragraphs:

2.2.1 Design and Installation of the Pressure Transducer Housing

Figures 5 and 6 explain the plan and detailed design of a stilling well for the pressure transducer water level recorder. The exact location of the pressure transducer housing is always determined on site. The project has newly adopted this housing design for wild rivers flow with high silt concentration. The stilling well has no inlets rather it consists of three perforated (<1mm holes) screened steel pipes of diameter 35, 25 and 10 cm. The space between the 35 and 25 cm round screened pipes is filled with rounded washed gravel of size 5-8 mm.

The stilling well is placed in the crossectional river profile on a concrete foundation plate and is anchored from the side to a solid rock; otherwise an anchoring block needs to be constructed. The stilling well can be submerged but should be accessible for maintenance and checking activities. On the other hand, the Standard Logistics Unit containing optical interface, humidity absorber, terminal strip, power supply, pressure probe cable etc, is installed in a steel pipe housing at a secure dry area above the maximum flood level. The logistics unit is secured within an ORG 46 Top Cap, which easily fits over 4", 5" or 6" diameter pipe. The steel pipe for the logistics unit should have a hole drilled at its lower end for routing the transducer cable. The long transducer cable between the standard logistics unit and the pressure transducer is protected underground in a PVC pipe.

2.2.2 Installation of the Orpheus Pressure Transducer and Standard Logistics Unit

Hardware needed for the installation of Orpheus includes (a) stilling well for placement of pressure probe inside it (b) PVC or steel conduit for routing the transducer cable (c) pipe of 4", 5" or 6" diameter with an OTT steel cap (ORG 46) for protecting the Logistic Unit; and (d) cable suspension clamp for exact positioning of the pressure probe in the stilling well. Installation of Orpheus has been discussed in the preceding paragraphs and is schematically shown in figure 5 and 6.

It is assumed that the pressure transducer housing (in the river crossectional profile) and Logistic Unit housing (on a dry secure place somewhere above maximum water level) have been installed onsite (see paragraph 2.2.1 above). For installation of the pressure transducer, open top cap of the logistic unit and detach the transducer cable from the unit. Install the pressure probe in the pressure transducer-housing, route the cable through the transducer-housing top cap, then through the hole in the 25cm pipe and through the underground conduit to the logistics unit housing pipe. Remember that the datalogger is pre-fitted within the probe body (water tight for upto 70 meters of water column). Finally reconnect the cable to the logistics unit. Configure the Orpheus and close the top cap. The transducer should be positioned in the pipe below the minimum water level.

Figure 4: Positioning of logistics unit in ORG 46 Protection cap

2.2.3 Positioning of Probe in Open Water

Although it is better to position the probe vertically within the stilling tube but when Orpheus gauge system is used in open water, it is not necessary to install the probe in vertical position. The probe is designed to be also used in a sloping position e.g. at a sloping bank. In case of such a sloping bank, the weight of the probe normally prevents it from becoming buoyant. The position of the probe may also be fixed by using a split pin or a bolt. To achieve this, the locking pin is inserted through the holes in a protective tube and in the black plastic cap located at the tip of the probe. The position of the probe is now fixed, and the safety connection is quite easy to detach for the purpose of cleaning.

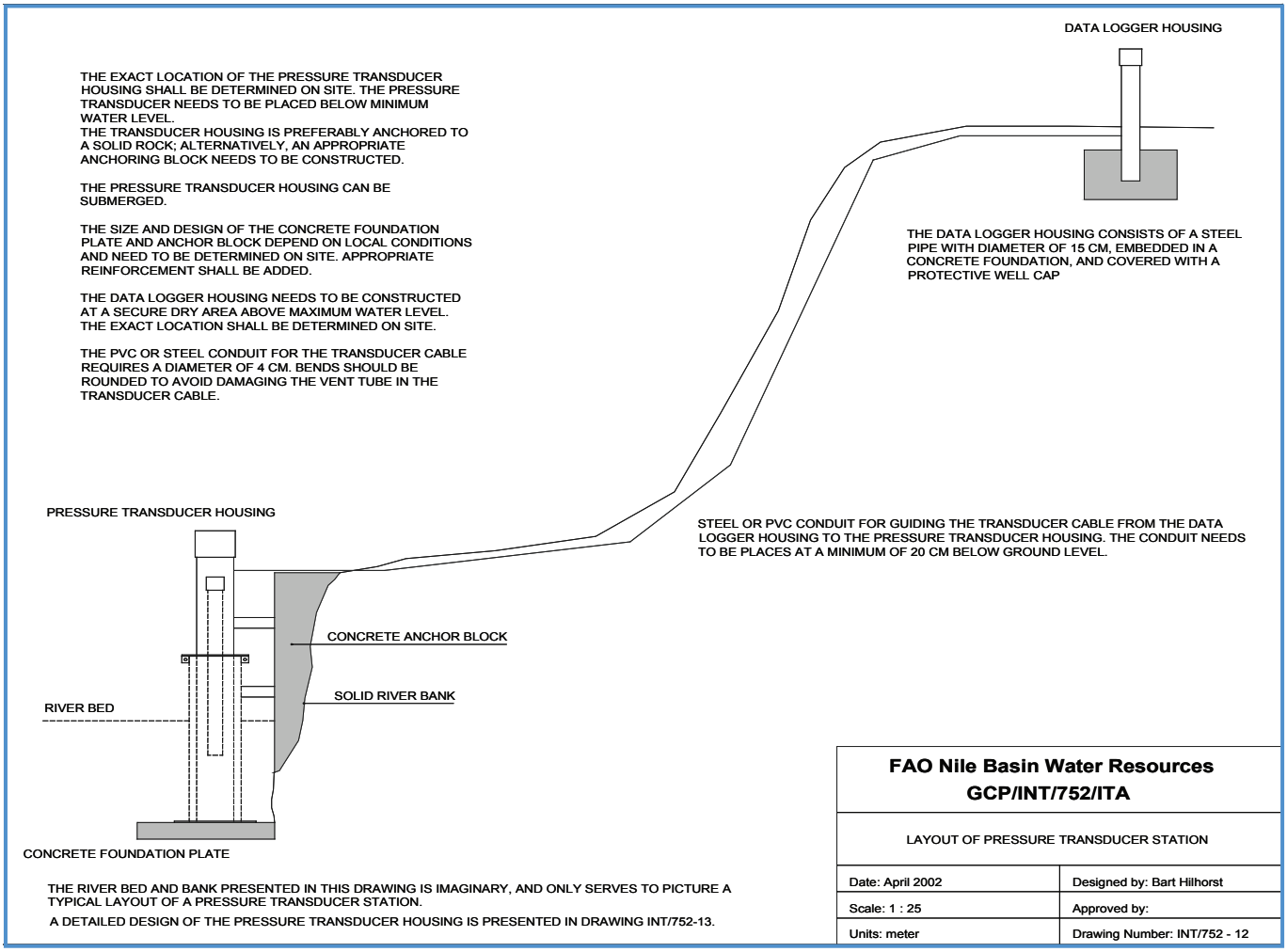


Figure 5: Schematic plan of the stilling well and standard logistics unit housing

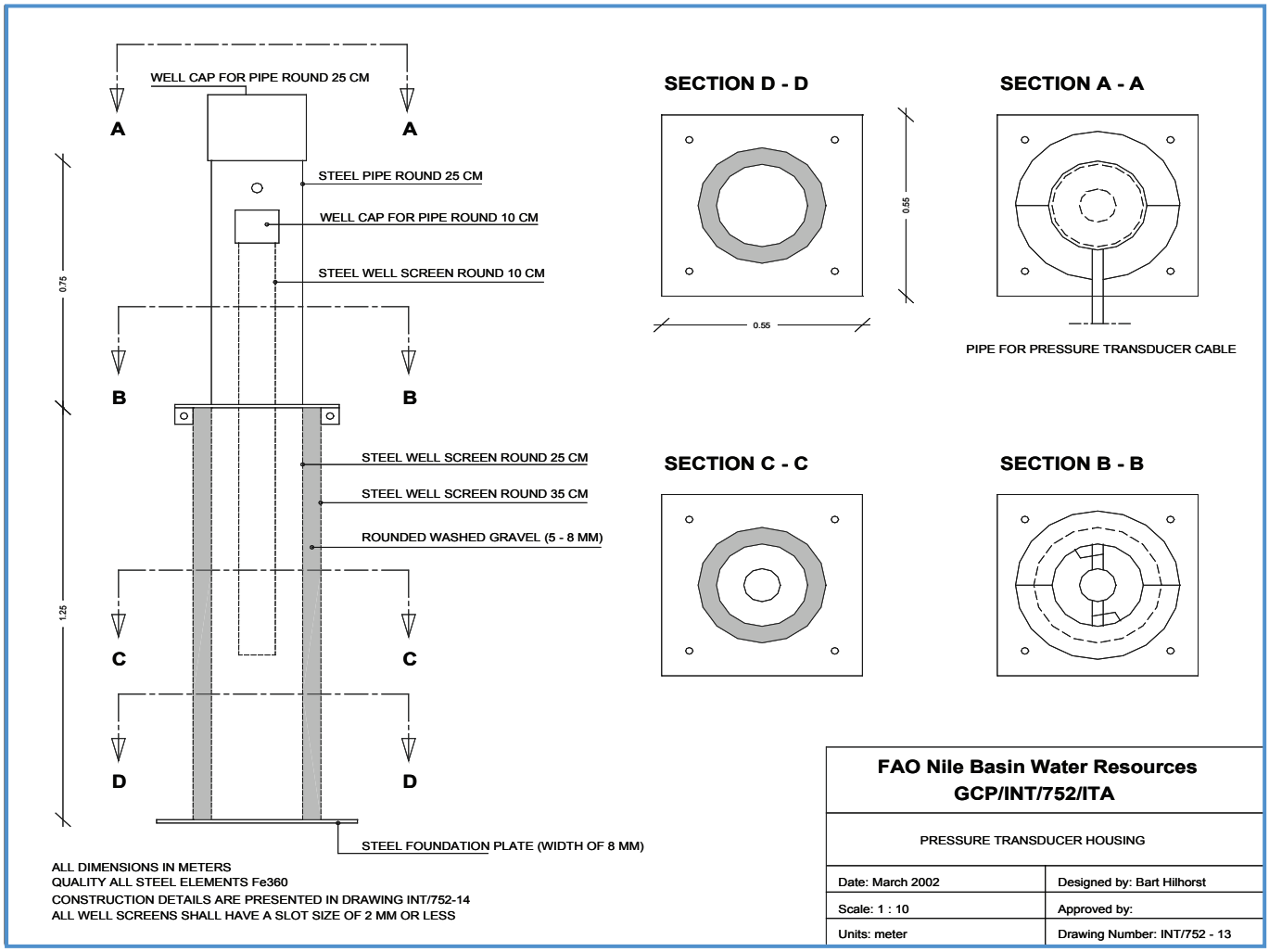


Figure 6: Design of the stilling well for the pressure transducer

Operation of the Orpheus

3.1 General

Once the Orpheus has been installed, the datalogger needs to be programmed and the required parameters need to be properly set. This is accomplished either using an OTT VOTA unit or using a PC/laptop. Before setting the parameters, Orpheus is activated by fitting the batteries inside it. Once the Orpheus has been activated and all the operating parameters are set, the datalogger starts recording according to the datalogger settings. Detailed explanation of how to operate the Orpheus has been explained in the following paragraphs:

3.2 Fitting the Batteries and Activating Orpheus

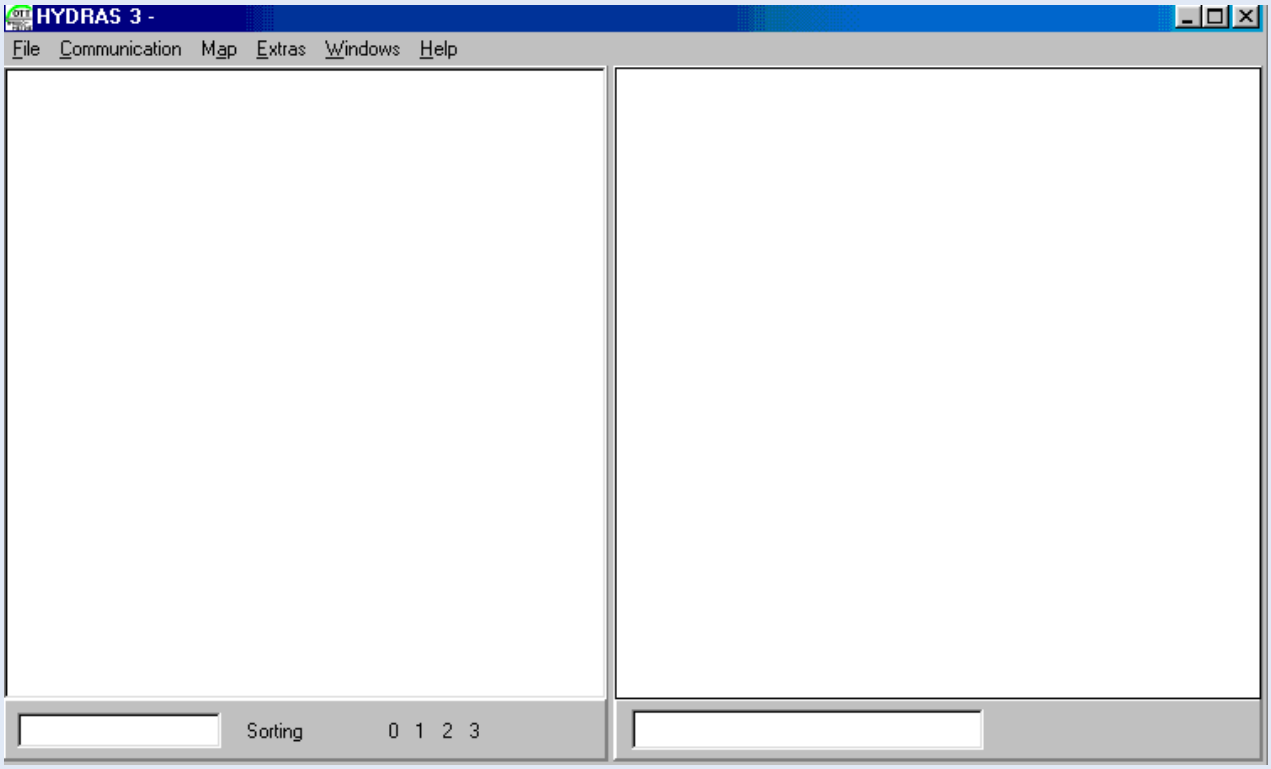
Orpheus uses four, commonly available, alkaline batteries i.e. C-cell (1.5 V) (LR 14.C.AM2). To insert the batteries, open the top cap of the logistics unit, remove the instructions paper from the batteries chamber and slip the batteries into the chamber. Tighten the cap of the logistics unit. Orpheus has now started measuring calculated values using the factory set up. Since this is a new set up, the operating parameters need to be reset [setting the operating parameters is explained in the proceeding paragraphs]. The batteries must be replaced if the battery voltage falls below 4.5 V. The life of the battery is up to more than a year depending upon the ambient temperature, data storage interval and communication between the VOTA unit or PC. This duration drops to 50% if the temperature is below zero degrees Celsius. Since this is not the case in the selected stations in the Nile Basin, the battery will work for more than a year. However, it is recommended to check the battery status at each visit to the station to be sure of proper functioning of the Orpheus. Changing the battery at a later stage has no effect on the stored data.

3.3 Creating Workspace, Region, Stations and Sensors in a PC using Hydras3 Software

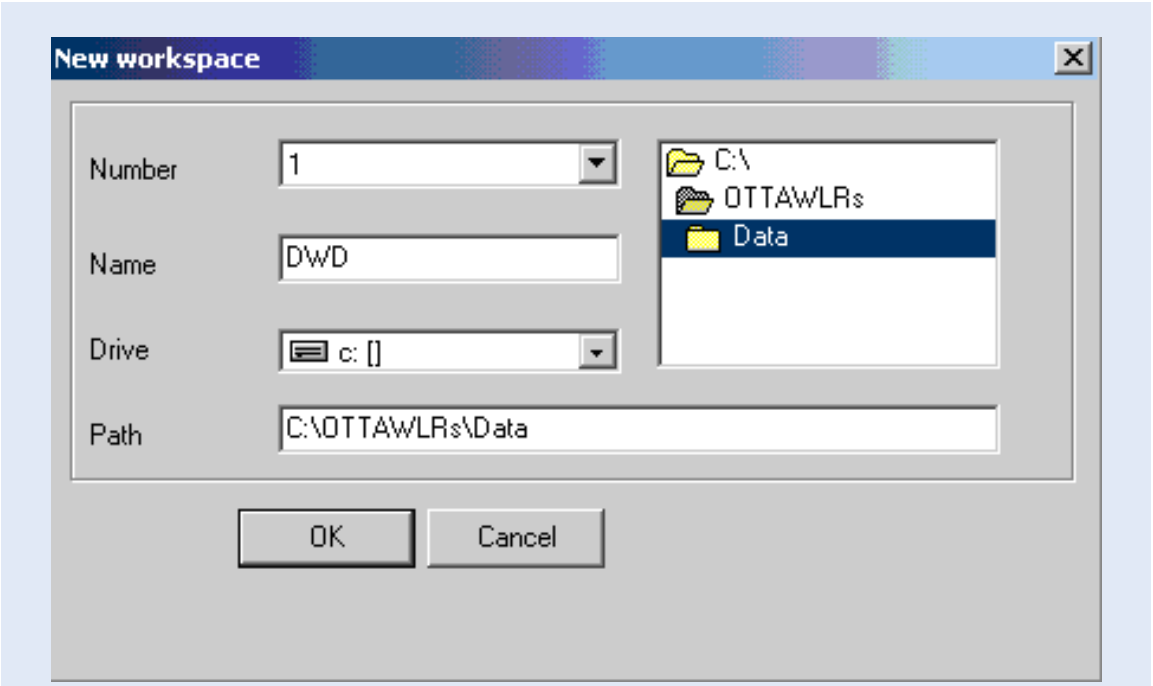
Before starting working with Orpheus, it is essential to create a workspace in the Hydras 3 software on the PC. A workspace includes region(s), station(s) and sensor(s). To create these, follow the steps below:

Step 1: Make sure the Orpheus communication software i.e. "HYDRAS 3" has been installed. If not, install it by inserting the CD into the CD drive and follow the instructions given on the CD cover. It is recommended to install the program in the following directory: "C:\OTTAWLRs" on your PC. Also create programme shortcut on the screen.

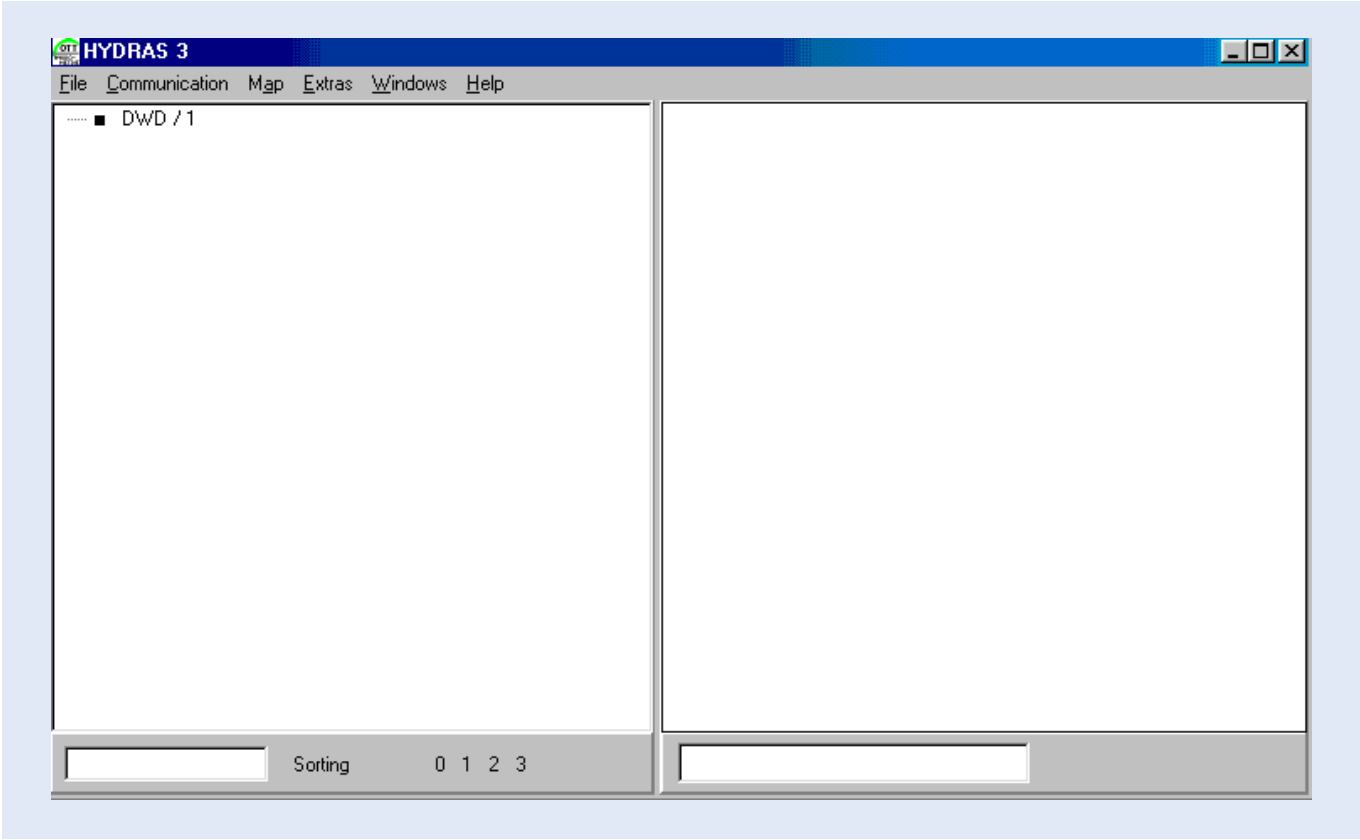
Step 2: Activate the Orpheus communication program "HYDRAS 3". The resulting program window is empty and will look like as shown below:



Step 3: Create a workspace by clicking on the "New Workspace" from the "File" main menu. The following window appears:

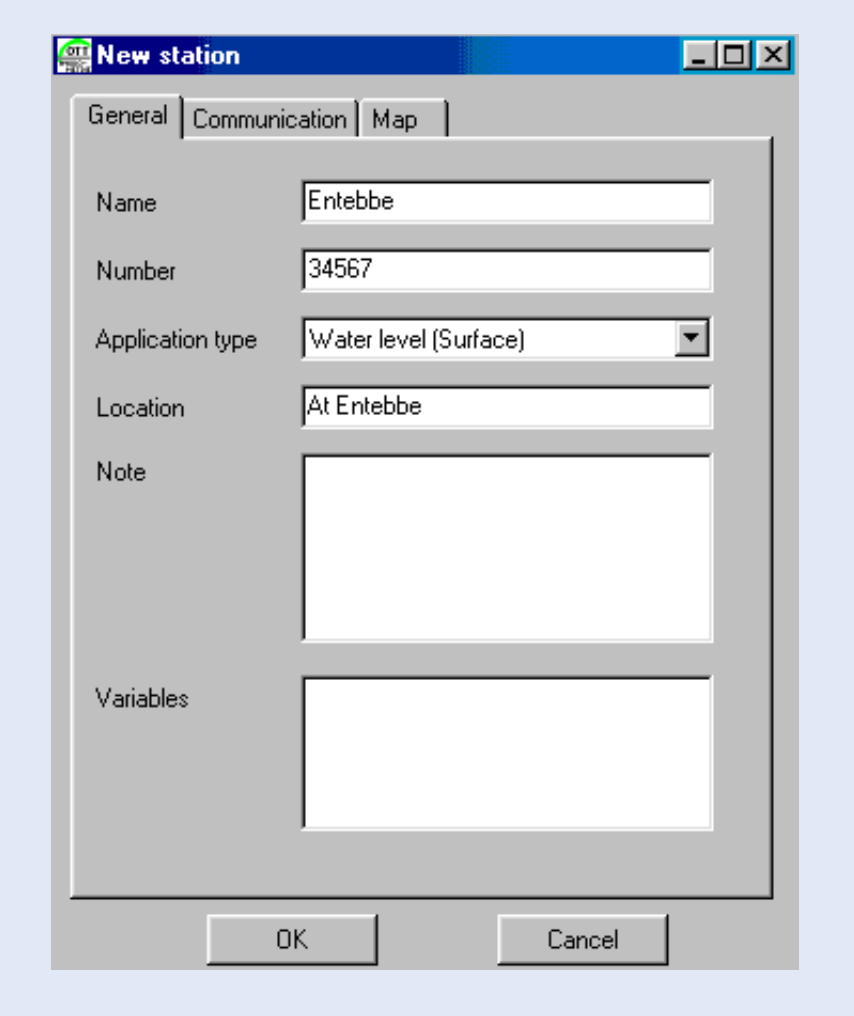


A workspace is a directory that contains a region/regions, stations within a region and sensor/sensors within a station. One can have the workspace with a name e.g. DWD. Path must be set by clicking in the path field and then clicking on the "C:\", then "OTTAWLRs" and then "Data" within the window [Note that right path should be selected otherwise the workspace will not be created]. The resulting window will look like this:



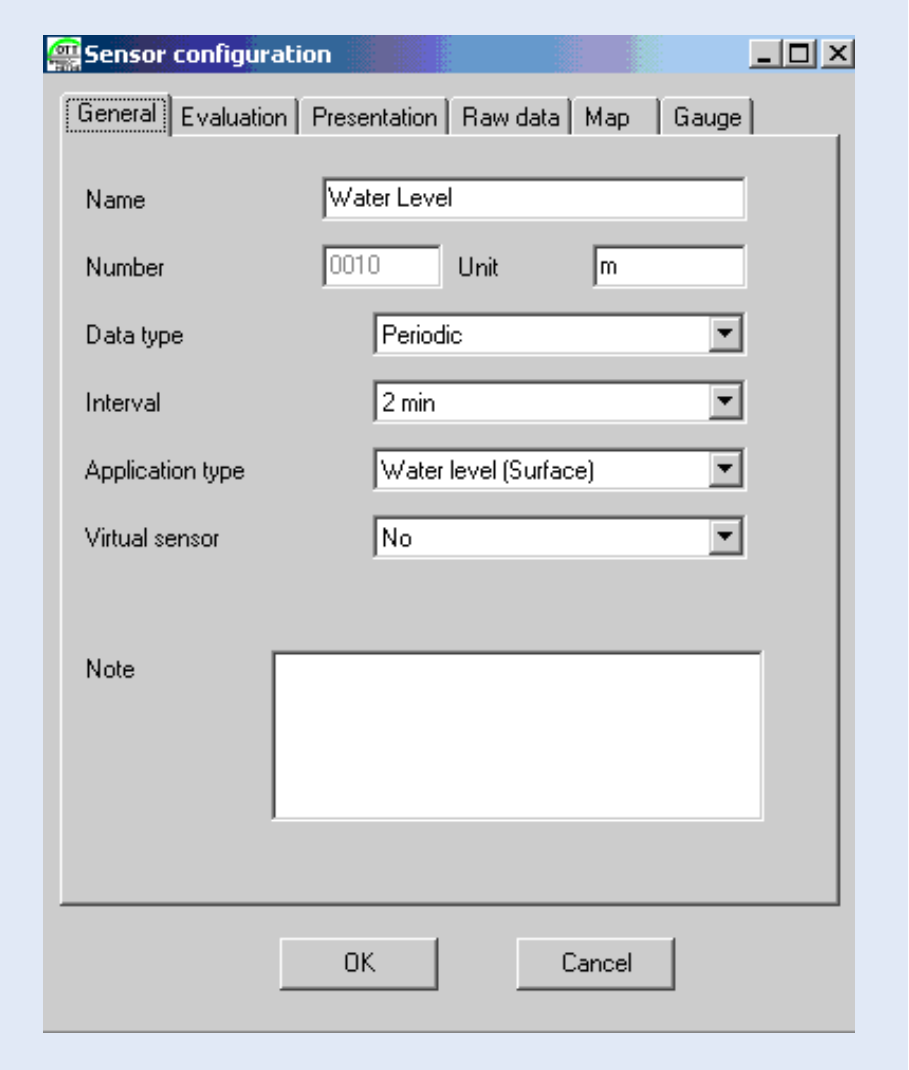
Double click on the black spot of the workspace "DWD". This workspace "DWD\1" has one region with the name "All Stations/999999999999". This region is automatically produced within the workspace, the name of which cannot be changed. Within this region, create the stations with their names and ID numbers where Orpheus are going to be installed. Every station will have one water level sensor i.e. Orpheus (in fact a station may have several sensors). To create these stations and sensors proceed with step 4.

Step 4: Right click on the region called "All Stations\999999999999" and select "New Station". A window will appear as shown below. Enter details of the gauging station and click OK.



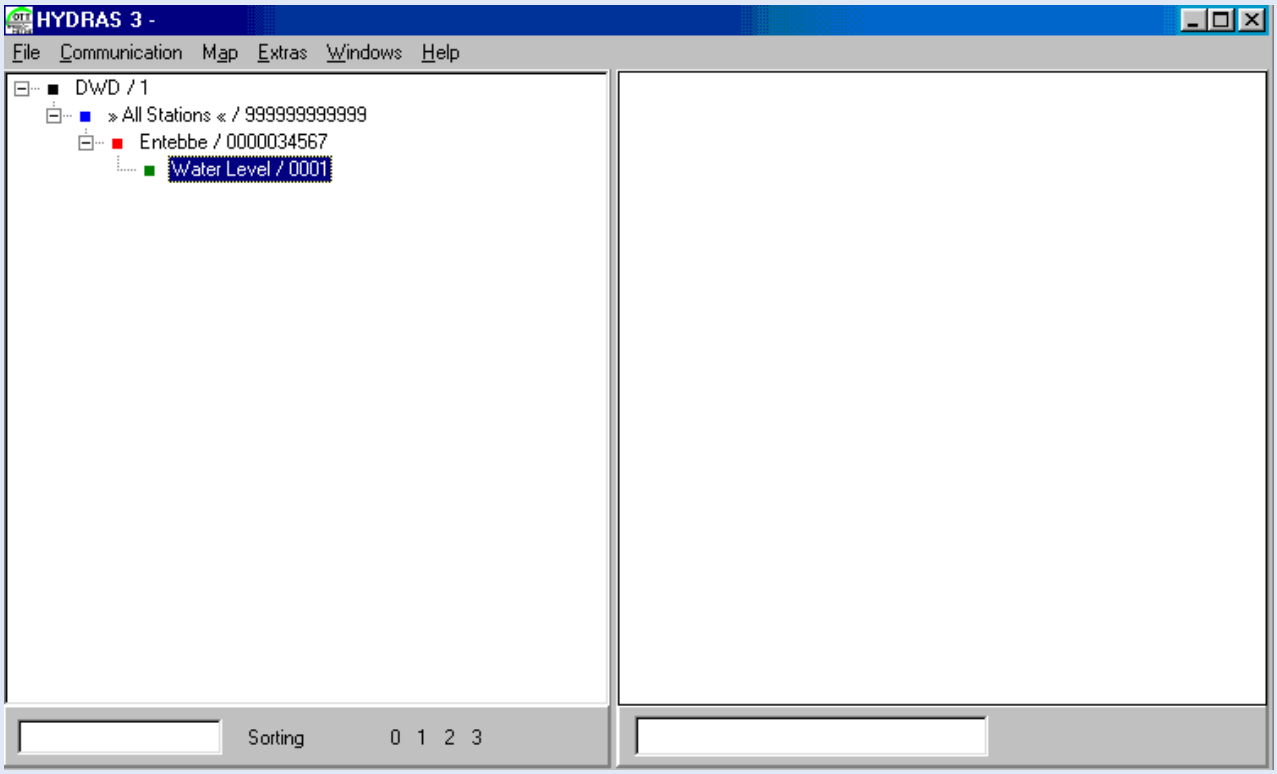
Note: Enter only the hydrometric number of the station and no zeros.

Step 5: Enter the sensor to the station by right clicking on the station and selecting "New Sensor". This is the sensor (Orpheus) which will be installed at the gauging site. Enter the sensor details in the resulting window as below:

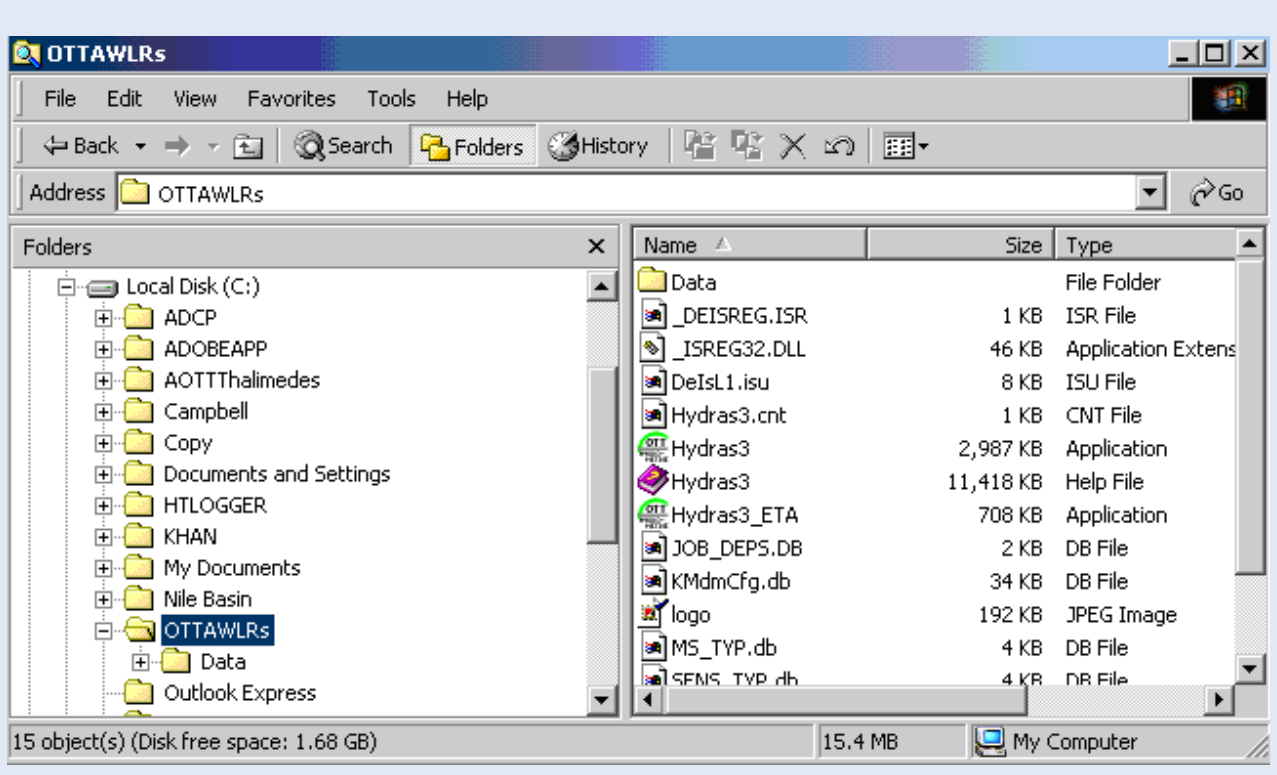


Proceed to the "Evaluation" tab in the same window and click in "Means" check box. In the "Presentation" tab enter the text for Y-axis as "Water Level (m)" and select graph type as "Polygon". In the scaling fields for "Mean Values" enter Y-Minimum as "0". Y-maximum, however, depends on the maximum water level recorded at the station in the past years and should be entered carefully. Ignore the "Raw data", "Map" and "Gauge" tabs.

The resulting program window with the workspace is shown below and can be explained as: the first workspace called "DWD/1" has at present one region called "All Stations/99999999999". This region has, for the time being, one station called "Entebbe/34567" which contains a sensor (Orpheus) for surface water level recording. Under the same workspace there may be several regions, under a region there may be many stations and under a station there may be several sensors from AOTT Company. If needed there can be several workspaces with different regions, stations and different sensors numbers. To keep it simple and easy to use, in Uganda, for example, the following workspace is found suitable (new stations with the same sensor (Orpheus) but with different datalogger and station number will be included under the same region).



When a workspace with region/regions, station/stations and sensor (s) has been created, the folder "OTTAWLRs" in the Windows Explorer will look like as shown below:



The raw data collected from Orpheus every time will be saved automatically to the sub-folder "Rawdata" as separate files in the form "Ed000, Ed001, Ed002.....".

Note: Do not delete or move any of these folders to another location otherwise the data will either not be collected or will become difficult to collect. This setup has been created by the program itself during the station and sensor configuration.

3.4 Setting the Operating Parameters for Orpheus

Setting the operating parameters for programming the Orpheus can be accomplished in two ways i.e.:

- Using the laptop/PC onsite
- Using OTT VOTA unit onsite

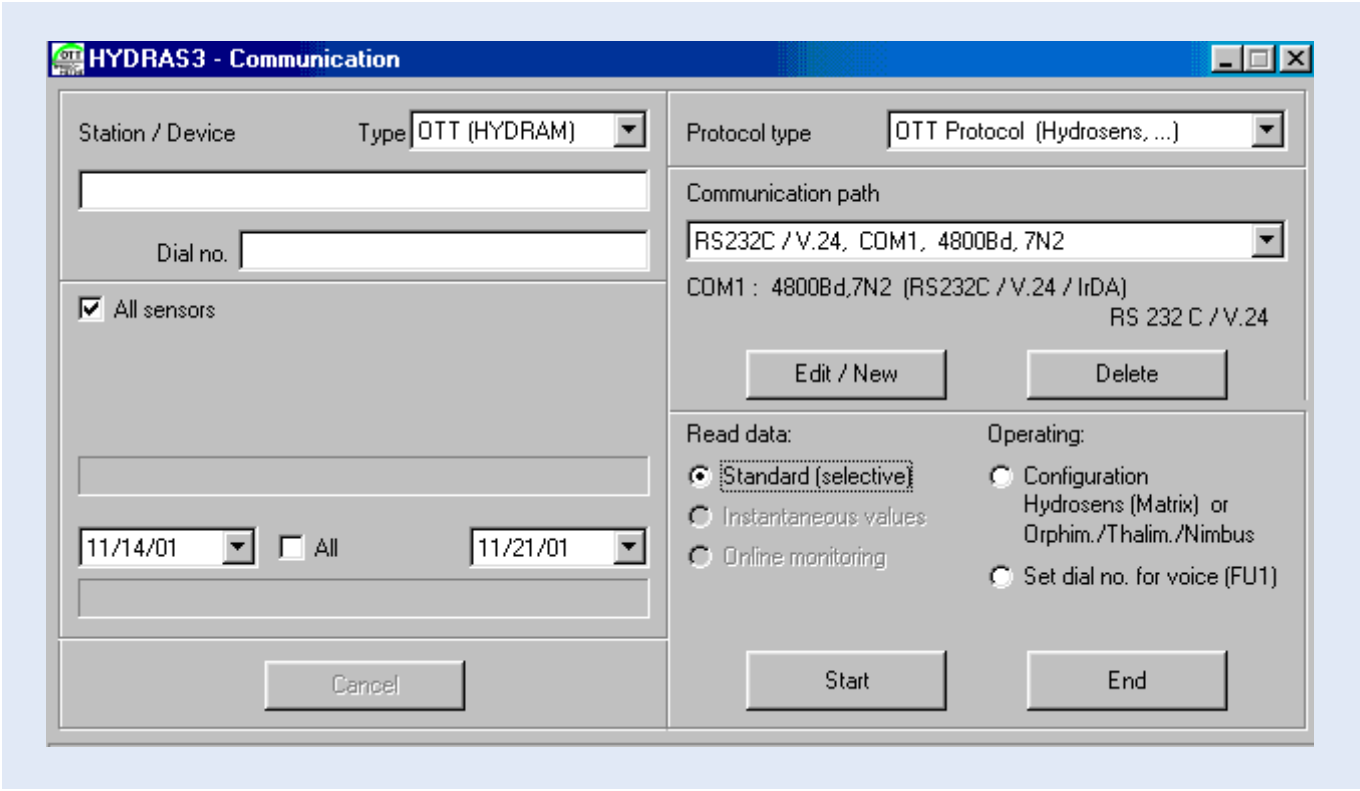
Configuring Orpheus with the laptop/PC is explained in the proceeding paragraph while using OTT VOTA for the same purpose is explained in Chapter 4.

3.4.1 Configuring Orpheus with a Laptop PC

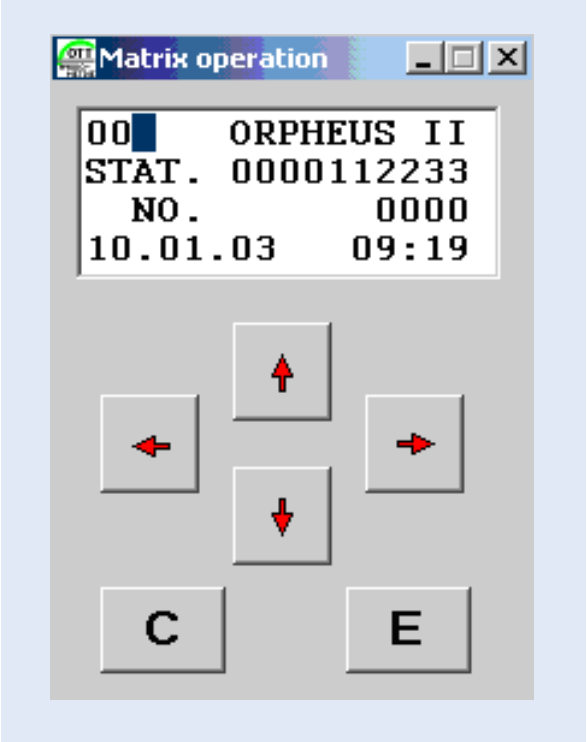
It is assumed that Orpheus has been installed onsite and that it needs to be reprogrammed according to the present manual gauge reading. For setting up the operating parameters with a laptop/PC, follow these steps:

Step 1: It is assumed that Hydras 3 software has been installed successfully in the PC and the workspace, region and stations, where Orpheus has been installed, have been created.

Step 2: Establish communication between the laptop PC and the Orpheus. This is achieved by connecting one end of the DuoLink serial cable to PC and putting the other end on the optical interface of the logistics unit. The magnetic characteristic of the DuoLink provides firm contact with the optical interface of the logistics unit. Click "Read/ Operate" on the "Communication" main menu item of the HYDRAS 3 software. The following window appears:



Change Type to "Orpheus" and check the "Configuration" box. The remaining setting on the window should remain the same. Now click on "Start" button while the IrDA interface is in firm contact with optical interface on the logistics unit. If the connection with the sensor is successful, the following window appears:



Orpheus operates through several groups of Matrixes.

Group 1 (Starting from Matrix 00 to 09): gives an overview or general information about the station, system date and time, power supply, sensor information, operating language etc.

Group 2 (from matrix 10 to 19): contains water level parameters. These are the most important group of matrixes for surface or ground water level measurements.

Group 3 (from matrix 20 to 69): for the optional measurement of water temperature (not important if the sensor is used for measuring surface water level).

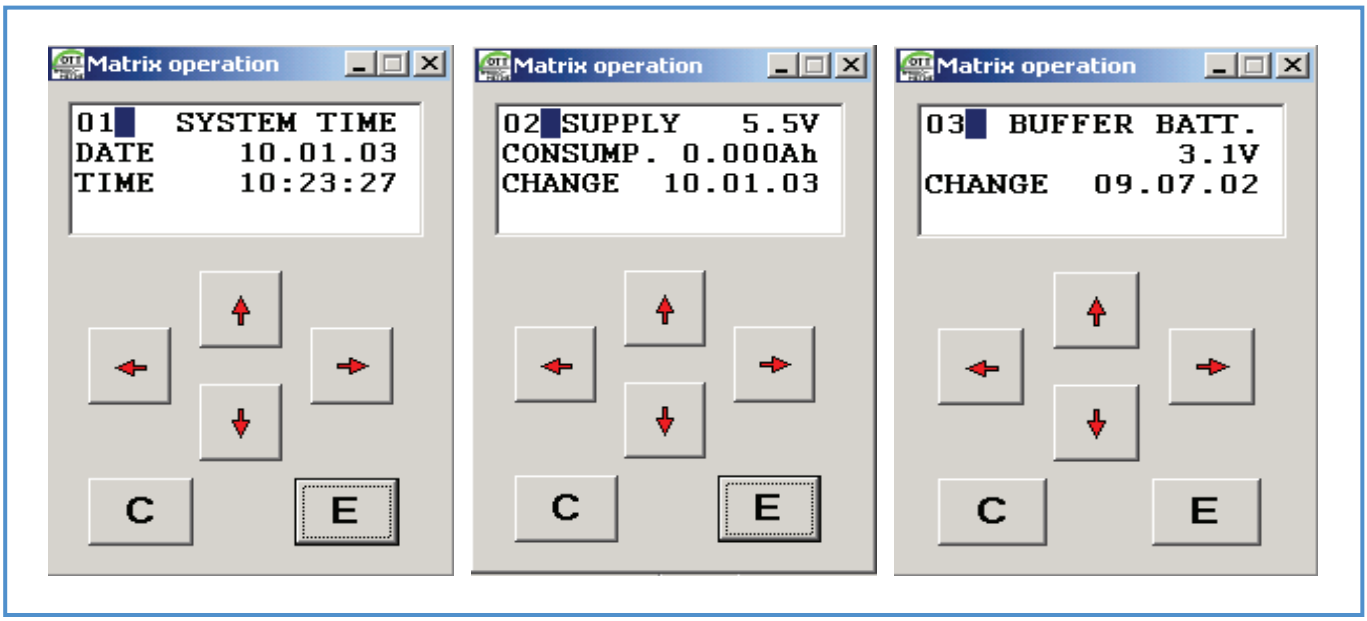
Group 4 (from matrix 70 to 79): data resets etc. Only matrixes 70 and 71 are important.

Movement between the matrixes of the same group is achieved by clicking on the left and right arrow buttons shown in the window above while changing from one group of matrixes to another is achieved by clicking on the up and down arrows. Matrixes important for configuring Orpheus for measuring surface water levels are dealt with in the following paragraphs:

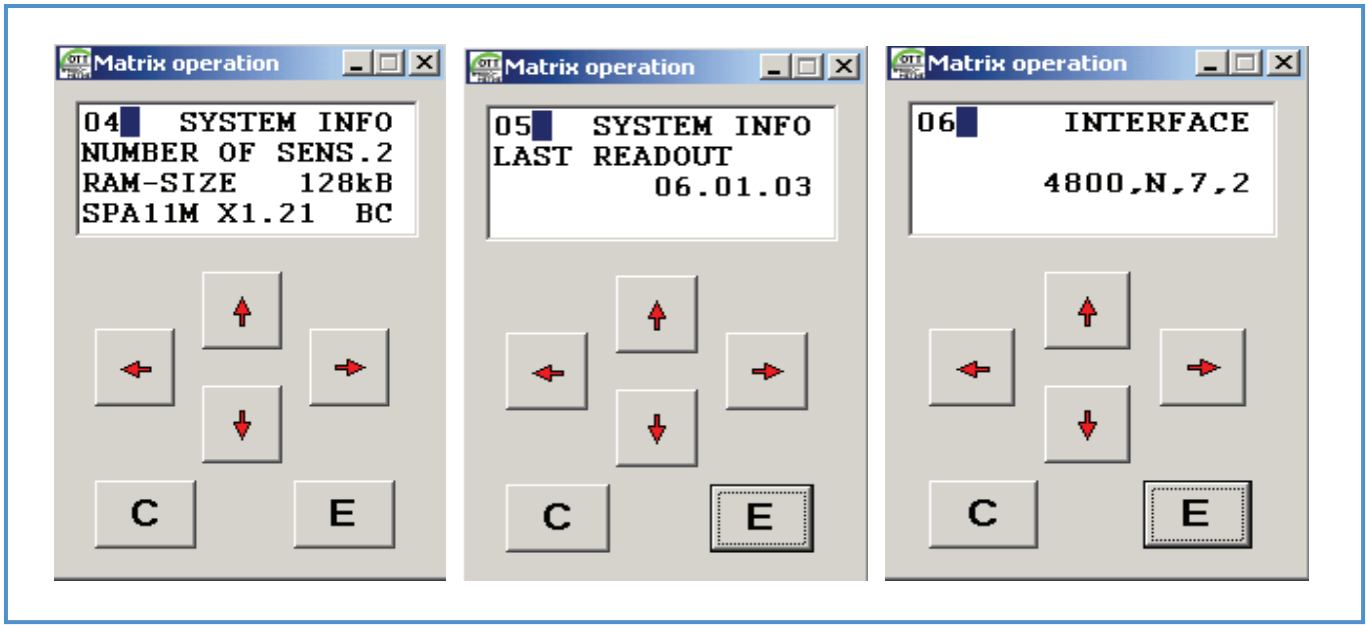
Step 3: This step explains the first group of matrixes as follows:

Matrix 00: is shown in the window above. Click enter (E) to change the station number only in this matrix. The numbers can either be changed by clicking on the up or down arrow keys or using the keyboard. The No. field corresponds to a code and is important only for a possible future networking of a number of stations. The data and time cannot be changed in this matrix.

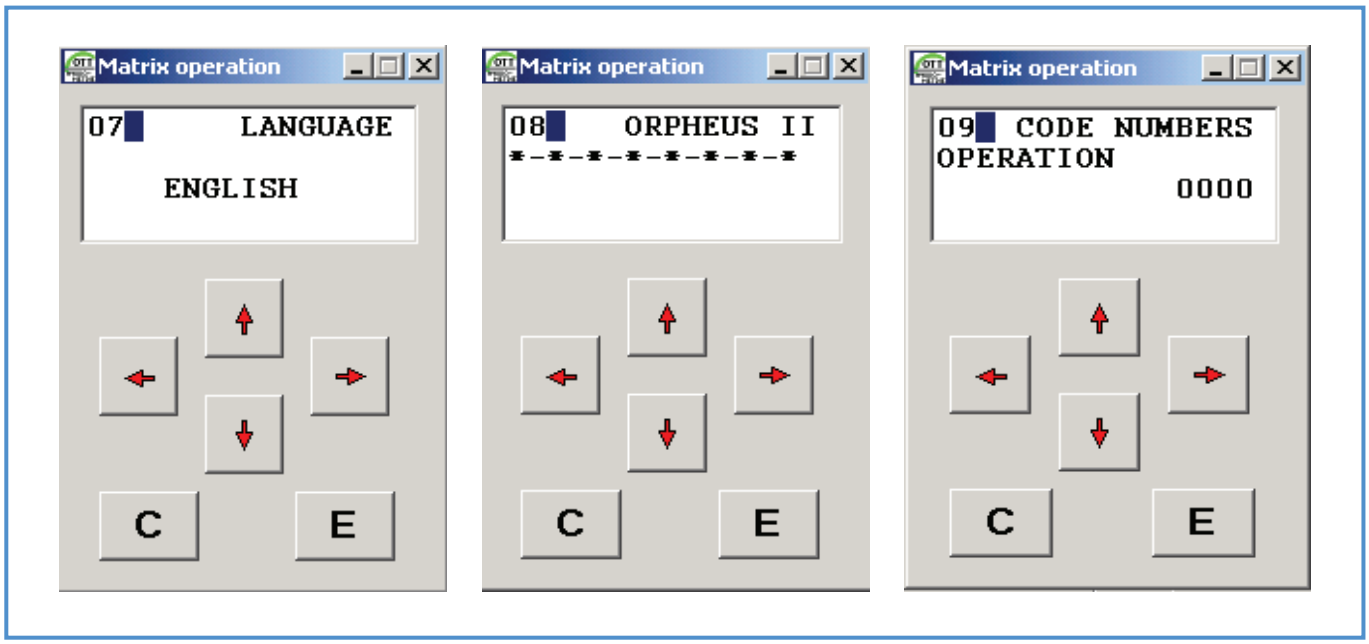
Matrix 01, 02, 03: Matrix 01 is used to change the date and time of the Orpheus while Matrixes 02 and 03 only give information about the power supply. Click on “E” to enter the exact date and time in matrix 01. The change field in Matrixes 02 and 03 indicate dates of the last battery change.



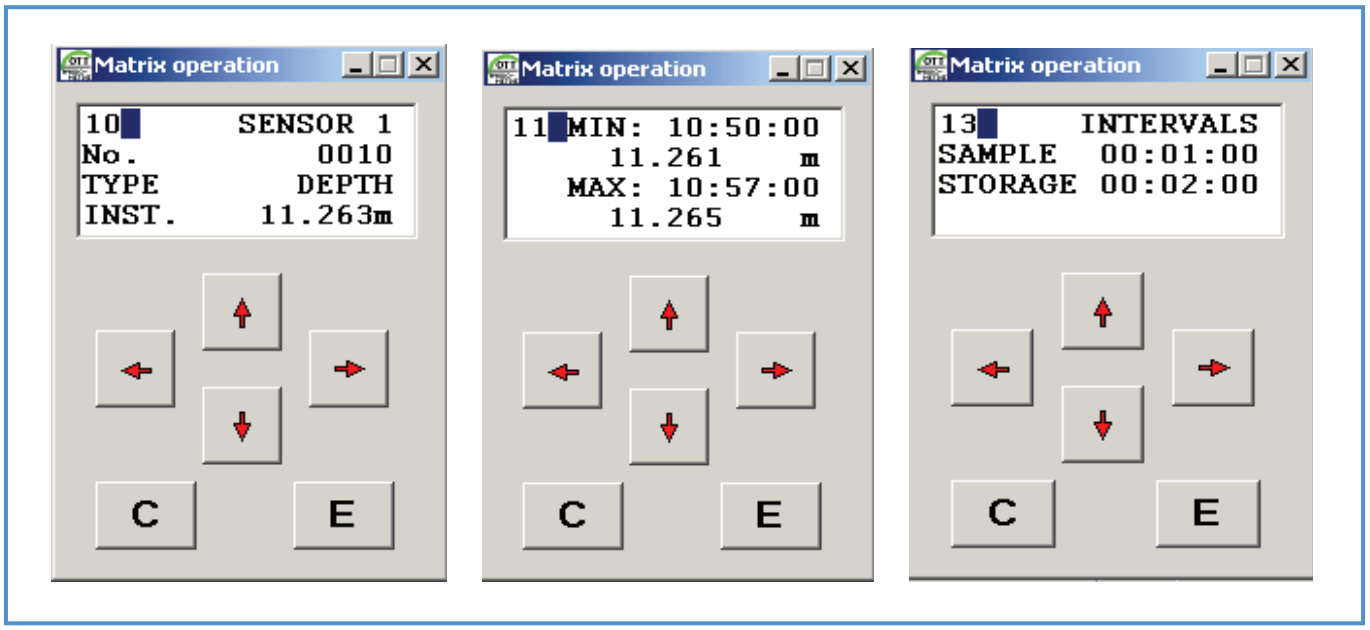
Matrix 04, 05, 06: These three matrixes, as shown below, only give general information about the system and nothing can be changed here manually. Matrix 04 shows 2 number of sensors because the present pressure probe body has two sensors i.e. water level and temperature. Matrix 05 gives information about the date of the last data readout or transfer from Orpheus to laptop PC or VOTA unit.



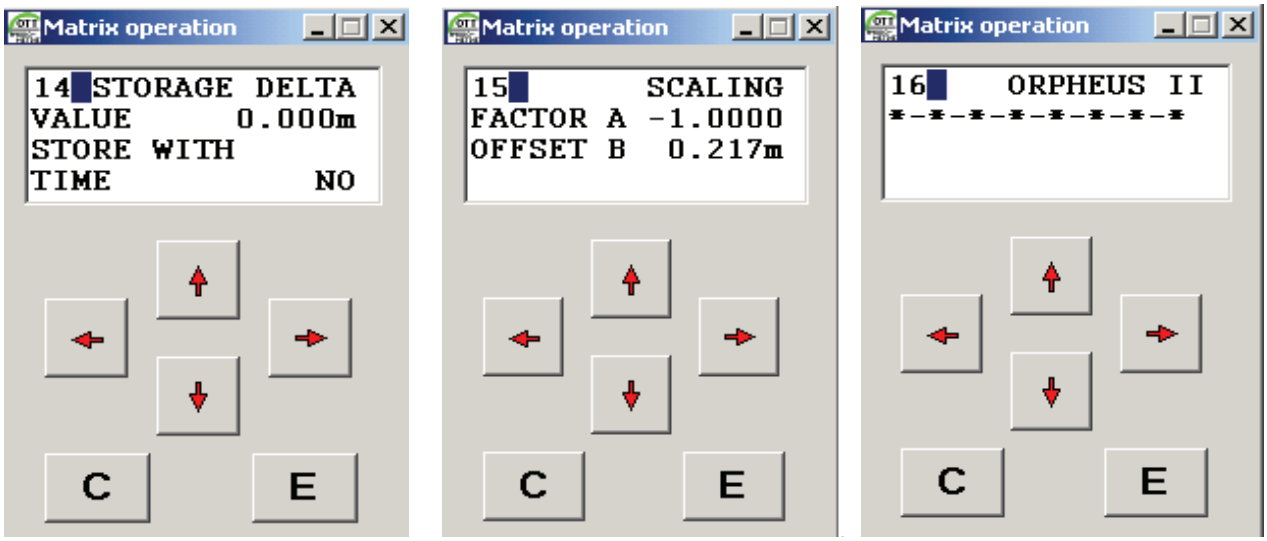
Matrix 07, 08, 09: Language of the Orpheus system can be changed in Matrix 07. Matrix 08 has no significance at all while the operator can enter a code number for access authorization in matrix 09. Code 0000 means that the code is disabled.



Step 4: This step deals with the most important group of matrixes as they contain water level parameters. The matrixes in this group are explained as follows:



Matrixes 10 – 19: The value in matrix 10 depends on the settings in matrixes 18 and 19. "No." depicts the sensor number i.e. 0010 stands for the water level sensor while 0020 stands for the temperature sensor. Instantaneous value changes according to the changes in water level with reference to a given gauge reading (matrix 19 and the scaling in matrix 15). The instantaneous value in matrix 10 cannot be changed manually in this matrix. Matrix 11 gives daily maximum and minimum water level and therefore no changes can be made in this matrix manually. Matrix 12 is of no use. Sample interval and data storage interval (e.g. quarter of an hour, hourly, two hourly etc) are set in matrix 13 and is therefore important. Click on "E" to enter the sample interval and storage interval. For example if the storage interval is selected for hourly data, the sample interval could be selected as 5, 10, 15, 20 or 30 minutes. The datalogger takes a value at each sample interval, keeps it in its memory and stores the average sample value at each storage interval

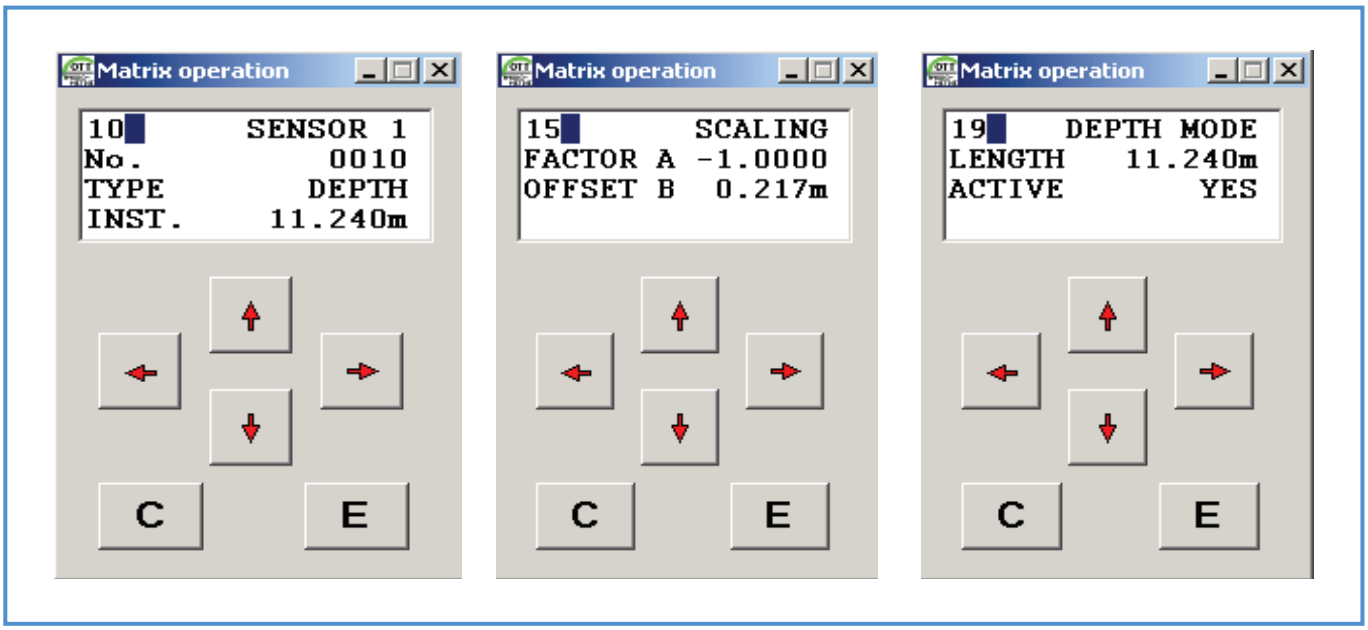


Selection of appropriate storage delta depends heavily on the hydrological regime of the respective river or lake. This has to be decided for each station separately according to the characteristics of the river or lake. For example a storage delta of 4cm (0.04m) for the lake levels will easily filter the effect of waves. This effect of waves has been observed at Entebbe Pier at around 4cm on average, recorded on a strip chart. At a river gauge station where there are sudden changes in the water level in short periods, the storage delta value should be kept zero and non-active. A wise selection of the storage delta will save a considerable storage capacity of the datalogger.

The scaling values in matrix 15 are extremely important and are used in combination with matrix 18 or 19. For fresh waters i.e. lake or river water "Factor A" is always kept +1.0000 or –1.0000. Offset is calculated as the difference in instantaneous value in matrix 10 and the gauge value in matrix 19. The interrelation among matrix 10, 15, 18 and/or 19 is explained with the help of the following example:

If the onsite gauge reading is e.g. 11.240m, the scaling in matrix 15 is e.g. A = 1.0000 & B = 0.000m (default values). The objective is to set the Orpheus for recording water level with reference to the present gauge reading that is 11.240m. To achieve this set the values in the matrixes 10, 15, 18 and 19 as follows:

Select Matrix 19, enter the "Length" value as 11.240m (gauge reading)and activate the matrix by selecting "YES". This automatically deactivates matrix 18. Matrix 19 is actually a depth mode but can also act like a float operated water level. The instantaneous value in matrix 10 comes out to be 11.458m, which needs to be brought down by entering the difference of 11.458m-11.240m = 0.218m as an "Offset" in matrix 15. The instantaneous value is now 11.240m but the datalogger starts recording in reverse order i.e. it records the rise in water level in descending order. To change the direction of recording, open matrix 15 and change the "Factor A" from +1.0000 to –1.0000. The set up of matrix 10, 15 and 19 should now look like as shown below:



The Orpheus is now ready and has started water levels recording according to the intervals set in matrix 13.

3.5 Retrieving Stored Data from Orpheus

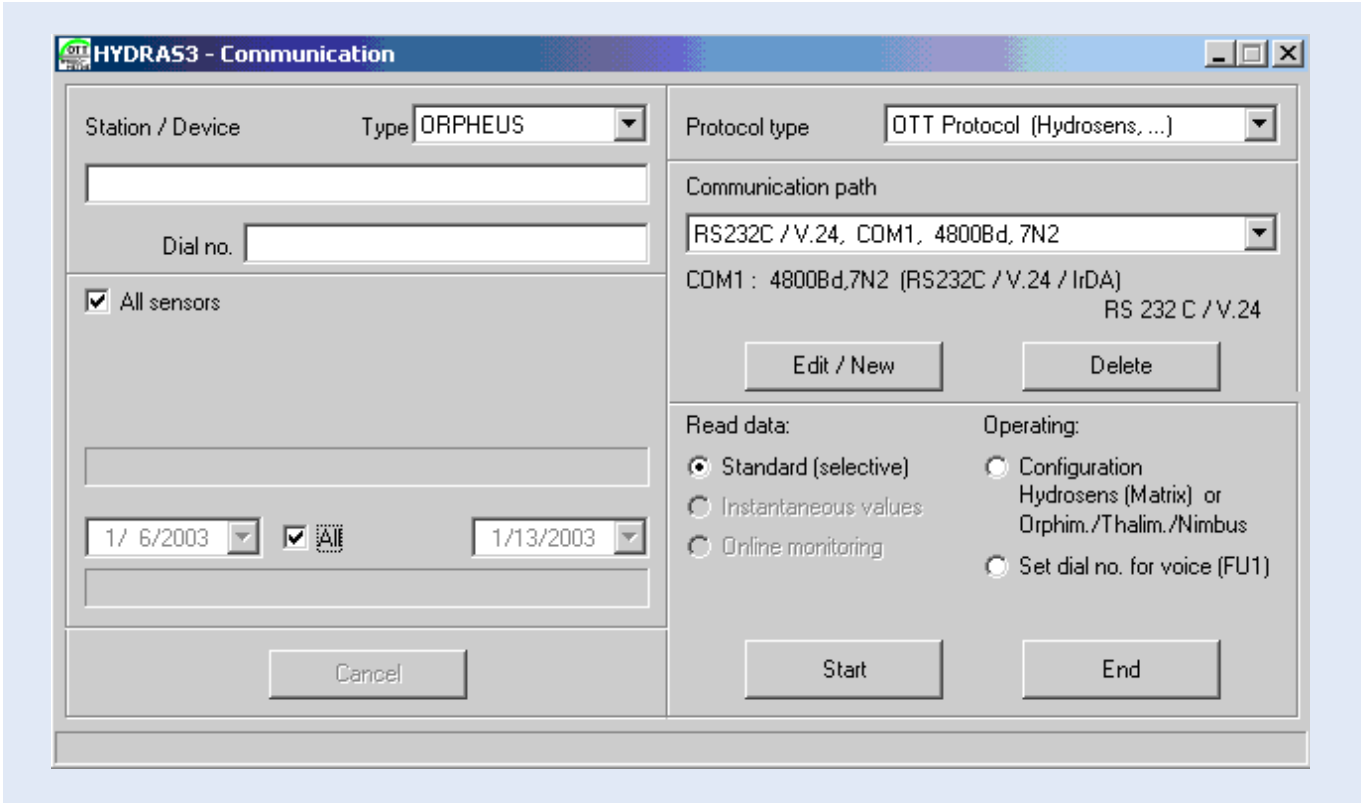
It is assumed that after successful installation, Orpheus has been recording data for a long time in the field on regular basis and that the stored data needs to be retrieved from the Orpheus. There are two ways to retrieve this data i.e.:

- With a laptop/PC or
- With OTT VOTA unit

Data retrieval from Orpheus with a laptop PC is explained in the following paragraphs of this chapter while data retrieval from Orpheus with OTT VOTA unit will follow in chapter 4.

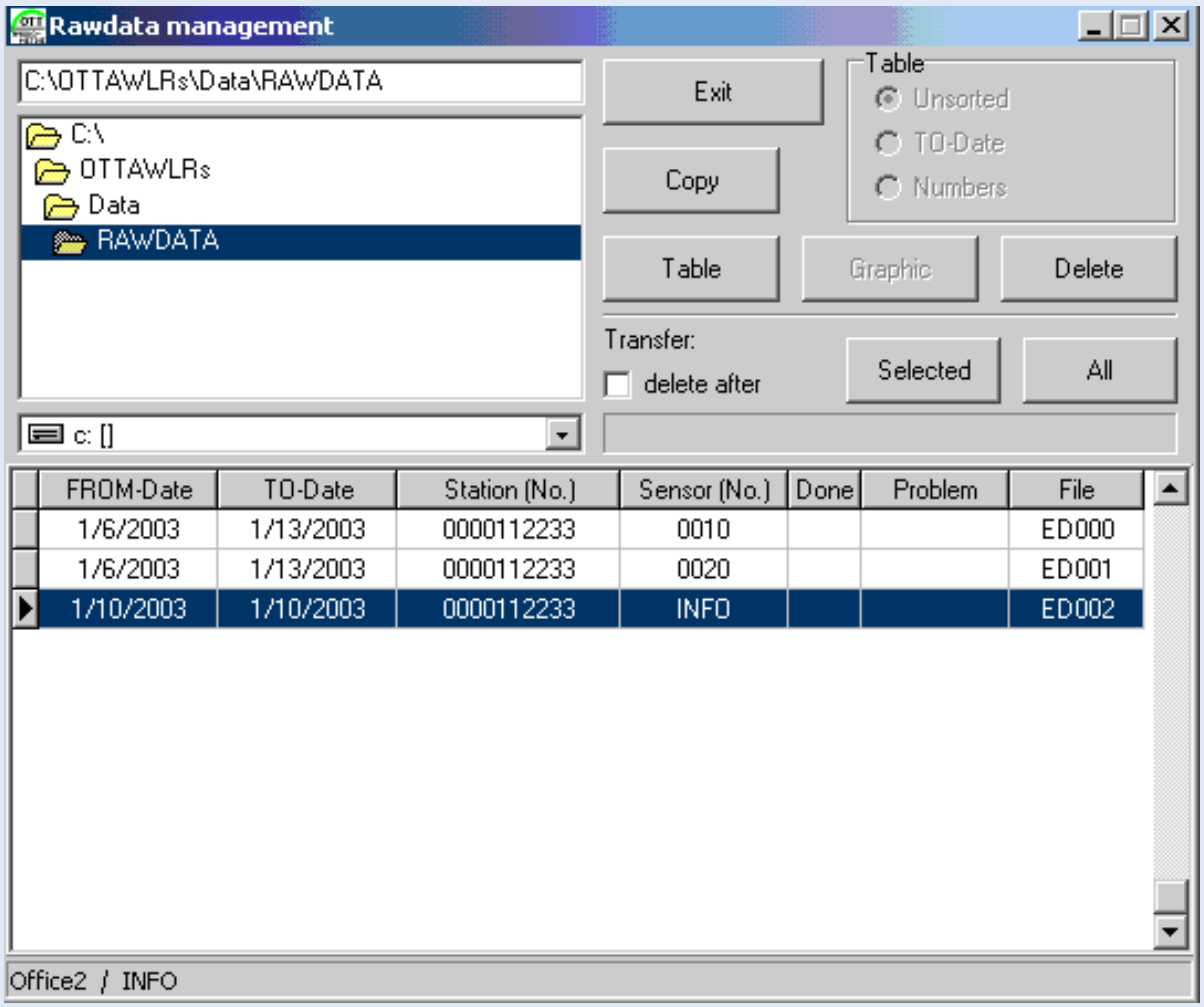
3.5.1 Retrieving Onsite Stored Data from Orpheus with the Laptop/PC

Step 1: It is supposed that the IrDA interface is connected to the computer port via a 9 to 9 pin serial cable and that the interface is put on the infrared sensor of the Orpheus. Activate the Orpheus software program HYDRAS 3 on the PC and double click on the black spot of the workspace "DWD/1". Select the region "All stations/999999999999" which contains the required station and sensor. Click on the "Communication" tab of the HYDRAS 3 main menu and click on "Read/Operate". Make changes in the resulting window shown below:



If data is needed for a specific period, then fill in the "from" and "to" dates fields otherwise check the "All" box which will give all the old and new data available in the Orpheus storage. Check the "Standard [selective]" check box and click on "Start" button. Wait till the data is downloaded to the PC. Click on "End" to finish the data transfer. Three files i.e. ED000, ED001 and ED002 have been retrieved at each download exercise.The data has now been downloaded and is stored in "Rawdata" sub-directory as a file "EdXXX" (where XXX shows the files downloaded each time).

Step 2: Retrieved data can be viewed within HYDRAS 3 by selecting "Communication" on the program main menu and clicking on "Raw data management". The following window appears:



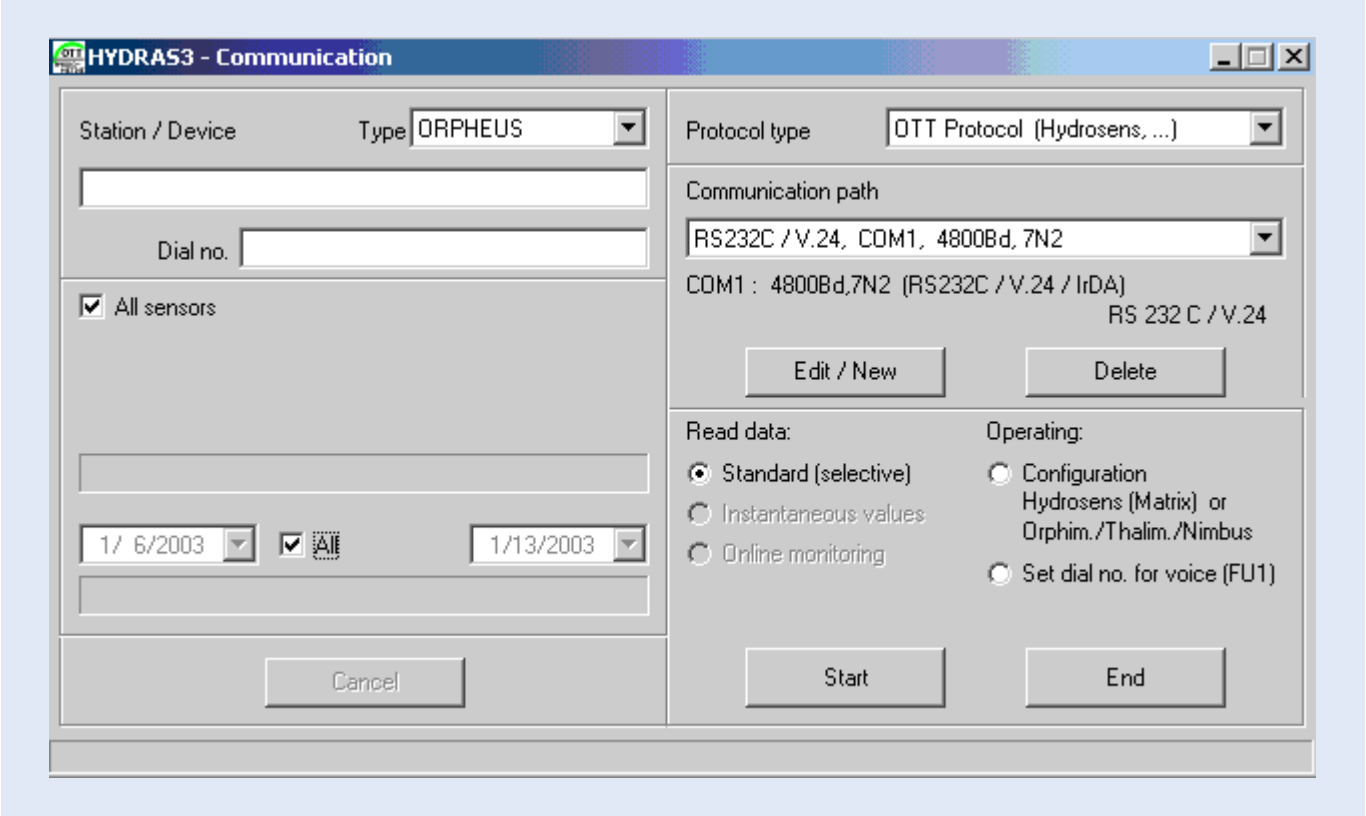
Since three files are downloaded at each download exercise, the first file with sensor number 0010 has the water level data, the second one with sensor number 0020 has water temperature data and the third file contains information about the sensor, station and previous downloads. The second and third files can be deleted here by selecting the file and clicking on "Delete" in the top right corner of the above window. The top left corner shows directory in which the data has been newly downloaded. The water level data in the new file "ED00" can be viewed by clicking on the "Table" button. The "Done" column is empty because this file has not been yet transferred to HYDRAS 3 format. The "Problem" column remains empty if no problems occur during the data conversion into the HYDRAS 3 format. This transfer of data format within the same window has been explained in Chapter 5, paragraph 5.2.1.

3.6 Deleting Stored Data From Orpheus Using a Laptop PC

It is not very important to delete old data from the Orpheus at each field visit as it has a ring type of memory, which means that once the datalogger is full of data, it starts overwriting the oldest data. However it is recommended to delete the old data from the datalogger at the time of its installation, which may contain unwanted data resulting from a different configuration. Deleting unwanted old data from Orpheus is explained in the following paragraph:

Connect the laptop PC to Orpheus via DuoLink and start the HYDRAS3 software on the PC.

Click on "Read/Operate" from the "Communication" main menu item of the HYDRAS 3 software.
The following window appears:



Change Type to "Orpheus" and check the "Configuration" box. The remaining settings on the window should remain the same. Now click on "Start" button and the matrix 00 will appear. Click on the down arrow key three times and matrix 70 will appear. Click on "E" in this matrix, change the code to 59 and click on "E" again. Changing the code to 59 allows to make changes in matrix 71. Move to matrix 71 by clicking on right arrow key, click on "E" to change the sensor no. to "ALL" and click on "E" again. This will reset the datalogger by deleting all the old unwanted data on Orpheus.

Using OTT VOTA Unit for Configuring Orpheus and Data Retrieval from the Orpheus

4.1 Introduction

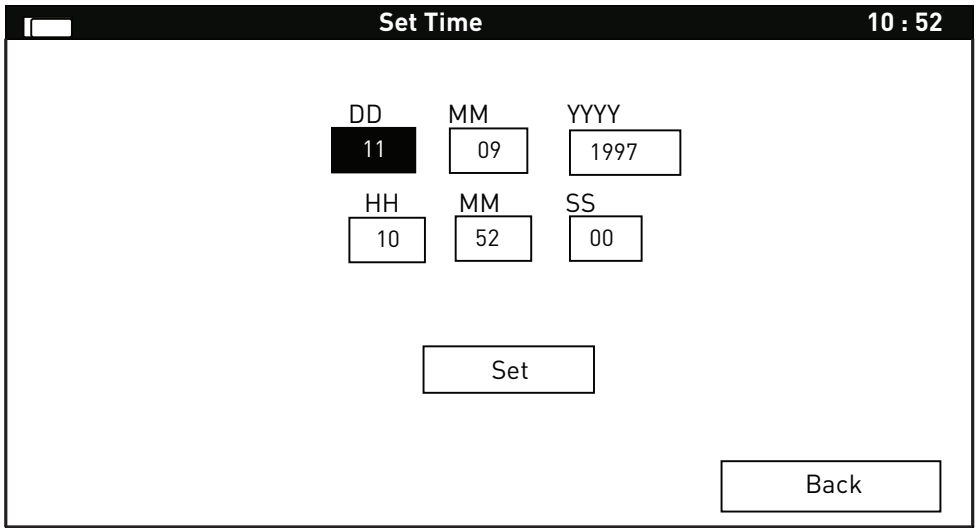
The VOTA multifunctional unit is based on a PC, designed for field service and includes preinstalled software and an illuminated VGA display. It is designed to configure the Orpheus and store hydrological measured values onsite and, is an alternative to notebooks. The VOTA has no keyboard; rather an operating knob called "jog shuttle", makes operation of the VOTA very easy. VOTA is activated by pressing the jog shuttle. A field/value is selected by turning the jog shuttle and is confirmed and activated by pressing it. VOTA is very easy to operate. No special computer knowledge is required.

An infrared interface adapter (IrDA) called "DuoLink" makes a wireless communication between an OTT datalogger and VOTA. The voltage is supplied by means of four commercially available 1.5 V alkaline batteries. This is discussed later in this chapter.

4.2 Initial Set-up and Operation of the VOTA

Activate VOTA by inserting the locally available 1.5 V alkaline batteries. The casing lock is unscrewed with a coin and tightened after the batteries have been inserted.

The VOTA is now automatically in stand-by mode. If still not active, activate it by pressing the "jog shuttle". When VOTA is activated for the first time, it runs through a boot sequence, which includes several hardware and software tests. Several messages appear during this test and the VOTA logo is also visible for a brief period. Finally the "Set Date/Time" window is displayed as shown in the Window below:



The entry field for the day is highlighted, and will start to flash when the jog shuttle is pressed. Enter the current day by turning the jog shuttle; press the jog shuttle to confirm the value. Turn the jog shuttle to move to the next fields and enter the values in the same way. VOTA will accept the current date and time by pressing the "Set" button. The new time is now visible in the upper right corner of the display.

It is important to reset the date and time while using at a later stage. This may happen if the batteries are removed for more than ten minutes. To reset the date and time at a later stage, select the menu items below in the order

given:
Select and Press “Management” from the main menu.
Press “System”.
Press “Set Date/Time”.

The “Set Time” window will open in the same way as shown in the window above. Change the fields as stated above.

VOTA can be operated in several languages i.e. Espanol, English, French, Deutsch and Japanese. The required language is selected as follows:

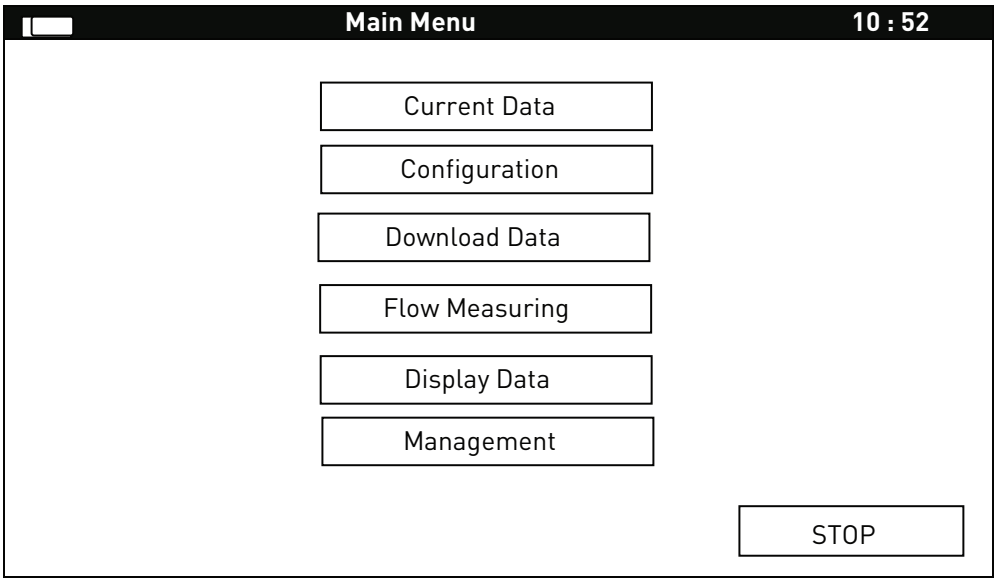
Select “Management” from the main menu.
Then select “System” field.
Press in the language field to select, e.g. English, as an operating language by turning and pressing the jog shuttle.

Note: The VOTA screen goes off to stand-by mode if not used for 30 seconds. In stand-by mode, VOTA is not fully deactivated but remains in energy-saving mode while the operating system and software are still running. Just pressing the jog shuttle once reactivates the screen.

Notes on the batteries: Battery life is up to six months in stand-by mode and up to 20 hours (at 20C ambient temperature) if the VOTA is continuously in operation. The battery life is reduced at low temperatures. The battery voltage can be monitored by means of a display in the upper left corner of the screen. If four or three bars are visible, battery status is good while two bars indicate adequate status. It is recommended to replace the batteries if only one bar is visible. VOTA displays a warning message “Battery capacity too low” if the batteries are exhausted. Replace the batteries immediately as it is impossible to continue working after this message is displayed.

To prevent the device from being switched on accidentally and simultaneous battery drain, there is a turn-on delay, which is activated using “STOP” field. It is, therefore, recommended to switch the VOTA to stand-by mode using the “STOP” field in the main menu during transport to a remote area. The VOTA in this case cannot be reactivated for hours. VOTA has one main menu as shown below;

Main menu with STOP field.



Once the VOTA is set up, it will always display main menu upon switching on. The individual menu items have the following functions:

Current Data: recalls current values such as level, depth, temperature, date and time in the data logger system.

Configuration: sets the operating parameters when setting up a datalogger for the first time.

Download Data: transfers the measured values stored in a datalogger to the VOTA.

Flow Measuring: carries out discharge measurement using OTT current meters.

Display Data: provides a graphical display of measured values downloaded to the VOTA.

Management: adjusts VOTA operating parameters i.e.
- sets operating language, date and time
- selects data readout device i.e DuoLink
- displays ambient temperature
- displays available data memory
- deletes data etc.

STOP: switches the VOTA to stand-by mode and activates the turn-on delay.

The individual menu items are discussed in detail in the following paragraphs.

4.3 Configuration:

This option is needed if the datalogger has to be programmed/configured for the first time. Following is an example on how to initially program the Orpheus using VOTA:

Connect the VOTA unit to Orpheus via DuoLink data readout device and select "Management" from the main menu, select "System" and select "DuoLink" under "Infrared".

Select "Serial" under "Configuration". The message "Connecting datalogger" is briefly displayed. Once the connection has been established, Matrix 00 appears on the screen. Structure and configuration of the Matrixes are the same as explained in chapter 3.

Note: It is very important to create the station and sensor in the workspace of the HYDRAS 3 software on the PC with the same parameters/values for which the Orpheus is configured. Otherwise, the software will not be able to read the data files transferred from VOTA to the PC. Creating stations and sensors in the workspace has been explained in chapter 3.

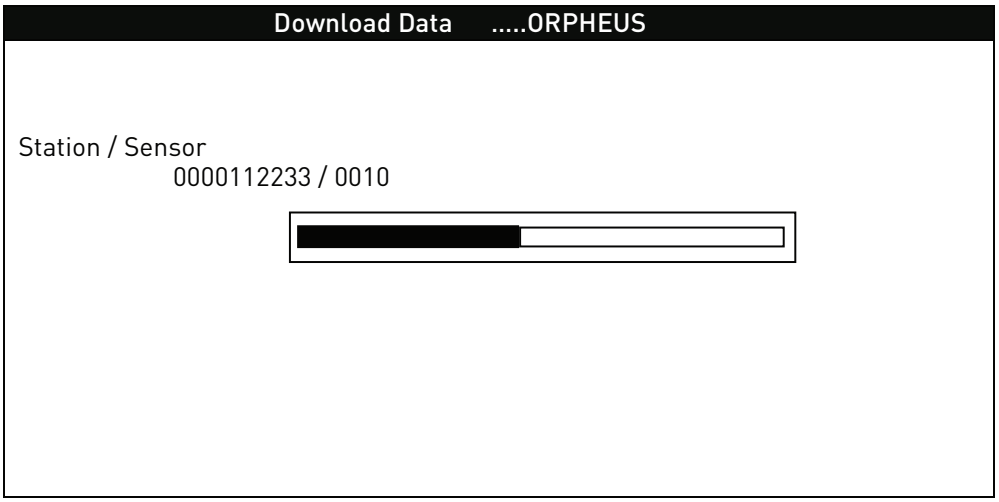
4.4 Data Download

This menu item is used to transfer all or part of the data measured from Orpheus to the VOTA. Retrieving this new data to VOTA is straight forward and is accomplished in the following way:

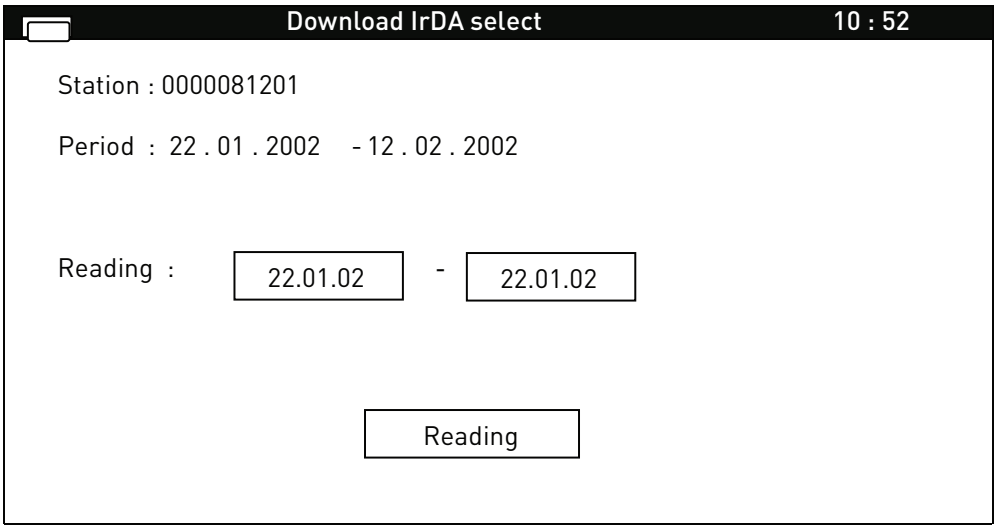
Connect VOTA to Orpheus via the DuoLink data readout device and select the VOTA fields in the following order:
"Management"
"System"
"Infrared" [select "DuoLink" as the data readout device]

Press on "Download Data" on the main menu and select "Serial". The message "Connecting datalogger" is briefly displayed. Once the connection has been established, the following window is opened which contains a progress indicator showing data download from Orpheus to VOTA. The progress indicator confirms the data download from the datalogger.

Download data via VOTA DuoLink

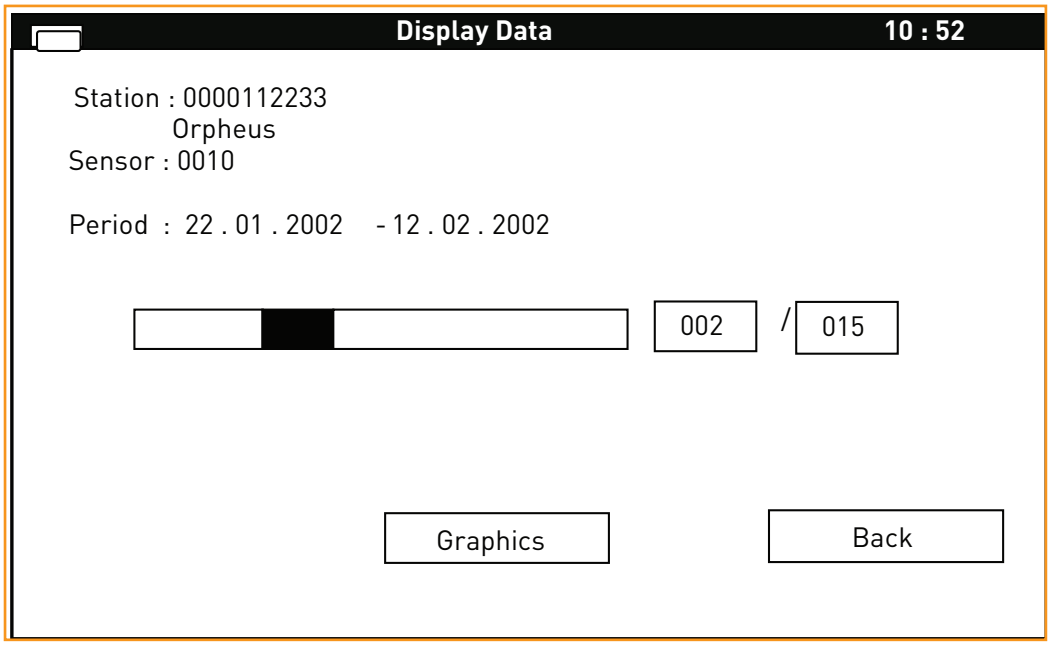


During this exercise, another window appears where the download period could be selected as shown below. The period since the last download reading is preset. After dates have been decided, click on "Reading". Wait till the data has been fully downloaded.



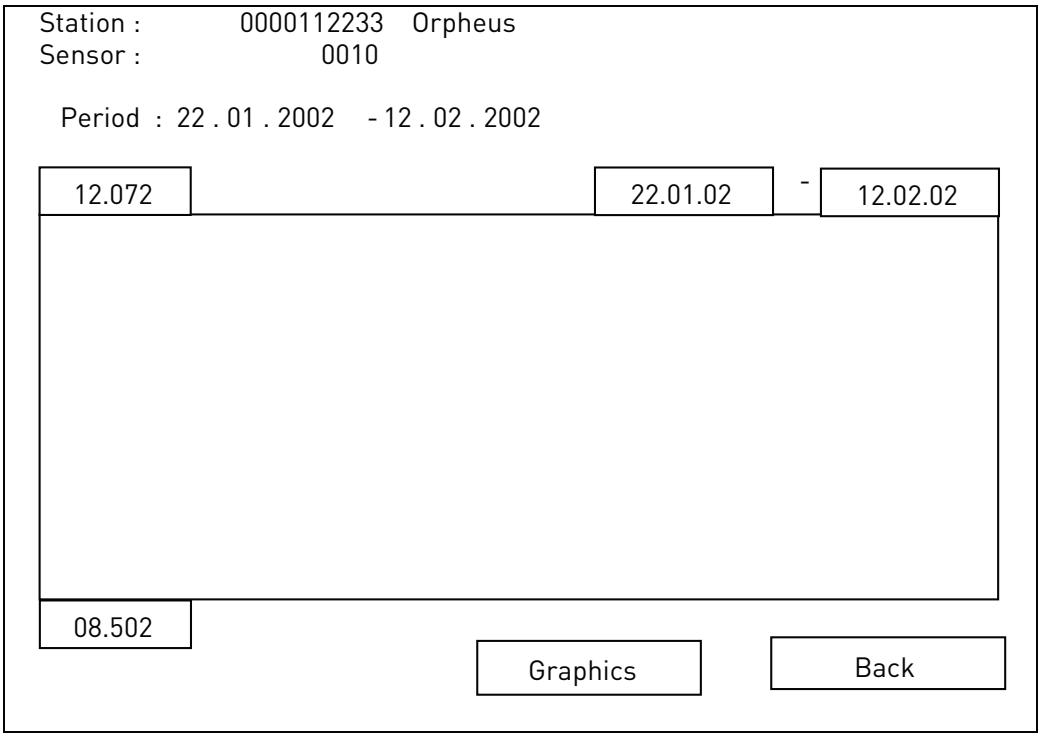
4.5 Data Display

For a quick onsite check, the recently retrieved data from the Orpheus to the VOTA can be displayed graphically on the VOTA in the following way:



Click on "Display Data" on the VOTA main menu and the following window will appear:

The above window shows that a total of 15 data files have been downloaded from one or more stations and that at present, data file No. 2 is selected. If the recent file is to be displayed i.e. file No. 015, then change the field with data file No. 002 to 015 in the window and press "Graphics" to display the data graphically. The following window then appears:



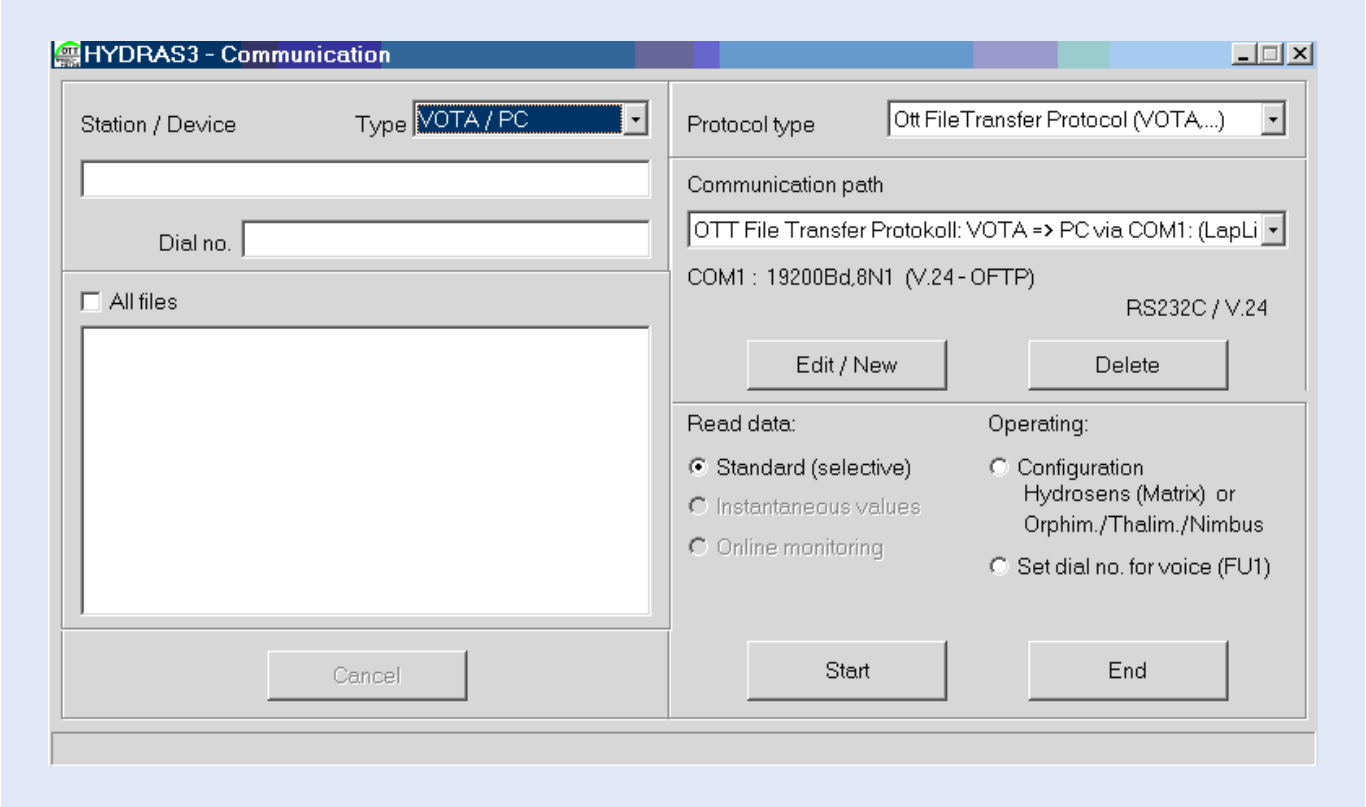
After selecting the range of the level in meters, i.e. the minimum and maximum level (top left and bottom left) and the display period, click on the "Graphics" and a graph will appear on the screen in the window shown above. The graph displays the level as a function of time.

4.6 Transferring Data Files from VOTA to PC

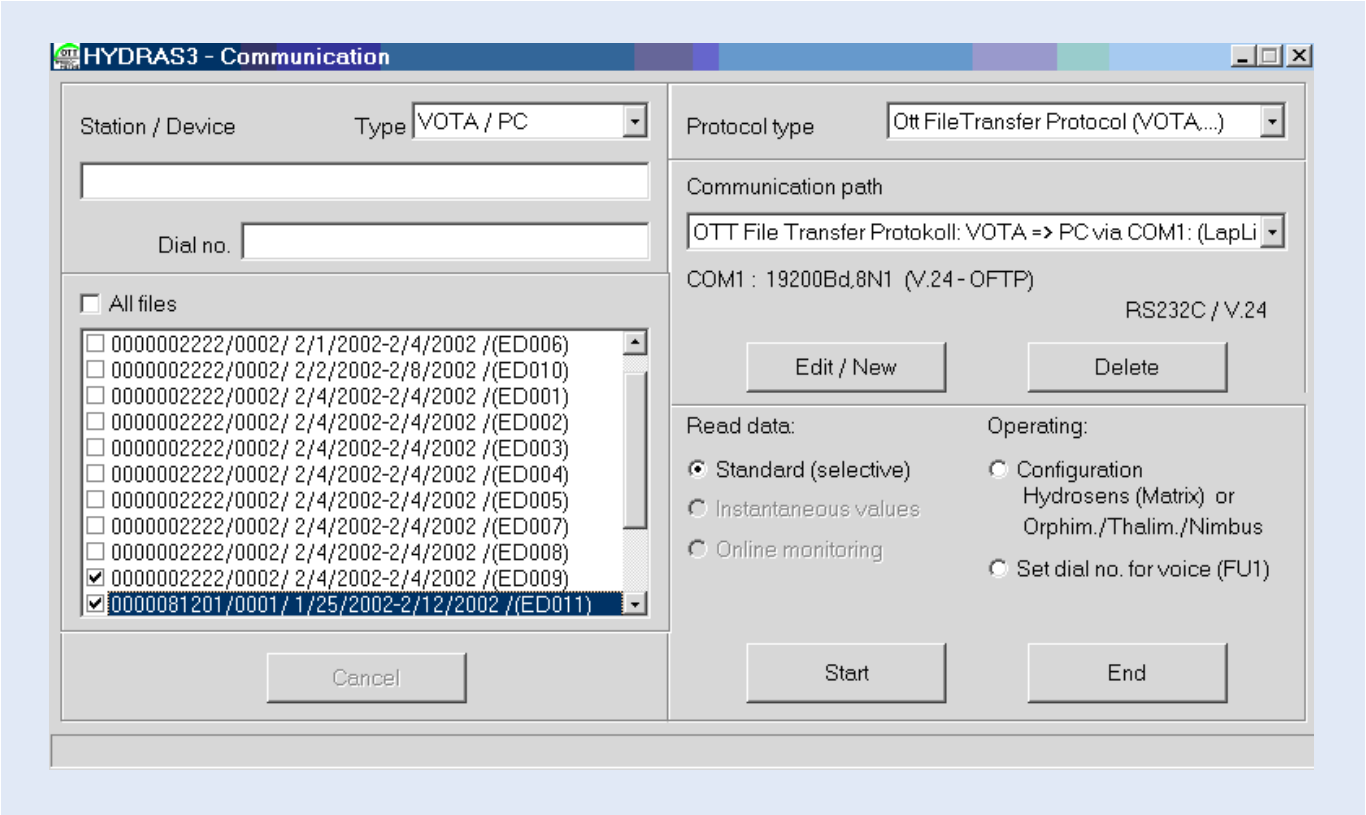
After retrieval from the datalogger, the data needs to be transferred from VOTA to PC. The following setup is required to accomplish this data transfer:

- 9 –9 pin female serial cable connecting VOTA to PC.
- Communication software "Hydras 3" already installed on PC.
- Start the program on PC and select "Read/Operate" from the "Communication" on the main menu.

Change the setup of the resulting window:



After clicking on "Start" in this window, a list of data files on the VOTA will appear as shown in the window below. Select the desired data files, which need to be transferred from VOTA to PC by checking the box of the data files.



Click on "Start" again to start the selected data transfer from VOTA to PC. The window will show the progress of data transfer and the following message "Erase all copied raw- data files in VOTA now?" will appear. Click on "Yes" if so required.

This newly transferred data file(s) can be checked to confirm the successful transfer in the same way as discussed in Chapter 3 (step 2 of the paragraph 3.2.1).

4.7 Deleting Data from VOTA

It is important to delete old data from VOTA in order to create memory space for the new data to be retrieved from the dataloggers. Data from VOTA can be deleted in two ways i.e.

- At the time of data transfer from VOTA to PC (this has been discussed in the paragraph 4.5).
- Through the "Delete data" function in the "Management" menu item in the VOTA. This is done in the following way:

Press on the "Delete data" function of the main menu item "Management" on the VOTA. Select "Delete all" if all the data has to be deleted from the VOTA or otherwise select "Selective delete" if some of the data files are required to be deleted. If the "Delete all" option is selected, a question "Do you really want to delete all data?" is displayed on the screen. Press in the "Yes" or "No" box.

4.8 Restarting VOTA

Sometimes the VOTA responds very slowly and sometimes even the display freezes. This shows that the VOTA has stopped functioning.

If the device is slow to respond then press on the commands in the order as given below:
"Management"
"System"
"Reset"

The VOTA will restart.

If the display is frozen then follow these instructions:

- Unscrew the battery casing lock using a coin.
- Wait for approximately 5 seconds
- Tighten the battery casing lock.

The VOTA is thus restarted.

If it still does not work, then try this:

- Open the three screws in the left hand side cover of the VOTA
- Remove the cover and press the reset key (red color). The VOTA is now restarted.
- Replace the cover on the VOTA and tighten the screws.

Note: The measured values are stored in the VOTA permanently and do not change with the change of batteries or when the device is stored over a longer period without batteries.

Initial Raw Data Processing

5.1 General

When the collected data from the field is transferred to the PC, it needs to be processed using Hydras 3 software. This chapter discusses how the data from Orpheus in the PC is converted into specific Hydras 3 format enabling the software to export it to ASCII text format. Most of the programmers need the data in this format. The resulting text files can be easily imported in MS Access as well, which is discussed in chapter 6.

5.2 Processing of the Retrieved Raw Data

The retrieved data (File: ED000) located in "Rawdata" subfolder needs to be processed in order to transfer it to HYDRAS 3 format and then to convert it to ASCII text. These processes are discussed in the following paragraphs:

5.2.1 Converting Retrieved Data into HYDRAS 3 Format using "Raw Data Management" Utility

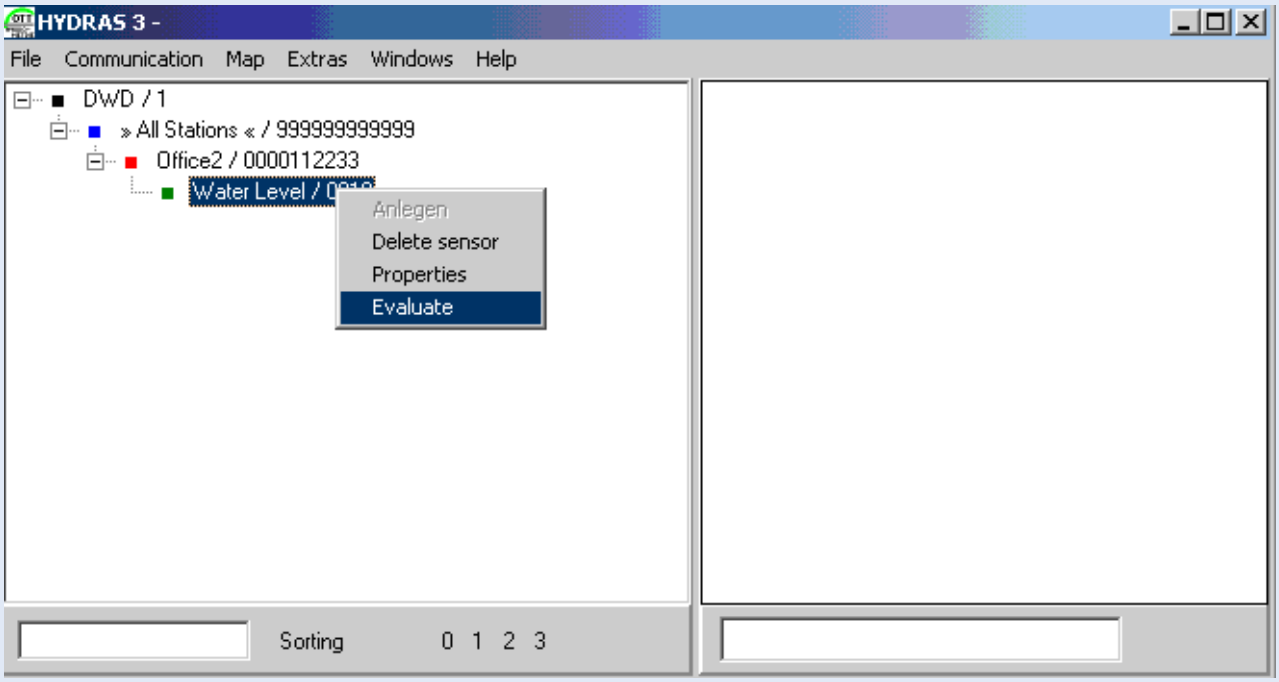
In the window given in step 2 of the paragraph 3.5.1, select the file that needs to be transferred to the HYDRAS 3 format, and click on "Selected" button. The file is now automatically transferred into the required format and the "Done" column is filled automatically by a "/". If no problem is encountered during this transfer, the "Problem" column will remain empty. The file should not be deleted at this point, as it is now ready to be converted into text ASCII file format.

P5: Problem P5 occurs if a sensor has been programmed repeatedly or if there is an old data with different operating parameters than the recent one. It happens that the user sometimes changes the operating parameters and reprograms Orpheus but forgets to delete the old data. Now a file has data with different data intervals, units and/or storage delta. The problem also occurs when these parameters are entered differently during programming the Orpheus than when the station and sensor were created in the workspace.

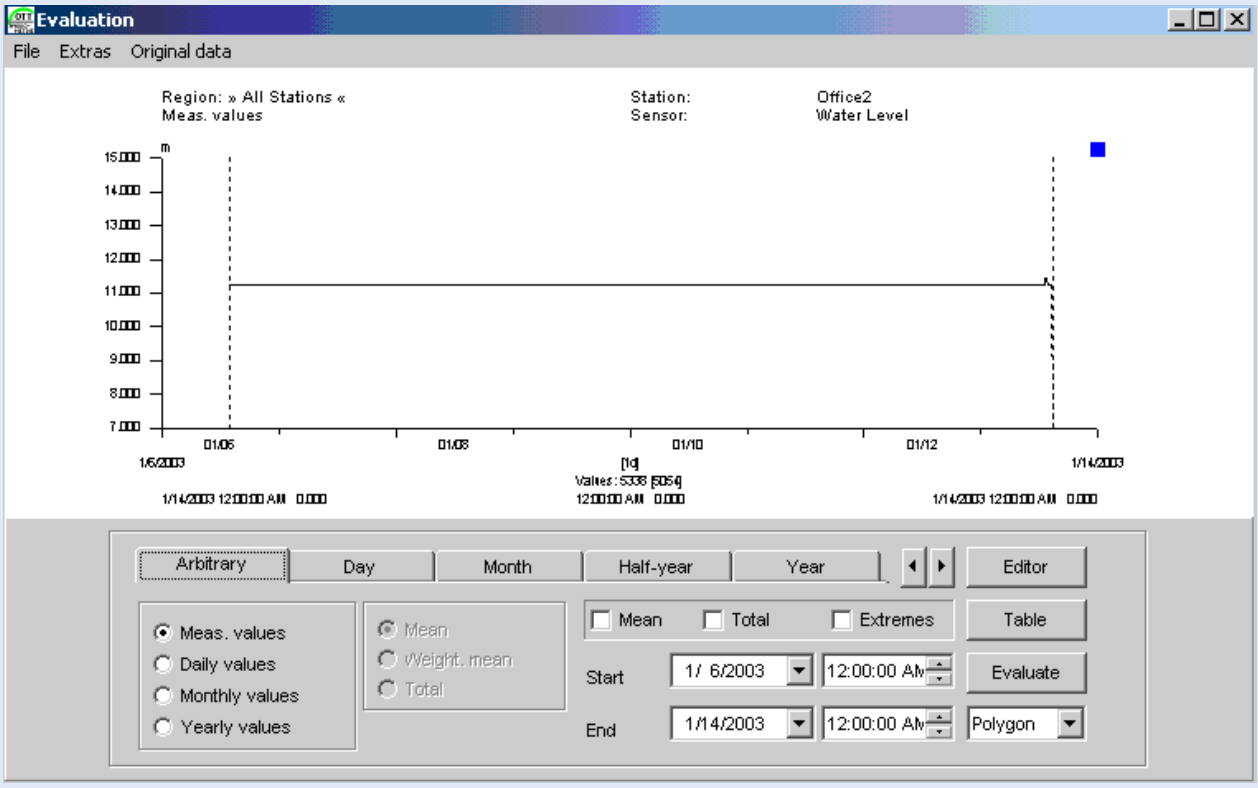
5.2.2 Converting HYDRAS 3 Raw Data File into Text File Format using "Evaluate" Utility

The retrieved data file from HYDRAS 3 format needs to be converted into ASCII text file format because a text file then can easily be imported in MS Access. The following steps are to be followed:

Step 1: Select the sensor of the respective station in the workspace and right click the right mouse button to select "Evaluate". This has been graphically shown in the windows below:

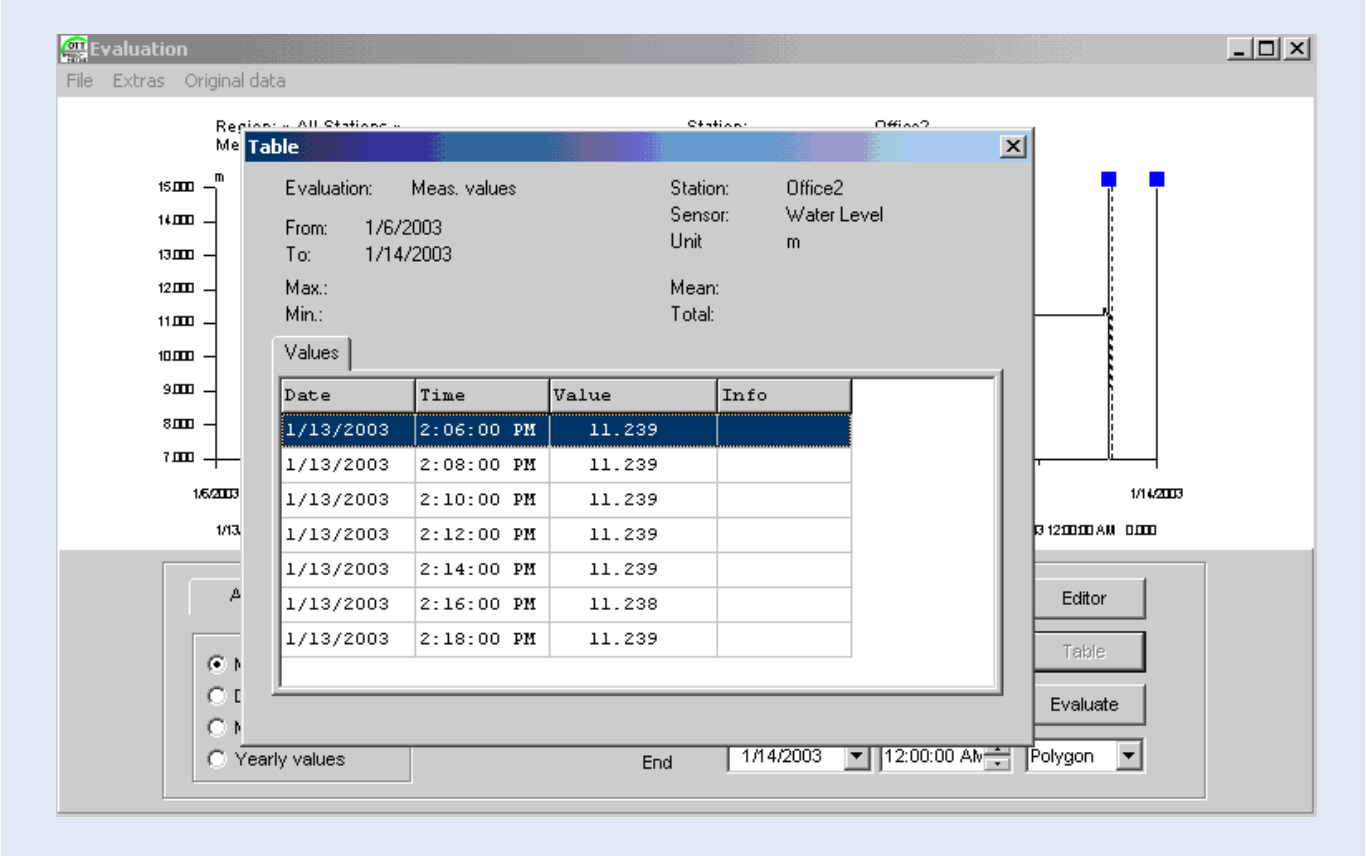


The resulting window is shown below:



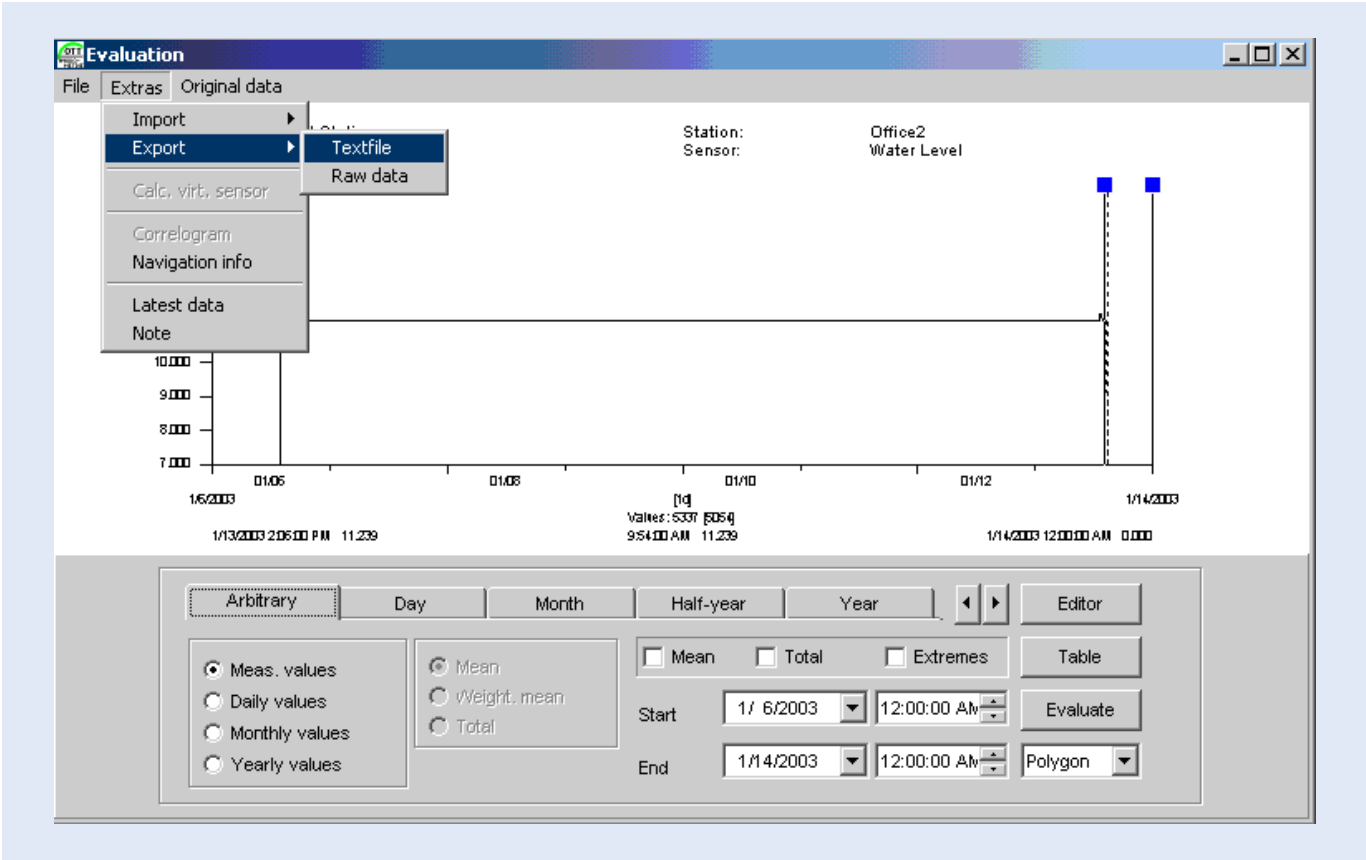
Step 2: The above window has a main menu, a graphical representation of the raw data that needs to be converted to text format, and the duration of the data in the raw data file. Specify the start and end dates in the above window and check the “Meas.values” box, as the measured values need to be extracted. The time of the last data retrieval

and the present data retrieval can also be specified. Next, click on the "Evaluate" button to select the specified data both graphically and numerically. If the water level on the graph is not very clear, scale down the water level on the graph by clicking on the "10.000m" as in the above window accordingly. The specified data can be seen numerically by clicking on the "Table" button of the window (a sub window with the name "Table" will also appear). All these have been shown below:

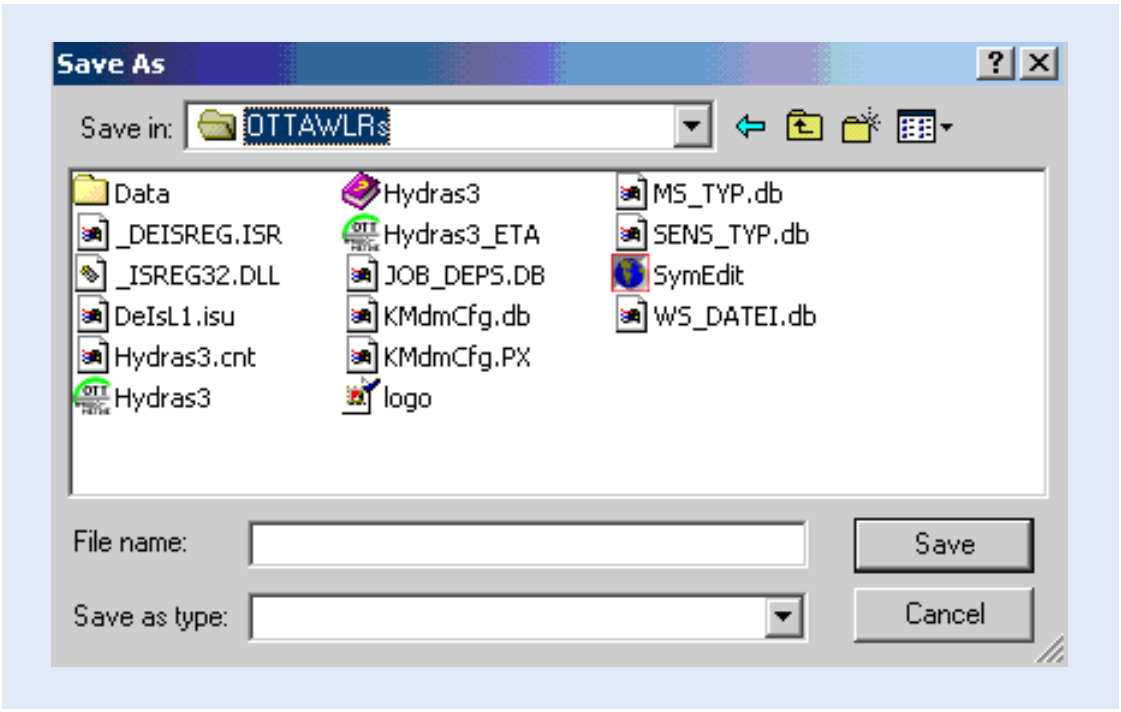


Step 3: Since the range of the data has been selected in the file "ED000" as cleared in the above step, it is now ready for conversion to text format. For this purpose, follow these instructions:

Click on "Extras" of the main menu of the Evaluation window and select "Textfile" under "Export" as shown below:

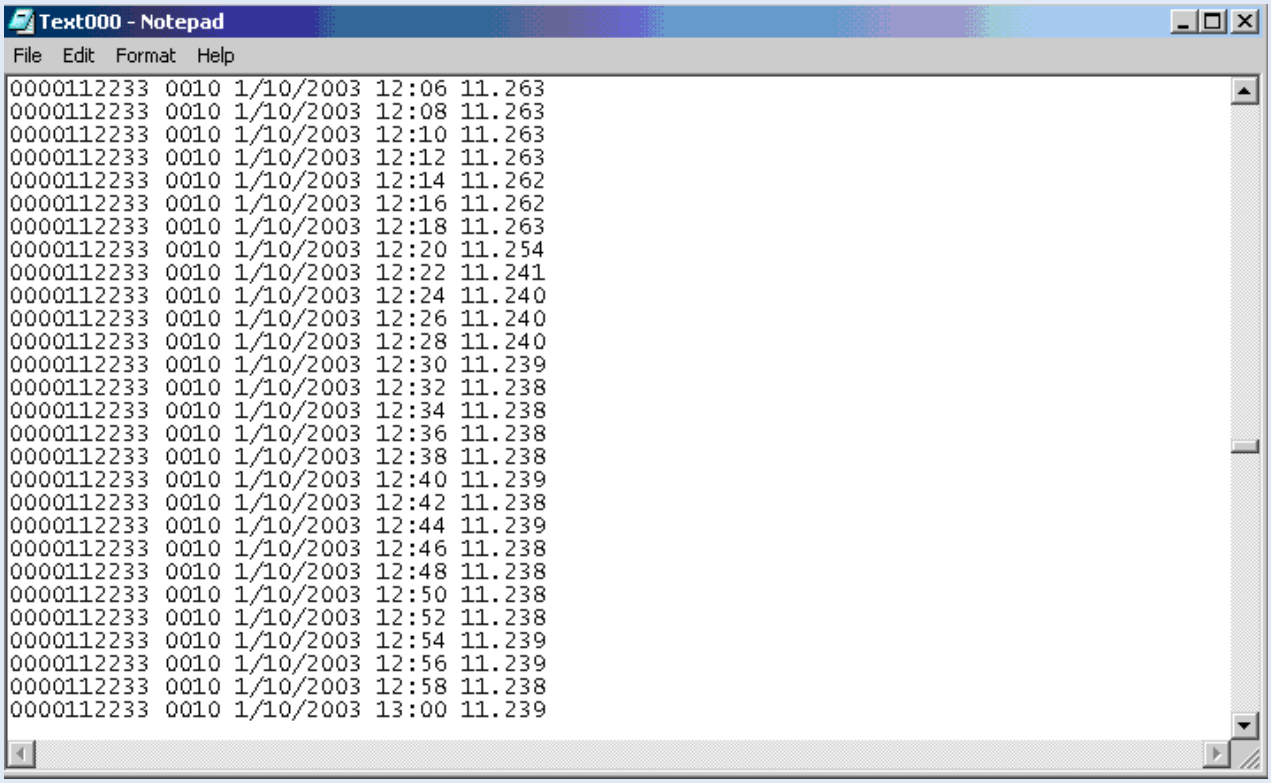


The following window will appear:



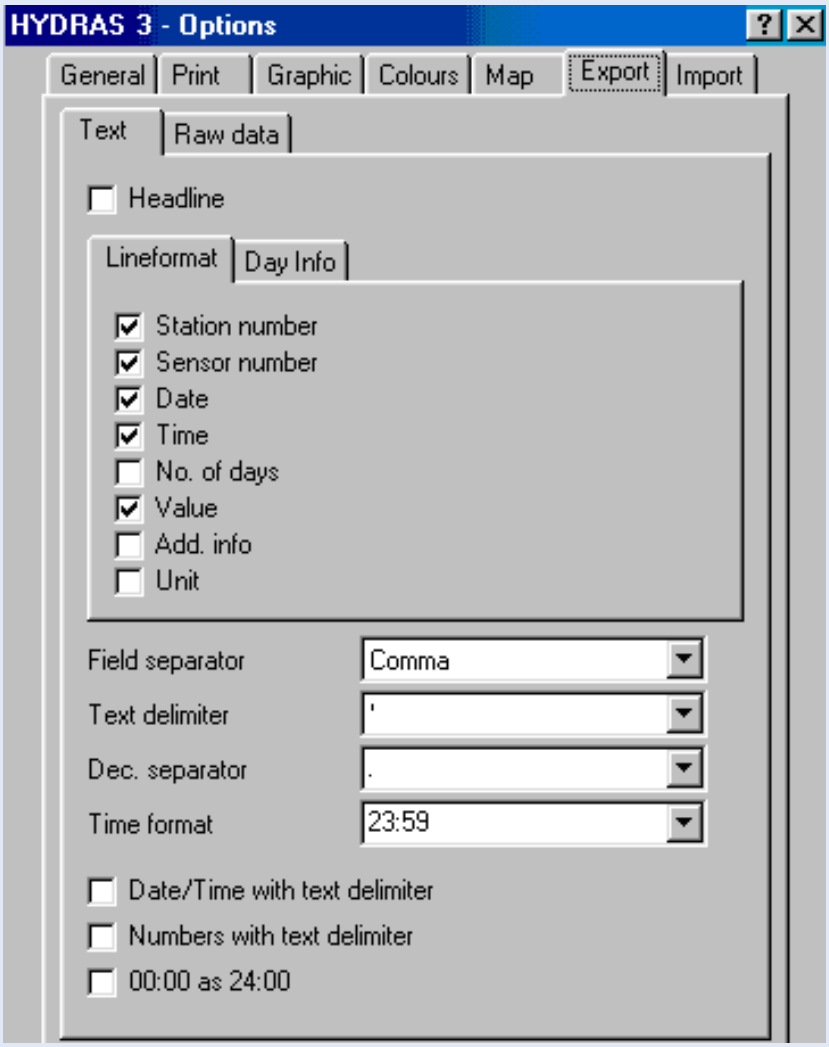
Name the resulting text data file (e.g. "Text00"). It is advised to give this file the same number as in the Rawdata file. To save this new text file in the "Rawdata" sub folder of the "Data" folder, specify the path by double clicking on the "Data" folder and then the "Rawdata" subfolder subsequently. Conclude the process by clicking on the "Save" button.

This text file can be viewed by double clicking on the file in the windows explorer as follows:



The first column shows the station ID, the second column shows the sensor number, the third column contains the complete date whereas the fourth and the fifth columns depict the time and water levels, respectively. This file is now ready to be imported in MS Access databases.

Important Note: Text files created above are easy to be imported in MS Access databases. The fourth column in the window above shows the time of measurement. Since MS Access recognizes 00:00 as 24:00 hours, so care should be taken that the 24:00 should be selected as 00:00 before exporting the raw data file (ED000) obtained from the data-logger to Text file format. This is done by opening the "Options" window under "File" menu of the HYDRAS 3 software and leaving the "00:00 as 24:00" box of the "Export" sub-window unchecked. This is shown in the following


HYDRAS 3 - Options
General
Print
Graphic
Colours
Map
Export
Import
Text
Raw data
Headline
Lineformat
Day Info
Station number
Sensor number
Date
Time
No. of days
Value
Add. info
Unit
Field separator
Comma
Text delimiter
'
Dec. separator
.
Time format
23:59
Date/Time with text delimiter
Numbers with text delimiter
00:00 as 24:00

Data Processing in MS Access and Final Storage into the Nile Basin Database

6.1 General

The Project, in the past, has established several types of automatic meteorological and automatic hydrological stations throughout the basin; it has been tried that the raw data obtained from the Orpheus be processed to its final destination in almost the same way. This will, up to a great extent, decrease confusion among the users who are already dealing with the management of the data obtained from such equipment.

Final destination of the meteorological and hydrological data obtained from such Automatic Stations [including Orpheus stations] in the Nile Basin Monitoring Network is the NBD: The Nile Basin Database developed in MS Access. But prior to reaching the final step of adding newly observed data to this database, one more intermediate operation has to be performed: importing the ASCII files generated by "Evaluate" function of the HYDRAS 3 (as described in chapter 5 of this Manual) into MS Access and restructuring them into a final NBD.

Figure 7 shows the remaining part of the data trajectory, i.e. the preprocessing actions in MS Access.

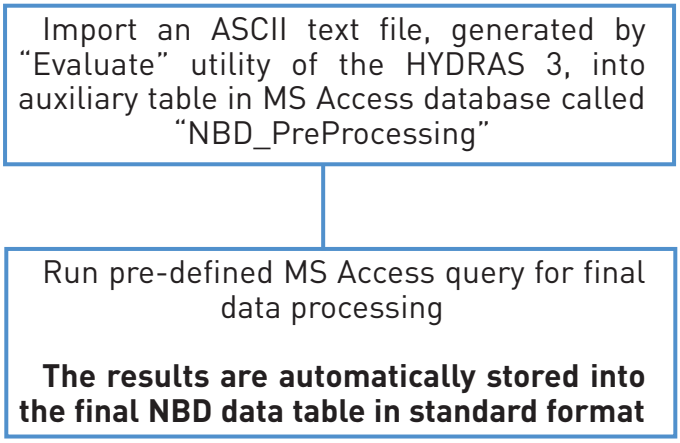


Figure 7: Final data processing steps in MS Access and subsequent removal and storage of raw files as backups.

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

6.2 MS Access Database "NBD_NEW DATA"

The data processing activities are carried out in an MS Access database file called "NBD_PreProcessing.mdb". The users will find this file in one of the following folders, given with full path name, depending on the country where used (this file structure is to be kept unchanged at all times):

- Users in Kenya: C:\MyDbase\NBD NEW DATA\Kenya Preprocessing
- Users in Rwanda: C:\MyDbase\NBD NEW DATA\Rwanda Preprocessing
- Users in Uganda: C:\MyDbase\NBD NEW DATA\Uganda Preprocessing
- Users in Burundi: C:\MyDbase\NBD NEW DATA\Burundi Preprocessing
- Users in Tanzania: C:\MyDbase\NBD NEW DATA\Tanzania Preprocessing
- Users in DR Congo: C:\MyDbase\NBD NEW DATA\DR Congo Preprocessing
- Users in Sudan: C:\MyDbase\NBD NEW DATA\Sudan Preprocessing
- Users in Egypt: C:\MyDbase\NBD NEW DATA\Egypt Preprocessing

This database file (NBD_PreProcessing.mdb) contains several pre-defined objects including tables and process-append queries. The database table and query names (for data obtained from Orpheus AWLR) are listed in Table 1

together with a brief description of their functions.

Table 1: Database objects and their function in MS Access database file "NBD_Pre Processing.mdb".

Group	Object Name	Type	Function
Group 1			
1.1	Hydro_Hourly_Orph	Table	Pre-defined table in which to import comma separated ASCII file "TextXXX.txt" obtained from Orpheus AWLR.
Group 2			
3.1	Hydro_Hourly_Orph	Query	A pre-defined query used to process data from the respective auxiliary table "Hydro_Hourly_Orph" in order to generate records in the NBD format, and to automatically append/store such records in the NBD table "AWLRS Hourly Water Levels"

As indicated by their numbering, the database objects listed in table 1 are divided into two different groups.

- Group 1 consists of an auxiliary table, in which to import the respective comma separated ASCII Text files generated by "Evaluate" utility of the HYDRAS 3 software.
- Group 2 consists of a process-append database query, specifically designed to generate records in the final NBD database format from data in the auxiliary table in Group 1 and to automatically append these records into the appropriate file and table of the NBD database.

The final NBD table in which the processed data will ultimately be stored/appended are located in the following database files (including the whole folder/directory path):

NBD table "AWLRS Hourly Water Levels" is located in:

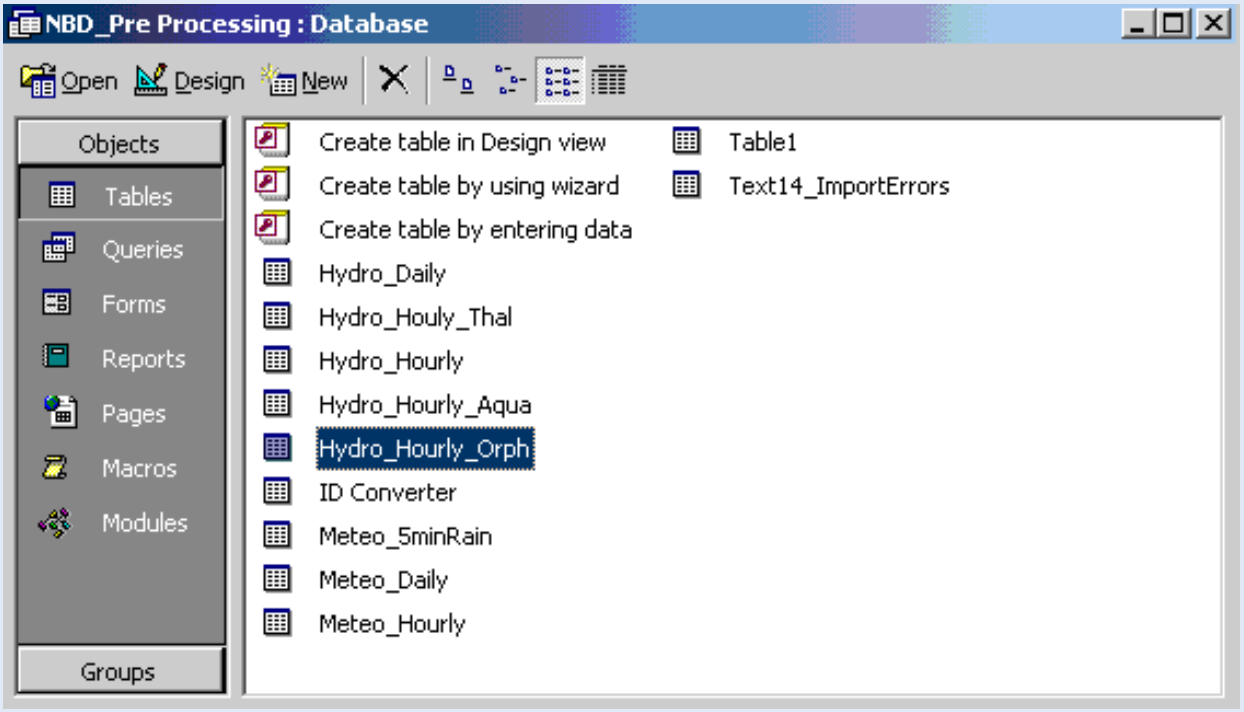
- C:\MyDbase\NBD\Daily Hydro-Meteorological Data\Daily Runoff Uganda.mdb – for data observed at the automatic meteorological and automatic water level recording stations in Uganda (there are now several such stations upgraded by the Project in Uganda)
- C:\MyDbase\NBD\Daily Hydro-Meteorological Data\Daily Runoff Rwanda.mdb – for data observed at the automatic meteorological and automatic water level recording stations in Rwanda (the project aims to establish such stations in Rwanda).
- C:\MyDbase\NBD\Daily Hydro-Meteorological Data\Daily Runoff Sudan.mdb – for data observed at the automatic meteorological and automatic water level recording stations in Sudan.

The above paths (folder structure) are included into the respective pre-designed MS Access queries indicated in Table 1 and should not be changed by the user as any change of the folder structure will result in loss of the processed data.

6.3 Importing ASCII Text Files Generated by "Evaluate" into MS Access

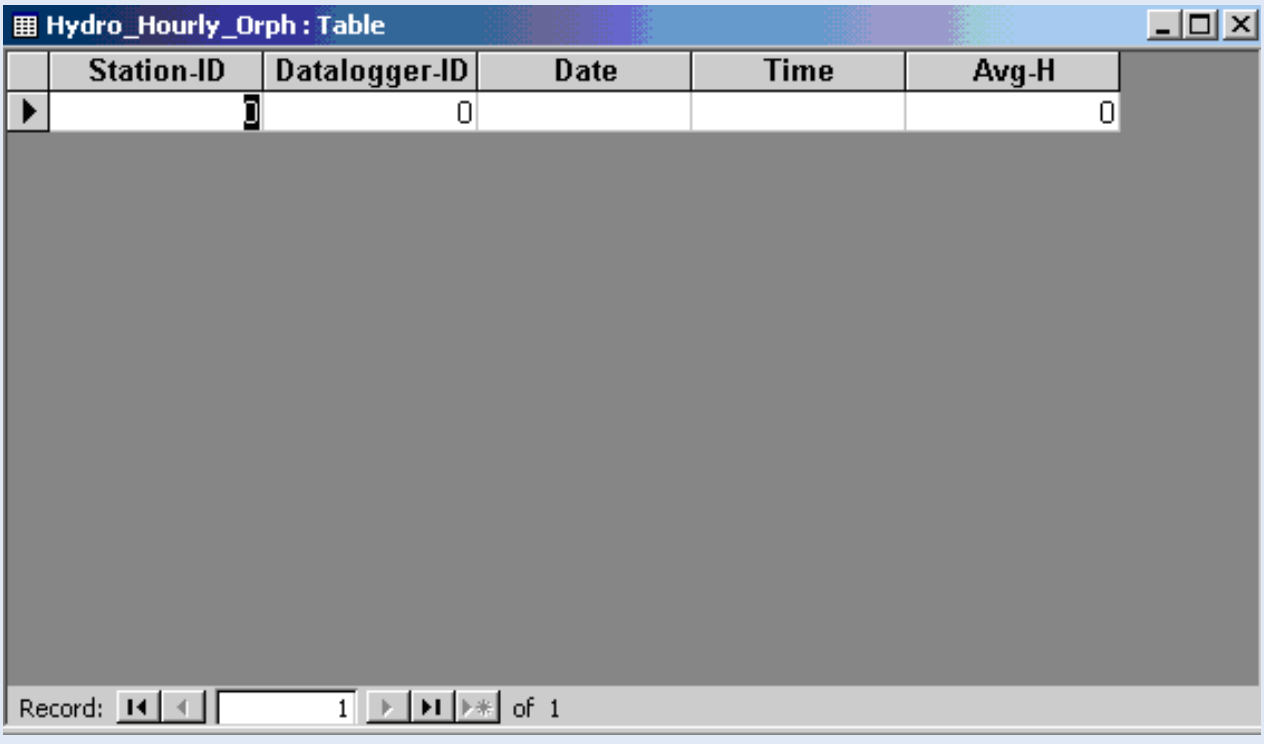
This paragraph describes procedure for importing ASCII text file "TextXXX.txt" into MS Access file "NBD_Pre Processing.mdb".

Step 1: Open the MS Access file "NBD_PreProcessing.mdb"; consult paragraph 6.2 above to locate the appropriate folder path of the file, which is country-dependent. In table view, the following database window appears:



The above window shows a pre-defined auxiliary table "Hydro_Hourly_Orph" where the text data files obtained from Orpheus AWLR. The other auxiliary tables have been created previously where the text data files obtained from other kind of automatic water level recording stations and automatic weather stations will be imported.

Step 2: Highlight the auxiliary table "Hydro_Hourly_Orph" and click "Open". The results is illustrated in the following screen:

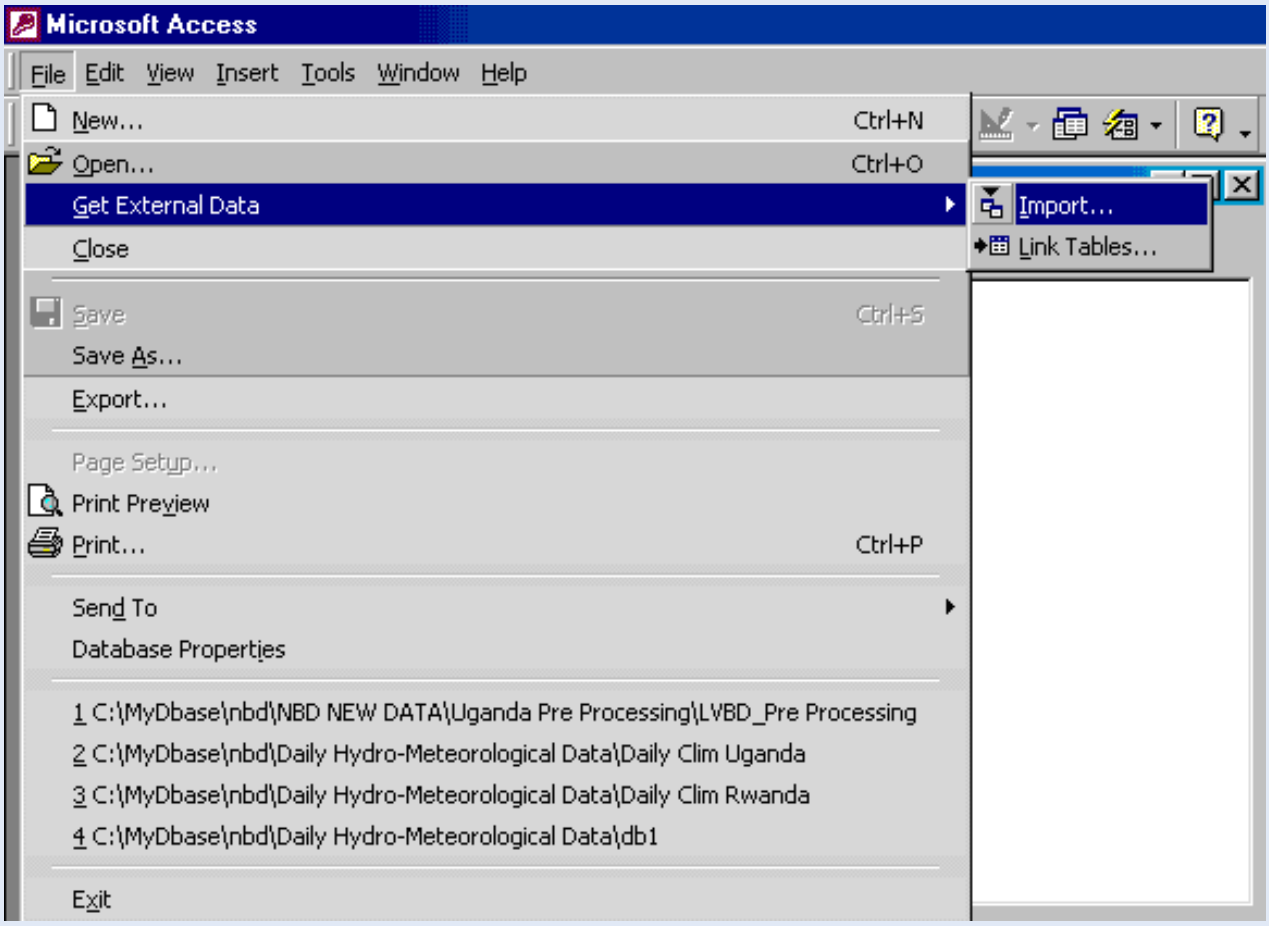


The table at present has no data. Most probably the "Hydro_Hourly_Orph" table will contain some old data from a previous transfer exercise. If so, delete this old data by clicking "Select All Records" in the Edit menu and then by choosing "Delete Records" from the Edit menu. Although primary key setting in the final NBD tables does not allow for data duplication, it is good policy to delete all records from the auxiliary tables.

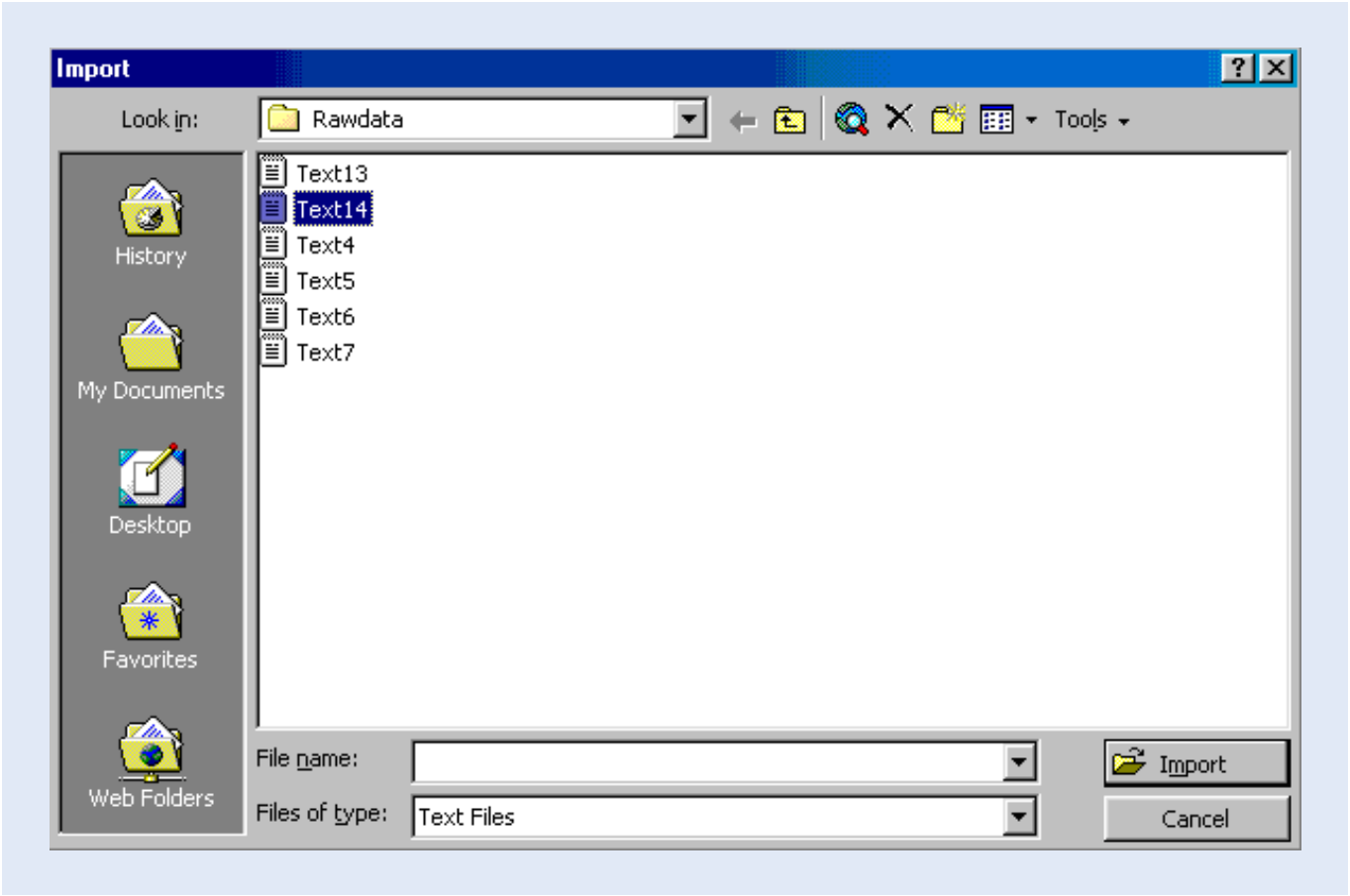
Step 3: Close "Hydro_Hourly_Orph" table.

This auxiliary table is now empty. No data duplication will occur during data import process 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.

Step 4: In the database window, select "Get External Data" from the File menu. Choose the sub command "Import", as presented below:

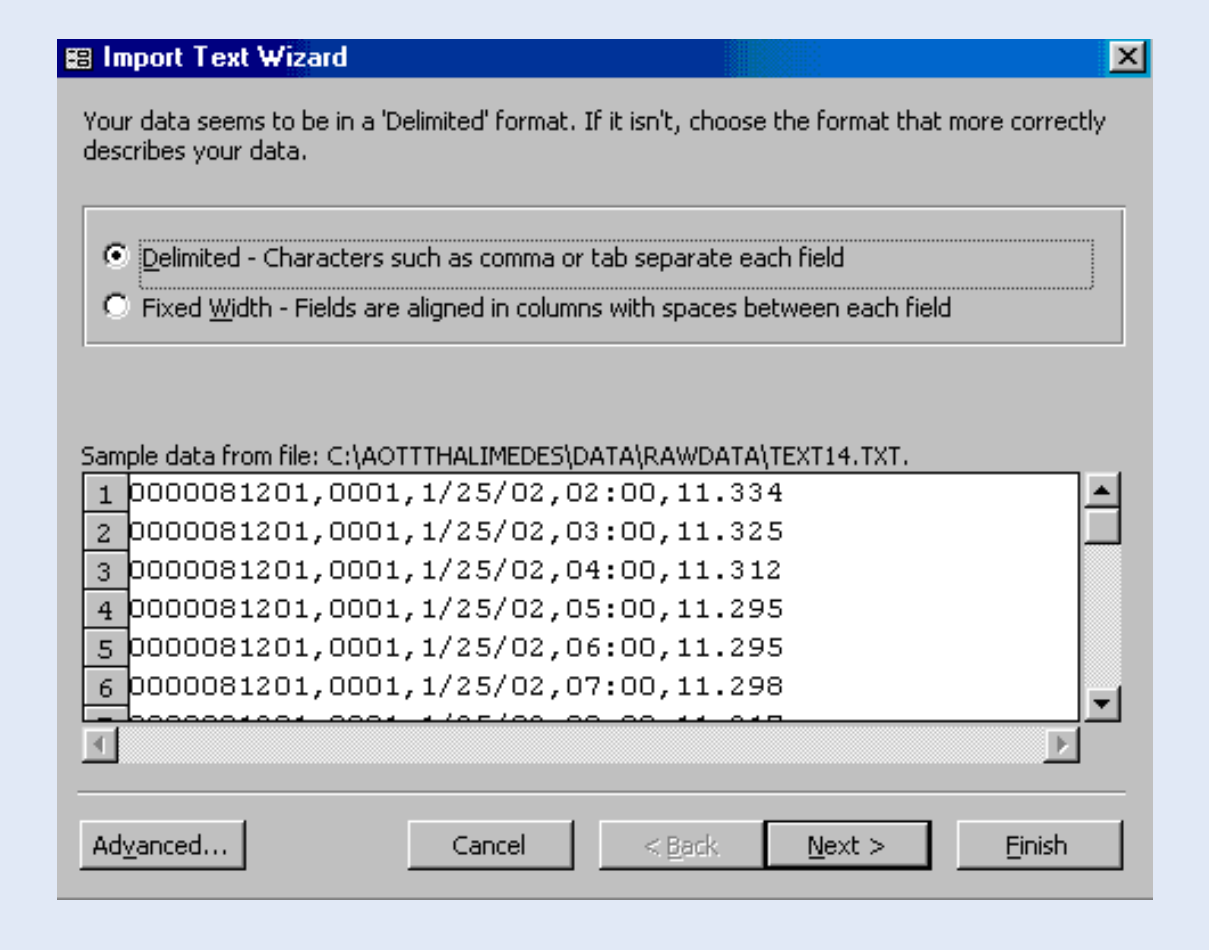


Step 5: In the subsequent window, navigate to the folder from where to import the concerned text data file of the type "TextXXX.txt". Use the appropriate Windows Explorer operations. If the recommended directory structure is used, "TextXXX.txt" is stored in folder C:\AOTAWLRs\Data\Rawdata. Make sure the "Files of type" (box below-left) is



set to Text Files.

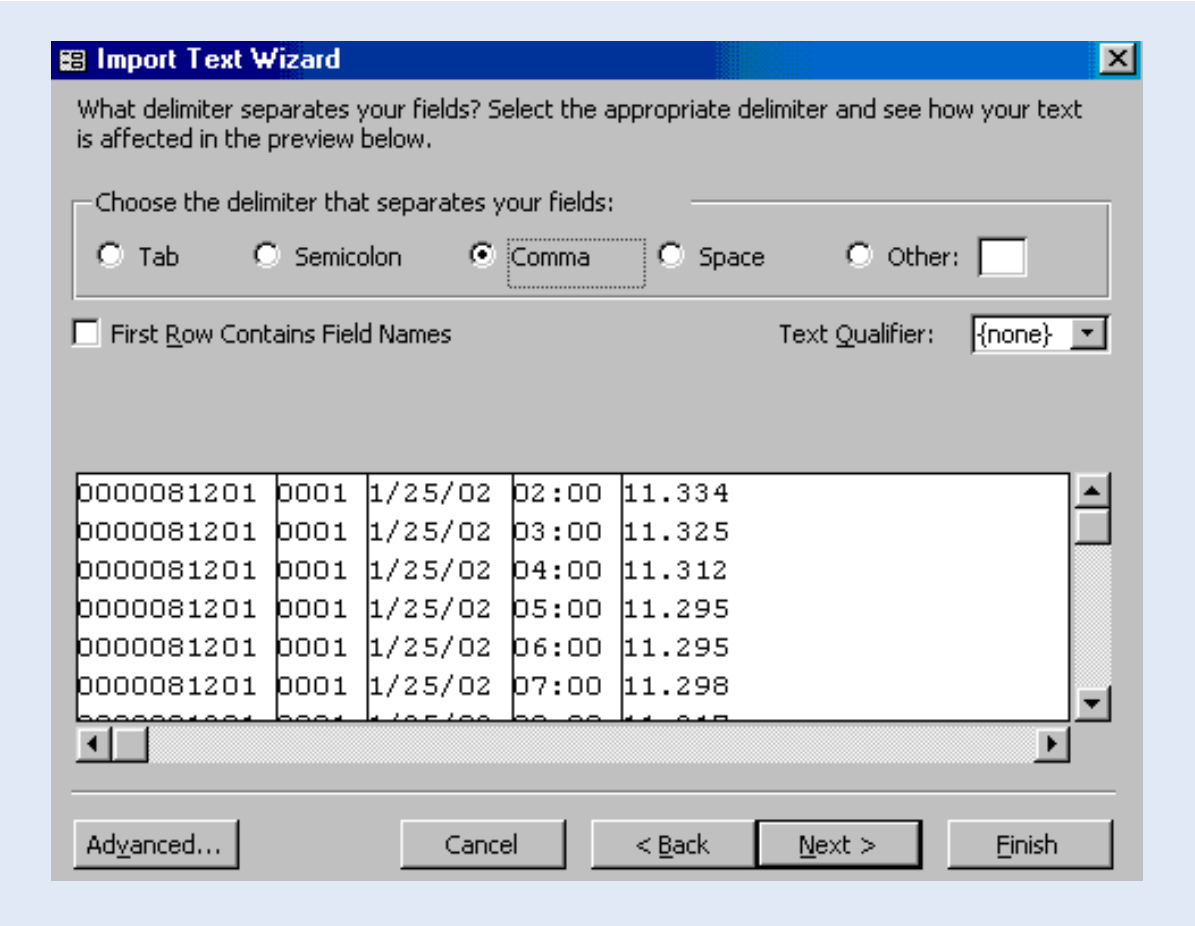
Step 6: Click “Import”.



The following "Import Text Wizard" pops up.

The Text file is comma-separated and thus falls into the category 'delimited'. This has been done on purpose as importing this format into MS Access has proved to be straightforward and flawless.

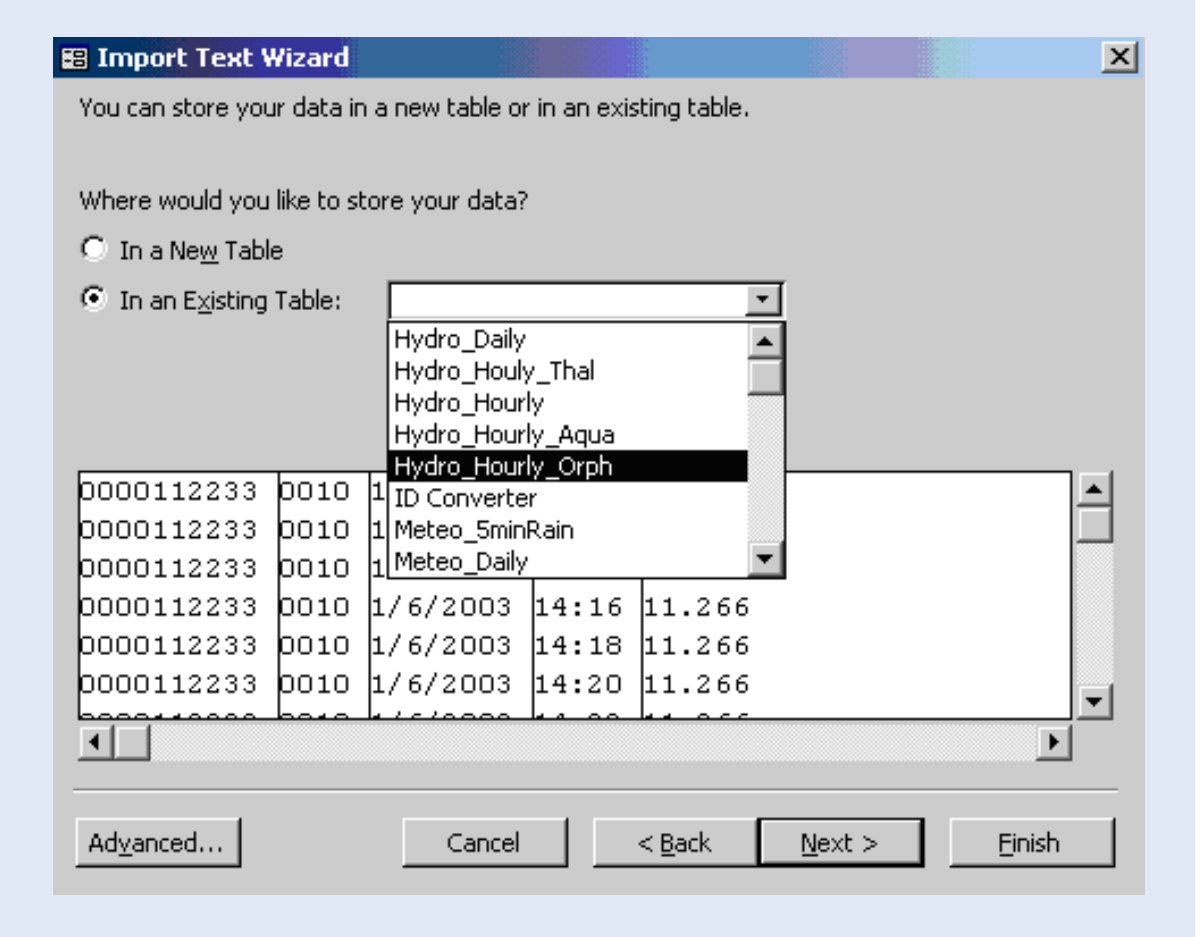
Step 7: Select 'Delimited" and click 'Next'. The screen illustrated below appears, which shows how the imported



text will be divided into various columns according to the applied delimiter.

Step 8: Select “comma” and click “Next”.

The subsequent window (shown below) is used to define the output location for the imported data. In this particular



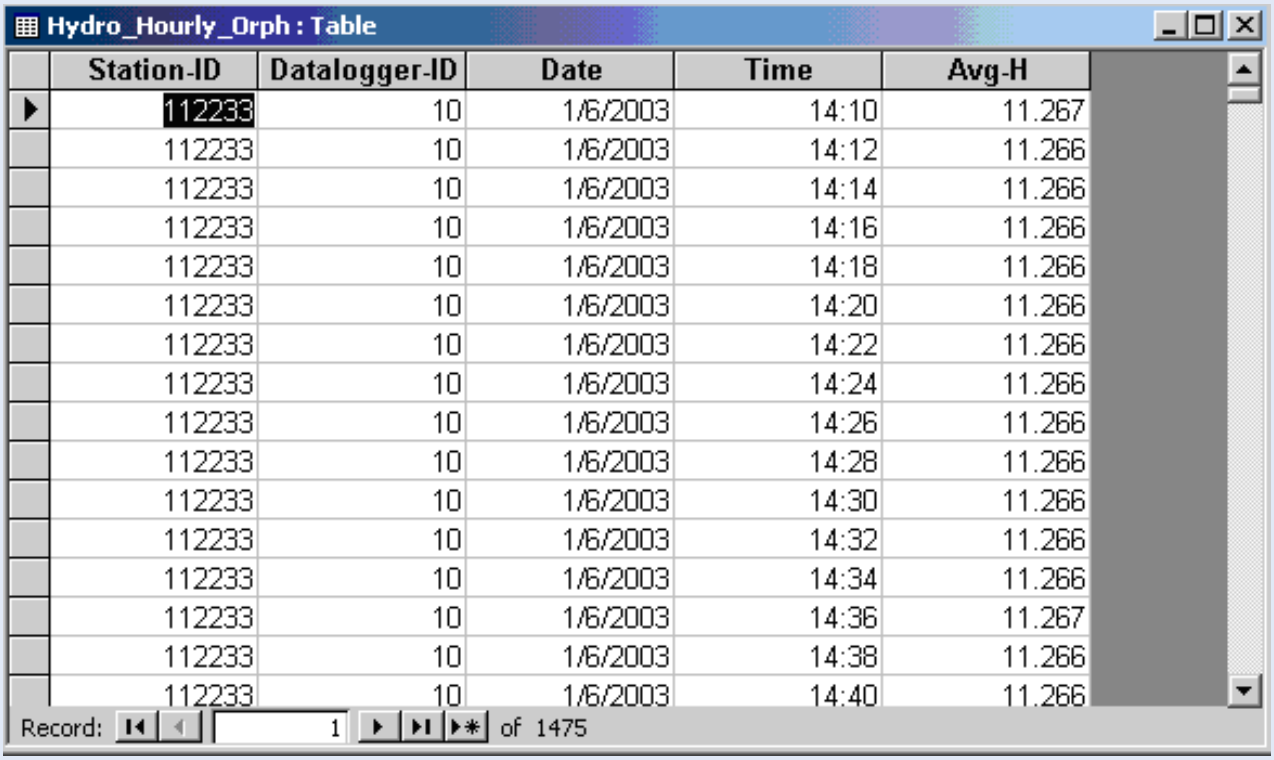
case, the new information is to be imported into an existing pre-defined auxiliary table Hydro_Hourly_Orph.

Step 9: Check "In an Existing Table" and navigate in the related list box to the "Hydro_Hourly_Orph" table. Click "Next".

This constitutes the final step in importing the "TextXXX.txt" ASCII file into the appropriate pre-defined MS Access table. If no importing errors are encountered, the Text Import Wizard finishes the process by giving the following message:

Step 10: Click OK.

The text file is now imported into the desired auxiliary MS Access table "Hydro_Hourly_Orph". View the results by opening the "Hydro_Hourly_Orph" table in the database window. Check on the integrity of data, in particular, the datalogger ID values and make corrections if necessary. The result is presented in the screen given below:



Hydro_Hourly_Orph : Table

Station-ID	Datalogger-ID	Date	Time	Avg-H
112233	10	1/6/2003	14:10	11.267
112233	10	1/6/2003	14:12	11.266
112233	10	1/6/2003	14:14	11.266
112233	10	1/6/2003	14:16	11.266
112233	10	1/6/2003	14:18	11.266
112233	10	1/6/2003	14:20	11.266
112233	10	1/6/2003	14:22	11.266
112233	10	1/6/2003	14:24	11.266
112233	10	1/6/2003	14:26	11.266
112233	10	1/6/2003	14:28	11.266
112233	10	1/6/2003	14:30	11.266
112233	10	1/6/2003	14:32	11.266
112233	10	1/6/2003	14:34	11.266
112233	10	1/6/2003	14:36	11.267
112233	10	1/6/2003	14:38	11.266
112233	10	1/6/2003	14:40	11.266

Record: 1 of 1475

This step concludes description of procedures for transfer of the contents of the Text file "TextXXX.txt" into the appropriate location in MS Access in preparation for final processing of data.

6.4 Processing of Imported Data in MS Access and Final Transfer into the NBD

After being imported into an auxiliary table in MS Access, the processed new data sets are subject to automatic final storage into the appropriate NBD file and table. This is performed in one go with a pre-defined query. When the Queries tab is activated in the database view, the "Hydro-Hourly_Orph" pre-defined query appears, as shown in the window below:

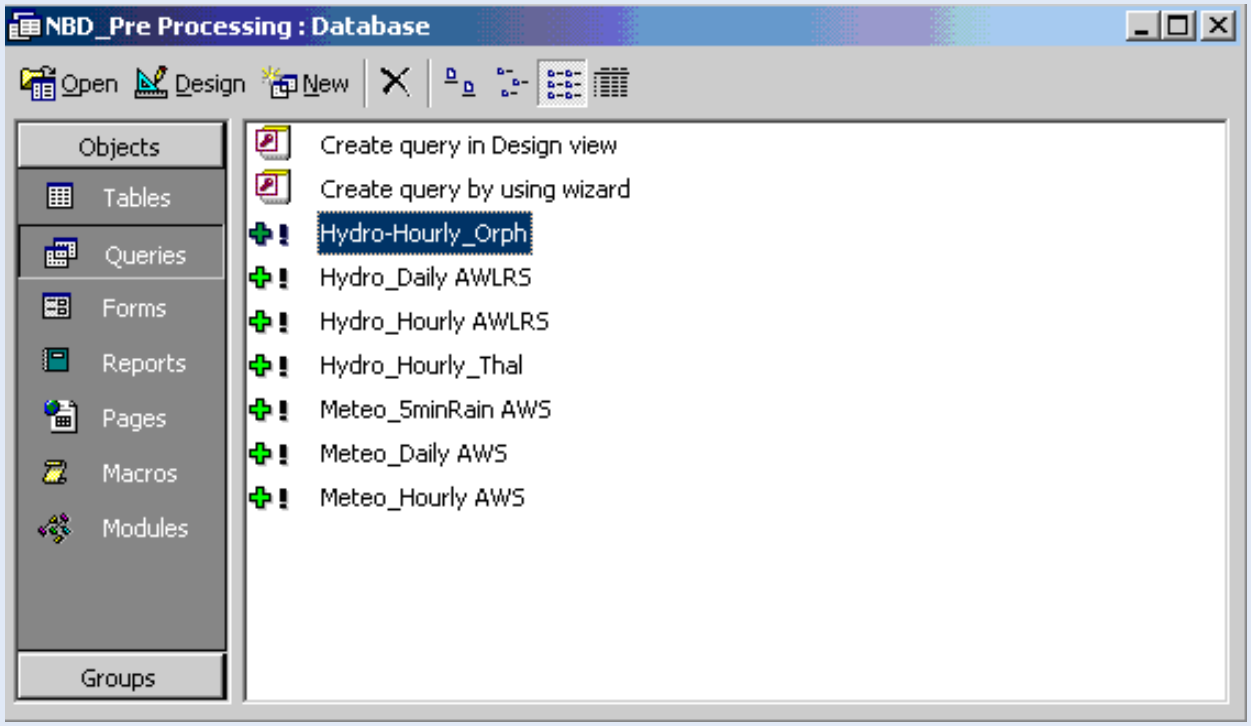


Table 2 presents the input and output tables for the above query "Hydro-Hourly_Orph". "Orph" stands for Orpheus Automatic Water Level Recording Stations, which have been established in the region within the GCP/INT/752/ITA project.

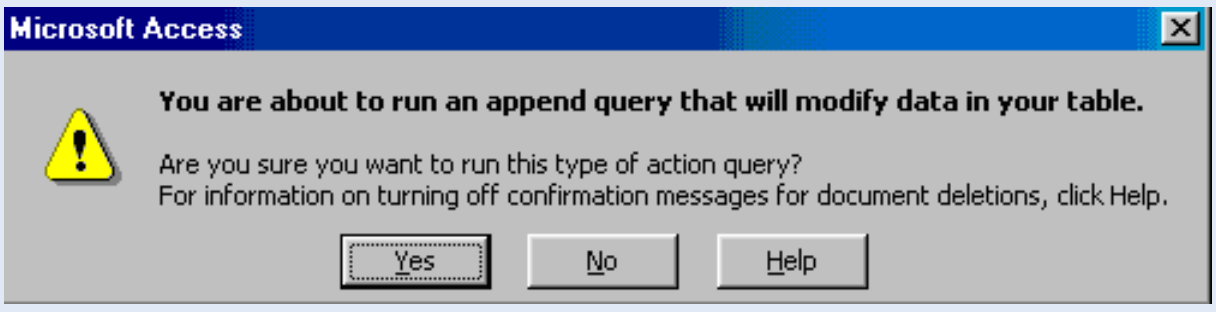
Table 2:Designated Input and Destination table for the pre-defined append query.

Input Auxiliary MS Access Table	Query for Data Processing and Final Transfer into NBD	Final NBD Destination Table
Hydro_Hourly_Orph	Hydro-Hourly_Orph	AWLRS_Hourly Water Levels

Table 2: Designated input and Destination table for the pre defined append query.

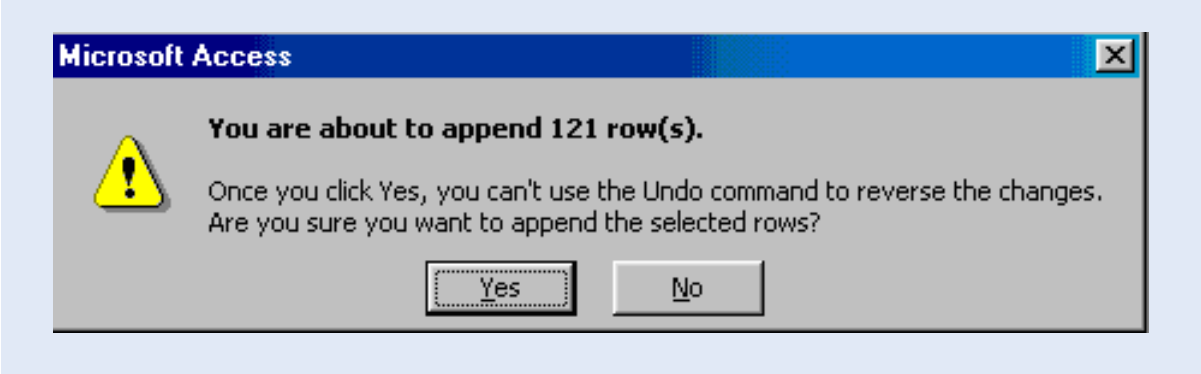
Finalize data processing by activating the appropriate query. That is, select and double click the "Hydro-Hourly_Orph" append query to process the newly imported data set from the "Hydro_Hourly_Orph" auxiliary MS Access table to the final "AWLRS_Hourly Water Levels". By this operation, data records from auxiliary table will be stored into the final NBD destination table "AWLRS_Hourly Water Levels".

The following message box pops up:



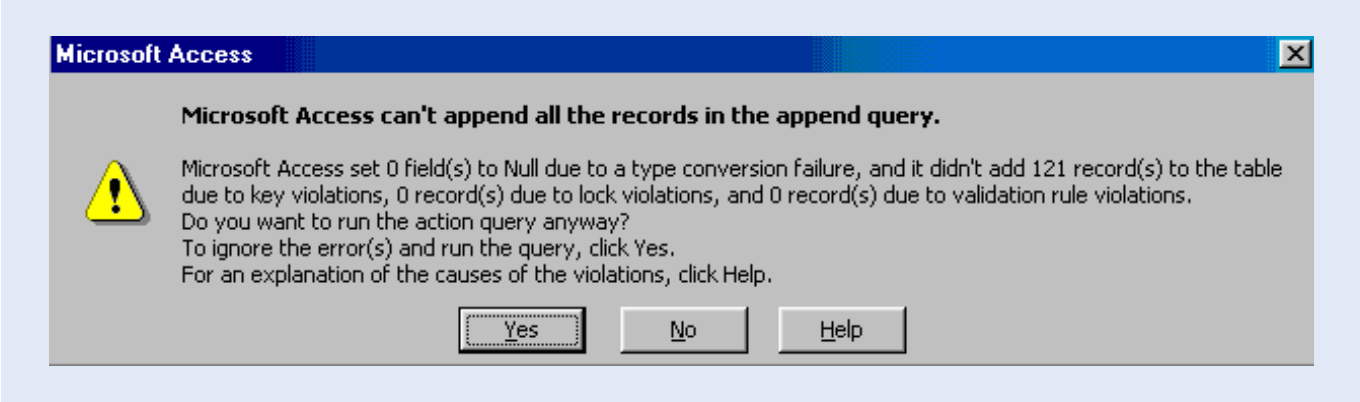
Click "Yes".

Another message box follows, as shown:



Click "Yes".

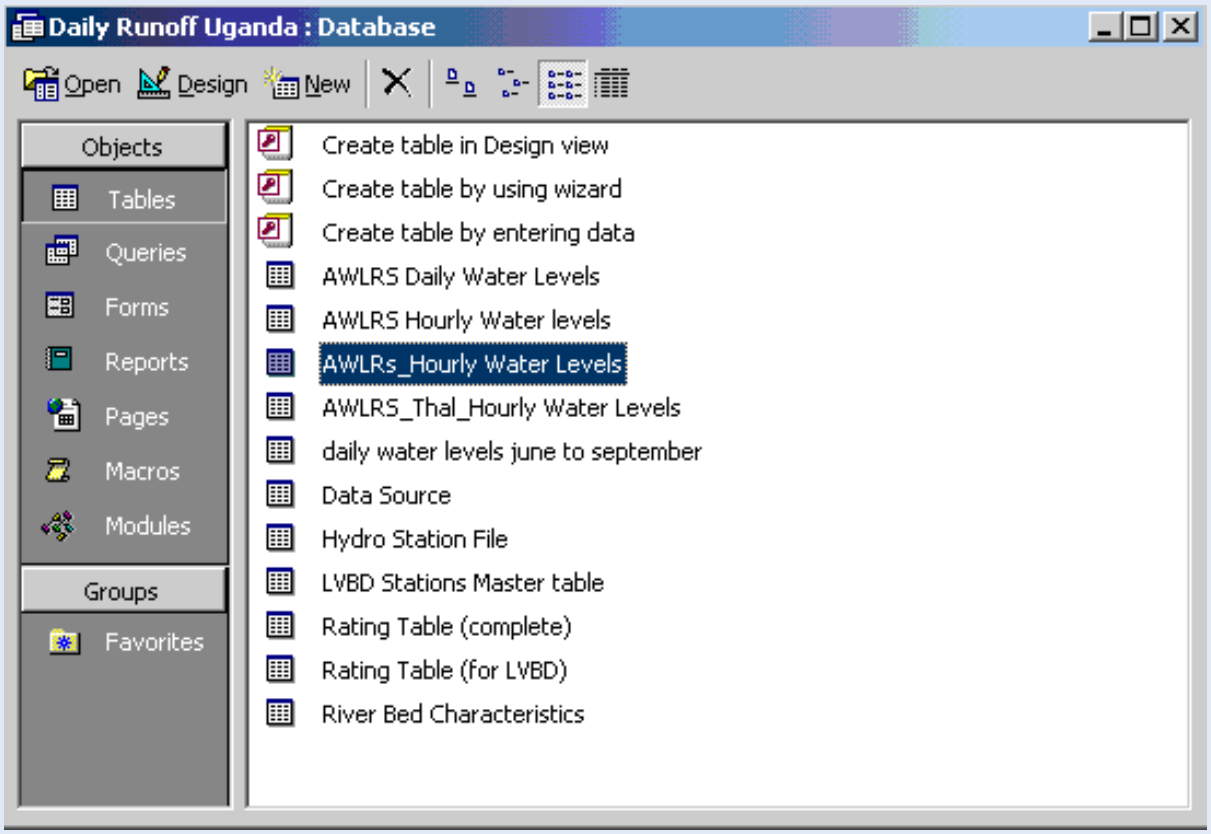
This steps finalizes the data processing in MS Access. The destination NBD table is by its primary key settings protected against duplicate records. If certain record(s) were added for the second time, the following message box will show up:



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.

In order to visualize the final results appended in the NBD destination table "AWLRS_Hourly Water Levels", locate this table in the appropriate NBD folder and file and open the table in the database view.

Highlight the "AWLRS_Hourly Water Levels" table from the NBD file "Daily Clim Uganda.mdb".



The following screen presents the fully processed data set in the NBD format.

AWLRs_Hourly Water Levels : Table

Station-ID	Date	Time	Source	Avg-H
112233	1/6/2003	14:10	104	11.267
112233	1/6/2003	14:12	104	11.266
112233	1/6/2003	14:14	104	11.266
112233	1/6/2003	14:16	104	11.266
112233	1/6/2003	14:18	104	11.266
112233	1/6/2003	14:20	104	11.266
112233	1/6/2003	14:22	104	11.266
112233	1/6/2003	14:24	104	11.266
112233	1/6/2003	14:26	104	11.266
112233	1/6/2003	14:28	104	11.266
112233	1/6/2003	14:30	104	11.266
112233	1/6/2003	14:32	104	11.266
112233	1/6/2003	14:34	104	11.266
112233	1/6/2003	14:36	104	11.267
112233	1/6/2003	14:38	104	11.266
112233	1/6/2003	14:40	104	11.266
112233	1/6/2003	14:42	104	11.266

Record: 1 of 1475

The above step concludes description of the procedures for data processing in MS Access and final storage of processed data records into the appropriate NBD destination table.

Once the hydrological data series are successfully processed in MS Access, the raw data files of the type "Ed000.dat" and the respective extracted output ASCII text files "TextXXX.txt", processed by using the Evaluate utility, have for all purposes, become obsolete.

For security reasons, these files are recommended not to be deleted but temporarily stored in the same folder C:\OTTAWLRs\Data\Rawdata; once the user is sure that these files are no longer needed, they may eventually be deleted from hard disk or stored on other computer media if felt of interest.