

Surface Water Data Entry & Processing by Using SWDES

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1. Introduction to SWDES

Under the Hydrology Project - I, executed in the peninsular India during 1995-2003 covering Central Water Commission (CWC), National Institute of Hydrology (NIH) and 9 peninsular States of India, a data entry software named *Surface Water Data Entry System* (SWDES) has been developed. The software has been developed using Visual Basic for Access with a Microsoft Access 97 back-end database. The software has been installed in various State and Central Govt. Organizations for the entry and processing of hydro-meteorological data.

The prime objective of this data entry software is to provide sufficient facilities for entering all types of meteorological and hydrological quality and quantity data. Primarily, the software provides suitable facilities for entry of rainfall, water level, stage-discharge, water quality, sediment and climatic data as observed by surface water agencies. The data so entered using this software is subjected to essential data entry checks so that the possibility of committing mistakes is minimized. The graphical interface is provided to give added advantage of visual validation of the entered data. The software is primarily used for entering the historical and current data, available with various agencies in huge volumes. This software provides a front end for the data entry personnel for entering and primarily validating all types of meteorological and surface water quality and quantity data.

2. Software and Hardware Requirement & Installation

SWDES is a dedicated software developed for use on personal computers in XP/Vista/Windows7 environment. To properly use this software, the user needs to be familiar only with Windows environment. Minimum recommended hardware and software support necessary for running this software program is:

Pentium with 700 MHz + (preferably - Pentium III or above)

Colour monitor with 840 x 600 resolution or more

128 MB+ RAM

10 GB+ Hard disk with minimum 200 MB free space

Operating system - Windows XP/Vista/Windows 7

Software - MS Office 2000 or above

CD-ROM drive with SWDES installation program and SWDES manual.

The software can be installed by running the Setup program (setup.exe). The Setup program will check the computer and will ask a series of questions before it installs the software. If the setup program detects running applications that may interfere with the installation, the user is suitably alerted. On successful installation, SWDES is listed as a program and can be run from the Windows Program Manager.

3. Features of Software

The software is primarily oriented towards easy and reliable data entry options for various hydro-meteorological quality and quantity variables. It organises the data into well-defined databases using concept of relational database systems. The main features of the software are as follows:

User Authorisation

Adequate facility for user authorisation and identification is available. Number of users can be authorised by the system manager for working with the software with varying level of authority.

Organised Databases

The data pertaining to different sub-basins or offices or periods can be organised in separate databases (referred as Workareas in the software) in a well-organised and methodical way.

Extended Data Types

A comprehensive set of variables is available in the program. The characteristics like description, unit and type of measurement of the variables are also maintained. Adequate flexibility is provided for adding new data types in the program.

Master Information

The software maintains a set of important hierarchical information on administrative and drainage boundaries and that on the offices controlling various observation stations. This master information helps in avoiding duplicate entries and wrong spellings for the same item in the database and at the same time the user is not required to waste time every time in keying-in the same information. The required item can be chosen simply by clicking it from the available list. Adequate facility is available in the system to extend or modify this type of information.

Static/semi-static Data

Software provides for the entry of necessary characteristics associated with the observation stations. The data pertaining to various variables is stored under well-defined data series, which also have useful characteristics, associated with them. The data on current meters and setting of the zero of gauge for different validity periods, cross-sectional profiles etc. are also stored in an organised manner.

Data Entry Screens

A number of user-friendly data entry screen layouts are available that are appropriate for data pertaining to different types of variables and time intervals.

Data Entry Checks

Adequate facilities are built into the system for providing a number of data entry checks so that the amount of data entry errors can be reduced to a very low level. Sufficient flexibility is available in the system for making these data entry checks more effective.

Graphical Options

Facility is provided in most of the data entry options to make plots of the data being entered. This provides the users a very convenient way to graphically visualise the entered data, which thereby will help in reduction of errors in data entry.

User-friendliness

The software provides sufficient level of user-friendliness while working with it. Most of the work is accomplished by choosing an item by clicking it from the available lists. Only the actual data to be entered are required to be keyed-in using the keyboard. Most of the actions are performed by choosing an option by clicking appropriate buttons. Suitable error and help messages are displayed for guiding the user to work with the software.

On-line Users' Manual

The software provides the contents of the user manual on-line. Appropriate portions of the manual are displayed on the basis of screens from which the help is invoked. Flexible and faster navigation facilities are provided, using hypertext, to browse through the manual conveniently.

A brief overview of some essential features or steps before working with SWDES are:

Starting SWDES

SWDES can be started in two ways: a) User can click the SWDES program from the SWDES group listed in the program folder, b) Program can also be started by double clicking the program file "SWDES.MDE" available in the directory in which the program has been installed.

Regional settings

SWDES support the date setting as per the "English (British)" system only and it takes the entries in date field in "dd-mm-yyyy" format. In case the system's regional settings are other than the "English (British)", then the program will not be started unless the system settings are changed to "English (British)". A message to this effect is displayed and the process of starting SWDES is aborted.

Screen resolution

The software also checks for the screen resolution of the computer system. In case the VGA setting is at 640x480 resolution, a suitable message warn the user that the system will not be able to access all features. In the case the resolution is 800x600 or higher, all the features will be available for use while working with the software.

Login for user authorisation

After the start of the program, the first screen displayed is the login window. The user has to enter the username and password to be able to work with the software. After installation, the user can use "ADMIN" and "ADMIN" as the username and password respectively for entering into the program. This initial user profile can be deleted by the administrator, if desired, and new profiles can be created for user authorisation. The layout of the login window is as shown in Figure – 1.

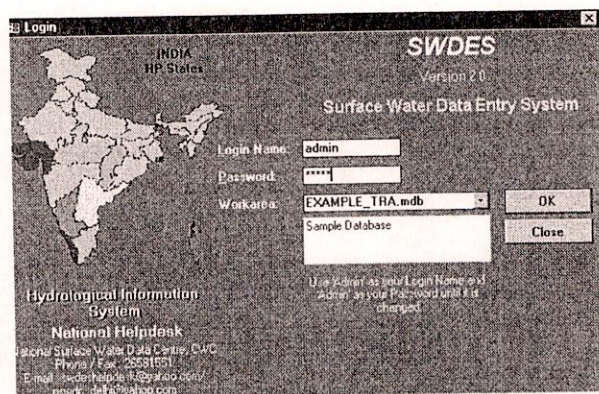


Figure – 1: Layout of Login Window of SWDES

4. Executing Various Options and Entering Data

After successful login in program, various options have to be chosen, executed and data has to be entered. Any command or action is carried out by either choosing a menu item or pressing a button. The data is entered from suitable data entry forms. Table – 1 shows various options in the main switchboard and corresponding secondary switchboards. Layout of main menu screen (main switchboard) is shown in Figure – 2.

Main switchboard items	Corresponding items in Secondary switchboards
Static/semi-static characteristics	Station characteristics
	Series characteristics
	Current meter characteristics
	R L of gauge zero
	X-section data
	Salient features of reservoir/diversion scheme
	Elevation-Area-Capacity data
Meteorological data	Rainfall - Daily
	Rainfall - Twice daily
	Rainfall - Hourly
	Climatic - Daily
	Climatic - Twice-daily
	Pressure/Temperature/Humidity - Hourly
	Sunshine duration - Hourly
Hydrological data	Water level - Multiple times a day
	Water level - Multiple times a day & temperatures
	Water level - Hourly
	Flow measurement data
Sediment data	Summary suspended sediment data
Water quality data	Laboratory information
	Parameter information
	Sample collection information
	Sample data entry & validation register
	WQ reports
	WQ graphs
	WQ options
Data validation	SRG & ARG data
	SRG (Twice daily) & ARG data
	ARG & sunshine duration data
	SRG data - Multiple stations
	Water level (Multiple times-a-day) - Multiple stations
	Water level (Hourly) - Multiple stations
	Climate data (Daily) - Multiple stations
	Climate data (Twice daily) - Multiple stations
Utilities	Data availability
	Block deletion of data
	Report on remarks
	Export of data
	Import of data
	Change switchboard items
Change workarea/ Exit SWDES	-

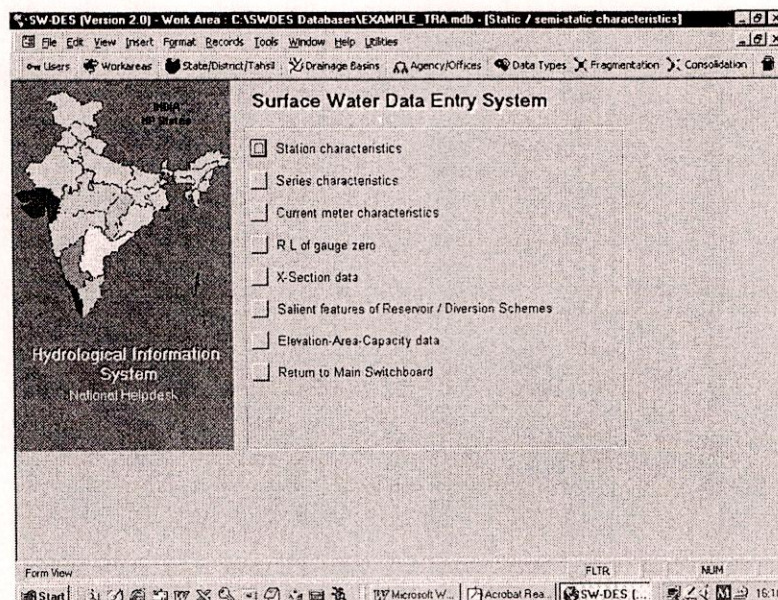


Figure - 2: Main switchboard displaying various menu items and buttons

The text of the menu items and their locations on these switchboards is changeable by choosing the option of "Change switch board items". The last option on all secondary switchboard, "Return to main switchboard" brings the control to the main switchboard. The option on main switchboard, "Switch to another workarea", closes the current database and brings the control to the login screen again. The user may choose another database from this screen and press "O.K" to work with the selected database. Figure – 3 shows a sample secondary switchboard.

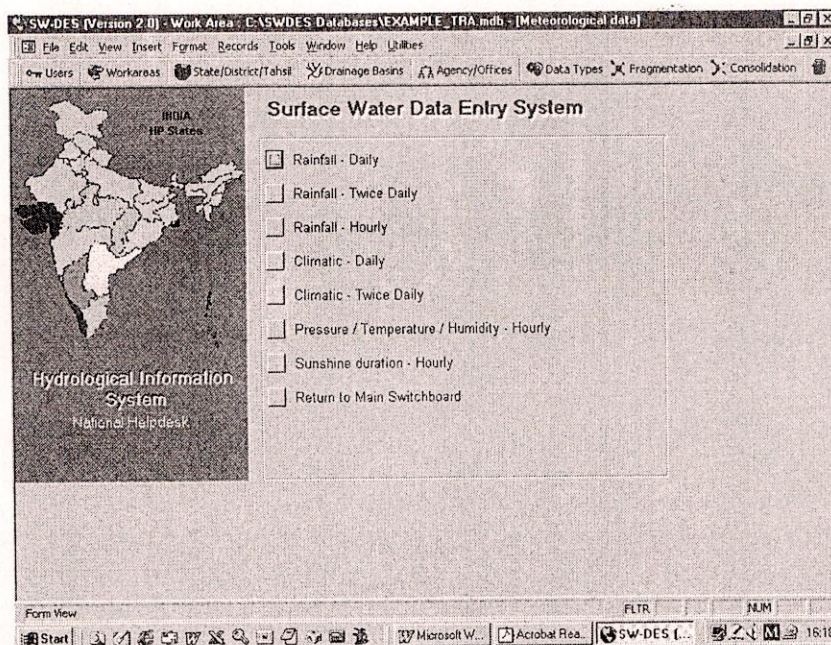


Figure - 3: Secondary switchboard displaying various menu items and buttons

4.1 Toolbar & Buttons

On the toolbar of main switchboard, there are a few buttons. The function of these buttons is to invoke the forms for viewing or entering the desired master information and to consolidate/fragment databases. The toolbar having six buttons, associated with the main switchboard is shown in Figure - 4. The function of these buttons is also listed thereafter.

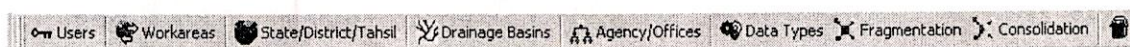


Figure - 4: Buttons on the toolbar associated with the main switchboard

Users button

For creating/editing/deleting user definitions.

Workareas button

For creating/editing/deleting workarea definitions.

State/District/Tehsil button

For maintaining hierarchical information on administrative boundaries.

Drainage Basins button

For maintaining hierarchical information on drainage units.

Agency/Offices button

For maintaining hierarchical information on various offices controlling the observation stations of agencies.

Data Types button

For maintaining information on various data types.

Fragmentation

For fragmenting one database into smaller databases on the basis of stations and period of data.

Consolidation

For consolidating two databases into one database.

Similarly, there are a few buttons available on toolbar of every data entry form. The function of such buttons is also to carry out the intended action. The toolbar on the forms for entry of static/semi-static data, carrying these buttons, is shown in Figure – 5.

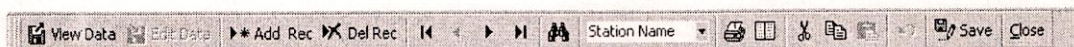


Figure – 5: Buttons on toolbar associated with the entry forms for static/semi-static data

View Data button

On opening any form, the “View Record” button is inactive by default since the form is already in the viewing mode. No editing is possible in this mode. In case the form is in another mode at any point in time, this button becomes active and can be clicked to bring the form to view mode, if desired. The importance of view mode is that no entry will get modified by mistake when looking at the records in the form.

Edit Data button

On opening any form, the “Edit Record” button is active and can be clicked to bring the form from view mode to edit mode, if desired. Only after the form is in edit mode, any modification in the existing record or addition of new record or deletion of existing record is possible.

Add Record button

On opening the form, the “Add Record” button is inactive since the form is in view mode and a record can be added only when the form is in edit mode. As soon as the “Edit Record” button is clicked, the “Add Record” button becomes active. At this stage the “Add Record” button can be clicked to add a new record.

Delete Record button

On opening the form, “Delete Record” button is inactive since the form is in view mode and a record can be deleted only when the form is in edit mode. As soon as the “Edit Record” button is clicked, the “Delete Record” button becomes active. At this stage the “Delete Record” button can be clicked to delete the record which is currently displayed on the form.

Navigation buttons

There are four buttons for purpose of navigation through the available records. These buttons are for going to the first, previous, next and last record respectively. These buttons are active or inactive according to the location of opened record in list.

Search buttons

There are two buttons which are useful in searching a record with a particular entry in one of its fields. One of these buttons, called "Set Field" button, allow to set the field of interest. The other button called "Find" button is used to search the record with the desired entry in this field from all available records. Other usual options like searching all fields, setting search direction, multiple search instances and matching the case type etc. are also available.

Print button

The print button is used to print a single record alongwith the screen layout.

Report button

The report button, shown as the picture of an open book, invokes an input box to make selection of fields to be reported in tabular form. Suitable queries can be built up using conditions and the output can be grouped and sorted in the desired form.

Editing buttons

There are four buttons to carry out usual editing operations of cutting, copying or pasting the desired text in the fields and for undoing the last action(s) respectively.

Save button

The "Save" button is used for saving entered fields at any point of time.

Close button

The "Close" button is used to close the opened form. While closing the form, the program also saves all the entries or modifications made in the form. Therefore, there is no particular need to first click the "Save" button before closing the form.

The toolbar on the forms for time series data entry carrying these buttons is shown in Figure – 6. There can be slight variation in the number and type of buttons for different data entry forms as per applicability and requirement but the overall concept of working with these buttons remains the same.

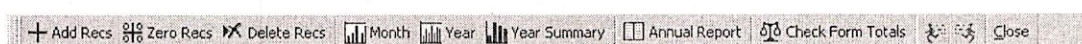


Figure - 6: Typical buttons on toolbar associated with forms for time series data entry

Add Record button

Entry of time series data is done month by month. Before the data can be entered, empty records are required to be created for the desired month and year. "Add Record" button creates these empty records and are displayed on screen for data entry.

Zero Record button

Some data series, like that of rainfall, has many zeros and few non-zero values. For expediting the data entry, such zero entries can be made automatically using this "Zero Record" button. If this button is clicked before creating the records then it creates the records which are all filled with zero. In case it is clicked after creation of the record and filling a few non-zero entries, then it fills the remaining blank entries with zeroes.

Delete Record button

"Delete Record" button is used to delete the records from the database. In case of time series data, data for complete month is deleted while for stage-discharge data only single observation data is deleted each time this button is pressed. Warning message is, however, displayed before the deletion process.

Graph buttons

A few buttons are available for plotting the graphs of data entered by the user. For daily and multiple times a day data, buttons for plotting data for a month or a year are available. Button for yearly summary showing the monthly totals is available for such cases. In the case of hourly data, button for plotting data of a day is available. Information on the graph buttons is easily obtainable if the mouse is kept undisturbed for a while on these buttons.

Report button

"Report" button is available for printing the listing of the entered data. For daily and multiple times a day data, yearly listing can be printed on one or more pages. For the case of hourly data, monthly listing can be obtained on a single page.

Data Entry Checks button

There are a few data entry checks which can be performed to see if various statistics (totals/averages etc.) of the entered data matches with that available in the manuscript. Such tests can be performed by clicking this "Data Entry Checks" button.

Navigation buttons

Two "Navigation" buttons are available for going to data of the next or previous month. These buttons help in conveniently and swiftly going to adjacent months.

Close button

"Close" button is used to close the form.

5. Data Entry Forms

The data entry is made by invoking the desired data entry form by clicking on the relevant menu item or button. A number of dedicated data entry forms are available for the entry of various types of data. These forms can be categorised in two major groups: one for the entry of master information and static/semi-static data and other for all types of meteorological hydrological, sediment and water quality data.

The layout of the forms for static/semi-static data typically has a list box in the left and the main area for entry of various fields. This list box displays all the records available in the database pertaining to that category. The current record being displayed is highlighted in this list box. The navigation buttons help in going to the desired record. The main area of the form comprises of several data entry fields pertaining to that form. Entry of data is accomplished using keyboard and navigation to different fields is done using "Tab" or "Enter" keys or with the help of the mouse.

Forms for entry of surface water data have three major functional parts. The first part is the portion of form showing the identification of the station and series and its associated series characteristics. Only the desired station and/or series is to be chosen from the available list and thereupon the associated characteristics are displayed. There is absolutely no necessity of making any data entry in this portion. The second part is the main area in which the appropriate tabular grid is displayed for making the required data entry. Suitable captions for all columns are displayed for easy identification and understanding. The dates, hours or timings are automatically filled up by the program wherever desirable. This avoids any error in the dates/hours and at the same time reduces the amount of data entry operations. The third portion of the form is for entry of certain averages or totals which are available in the manuscript. This allows data entry checks to see if these manuscript entries match with what has been entered in the form. Apart from this, the form also has two fields for specifying the year and month for which the data has to be entered or edited. Easy pull down list for the months and navigating buttons for years are available to specify the desired year and month conveniently and swiftly. These data entry forms also have several buttons on the toolbar as described earlier for adding records, making graphs and reports, checking data entry errors, navigation etc.

SW-DES (Version 2.0) - Work Area: C:\SWDES Databases\EXAMPLE_TRA.mdb - [Station Particulars]

File Edit View Insert Format Tools Records Tools Window Help Utilities

View Data Edit Data Add Recs Delete Recs Choice Close

View Session...

Station Code	Station Name	Station Code	Details
0001	Sabarnati at Dharoi Dam	AG000J3	Mancherla
0002	Sabarnati at V.N. Bridge	State	Andhra Pradesh
0003	Sabarnati at Vaulha	District	Adilabad
1221	Sabarnati at Kheirabadi	Tahsil / Taluk	Mancherla Mandal
1407	Sabarnati at Gandhinagar	Major Basin/Zone	Ganga-Brahm-Meghna Basin
AG000J3	Mancherla	Independent River	Godavari
AG000F3	Yelli	Tributary	
AG00059	Dhalegaon	Sub Tributary	
AGP20F4	DEGLDOR	Sub Sub Tributary	
AGP00A5	Purna	Local River	Godavari
AK000E7	34, Pondugala	Latitude	18°50'00" N
BARDOL1	MINDOLA @ BARDOL	Longitude	79°27'00" E
Biodra	Biodra	Altitude	137.000 m
Chackman	Chackman	Dist. to outlet	
Kashli	Kashli	Rel. Toposht no	
KOILSAGAR	KOILSAGAR	Catchment area	102900.00 Km²
Mahendabadi	Mahendabadi	Owner Agency	CWC
NS000D5	Sabarnati at Nabhoi	HIS Agency	CWC
NS000D2	Wairak at Kheda	State/regional Office	K & G B O, Hyderabad
NS000J7	Wairak at Gadvel (Rak)	Circle Office	Godavari Circle, Hyderabad
Pargson	Pargson	Divisional Office	U Godavari Div., Hyderabad
ROORKEE	ROORKEE	Sub-divisional Office	Manjira S.D, Nizamabad
		Section Office	Site Mancherla

Data Available for: [Buttons]

Form View NUM

Figure - 7: Form for entering station characteristics with various buttons on toolbar

SW-DES (Version 2.0) - Work Area: C:\SWDES Databases\EXAMPLE_TRA.mdb - [Rainfall - Daily]

File Edit View Insert Format Records Tools Window Help Utilities

Add Recs Zero Recs Delete Recs Month Year Year Summary Annual Report Check Form Totals Close

Station Name	Series Code	DL	Rainfall at 08:30	Cum. Rainfall	Remarks
Chaskman	MPS	1	6.4	6.4	
		2	0.6	7.0	
		3	1.0	8.0	
		4	0.0	8.0	
		5	0.0	8.0	
		6	0.2	8.2	
		7	0.0	8.2	
		8	0.0	8.2	
		9	6.6	14.8	
		10	18.2	33.0	
		11	5.4	38.4	
		12	9.0	47.4	
		13	45.0	92.4	
		14	13.8	106.2	
		15	1.6	107.8	
		16	2.4	110.2	
		17	0.2	110.4	
		18	0.3	110.7	

Data Limits	
U. Warning	164.0
Maximum	205.0
Units	mm

User Level: 1

As entered	As in form	Remarks in case of mismatch
Total Rainfall (Mth)	120.7	120.7
Rainy Days (Mth)	18	18
Max. Daily Rainfall	45.0	45.0

Form View NUM

Start Microsoft W... Acrobat Rea... SW-DES (... 16.37

Figure - 8: Form for entering daily rainfall data alongwith various buttons on the toolbar

5.1 Entry of Master Information

The software maintains a set of important information on data types, administrative and drainage boundaries and that on the owner agency and various offices at which data from an observation station is processed. This master information helps in avoiding duplicate spellings for the same item in the database and at the same time, the user is not required to waste time in keying-in same information. The required item can be entered, whenever required, by clicking it from the available list. There is adequate facility available in the system to extend or modify this type of information.

5.2 Entry of Static/Semi-static Characteristics

Attributes associated with the observational stations or equipment, which do not change with time, are considered as static type of data. Some of these attributes change, but very infrequently, and are thus taken to be of semi-static nature. SWDES stores the characteristics associated with the observation stations, data series, reduced level of gauge zero and current meters so that the same is available for reference and querying subsequently. Options for X-section profiles data, salient features of reservoir/diversion scheme and elevation-area-capacity relationships are also available in this main option of static/semi-static data. The layout of the form showing the options on static/semi-static characteristics is shown in Figure - 2.

5.3 Entry of Station Characteristics

Many important attributes to each observational station can be assigned for defining its location in terms of geographical, administrative or drainage units and for indicating various offices which have control on its operations. Locational attributes are important for the purpose of finding inter station distances and difference in altitudes for the purpose of data processing. These characteristics are also very important for the purpose of retrieval of data pertaining to particular range of these attribute(s).

The screenshot shows the 'Station Particulars' form in the SWDES (Version 2.0) software. The form is titled 'Station Particulars' and is divided into several sections. The 'Station Name' section includes fields for Station Name, State, District, and Taluk. The 'Location Details' section includes fields for Major Basin/Zone, Independent River, Tributary, Sub Tributary, Sub Sub Tributary, and Local River. The 'Station Setup' section includes fields for Station Name, Bank, and Station Setup. The 'Agency Information' section includes fields for District Agency, HIS Agency, State/Regional Office, Circle Office, Divisional Office, Sub-Divisional Office, and Section Office. The form also includes a 'Data Available to' section at the bottom.

Figure – 9: SWDES Form for entry of station characteristics

5.4 Entry of Series Characteristics

The bulk of hydrological data is time series data. At every station, a number of variables are observed and sometimes at varying time intervals. Thus, the time series data is required to be organised in different series at every station for each combination of the required variables and time intervals of observation. These series are attributed with certain key characteristics, which are useful for identification and providing necessary information about the series and in validation of the elements of the series. Any time series can be recognised by its series identification code which comprises of three parts: station code, data type and time interval code. The combination of these entities is considered to be unique and defines a specific series as illustrated here:

Series identification code = Station code + Data type + Time interval code

Time interval code

Time interval code is used to indicate the interval of time between successive observations. Depending upon the variation of time interval between various observations, the time series can be of three different types:

- Equidistant,
- Cyclic, and
- Non-equidistant

For an equidistant time series, all data points are spaced equally in time (in terms of calendar or time units). The time interval between the data points in the non-equidistant series is not uniform. The cyclic series is the one for which, though two or more adjacent time intervals may not be identical but there is a perfect repetition or recurrence of the set of these unequal time intervals. Thus, for the equidistant and cyclic time series, the time instants of the observations can be uniquely defined if the time intervals are known. It is enough if the starting time and ensuing set of repetitive time interval(s) are known to fully define the times of observation of all the data in the series. Assigning codes for time intervals facilitates defining time intervals objectively and flexibly which also helps in exchanging data between different databases.

Data Limits

Every series is attributed with a few data limits, which are important in applying data entry checks and subsequently, while screening the data for doubtful values. Since, most of the hydrological and meteorological variables are result of some physical process, they are expected to occur or vary within certain limits. Though these limits cannot always be quantified accurately, however, a good estimate of these limits serves the purpose of scrutinising the data for their validity. Six such limits, which can be assigned for any time series are: (a) minimum value, (b) Lower warning level, (c) upper warning level, (d) maximum value, (e) maximum rate of rise, (f) maximum rate of fall.

5.5 Entry of RL of Gauge Zero

At the stream gauging stations, water level is always measured with respect to the zero of the gauge. The zero of the gauge is established as per the requirement and flow conditions prevailing at individual stations. Thus, zero of the gauges for different stations are obviously at unequal elevation with respect to a common datum. For making any comparison of water level at two or more gauging stations, it is necessary to bring all the water level observations at all the gauging stations to a common datum. Also, with the passage of time, gauges may be displaced or destroyed or they may be changed in elevation as the result of erosion of beds. In order that the records of stage may assuredly refer to the same datum throughout the period of record, the datum of each gauge must be referred to and occasionally checked with at least one and preferably two or more bench marks that are entirely detached from the gauge, its support or shelter, and that are not liable to destruction or change in elevation.

5.6 Entry of Current Meter Ratings

Current meters or flow meters are one of the important equipment employed for measurement of flow velocities. The relation between speed of rotation of current meter to the velocity of water which, causes the rotation, is defined by the meter rating. The current meter should be rated from time to time, whenever it is repaired or modified in any way and in any event, after a prescribed period of use.

The entries for current meter ratings are maintained with the help of two forms. One form, "Current Meter Information", is for maintaining the list of current meters and those properties which do not change with time. Other form, "Current Meter Ratings" is used for entering the actual current meter ratings for each current meter for various validity periods. Both these type of data can be entered by choosing the option of "Static/semi-static Characteristics" from the main switchboard and then choosing the menu item "Current Meter Characteristics".

5.7 Entry of cross-sectional data

Cross-section data comprise of the pairs of distance and elevation of several points on the cross-sectional profile of the river gauging section. The distances are taken with respect to an origin on the gauging section and elevation is reported with respect to the mean sea level as the datum. The date of survey is always associated with the cross-sectional data. The layout of the form for entry of cross-sectional data is as shown in Figure – 10 while a plot of river cross-section is shown in Figure - 11.

Any cross-section record is identified by the station code and the date of the cross-section observation. Reference information on the gauge line can be entered as text in the field given on the form. The R.L. of gauge zero is brought from the database and is displayed for purpose of reference and plotting with the cross-section. The tabular layout for the entry of cross section data comprises five columns:

SW-DES (Version 2.0) - Work Area : C:\SWDES Databases\EXAMPLE_TRA.mdb - [X-Section Master : Form]

File Edit View Insert Format Records Tools Window Help Utilities

View Data Edit Data Add Data Delete Station Code Save Close

View Session...

Sno.	Reduced Dist. (m)	UGL	Elevation (m)	CGL	DGL
1	0.00	128.781	133.591	130.986	
2	30.00	128.791	132.936	134.126	
3	60.00	128.506	131.606	132.641	
4	90.00	127.226	128.827	132.921	
5	120.00	126.846	128.786	129.891	
6	150.00	127.006	128.501	128.955	
7	180.00	127.506	127.466	128.516	
8	240.00	127.726	127.821		
9	300.00	127.086	127.236	127.467	
10	360.00	126.306	126.746	127.336	
11	420.00	126.611	127.816	127.231	
12	480.00	126.586	127.556	126.956	
13	540.00	127.006	126.006	127.506	
14	600.00	127.016	126.926	127.446	
15	660.00	125.566	126.546	127.006	
16	720.00	125.516	127.006	125.726	
17	780.00	0.000	127.026	126.616	

Station Code: AG0003 Date: 24/05/1997

Gauge Line Reference: R L of Zero Gauge 124.316

UGL: Base Value 150 Dist from CGL 150

CGL: Base Value Standard Left Bank Side

DGL: Base Value 150 Dist from CGL

Add Sort Add Cell Del Cell Graph Report multicolumn Report

Form View NUM

Figure - 10: Data entry form for cross sectional data

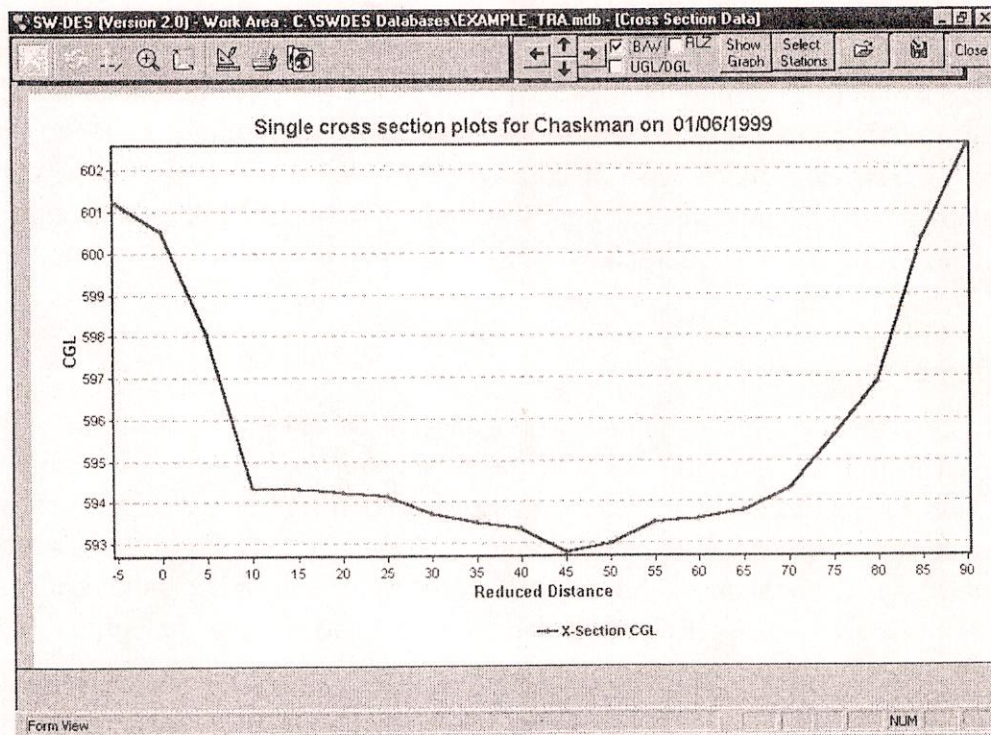


Figure - 11: Plot of cross sectional profile

6. Entry of Meteorological Data

There are two types of hydro-meteorological stations: (a) the rainfall station and (b) the climatic stations. The standard non-recording raingauge and/or autographic or digital recording raingauge is installed at the rainfall stations. Apart from the rainfall stations, there are few climatic stations at which a number of hydro-meteorological parameters like rainfall, dry and wet bulb temperatures, minimum and maximum temperatures, relative humidity, pressure, wind speed and direction, pan evaporation and sunshine duration are observed. From some such stations, the data is reported once a day while others report it on twice daily or four times a day basis. Also, few parameters like temperature, humidity and pressure are also observed using autographic equipment and thus are available at shorter intervals.

6.1 Entry of rainfall data

First of all, the series in which the data is to be entered has to be initialised, in case it is not existing in the database. The initiation of series requires selection of the combination of station, parameter and time interval. The parameter for rainfall observed using a standard non-recording raingauge is "MPS". The time interval code for daily data is "3,1,0,0" and the time label has to be the standard time of observation, say 0800 hrs or 0830 hrs as per the case. Sample form for daily rainfall data entry is shown in Figure – 12.

The screenshot displays the 'SW-DES (Version 2.0) - Work Area: C:\SWDES Databases\EXAMPLE_TRA.mdb - (Rainfall - Daily)' window. The interface includes a menu bar (File, Edit, View, Insert, Format, Records, Tools, Window, Help, Utilities) and a toolbar with options like '+ Add Recs', 'Zero Recs', 'Delete Recs', and various view filters (Month, Year, Year Summary, Annual Report, Check Form Totals). The main form is divided into several sections:

- Station Information:** Station Name: Chaskman, Station Code: Chaskman, Para. ID: MPS, T1: 3, Div: 1.
- Sub-Division:** W.R. Sub Dn. 5 Shirur
- Local River / Basin:** Bhima
- Latitude:** 18°55'15"
- Longitude:** 73°50'06"
- Data Limits:** U Warning: 164.0, Maximum: 205.0, Units: mm.
- User Level:** 1
- Rainfall Data Table:** A table with columns 'Dt.', 'Rainfall at 08:30 Hrs', 'Cum. Rainfall', and 'Remarks'. It contains 18 rows of data for the month of July 2000.
- Summary Section:** A table comparing 'As entered' and 'As in form' values for 'Total Rainfall (Mth)', 'Rainy Days (Mth)', and 'Max. Daily Rainfall'. It also includes a 'Remarks in case of mismatch' field.

The 'Form View' button is located at the bottom left, and the 'NUM' button is at the bottom right.

Dt.	Rainfall at 08:30 Hrs	Cum. Rainfall	Remarks
1	6.4	6.4	
2	0.6	7.0	
3	1.0	8.0	
4	0.0	8.0	
5	0.0	8.0	
6	0.2	8.2	
7	0.0	8.2	
8	0.0	8.2	
9	6.6	14.8	
10	18.2	33.0	
11	5.4	38.4	
12	9.0	47.4	
13	45.0	92.4	
14	13.8	106.2	
15	1.6	107.8	
16	2.4	110.2	
17	0.2	110.4	
18	0.3	110.7	

	As entered	As in form	Remarks in case of mismatch
Total Rainfall (Mth)	120.7	120.7	
Rainy Days (Mth)	18	18	
Max. Daily Rainfall	45.0	45.0	

Figure - 12: Form for entry of daily rainfall data

SW-DES (Version 2.0) - Work Area : C:\SWDES Databases\EXAMPLE_TRA.mdb - [Rainfall - Hourly]

File Edit View Insert Format Records Tools Window Help Utilities

+ Add Recs 0% Zero Recs Del Recs Hrlly Hrlly(Met.) Monthly Report Check Form Totals Close

Station Name: Chaskman Sub-Division: W.R. Sub Dn. 5 Shirur Local River / Basin: Bhima Year: 1998

Series Code: Chaskman Para. ID: MPA T1: 4 Div.: 1 U-Warning: Maximum Units: mm

Day	0930	1030	1130	1230	1330	1430	1530	1630	1730	1830	1930	2030	2130	2230	2330	0030	0130	0230	0330	0430	0530	0630	0730	0830
1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
3	0.0	0.0	0.1	0.0	0.3	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.1	0.0	0.1
4	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.5	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	0.0	0.4	0.0	0.9	0.0	1.2
5	0.0	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	0.9	1.1	0.5	0.0	0.0	0.0	0.3	0.0	0.0	0.0	1.5	0.0	0.0	0.0
6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.3	0.0	0.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4	0.6	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.0	0.0	0.0	0.0	0.1
Total	0.1	0.6	3.3	1.3	7.3	16.8	8.7	1.9	5.3	12.6	30.0	10.5	3.7	3.4	7.1	5.8	16.2	7.2	4.0	3.0	3.2	3.8	1.1	2.4

Total as in form: 0.1 0.6 3.3 1.3 7.3 16.8 8.7 1.9 5.3 12.6 30.0 10.5 3.7 3.4 7.1 5.8 16.2 7.2 4.0 3.0 3.2 3.8 1.1 2.4

As entered As in form Remarks in case of mismatch

Max. Hourly Rain: 16.0 16.0

No. of Rainy Days: 26 26

User Level: 1

Form View NUM

Figure - 13: Form for entry of hourly rainfall data

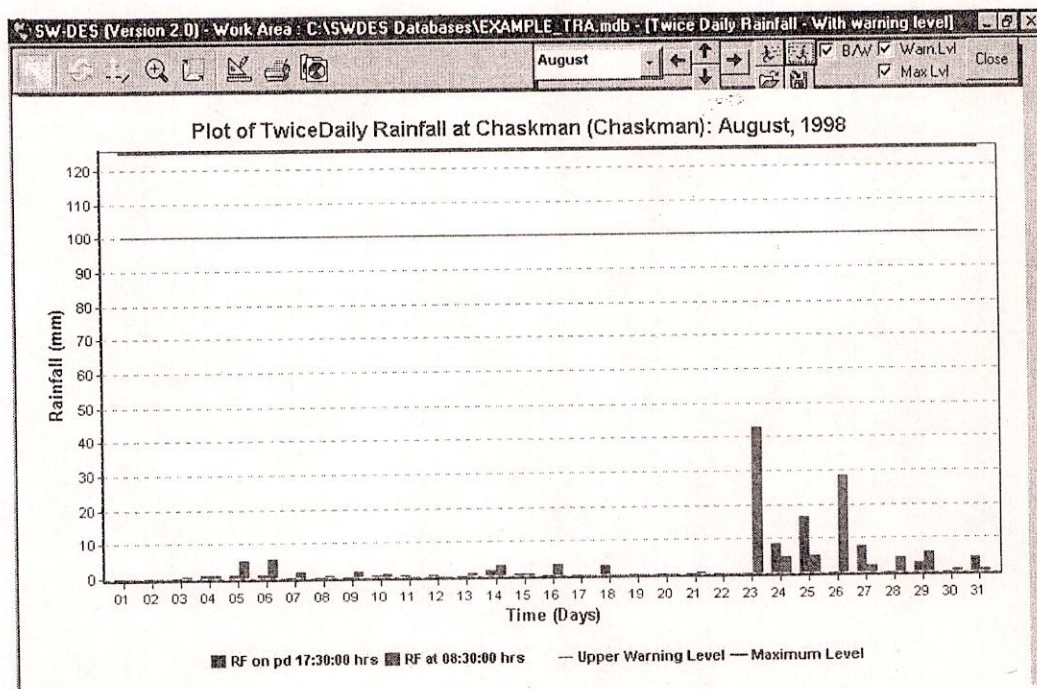


Figure - 14: Plot of twice-daily rainfall data for a month

6.2 Entry of climatic data

The parameter codes for climatic parameters observed using a standard non-recording equipment for rainfall, dry bulb temperature, wet bulb temperature, minimum temperature, maximum temperature, pressure, relative humidity, instantaneous wind speed, average wind speed, wind direction, pan evaporation and temperature of pan water are MPS, MTD, MTW, MTN, MTX, MBS, MHS, MWI, MWS, MW1, MEP and MTW respectively. These data types are also displayed in the form of a pop-up message box whenever the cursor is rested on the column title for a while. Units applicable for these data types are also mentioned with the title in each column. The time interval code for daily data is "3,1,0,0" and time label has to be the standard time of observation. Sample form for entry of climatic data is shown in Figure – 15.

Day/Hour	Absolute Pressure (mb)	Min Temp (°C)	Max Temp (°C)	Temp Dry Bulb (°C)	Temp Wet Bulb (°C)	Relative Humidity (%)	Inst. Wind Speed (km/hr)	Avg. Wind Speed (km/hr)	Wind direction (16pts)	Rainfall (mm)	Pan Evaporation (mm)	Temp. of Pan water (°C)	Remarks
1:00:30		28.0	22.5	22.0	96.0		0.8	W	+	0.0	0.4	23.0	
2:00:30		28.0	23.5	23.0	96.0		3.4	SE	+	0.0	1.4	24.0	
3:00:30		28.0	24.5	23.0	88.0		3.6	W	+	0.3	1.1	24.0	
4:00:30		27.0	25.5	22.5	76.0		5.2	SW	+	1.2	1.4	24.0	
5:00:30		26.5	24.5	22.5	84.0		3.2	SW	+	5.6	0.9	24.0	
6:00:30		28.5	24.0	22.0	83.0		4.8	SW	+	6.3	0.8	24.0	
7:00:30		28.5	23.0	22.5	96.0		4.1	SW	+	1.4	1.0	24.0	
8:00:30		27.5	23.0	22.5	96.0		4.4	W	+	0.2	1.0	24.0	
9:00:30		28.5	23.0	22.0	91.0		4.3	SW	+	1.4	1.0	24.0	
10:00:30		26.0	24.5	22.5	84.0		4.6	SW	+	1.1	1.0	24.0	
11:00:30		28.0	24.0	22.5	87.0		6.7	W	+	0.2	1.6	24.0	
12:00:30		27.0	23.5	22.5	91.0		2.4	W	+	0.2	0.9	24.0	
13:00:30		28.0	24.5	23.0	88.0		3.0	SW	+	0.6	0.8	24.0	
14:00:30		27.0	23.5	21.5	83.0		4.8	W	+	4.6	1.0	23.0	
15:00:30		26.5	24.0	22.0	83.0		4.4	SW	+	0.7	0.9	23.0	
16:00:30		29.5	23.5	22.5	87.0		2.2	SW	+	3.2	1.2	23.0	
Total		27.4	23.7	22.5	90.1		2.8	W	+	164.8	33.0	22.9	as entered, as in form
Total/Avg			27.4							164.8			

Figure - 15: Form for entry of daily climatic data

Day/Hour	28.90	28.30	27.90	27.60	27.40	27.80	29.20	30.20	32.10	33.20	34.80	35.70	36.60	37.40	37.10	36.00	36
28.90	28.30	27.90	27.60	27.40	27.80	29.20	30.20	32.10	33.20	34.80	35.70	36.60	37.40	37.10	36.00	36	
29.60	29.40	28.60	29.00	28.20	28.40	30.40	32.30	33.60	35.30	35.80	35.80	37.20	37.50	38.00	38.10	38	
30.00	29.10	28.80	28.50	28.60	28.60	29.50	31.50	34.70	34.90	35.10	35.60	36.70	37.20	37.60	36.00	37	
30.00	30.20	29.70	30.10	30.10	30.00	30.70	32.50	34.10	35.00	35.60	36.10	37.20	37.90	37.60	28.30	37	
29.00	29.50	29.10	28.80	28.20	28.30	29.50	31.10	33.30	35.10	35.50	36.80	37.40	38.30	38.00	38.60	34	
28.70	28.20	28.00	28.00	28.20	28.60	29.70	32.20	33.70	37.00	36.20	37.70	37.40	38.30	38.60	39.10	39	
28.10	27.90	27.50	27.00	26.10	26.10	28.80	31.70	33.30	35.10	36.00	37.50	38.40	38.90	39.60	39.50	38	
28.60	28.90	27.90	28.90	28.90	29.10	29.90	31.00	33.30	33.90	35.60	36.80	36.40	37.30	39.30	38.70	37	
29.70	29.70	29.60	29.40	28.80	28.60	30.20	31.60	34.30	34.90	36.70	37.50	37.90	37.50	39.10	37.40	32	
26.50	26.30	26.10	26.80	26.80	27.90	28.80	30.90	30.20	22.60	22.60	24.30	26.10	27.20	28.80	29.10	29	
25.70	25.60	26.20	25.60	23.90	22.70	22.40	22.30	22.30	23.20	24.00	27.90	28.90	29.80	30.70	32.60	34	
27.60	27.00	26.30	25.90	25.20	25.50	28.30	29.70	31.30	32.70	33.80	33.90	34.00	34.40	33.40	27.90	30	
26.30	25.80	25.40	25.10	24.90	24.90	27.90	29.20	31.10	31.80	33.00	32.50	34.50	35.00	35.50	34.70	34	
26.80	26.70	26.40	26.10	25.90	26.10	28.50	32.10	34.40	34.90	36.60	36.10	35.40	36.50	36.20	36.30	35	

Figure - 16: Form for entry of hourly climatic data

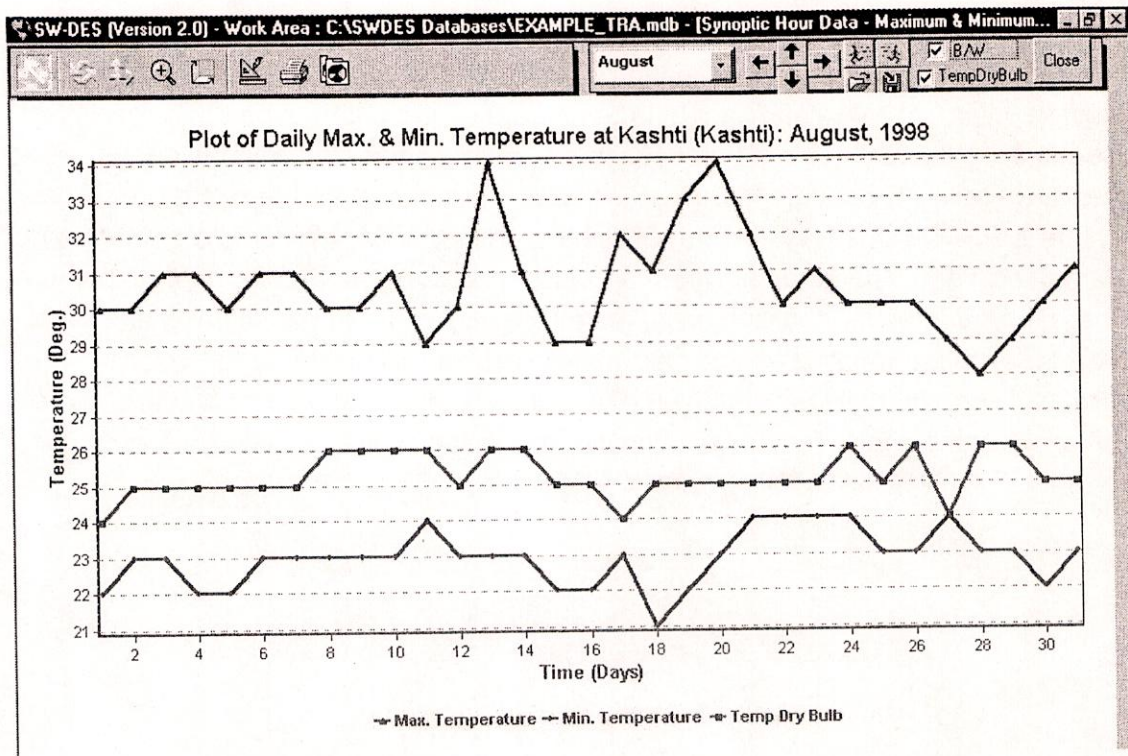


Figure – 17: Plot of daily climatic data on minimum and maximum temperatures

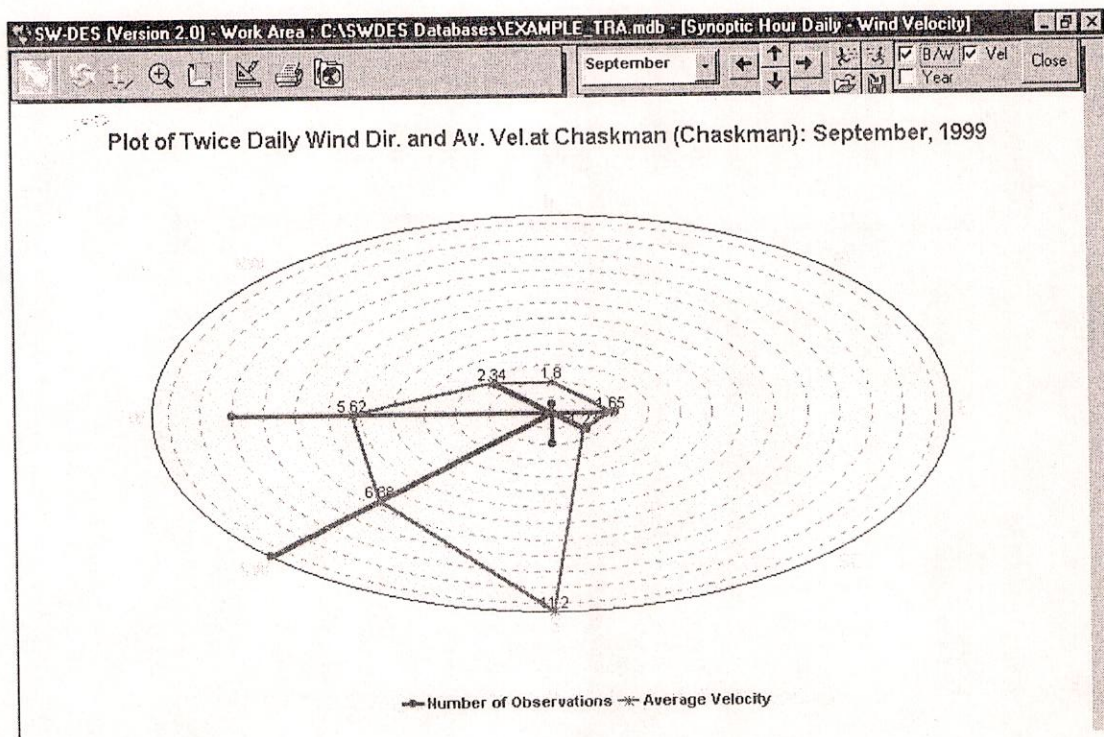


Figure - 18: Plot of wind rose diagram

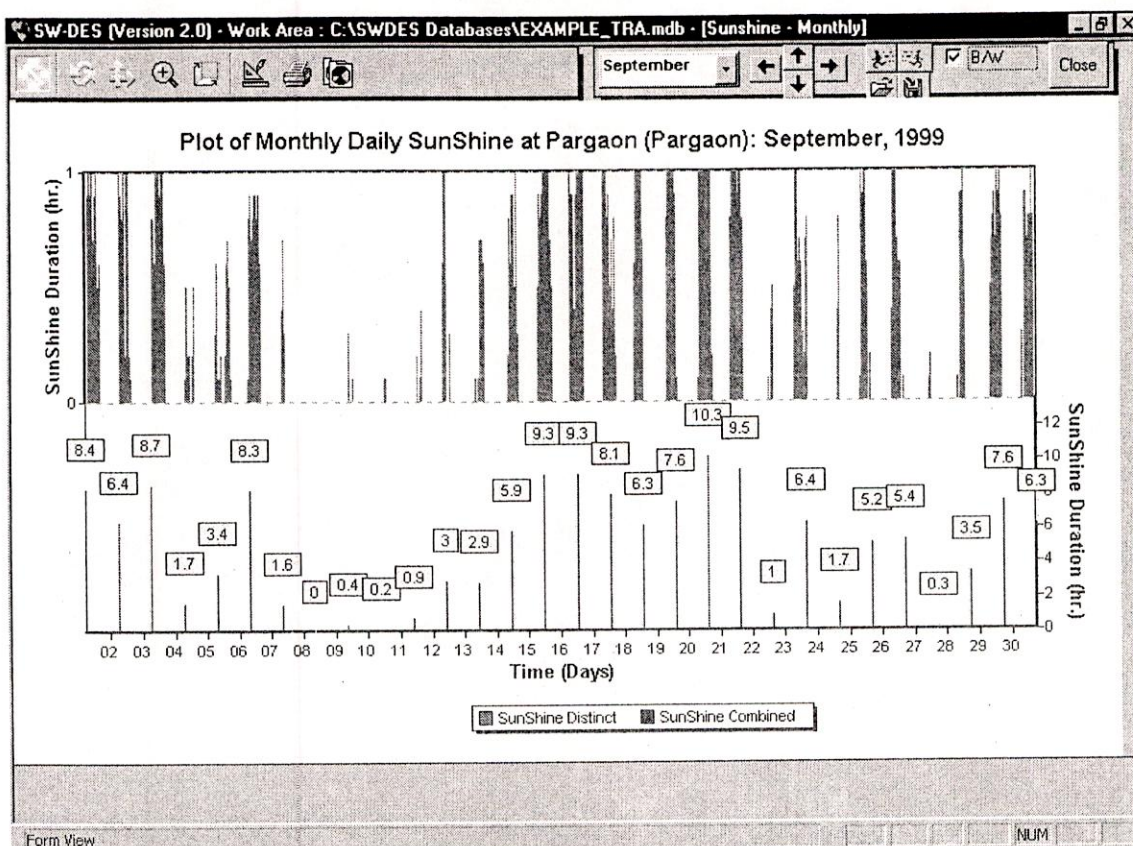


Figure - 19: Plot of daily sunshine duration for the month

6.3 Data validation options for meteorological data

Validation of data using graphical means is carried out simultaneously while data is entered in respective data entry forms. Few more data validation options are available to ensure consistency of data entered by making comparison of related data that are observed and entered independently. These options are listed under the "Data validation" option on the main switchboard (Table - 1).

For meteorological data various data validation options available are on comparison of: (a) SRG and ARG data, (b) SRG (twice-daily) and ARG data, (c) ARG and sunshine duration data, (d) SRG data at multiple stations, (e) daily climate data at multiple stations and (f) twice-daily climate data at multiple stations. Sample plots for some of these options are presented below.

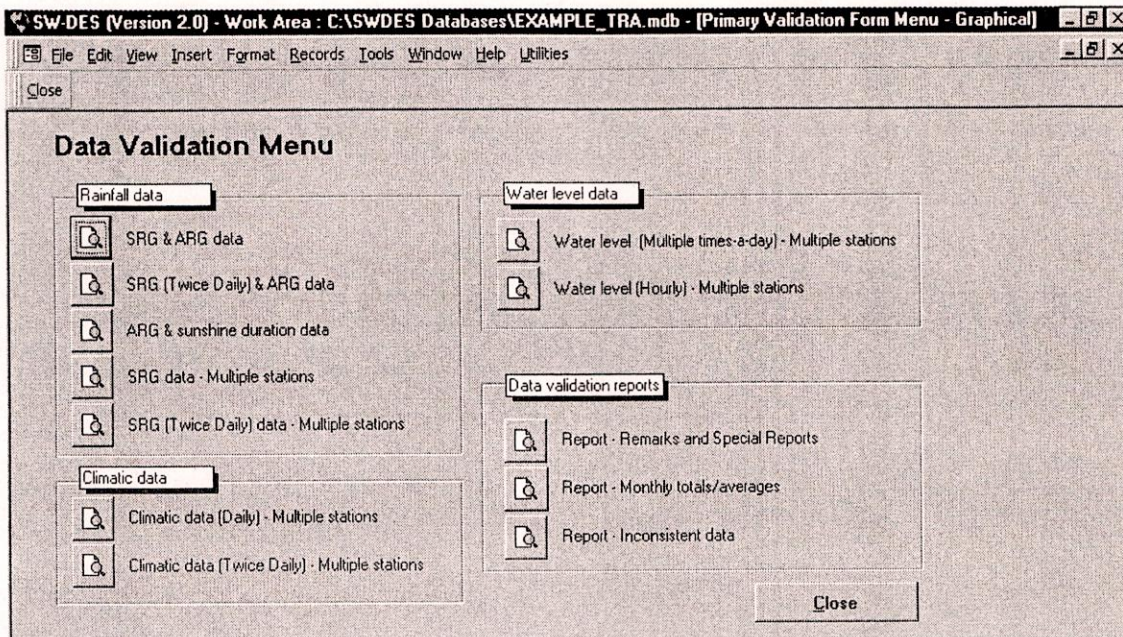


Figure - 20: List of data validation options

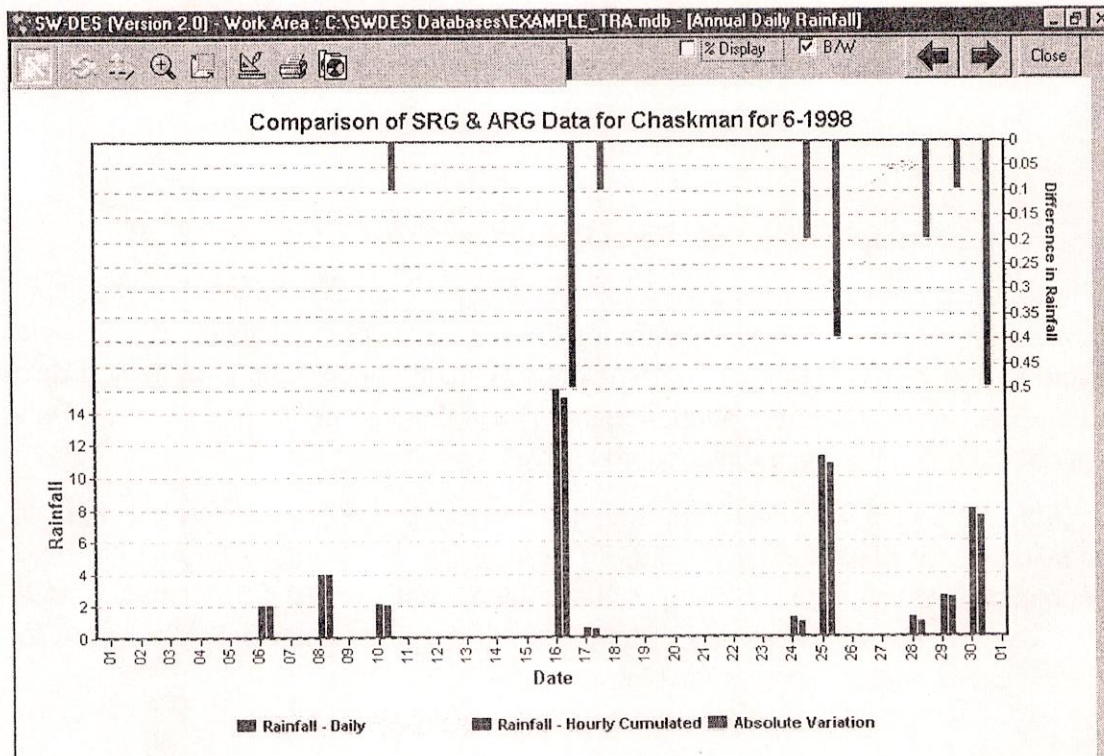


Figure - 21: Plot of SRG and ARG comparison

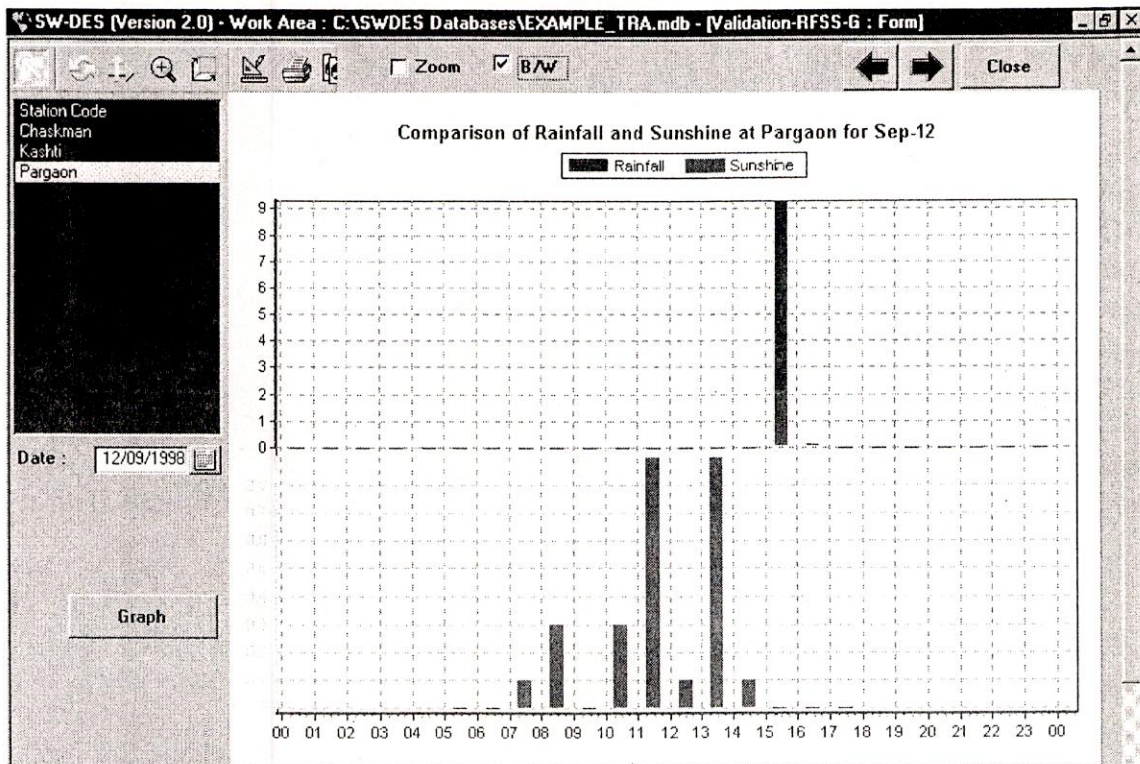


Figure - 22: Plot of ARG and sunshine duration comparison

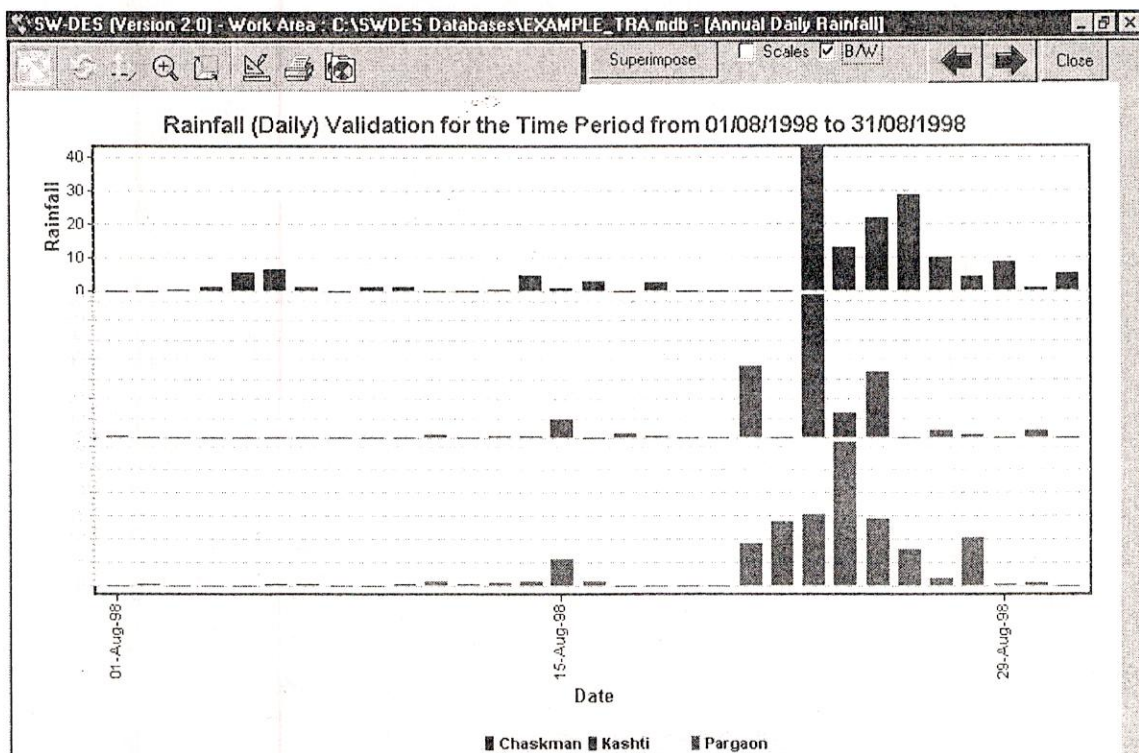


Figure - 23: Comparison of daily rainfall at multiple stations

7. Entry of Hydrological Data

Observations on water level, stage-discharge measurements and sediment concentration are the main raw hydrological data required to be entered. Water level is primarily observed in two ways: (a) from staff gauges and (b) from autographic or digital type water level recorders. From the staff gauges, the observations are generally made once in a day in lean season and at multiple times a day during flood times. For flashy rivers, staff gauges may even be read at hourly intervals during flood season. However, standard timings are generally followed for the observations during the day by different agencies. An autographic type of water level recorder on the other hand gives a continuous record of water level in time. These autographic records have to be read manually and the data is normally reported at one hour time interval or lesser, if required. The digital data from a digital water level recorder can either be at equal time intervals, usually at quarter or half hour interval, or can be reported for only those instants when there is a change in water level which is more than a pre-set amount.

Stage-discharge observations are the primary data for establishing relationship between the stage and discharge, called the rating curve, at any river gauging station. The discharges are generally estimated indirectly by: (a) observing the flow velocities at a number of points across the area of flowing water and computing discharge by area-velocity methods and (b) observing the slope of the surface profile and computing discharge by slope-area method. Under normal circumstances, the velocities are observed using flow meters (current meters) but in difficult circumstances and when the flow meters are not available, the float method or slope-area method is also resorted to.

7.1 Entry of water level data

Water level at a few instants in a day is generally observed using staff gauge. First of all, the series has to be initialised. The initiation of series requires selection of combination of station, parameter and time interval. The parameter code for water level with respect to gauge zero observed using a staff gauge is "HZS". The time interval code for daily data is "3,1,0,0" and the time label has to be the standard time of observation, e.g., 0800 hrs etc.. In most cases of multiple water level observations, the observations are taken in day hours only and thus results in a cyclic type of time series. For example, the time interval code for a series having three observations in the day at 0800, 1300 and 1800 hrs. will be "3,3,C,C" with three time labels as 0800, 1300 and 1800 hrs. Data for up to four observations a day can be entered using this form. The form functions for any parameter ID having first two characters as "HH or HZ". Sample forms for entry of water level multiple times a day is shown in Figure – 24 while form for hourly measurements is presented in Figure – 25. A sample plot of water level data is shown in Figure – 26.

SW-DES (Version 2.0) - Work Area: C:\SWDES Databases\EXAMPLE_TRA.mdb - [Water Level: 1 - 4 times a Day]

File Edit View Insert Format Records Tools Window Help Utilities

+ Add Recs * Delete Recs * Graph-Month * Graph-Year * Report * Check Form Totals * Close

Station Name: DEGLDOR

Gauge of Water Level Observation:

DL	08:00	12:00	18:00	Remarks
1	1.810	1.790	1.790	
2	1.750	1.750	1.750	
3	1.750	1.750	1.750	
4	1.880	2.020	1.960	
5	1.800	1.790	1.790	
6	1.770	1.760	1.760	
7	4.680	3.210	2.720	
8	3.000	2.660	2.460	
9	2.380	2.250	2.270	
10	2.150	2.140	2.130	
11	2.080	2.060	2.040	
12	2.700	2.590	2.300	
13	2.060	2.020	1.980	
14	2.420	2.270	2.200	
15	2.020	2.000	1.970	
16	1.950	1.870	1.870	
17	1.810	1.790	1.760	
18	1.710	1.700	1.630	
19	4.860	3.590	4.080	
20	2.300	2.240	2.170	

Year: 1998
Month: September
Zero RL: 351.000

Sub-Division: Purna SD, Nanded
Local River / Basin: Purna / Godavari
Latitude: 19°11'00"
Longitude: 77°02'00"

Data Limits:
Minimum: L Warning U Warning Maximum
Max Hdr Max Rdr Units
m m

User Level: 1

Min: 1.710 1.700 1.630
Max: 4.860 3.590 4.080
Avg: 2.300 2.240 2.170

Remarks in case of mishap:

Form View

Figure - 24: Form for entry of water level data at multiple times a day

SW-DES (Version 2.0) - Work Area: C:\SWDES Databases\EXAMPLE_TRA.mdb - [Water Level: Hourly]

File Edit View Insert Format Records Tools Window Help Utilities

+ Add Recs * Delete Recs * Hourly * Monthly * Report * Check Form Total * Close

Station Name: Pargoon

Gauge of Water Level Observation:

W.R. Sub Div. S. Shew	08:00	12:00	18:00	Remarks
1	3.340	3.360	3.370	
2	3.250	3.240	3.230	
3	3.190	3.180	3.170	
4	3.100	3.100	3.090	
5	3.050	3.050	3.050	
6	3.360	3.380	3.400	
7	3.700	3.690	3.680	
8	3.700	3.690	3.680	
9	3.490	3.470	3.470	
10	4.090	4.100	4.100	
11	4.010	3.990	3.960	
12	3.640	3.660	3.710	
13	4.010	4.030	4.060	
14	3.980	3.980	3.990	

Year: 1998
Month: August
Zero RL: 351.000

Sub-Division: Pargoon
Local River / Basin: Pargoon
Latitude: 18°33'30"
Longitude: 74°22'30"

Data Limits:
Minimum: L Warning U Warning Maximum
Max Hdr Max Rdr Units
m m

User Level: 1

Min: 3.340 3.360 3.370
Max: 4.090 4.100 4.100
Avg: 3.980 3.980 3.990

Remarks in case of mishap:

Form View

Figure - 25: Form for entry of hourly water level data

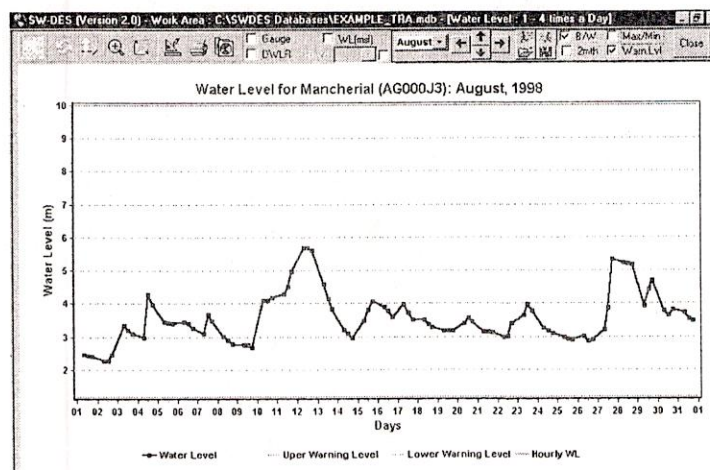


Figure - 26: Plot of water level data for a month

7.2 Entry of flow measurement data

The velocity observations normally result in huge amount of data for each discharge observation. For the purpose of reference, many other details such as mode of crossing, type of equipment used, condition of water and weather etc. are also recorded. After each stage-discharge observation, the observer compiles the field notes in proper forms and then computes discharge and other characteristics of flow. Since the primary and summary stage-discharge data comprises of a huge number of types of data, its entry is accomplished using five sub-forms: (a) entry of gauge data, (b) entry of current metering observations, (c) entry of float observations, (d) entry of slope observations (e) entry of summary stage-discharge data and (f) entry of summary suspended sediment data, as presented below in pictorial form.

Figure - 27: Form for entry of gauge data and reference info for stage-discharge measurements

Figure - 28: Form for entry of flow measurement info using current meter

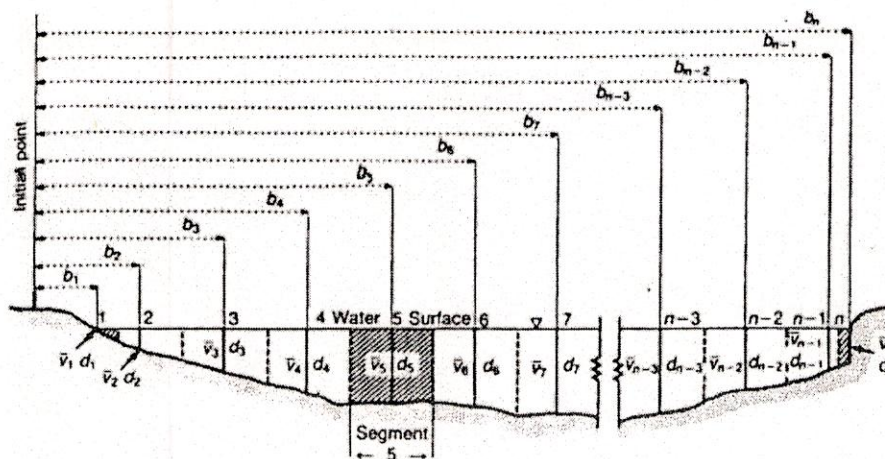


Figure - 29: The mid-section method of computing current meter measurements

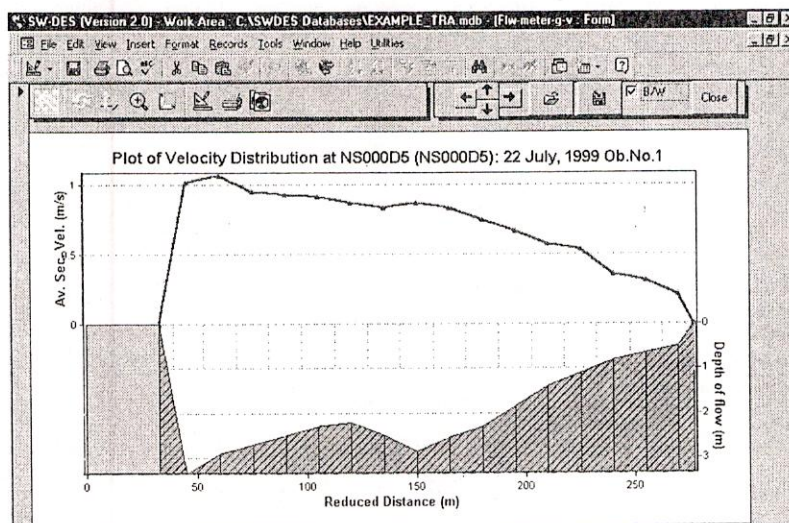


Figure - 30: Plot of mean velocity profile along the gauging section

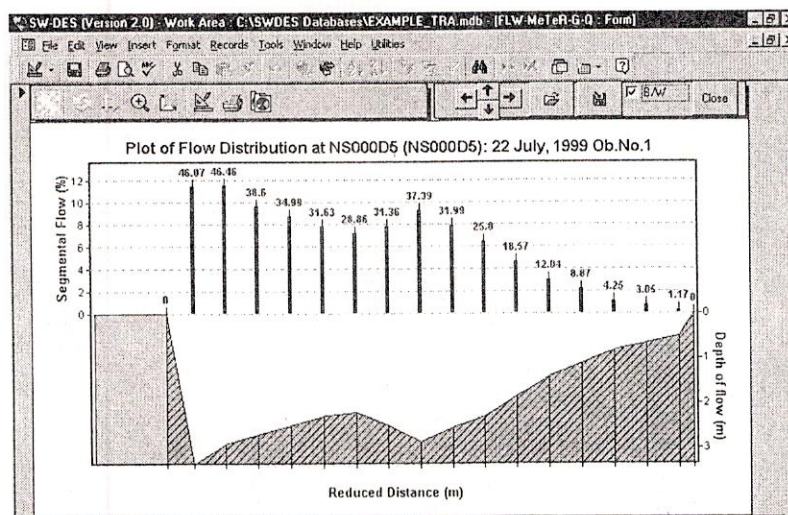


Figure - 31: Plot of flow passing through various segmental areas

SW-DES (Ver 1.02) - Work Area: SAMPLE_SWDES - (FlowMaster)

File Edit View Insert Format Records Tools Window Help

+ Add Recs

Station Name: Station Code: Jar Level: 1 Sub-Station: Sub-Station:

Year: 1999 Month: November Day: MO No: Time From: Local River / Basin:

General & Gauge Information Float Measurements Flow by Slope Area Method

No. of Concentrations: Conditioned for Use:

Type of Float Used: Length of Flow Run:

U/S Sectional Details				D/S Sectional Details			
Comp. No.	Flow No.	Sec. No.	Sec. Area	Comp. No.	Flow No.	Sec. No.	Sec. Area

Compute Add Records

Top Width: Calculated: Calculated by:

Wetted Perim: Calculated: Calculated by:

Area: Calculated: Calculated by:

Discharge: Calculated: Calculated by:

Comp. No.	Flow No.	Obs. No.	Time by Float	Velocity or Flow Constant	Obs. No.
1	1	1	0.00	No.	
		2	0.00	No.	
		3	0.00	No.	
		4	0.00	No.	
2	2	1	0.00	No.	
		2	0.00	No.	
		3	0.00	No.	

Transfer

Figure - 32: Form for entry of velocity observations using floats

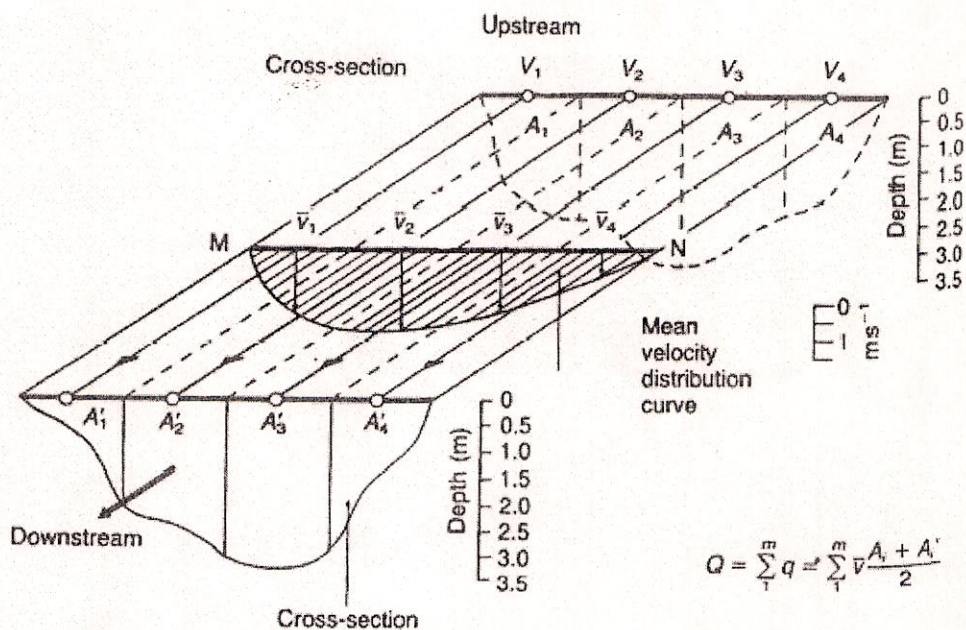


Figure - 33: Computation of discharge from float measurement

SW-DES (Version 2.0) - Work Area : C:\SWDES Databases\EXAMPLE_TRA.mdb - [Stage Discharge Summary]

File Edit View Insert Format Records Tools Window Help Utilities

New Record + Add Recs X Delete Record Report Check Zero of RL Dry / NoFlow Close

Station Name: Mancherial Station Code: AG000J3 Zero RL: 124.316 Year: 1998

Sub-Division: Manjira SD, Nizamabad Local River / Basin: Godavari Lat: 18°50'00" Long: 79°27'00" Month: April

User Level: 1

Day	Time	Obs. No	Mean Gauge	WL w.r.t. M.S.L.	Discharge (Q) (m ³ /s)	Observed / Computed	Area (A) (sq.m)	Surface Slope (S) (m/m)	Top Width	Wetted Perimeter	Hyd. Radius	Velocity (m/s)	Manning (N)	Gradient (m/day)
1	08:00	1	0.950	125.258	3.039	Observed	12.84	0.00093	30.00	30.00	0.428	0.237	0.0730	
2	08:00	1	0.940	125.258	2.802	Observed	12.36	0.00093	30.00	30.00	0.412	0.227	0.0740	
3	08:00	1	0.935	125.258	2.605	Observed	12.14	0.00093	30.00	30.00	0.405	0.215	0.0780	
4	08:00	1	0.930	125.245	2.494	Observed	11.66	0.00093	30.00	30.00	0.389	0.214	0.0760	
5	08:00	1	0.930	125.244	2.600	Computed								
6	08:00	1	0.930	125.245	2.477	Observed	9.84	0.00093	32.00	32.00	0.308	0.252	0.0550	
7	08:00	1	0.920	125.236	2.303	Observed	11.14	0.00090	30.00	30.00	0.371	0.207	0.0750	
8	08:00	1	0.910	125.225	2.400	Computed								
9	08:00	1	0.900	125.216	2.200	Computed								
10	08:00	1	0.900	125.215	2.200	Computed								
11	08:00	1	0.890	125.209	2.057	Observed	10.54	0.00090	30.00	30.00	0.351	0.195	0.0770	
12	08:00	1	0.885	125.201	2.000	Computed								
13	08:00	1	0.875	125.191	1.985	Observed	7.90	0.00090	30.00	30.00	0.263	0.251	0.0490	
14	08:00	1	0.875	125.181	1.900	Computed								
15	08:00	1	0.875	125.151	1.968	Observed	10.34	0.00090	30.00	30.00	0.345	0.190	0.0780	
16	08:00	1	0.870	125.108	1.768	Observed	9.84	0.00090	30.00	30.00	0.328	0.180	0.0790	

Form View CAPS NUM

Figure - 34: Form for entry of stage-discharge summary data

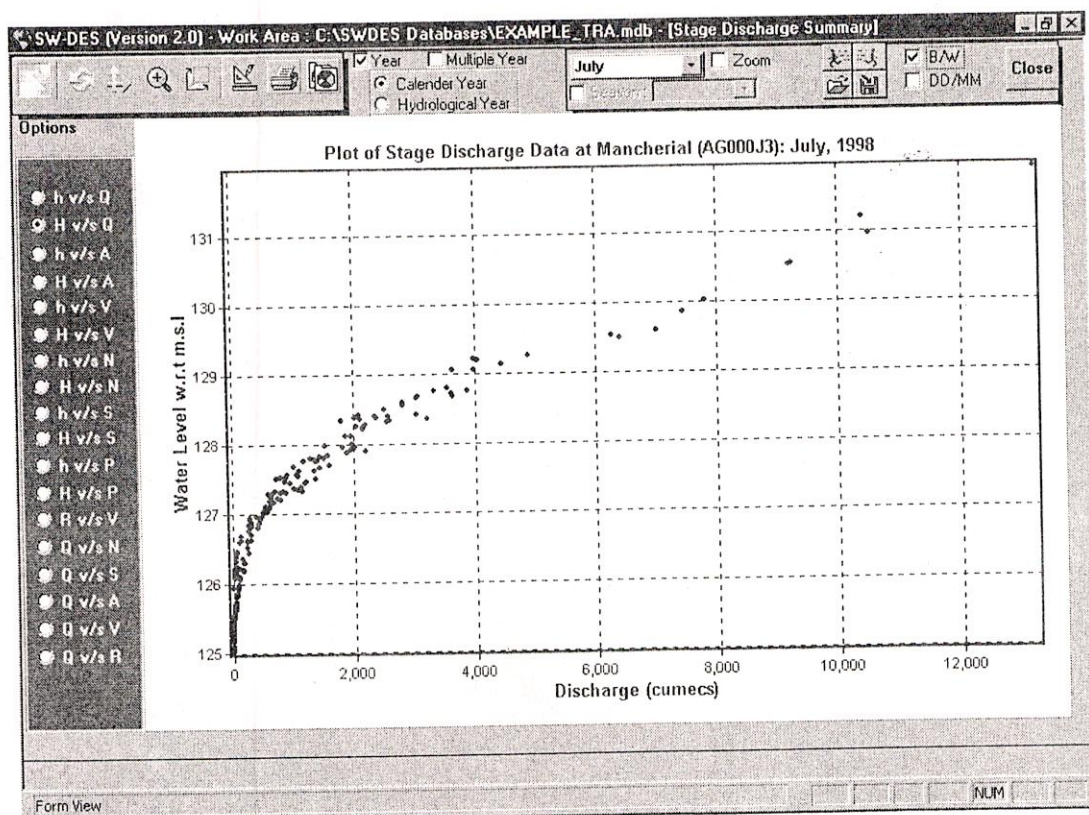


Figure - 35: Plot of observed discharge against water level