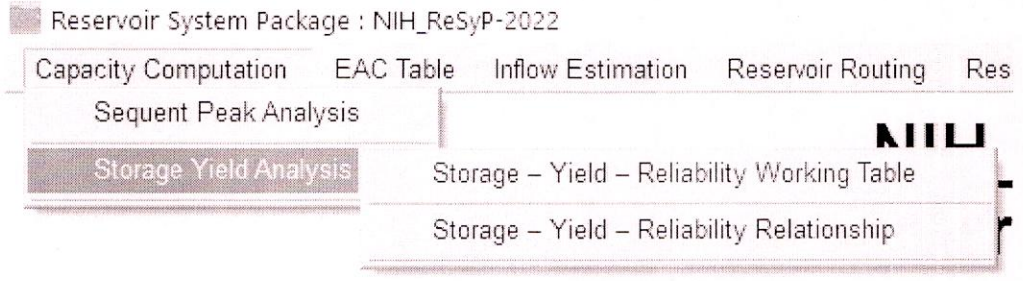
MODULE - 1: Capacity Computation

Main aim of this module is to estimate reservoir capacity using different approaches. This has two submodules Sequent Peak Analysis and Storage Yield Analysis based on approaches used for Capacity Computations. The Storage Yield Analysis submodule is further divided into two submodules 1. Storage-Yield-Reliability Working Table and 2. Storage-Yield- Reliability Relationship for different analysis.

These modules are described briefly and stepwise procedure to use the ReSyP model for these functionalities are discussed further.



1.1 Capacity Computation Using Sequent Peak Analysis

After estimating the available water resources and total water requirements for different purposes at a prospective project site. When the total available water resource is more than the water requirements for all purposes and a prospective site for storage reservoir is finalized, the next important decision to be taken is about the capacity of the reservoir to be constructed. This module concentrates on the Sequent-peak method of computing capacity for a reservoir.

A number of techniques are available for computing storage capacity for various conservation purposes (irrigation, municipal and industrial water supply, hydropower generation, environmental flow etc.). This module uses the Sequent-peak method (which provides the analytical solution of the mass curve method) for computing the capacity for a reservoir. This method avoids the need to choose the correct starting storage and is particularly suited for the analysis of large data.

Major input requirements for the module include inflow and demand sequence and it can be run at 10-daily and monthly time steps. As an output, the module generates a sequence of desired reservoir storage to meet the specified inflow and demand sequence.

1.1.1 Input Data Description

The input data form for this module is shown in Figure – 2. The form for input/ output filenames and analyze in sequent-peak analysis is shown in Figure – 3. The file extension for input file is ***.spi***, for output file is ***.spo***, and for graphical file is ***.spg***. Three input values and two time series are required to be specified as described below:

Title of the analysis

Specify the title of the data file containing general details of the analysis for remembrance at a later date (not more than 100 characters).

Time step size (1-TD/2-M)

Specify the time step of analysis (1 for 10-daily (TD) and 2 for monthly data).

Number of values in inflow/demand data series

Specify the number of values in inflow and demand data series. Using this number, the tabular form for entry of inflow and demand time series automatically generates the specified number of empty cell rows corresponding to number of values in the inflow/demand sequence. Maximum number of time steps (10-daily/monthly) have been limited to 3600.

It is to mention that the inflow and demand time series must be specified for complete water years. Thus for 10-daily data, number of time steps must be divisible by 36; and for monthly data, number of time steps must be divisible by 12. Otherwise, the program aborts and prompts for entry of number of 10-days divisible by 36 (for 10-daily time step) or number of months divisible by 12 (for monthly time step) for entry of inflow and demand time series for complete water years.

Inflow time series

Enter the inflow sequence in the inflow column corresponding to different time steps of the specified period. All cells in the inflow column need to be entered.

Demand time series

Enter the demand sequence in the demand column corresponding to different time steps of the specified period. If the same demand sequence is to be followed in different years, then the values in corresponding time steps in different years need to be repeated. All cells in the demand column need to be entered.

1.1.2 Assumptions

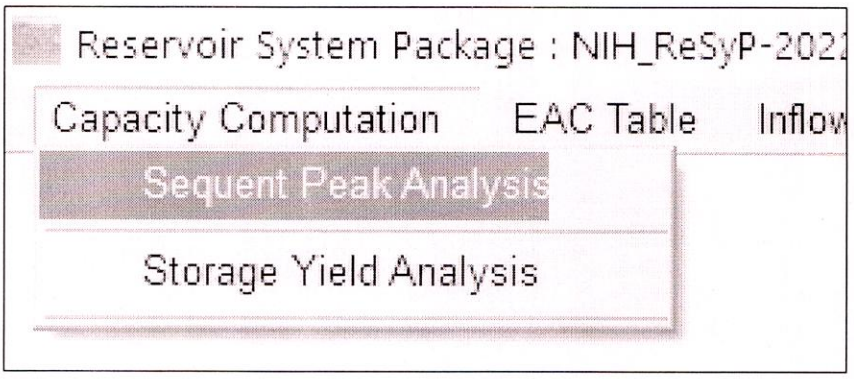
Some assumptions while specifying the data are as follows:

a) Metric system of units has been adopted and the desirable units of data sequence are specified in the column header. Inflow and demand sequences are to be specified in the units of million cubic meter (MCM).
b) First value of inflow/demand sequence correspond to beginning of a water year.
c) The total volume of inflow must be equal to or more than the total volume of demands in the period of analysis. Otherwise, the program aborts and prompts for the revision of inflow/demand time series till this condition is satisfied.

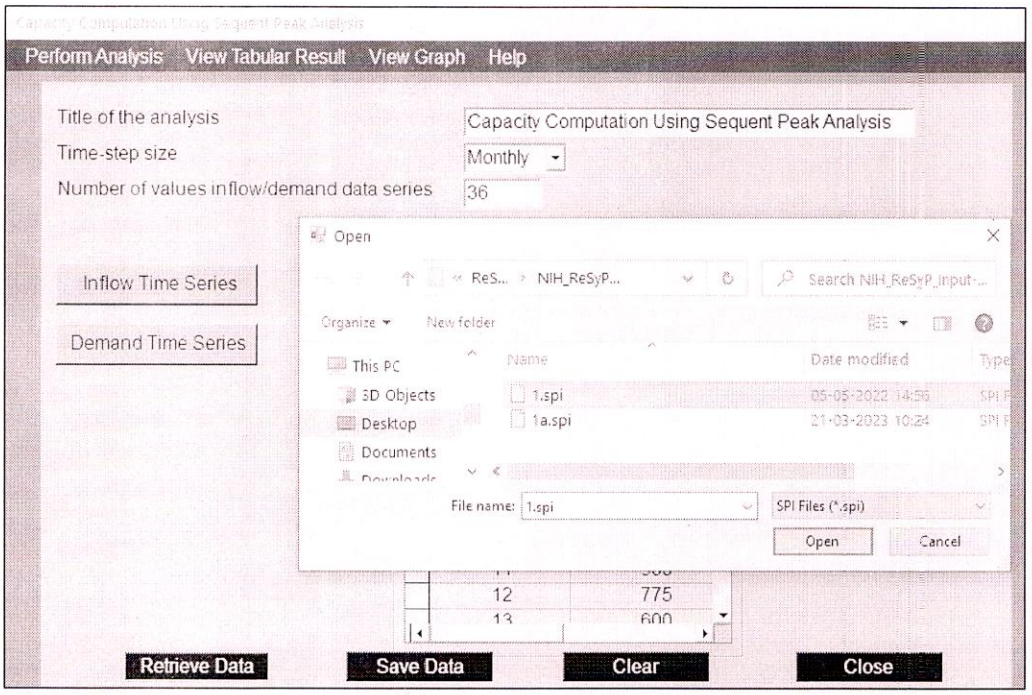
1.1.3 Steps of Analysis

Following steps may be adopted for using the sequent-peak analysis module:

a) Select ***Sequent-peak Analysis*** sub-module of the ***Capacity Computation*** module. The module will open along with the form for entry of its database.



b) Either retrieve an already existing data file by clicking on the ***Retrieve Data*** button or generate a new file by clearing the default data (by clicking on the ***Clear*** button) in the opening data form and fill all the data cells.

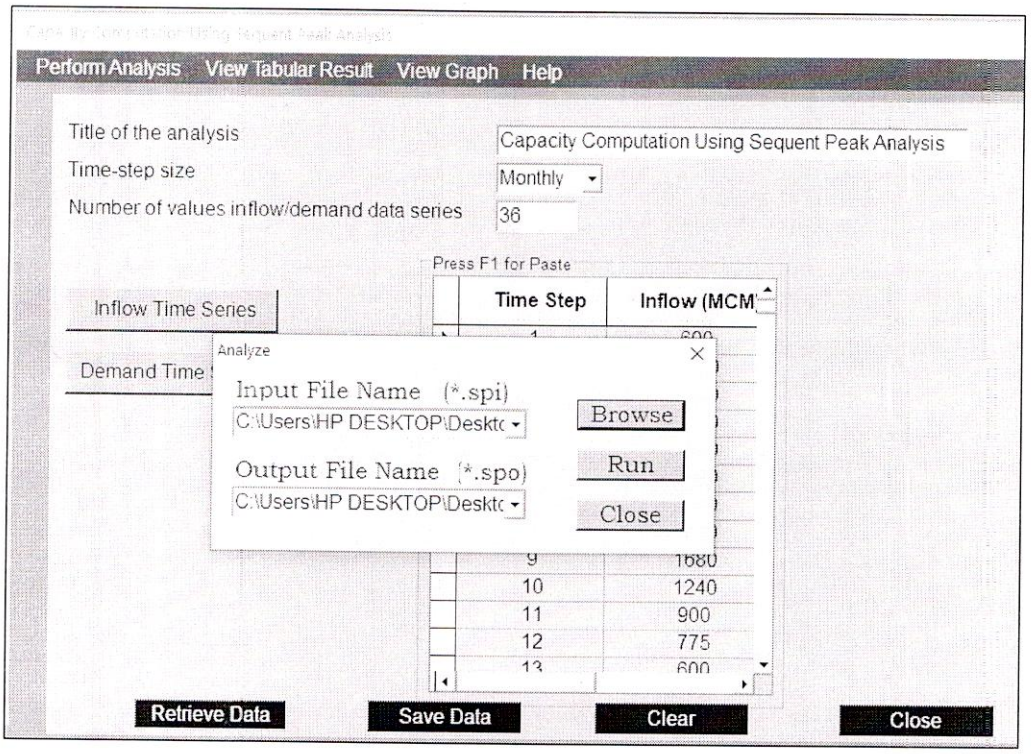


c) After entry of all data cells in the opening form, click on the ***Inflow Time Series*** or ***Demand Time Series*** button. Depending on the number of time steps selected in the main form, tabular forms with empty cells are generated for input of inflow or demand sequence. Fill all the values in the inflow and demand columns corresponding to different time steps.

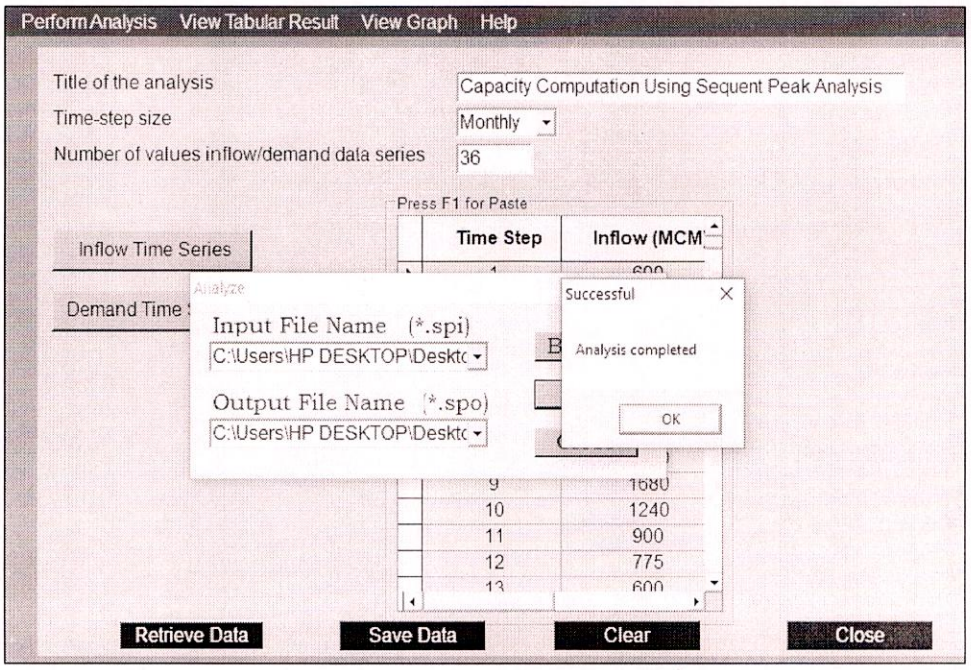
It is also possible to ***Copy-Paste*** the inflow and/or demand sequence from MS-Excel. In that case, copy the inflow and/or demand time series together from MS-Excel and bring the cursor to the first row in the Inflow or Demand column and press F1 (function key). Data will get pasted in different cells in the table. Check that inflow/demand data is present in all cells of the table.

d) After entry of all data cells in the inflow and demand columns, click on the ***Save Data*** button in the main form. A separate window for saving the data file will appear. First select the desired directory and then specify the desired filename for the data file. The file will be saved as ***.spi*** file. There is no need to specify the extension in the filename. It will be automatically attached with the filename.

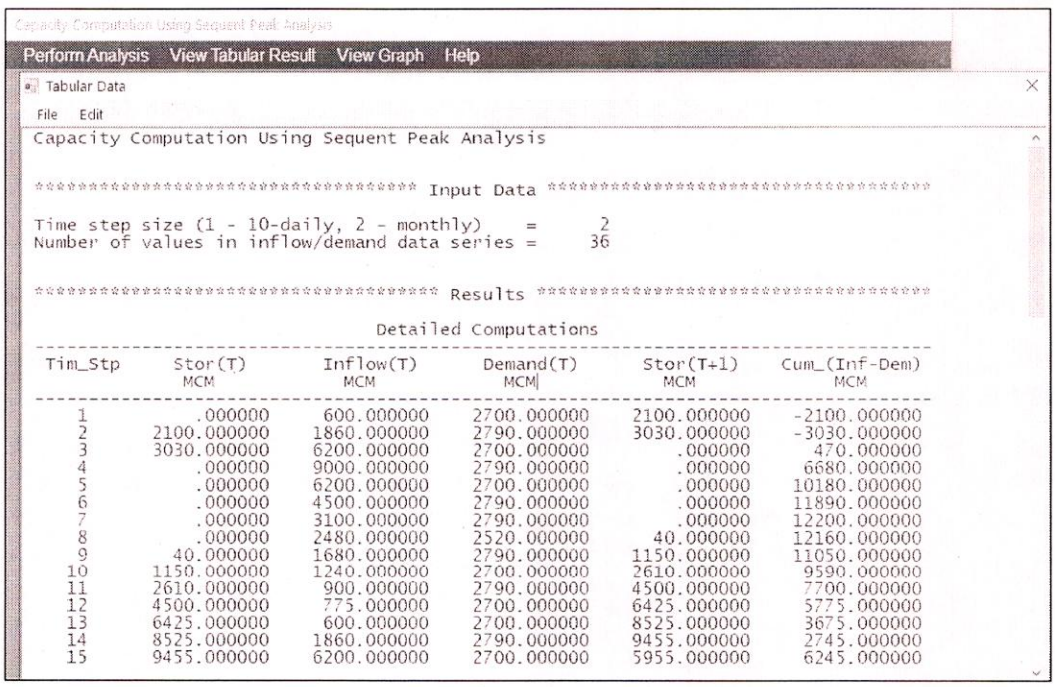
e) Click on the ***Perform Analysis*** button which will open-up a form for the specification of input and output files before the execution of the sequent-peak program. First click on the ***Input File Name*** cell and then click on the ***Browse*** button. This will open a window for selecting the input file. Go to the desired directory and select the requisite data file. Click on the ***Open*** button to select the file. The file along with the path will appear in the ***Input File Name*** cell. Next, click on the ***Output File Name*** cell and repeat above steps. The filename along with the path will appear in the ***Output File Name*** ceil.



f) <u>After specifying the input and output filenames along with their location, the ***Run*** button gets **activated**</u>. Click on the ***Run*** button to execute the program with the specified input and output filenames. After the program is run (in a window in DOS environment which closes automatically after the program execution is complete), click on the ***Close*** button to exit from the Analyze form.



g) Click on the ***View Tabular Results*** button. To view data/results in tabular form, click on the ***Tabular*** button which will invoke the ***Notepad***. Click on the ***File*** and then ***Open*** and a window for file selection will appear. Go to the desired directory and select the requisite Input/Output filenames to see Input/Output files. It needs to be mentioned here that in this window, only files with extension ***.spi*** or ***.spo*** will be displayed. Select the desired filename and click on the ***Open*** button. The file will be displayed in the **Notepad**.



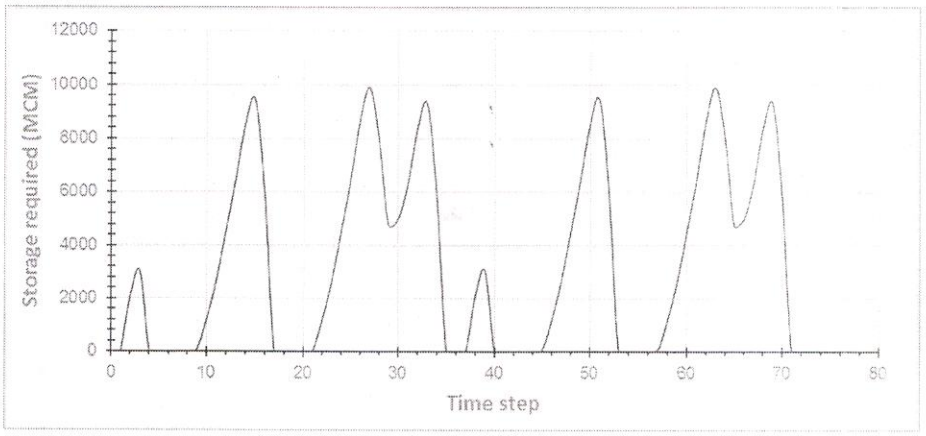
h) To view the results in graphical form, click on the ***View Graphs*** button. A window with two graphical options will invoke for Sequent-Peak analysis:

- Inflow and demand, and
- Variation in reservoir storage.

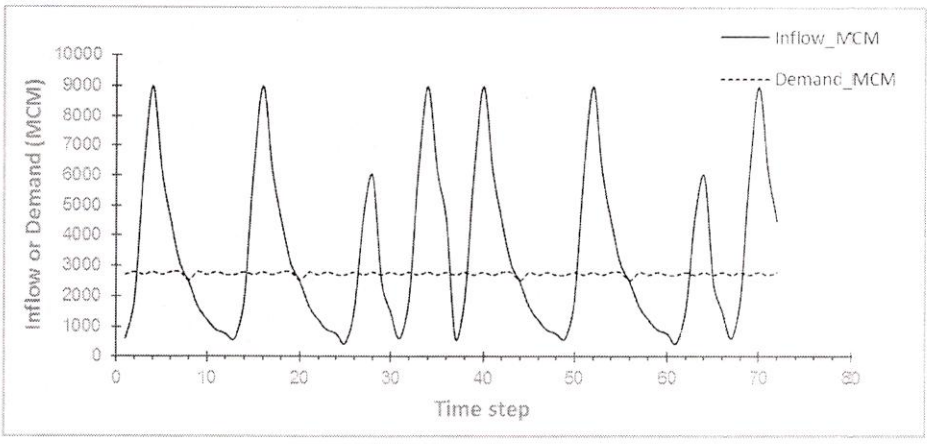
Select the desired option and then click on the ***View Graph*** button. The corresponding graph will be displayed which can be copy-pasted in a document.

i) It is also possible to prepare the graphs in MS-Excel with specific requirements. For this purpose, ready-made graphs have been prepared in MS-Excel which can be modified. Open the graphical file (*.spg) in MS-Excel as ***"Delimited"*** file with ***"Space"*** delimiters and with column data format as ***"General"***. The file will open in a separate MS-Excel sheet. Select and copy the whole worksheet and paste it in ***"Input"*** worksheet of ***"SP_Graph.xlsx"*** file of MS-Excel which is already built in.

The graphs can be saved as picture file and then copy-pasted anywhere in a document. The two graphs for the sample analysis are shown in Figures below.



Graph showing variation of required reservoir storage with time



Graph showing inflow/demand sequence at the reservoir

j) Close the ***Sequent-peak Analysis*** sub-module by clicking on the ***Close*** button.

1.2 Storage-Yield-Analysis

Storage-yield analysis is used to determine the volume of reservoir storage required to augment river flow in order to provide a specified water demand with a stated reliability. It is also used to reassess the water demand which can be satisfied by existing reservoirs. When a sufficient long record of monthly or annual flows is available, then analysis of that series using suitable methods can provide the required storage capacity estimates once the levels of demand and reliability are specified.

1.2.1 Storage-Yield-Reliability Working Table

This module generates the working table of a proposed reservoir with specified storage capacity (or annual yield) based on the available inflow sequence and the demand pattern in different months and computes the reliability of the reservoir in meeting the demands. Some additional features have been added in the module for more detailed analysis of a proposed reservoir as given below:

a) A factor is introduced to specify the allowable monthly deficit (in percent). This is used in the computation of monthly time reliability of a reservoir. Say, if 10% is the allowable monthly deficit, then that month is considered as a failure month in which the supply is less than 90% of the demand. Otherwise, it is considered as a success.

b) A factor is introduced to specify the allowable failure months in a water year (0 – 12). This is used in the computation of annual time reliability of the reservoir. Say, if 1 month is specified as the allowable failure month, then that year is considered as a failure year in which the failure months exceed 1 in a year. The number of successful years are computed and annual time reliability of the reservoir is worked out accordingly.

c) Similarly, annual volume reliability of the reservoir is also computed and a factor is introduced to specify the allowable annual volume deficit (in percent). Say, if 10% is the allowable annual volume deficit, then that year is considered as a failure year in which the annual supply in a water year is less than 90% of the annual demand. Otherwise, it is considered as a success.

The input requirement of the module includes the general details of reservoir such as Full Reservoir Level (FRL), Dead Storage Level (DSL), EAC table, normal monthly evaporation depths, monthly demand distribution pattern, and inflow sequence to the reservoir at monthly time step.

1.2.1.1. Assumptions

Some of the assumptions while specifying the data are as follows:

a) Starting value of inflow and demand sequence correspond to the beginning of a water year.

b) Metric system of units has been adopted and the desirable units of data sequence are specified in the column header. Inflow and demand sequences are to be specified in million cubic meter (MCM).

c) The inflow series need to be specified for complete water years. Since monthly time step is used in the analysis, number of time steps must be divisible by 12. Otherwise, the program aborts and prompts for entry of number of months divisible by 12 for entry of inflow time series for complete water years.

1.2.1.2. Data Checks

Some of the checks performed by the module include:

a) Initial storage capacity should be higher than the storage capacity at Dead Storage Level. Otherwise, the module invokes the message and aborts.

b) Elevation-Area-Capacity (EAC) table of reservoir is checked. If the area (or capacity) at any reservoir level decreases with rising elevation, the program aborts and flags the line number in the EAC table for correction.

c) The capacity at each level of EAC table above the lowest level is checked by using the prismoidal formula. If the difference in the computed and specified capacity is greater than 10%, a message is flagged at the screen and in the result file after the presentation of Elevation-Area-Capacity Table in the Input Data section. The program does not abort in this case.

1.2.1.3. Input Data Description

The file extension for input files is ***.sti*** and file extension for output files is ***.sto*** and for graphical file is ***.stg***. Various items that are input to the program are described below:

Title of the analysis

Specify the title of the data file containing general details of the analysis for remembrance at a later date (not more than 100 characters).

Starting year of inflow series

Specify the starting year (numeric) of the inflow sequence. The same will be specified in the working table in output file.

Starting month of water year

Specify the starting month (numeric) of the water year. The first value of inflow sequence corresponds to the starting month of a water year.

Number of values in inflow series

Specify the number of months for which inflow sequence is available. Using this number, the form for inflow entry will automatically generate the specified number of empty cell rows corresponding to different months and years of inflow sequence.

Average annual flow at project site (MCM)

Specify the average annual inflow at the project site. This is helpful in specifying a reasonable value of desired annual yield or storage capacity of the proposed project.

Number of data points in EAC table

Specify the number of elevations for which corresponding water spread areas and cumulative storage capacity are available in the EAC table. Based on the entered value, the form for entry of EAC table will automatically generate the specified number of empty cells for input of elevation, area, and capacity.

Dead storage level (m)

Specify the dead storage level of the reservoir (in m). As and when the reservoir level reduces below this value, no demand is met from the reservoir. However, evaporation losses are computed as long as there is water in the reservoir.

Initial storage capacity (MCM)

Specify the initial storage capacity of the reservoir (in MCM) at the start of the simulation analysis. This can be taken as storage capacity at Full Reservoir Level (FRL) or Dead Storage Level (DSL) or somewhere in-between capacities at FRL and DSL. As mentioned earlier, it should never be taken below capacity at DSL.

Yield known, storage to be calculated

There are two options in storage-yield analysis. Either the annual yield from the reservoir is known and required storage is to be calculated or vice versa. The option is to be specified as ***Y*** or ***N***. If 'Y' is selected, then one needs to specify the annual yield from the reservoir. If 'N' is selected, then specify the available storage of the reservoir and annual yield will be computed.

Desired annual yield (MCM)

If yield is known and storage is to be calculated, then this cell will become active and data cell corresponding to specify storage will get deactivated. One needs to specify the desired annual yield from the reservoir in the data cell.

Available reservoir storage (MCM)

If reservoir storage is known and annual yield is to be calculated, then this cell will become active and cell corresponding to specify annual yield will get deactivated. One needs to specify the available storage capacity of the reservoir in the data cell.

Required monthly reliability (%)

Specify the desired monthly time reliability of the reservoir (in percent). Computations for reservoir storage/ annual yield will be revised till the desired reliability in meeting the demands is achieved within the limitations of available water in the reservoir and demand pattern in different months.

Allowable monthly volume deficits (%)

Specify the factor which is used in the computation of monthly time reliability of the reservoir. Say, if 10% is the allowable monthly volume deficit, then that month is considered as a failure month in which the supply is less than 90% of the demand. Otherwise, it is considered as a success.

Allowable annual volume deficits (%)

Specify the factor which is used to compute the annual volume reliability of the reservoir. Say, if 10% is the allowable annual volume deficit, then that year is considered as a failure year in which the annual supply in a water year is less than 90% of the annual demand. Otherwise, it is considered as a success.

Allowable number of failure months per year (0 - 12)

Specify the allowable number of failure months in a water year (0 – 12). This is used in the computation of annual time reliability of the reservoir. Say, if 1 month is specified as the allowable failure month, then that year is considered as a failure year in which the failure months exceed 1 in a year. The number of successful years are computed and annual time reliability of the reservoir is worked out accordingly.

E-A-C table

Clicking on the ***E-A-C Table*** button opens a table for entry of elevation, area, and capacity of the reservoir. The number of cells depends on the data specified in the cell corresponding to number of data points in EAC table.

Evaporation depths (mm)

Clicking on the ***Evaporation Depths*** button opens a table for entry of normal evaporation depths in different months of a water year.

Monthly yield fractions

Clicking on the ***Monthly Yield Fractions*** button opens a table for entry of monthly yield fractions in different months of a year. These fractions are multiplied by the annual yield to compute the demands in different months. Same demand pattern is used for all the years of analysis.

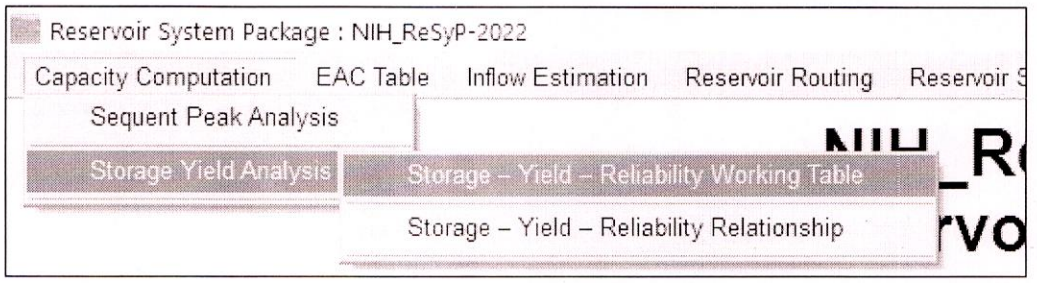
Inflow sequence

Clicking on the ***Inflow Time Series*** button opens a table for entry of inflow values in different months of the analysis period. The number of cells in the table depends on the data specified in the cell corresponding to number of months for inflow series.

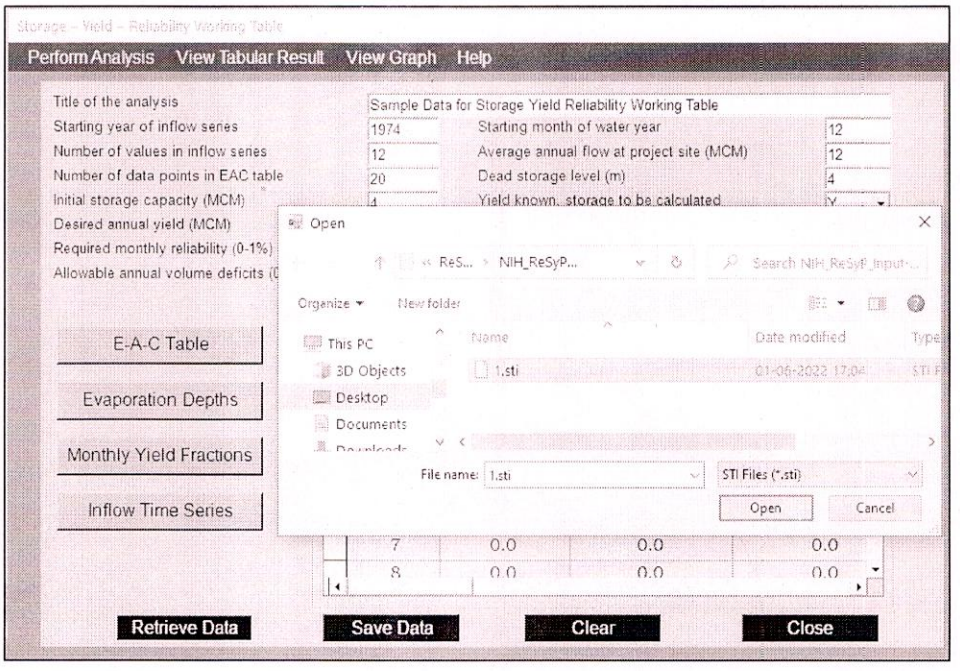
1.2.1.4. Steps of Analysis

Following steps are used for Storage-Yield-Reliability Working Table module:

a) Select the ***Storage-Yield-Reliability Working Table*** sub-module of ***Storage-Yield Analysis*** module under the ***Capacity Computation***. The module will open along with the form for entry of its database.



b) Either retrieve an already existing data file by clicking on the ***Retrieve Data*** button or generate a new file by clearing the default data (by clicking on the ***Clear*** button) in the opening data form and fill all the data cells.



c) After entry of all data cells in the general data section, click on the ***E-A-C Table*** button. Depending on the options selected in the general data section, a form with empty cells for input of elevation, area, and capacity values will appear. Fill all the values in the table **in specified units**.

d) Next, click on the ***Evaporation Depths*** button. Fill values corresponding to 12 months in the table **in specified units**.

e) Next, click on the ***Monthly Yield Fractions*** button. Fill values corresponding to 12 months in the table as fractions.

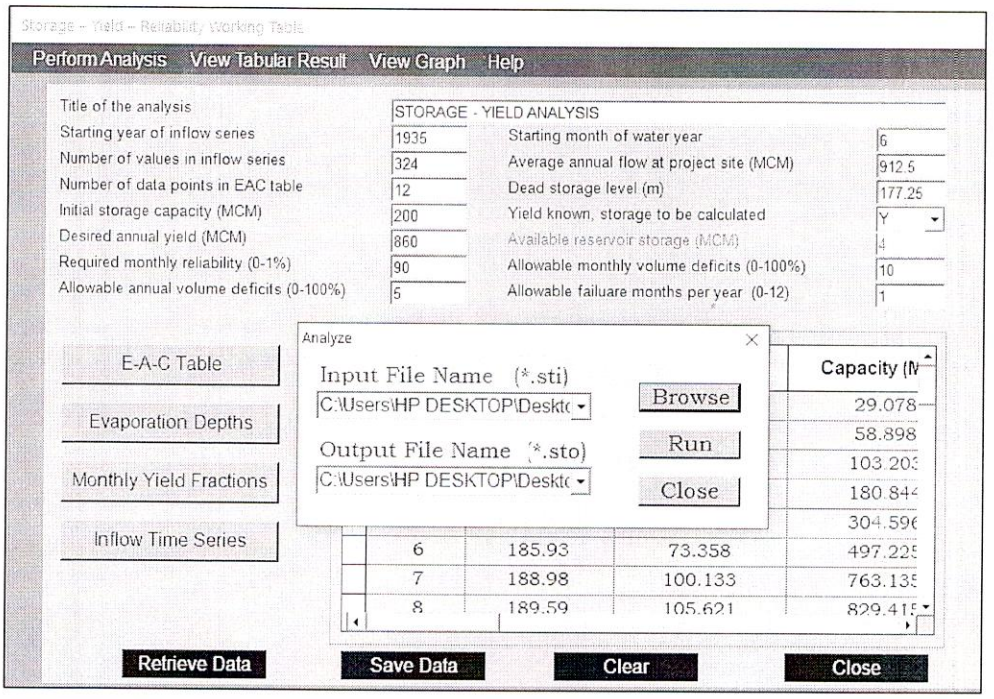
f) Next, click on the ***Inflow Time Series*** button. Depending on the options selected

in the general data section, a form with empty cells for input of inflow values will appear. Fill all the values in the table **in specified units**.

In all tabular data, it is also possible to ***Copy-Paste*** the data of all columns from MS-Excel. In that case, copy the data of all columns together from MS-Excel and bring the cursor to the first row in the table and press F1 (function key). Data will get pasted in all columns in the table. Check that data are present in all cells of the table.

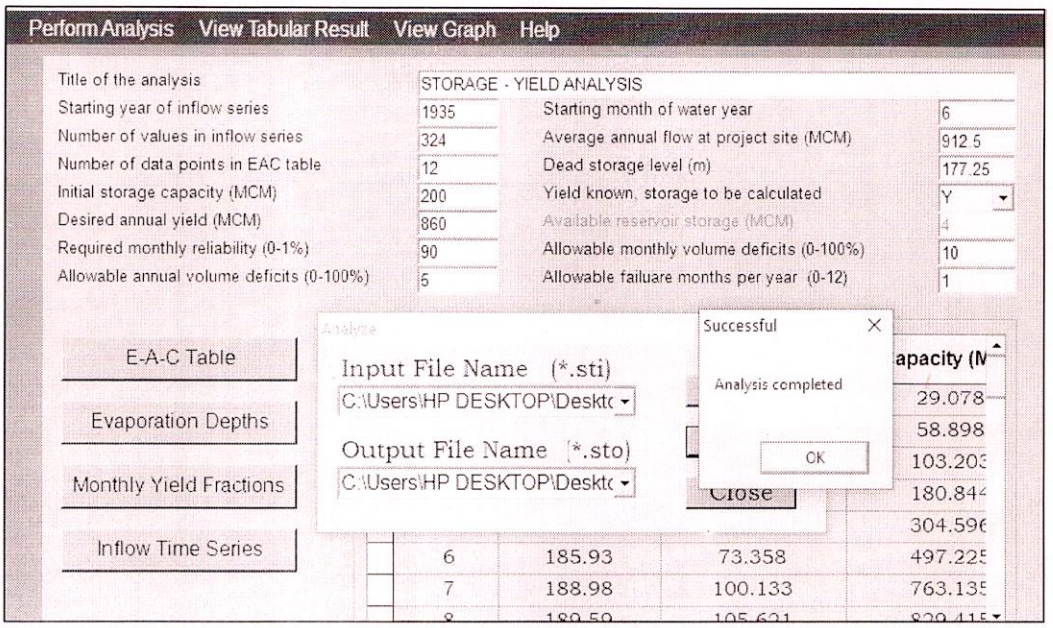
g) After entry of all data cells in the general data section and the tabular data, click on the ***Save Data*** button. A separate window for saving the data file will appear. First select the desired directory and then specify the desired filename for the data file. The file will be saved as ***.sti*** file. There is no need to specify the extension in the filename. It will be automatically attached with the filename.

h) Click on the ***Perform Analysis*** button which will open-up a form for the specification of input and output files before the execution of the related program. First click on the ***Input File Name*** cell and then click on the ***Browse*** button. This will open a window for selecting the input file. Go to the desired

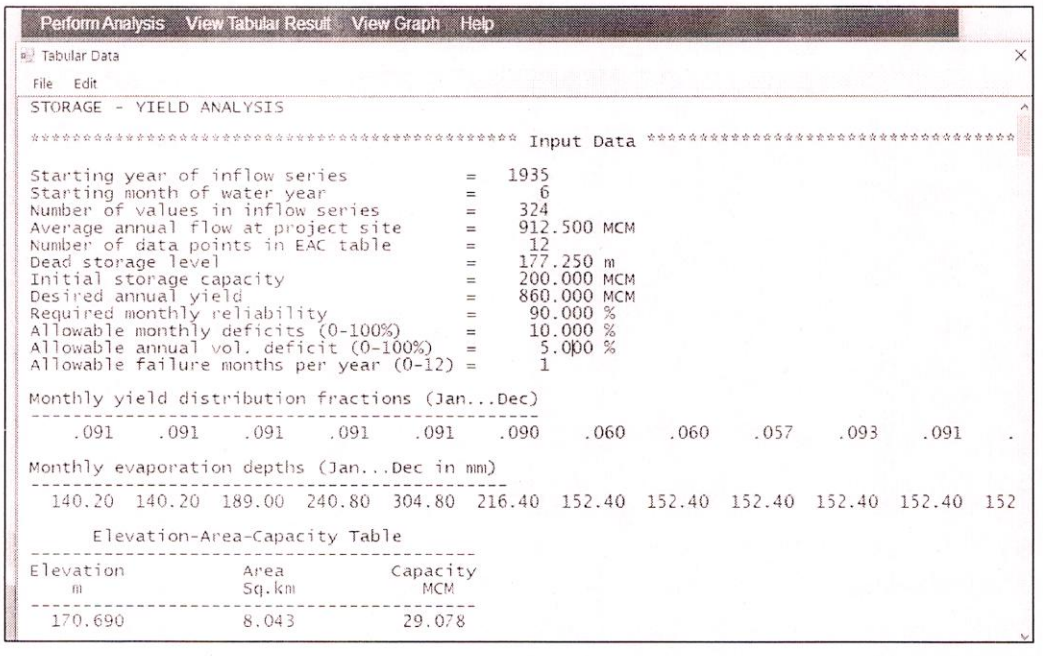


directory and select the requisite data file. Click on the ***Open*** button to select the file. The file along with the path will appear in the ***Input File Name*** cell. Next, click on the ***Output File Name*** cell and repeat above steps. The filename along with the path will appear in the ***Output File Name*** cell.

i) After specifying the input and output filenames along with their location, the ***Run*** button gets **activated**. Click on the ***Run*** button to execute the related program with the specified input and output filenames. The program runs (in a window which closes automatically after the program execution is complete).



j) Click on the ***View Tabular Results*** button. To view data/results in tabular form, click on the ***Tabular*** button which will invoke the ***Notepad***. Click on the ***File*** and then ***Open*** and a window for file selection will appear. Go to the desired directory and select the requisite Input/Output filenames to see Input/Output files. It needs to be mentioned here that in this window, only files with extension ***.sti*** or ***.sto*** will be displayed. Select the desired filename and click on the ***Open*** button. The file will be displayed in the **Notepad**.



k) To view the results in graphical form, click on the ***View Graphs*** button. A window with two graphical options will invoke:

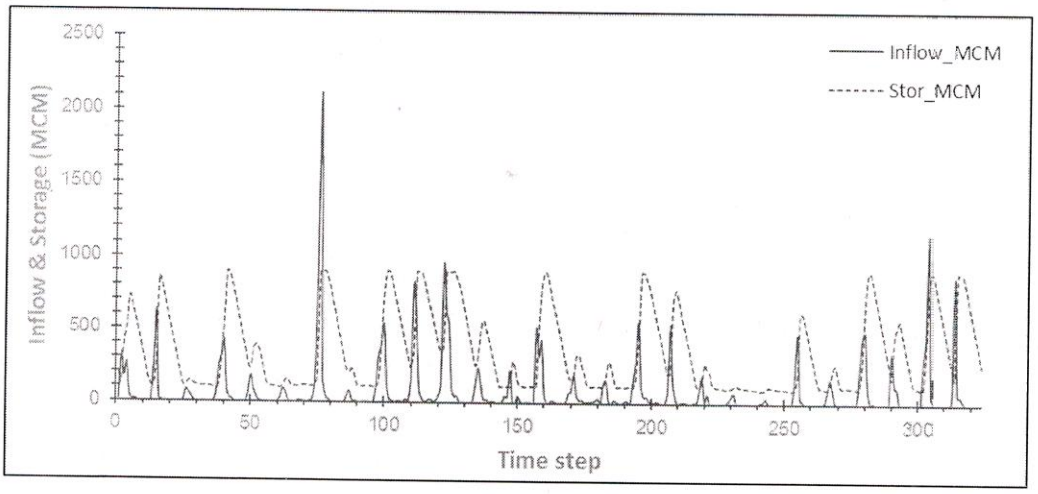
- Inflow and reservoir storage, and
- Demand and supply.

Select the desired option and then click on the ***View Graph*** button. The corresponding graph will be displayed which can be copy-pasted in a document.

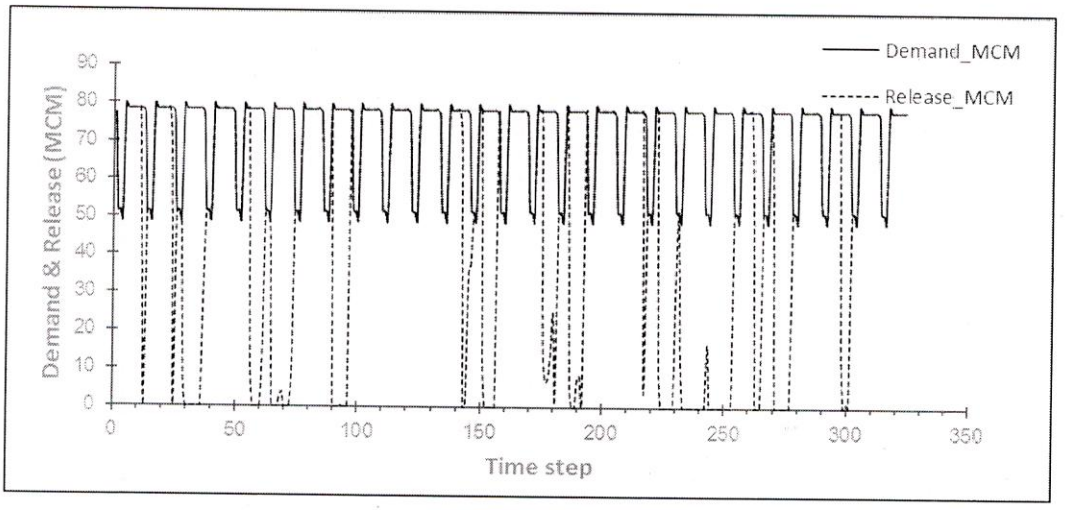
l) It is also possible to prepare the graphs in MS-Excel with specific requirements. For this purpose, ready-made graphs have been prepared in MS-Excel which can be modified. Open the graphical file (*.stg) in MS-Excel as ***"Delimited"*** file with ***"Space"*** delimiters and with column data format as ***"General"***. The file will open in a separate MS-Excel sheet. Select and copy the whole worksheet and paste it in ***"Input"*** worksheet of ***"SYWT_Graph.xlsx"*** file of MS-Excel which is already built in. Two graphs are generated:

- Inflow and reservoir storage, and
- Demand and release.

The graphs can be copied and pasted anywhere in a document. The two graphs for the sample analysis are shown in Figures below.



Graph showing inflow and reservoir storage with time



Graph showing inflow/demand sequence at the reservoir

m) Close the ***Storage-Yield-Reliability Working Table*** sub-module by clicking on the ***Close*** button.

1.2.2 Storage-Yield-Reliability Relationship

Storage-yield analysis is used to determine the volume of reservoir storage required to augment river flow in order to provide a specified water demand with a stated reliability. It is also used to reassess the water demand which can be satisfied by existing reservoirs. When a sufficient long record of monthly or annual flows is available, then analysis of that series using suitable methods can provide the required storage capacity estimates once the levels of demand and reliability are specified.

This module has been added to compute the possible annual yield from a proposed reservoir corresponding to different values of storage capacities with various required reliability levels (monthly time reliability) and a table is generated. The table can be used to plot the graphs for possible yield from the reservoir corresponding to different reliability levels for different storage capacities. For the computations, upper and lower bounds of storage capacity and number of incremental steps of storage capacity need to be specified. Similarly, the upper and lower bounds of required reliability and number of incremental steps for required reliability are also specified and the computations are made at all specified storage capacities at required reliability levels. All other inputs, assumptions, and data checks are made in the same way as for the storage yield working table module.

1.2.2.1. Input Data Description

The file extension for input files is ***.sri*** and file extension for output files is ***.sro*** and for graphical file is ***.srg***. Various items that are input to the program are described below:

Title of the analysis

Specify the title of the data file containing general details of the analysis for remembrance at a later date (not more than 100 characters).

Starting year of inflow series

Specify the starting year (numeric) of the inflow sequence.

Starting month of water year

Specify the starting month (numeric) of the water year. The first value of inflow sequence corresponds to the starting month of a water year.

Number of values in inflow series

Specify the number of months for which the inflow sequence is available. Using this number, the form for inflow entry will automatically generate the specified number of empty cells corresponding to different months and years of inflow sequence.

Average annual flow at project site (MCM)

Specify the average annual inflow at the project site. This is helpful in specifying the upper and lower bounds of storage capacity of the proposed project.

Number of data points in EAC table

Specify the number of elevations for which corresponding water spread areas and cumulative storage capacity are available in the EAC table. Based on this value, the form automatically generates the specified empty rows for input of elevation, area, and storage capacity.

Dead storage level (m)

Specify the dead storage level of the reservoir (in m). As and when the reservoir level reduces below this value, no demand is met from the reservoir. However, evaporation losses are computed as long as there is water in the reservoir.

Upper bound of storage capacity (MCM)

Specify the upper bound of storage capacity of the reservoir (in MCM). The yield from the reservoir is computed considering different storage capacities at various reliability levels up to the specified upper bound of storage capacity.

Lower bound of storage capacity (MCM)

Specify the lower bound of storage capacity of the reservoir (in MCM). The yield from the reservoir is computed at different storage capacities (within the upper and lower bounds) at various reliability levels.

Number of incremental steps for storage capacity

Specify the number of incremental steps for storage capacity. The difference of storage capacity at the upper and lower bounds is divided by the number of incremental steps and the reservoir yield is computed at the upper and lower storage capacities and at all intermediate storage capacities at various reliability levels.

Upper bound of required monthly reliability (%)

Specify the upper bound of required monthly time reliability (in percent). The yield from the reservoir is computed at different storage capacities and at various reliability levels up to the specified upper bound of required monthly time reliability.

Lower bound of required monthly reliability (%)

Specify the lower bound of required monthly time reliability (in percent). The yield from the reservoir is computed at different storage capacities (within the upper and lower bounds) at various reliability levels within the upper and lower bounds.

Number of incremental steps for reliability

Specify the number of incremental steps for required reliability levels. The difference of reliability levels at the upper and lower bounds is divided by the number of incremental steps and the reservoir yield is computed within the upper and lower storage capacities and at various intermediate reliability levels.

It needs to be mentioned that since a number of computations are made and unidirectional search is carried out to achieve required reliability, it may not be feasible

to achieve the exact specified reliability levels. However, efforts are made to reach closer to the specified reliability levels.

Allowable monthly volume deficits (%)

Specify the factor which is used in the computation of monthly time reliability of the reservoir. Say, if 10% is the allowable monthly volume deficit, then that month is considered as a failure month in which the supply is less than 90% of the demand. Otherwise, it is considered as a success.

Allowable annual volume deficits (%)

Specify the factor which is used to compute the annual volume reliability of the reservoir. Say, if 10% is the allowable annual volume deficit, then that year is considered as a failure year in which the annual supply in a water year is less than 90% of the annual demand. Otherwise, it is considered as a success.

Allowable failure months per year (0 - 12)

Specify the allowable number of failure months in a water year (0 – 12). This is used in the computation of annual time reliability of the reservoir. Say, if 1 month is specified as the allowable failure month, then that year is considered as a failure year in which the failure months exceed 1 in a water year. The number of successful years are computed and annual time reliability of the reservoir is worked out accordingly.

E-A-C table

Clicking on the ***E-A-C Table*** button opens a table for entry of elevation, area, and storage capacity of the reservoir. The number of cells depends on the data specified in the cell corresponding to number of data points in EAC table.

Evaporation depths (mm)

Clicking on the ***Evaporation Depths*** button opens a table for entry of normal evaporation depths in different months of a water year.

Monthly yield fractions

Clicking on the ***Monthly Yield Fractions*** button opens a table for entry of monthly yield fractions in different months of a year. These fractions are multiplied by the annual yield to compute the demands in different months. Same demand pattern is used for all the years of analysis.

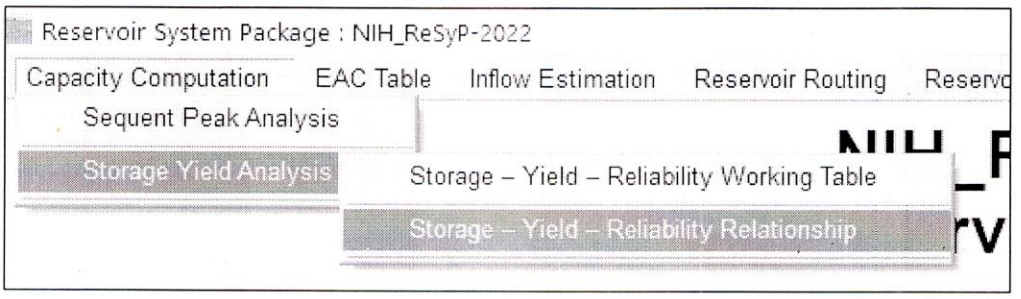
Inflow sequence

Clicking on the ***Inflow Time Series*** button opens a table for entry of inflow values in different months of the analysis period. The number of cells in the table depends on the data specified in the cell corresponding to number of months of inflow series.

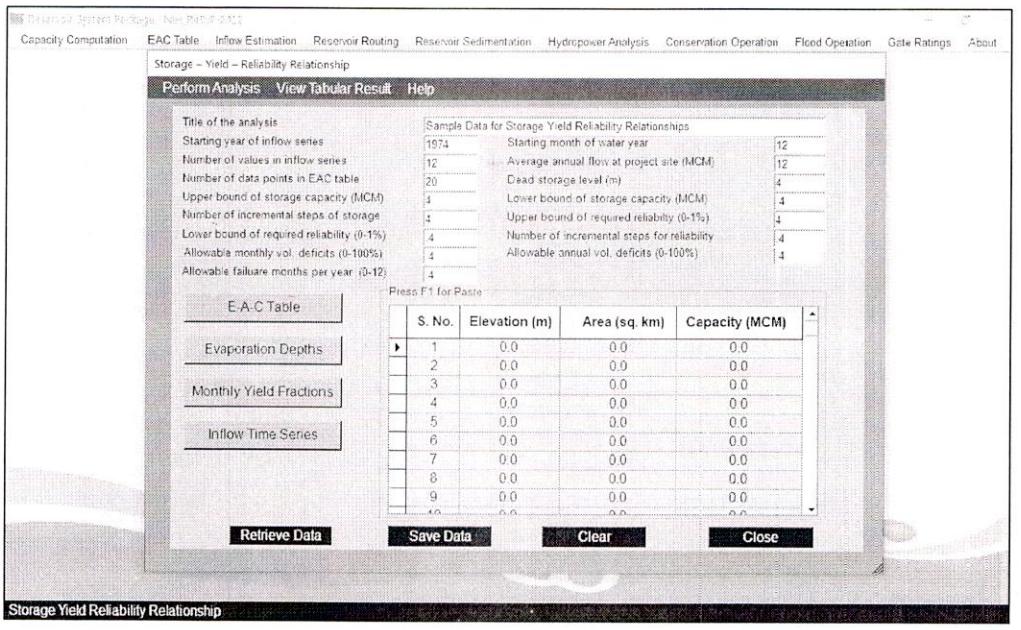
1.2.2.2. Steps of Analysis

Following steps are used for Storage-Yield-Reliability Relationships module:

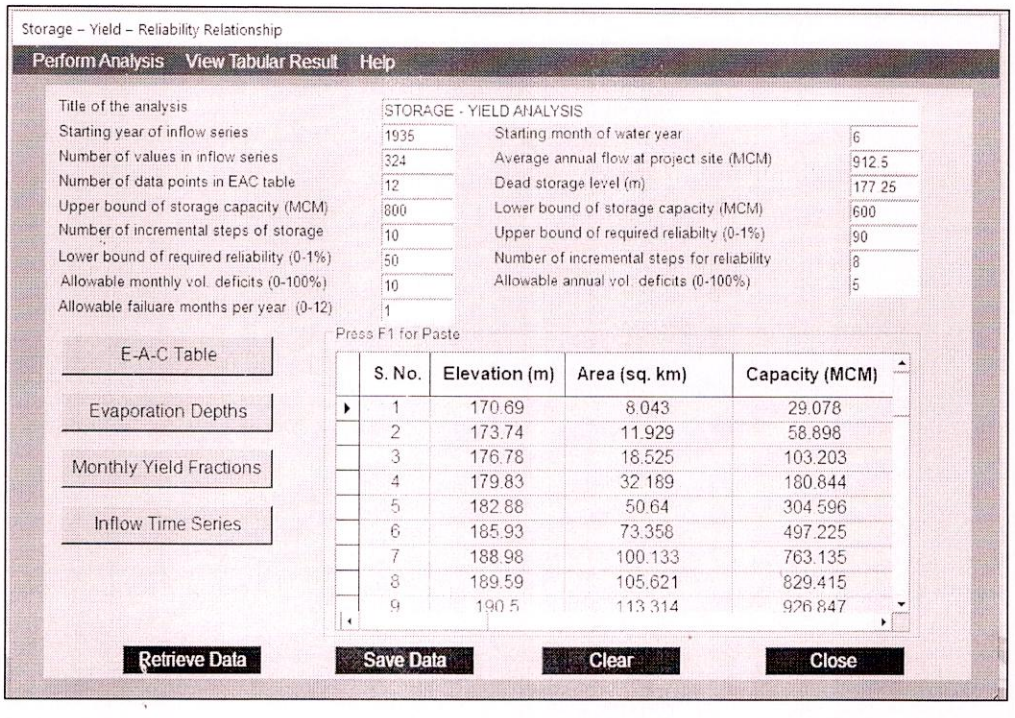
a) Select the ***Storage-Yield-Reliability Relationships*** sub-module of ***Storage-Yield Analysis*** module under the ***Capacity Computation***. The module will open along with the form for entry of its database.



The module will open along with the form for entry of its database.



b) Either retrieve an already existing data file by clicking on the ***Retrieve Data*** button or generate a new file by clearing the default data (by clicking on the ***Clear*** button) in the opening data form and fill all the data cells.



c) After entry of all data cells in the general data section, click on the ***E-A-C Table*** button. Depending on the options selected in the general data section, a form with empty cells for input of elevation, area, and capacity values will appear. Fill all the values in the table **in specified units**.

d) Next, click on the ***Evaporation Depths*** button. Fill values corresponding to 12 months in the table **in specified units**.

e) Next, click on the ***Monthly Yield Fractions*** button. Fill values corresponding to 12 months in the table as fractions.

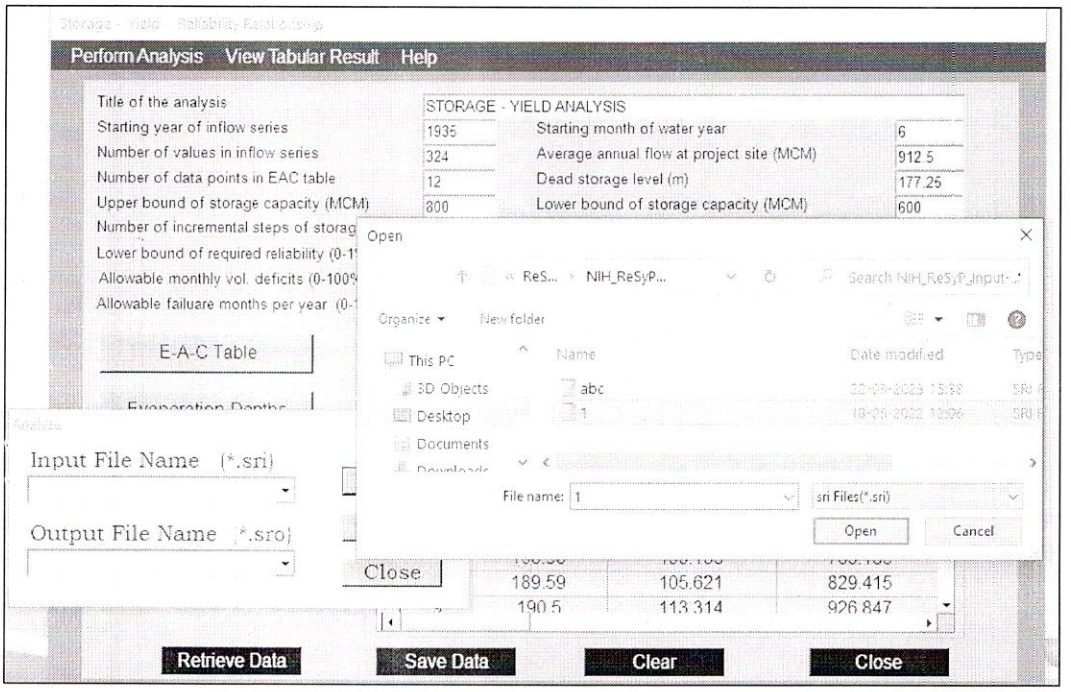
f) Next, click on the ***Inflow Time Series*** button. Depending on the options selected in the general data section, a form with empty cells for input of inflow values will appear. Fill all the values in the table **in specified units**.

In all tabular data, it is also possible to ***Copy-Paste*** the data of all columns from MS-Excel. In that case, copy the data of all columns together from MS-Excel and bring the cursor to the first row in the table and press F1 (function key). Data will get pasted in all columns in the table. Check that data are present in all cells of the table.

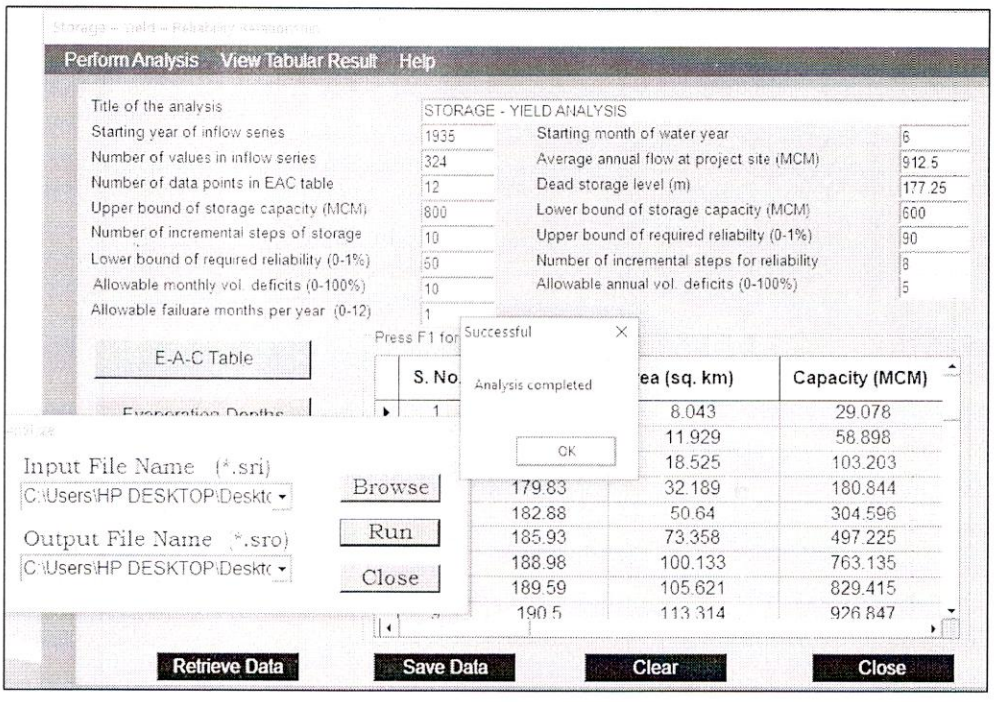
g) After entry of all data cells in the general data section and the tabular data, click on the ***Save Data*** button. A separate window for saving the data file will appear. First select the desired directory and then specify the desired filename for the data file. The file will be saved as ***.sri*** file. There is no need to specify the extension in the filename. It will be automatically attached with the filename.

h) Click on the ***Perform Analysis*** button which will open-up a form for the specification of input and output files before the execution of the related program. First click on the ***Input File Name*** cell and then click on the ***Browse*** button. This

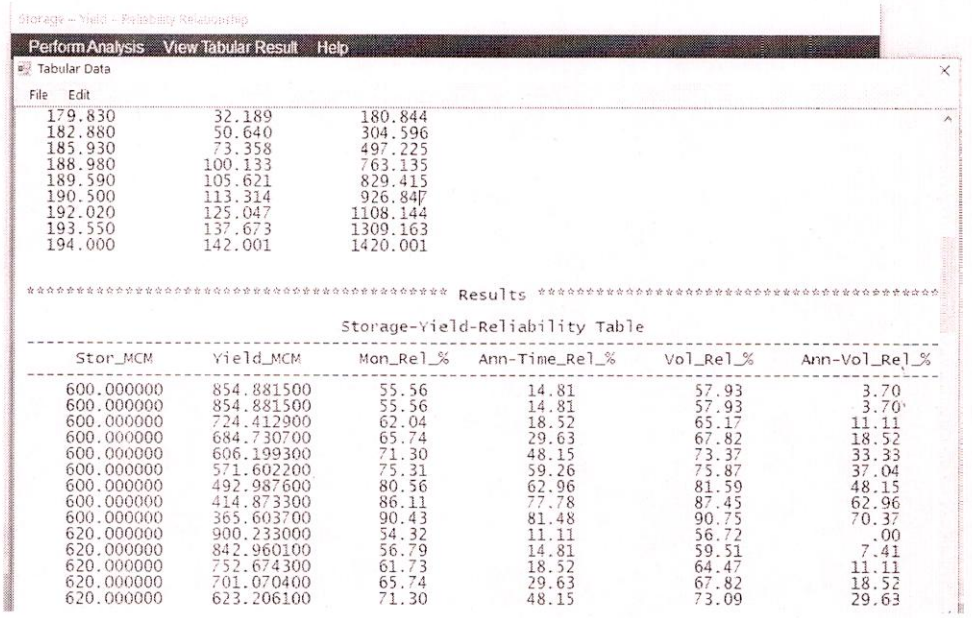
will open a window for selecting the input file. Go to the desired directory and select the requisite data file. Click on the ***Open*** button to select the file. The file along with the path will appear in the ***Input File Name*** cell. Next, click on the ***Output File Name*** cell and repeat above steps. The filename along with the path will appear in the ***Output File Name*** cell.



i) After specifying the input and output filenames along with their location, the ***Run*** button gets **activated**. Click on the ***Run*** button to execute the related program with the specified input and output filenames. The program runs (in a window which closes automatically after the program execution is complete).



j) Click on the ***View Tabular Results*** button. To view data/results in tabular form, click on the ***Tabular*** button which will invoke the ***Notepad***. Click on the ***File*** and then ***Open*** and a window for file selection will appear. Go to the desired directory and select the requisite Input/Output filenames to see Input/Output files. It needs to be mentioned here that in this window, only files with extension ***.sri*** or ***.sro*** will be displayed. Select the desired filename and click on the ***Open*** button. The file will be displayed in the **Notepad**.



k) To view the results in graphical form, it is possible to prepare the graphs in MS-Excel with specific requirements. For this purpose, ready-made graphs have been prepared in MS-Excel which can be modified. Open the graphical file (*.srg) in MS-Excel as ***"Delimited"*** file with ***"Space"*** delimiters and with column data format as ***"General"***. The file will open in a separate MS-Excel sheet. Select and copy the whole worksheet and paste it in ***"Input"*** worksheet of ***"SYR_Graph.xlsx"*** file of MS-Excel which is already built in. Three graphs are generated:

- Monthly reliability and yield for different storage capacities,
- Annual reliability and yield for different storage capacities,
- Volume reliability and yield for different storage capacities.

The graphs can be copied and pasted anywhere in a document. The three graphs for the sample analysis are shown in Figures below.

l) Close the ***Storage-Yield-Reliability Relationship*** sub-module by clicking on the ***Close*** button.

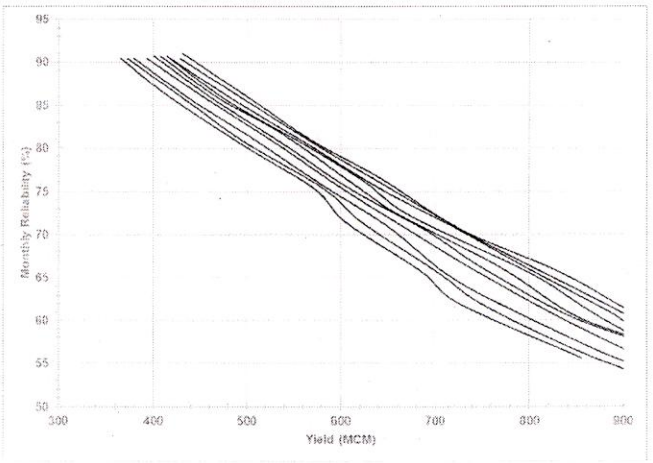


Figure: Monthly reliability and yield for different storage capacities

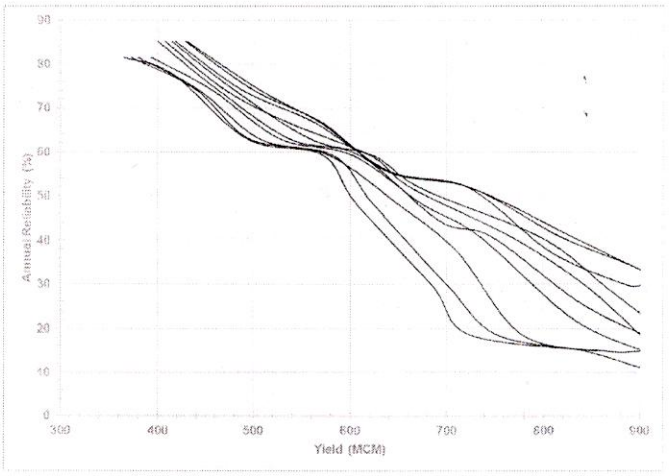


Figure: Annual reliability and yield for different storage capacities

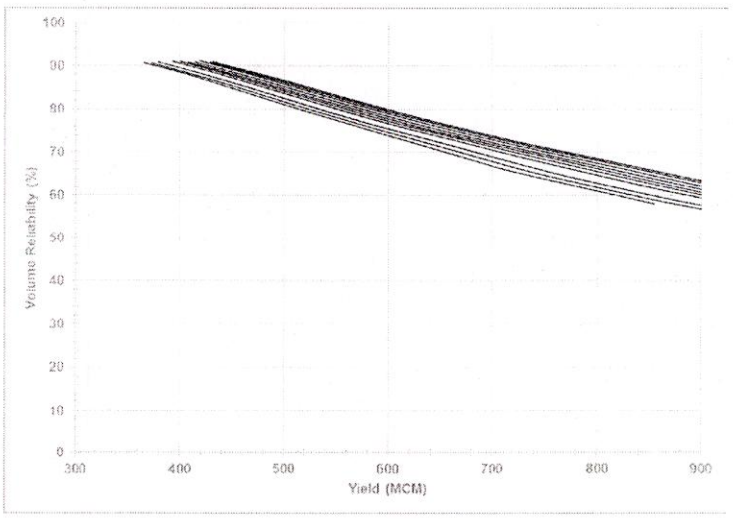


Figure: Volume reliability and yield for different storage capacities