

Infrastructure Services Department

LIVINGSTONE SHIRE DRAINAGE INFRASTRUCTURE NETWORK

COMPUTER MODELLING XPRAFTS Model Guidelines

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Abbreviations

LSC	Livingstone Shire Council
ARR	Australian Rainfall & Runoff
IFD	Intensity-Frequency-Duration
ARI	Average Recurrence Interval

1.0 OBJECTIVES

The objectives of these guidelines are for Livingstone Shire Council (LSC) to:

- Provide advice on using XPRAFTS in building models for works within Livingstone Shire Region.
- Provide directions on parameters for consistency between various models.

2.0 LIMITATIONS

The following limitation and condition apply in using these guidelines:

- Objectives of these guidelines do not include providing guidance in learning skills in the software, no interpretation of model behaviour and in the results and making conclusions.
- It is assumed that users of these guidelines will be familiar with the use of XPRAFTS.
- These guidelines should be read in conjunction with the “**XPRAFTS – GETTING STARTED MANUAL**”, which outlines all the definitions, assumptions and methodologies provided within the XPRAFTS software package. A copy of the manual can be downloaded from this link.
xpsolutions.com/assets/downloads/xprafts/xprafts-gsm.pdf
- Livingstone Shire Council uses XPRAFTS for the following purposes *only*:
 - Creating and defining catchments and sub-catchments.
 - Simulating storm events (Q1 – Q100) to determine the peak flow time of a catchment/ sub-catchment.
 - Generating a hydrograph and hyetograph file to be used in TUFLOW which is required for finalisation of a flood/ rain model.

3.0 MODELLING STEPS

The council's use of XPRAFTS can be broken down into 4 major steps as listed in the figure below. This section of the report will guide the user on how to use XPRAFTS in accordance to Council's design parameters and standards.

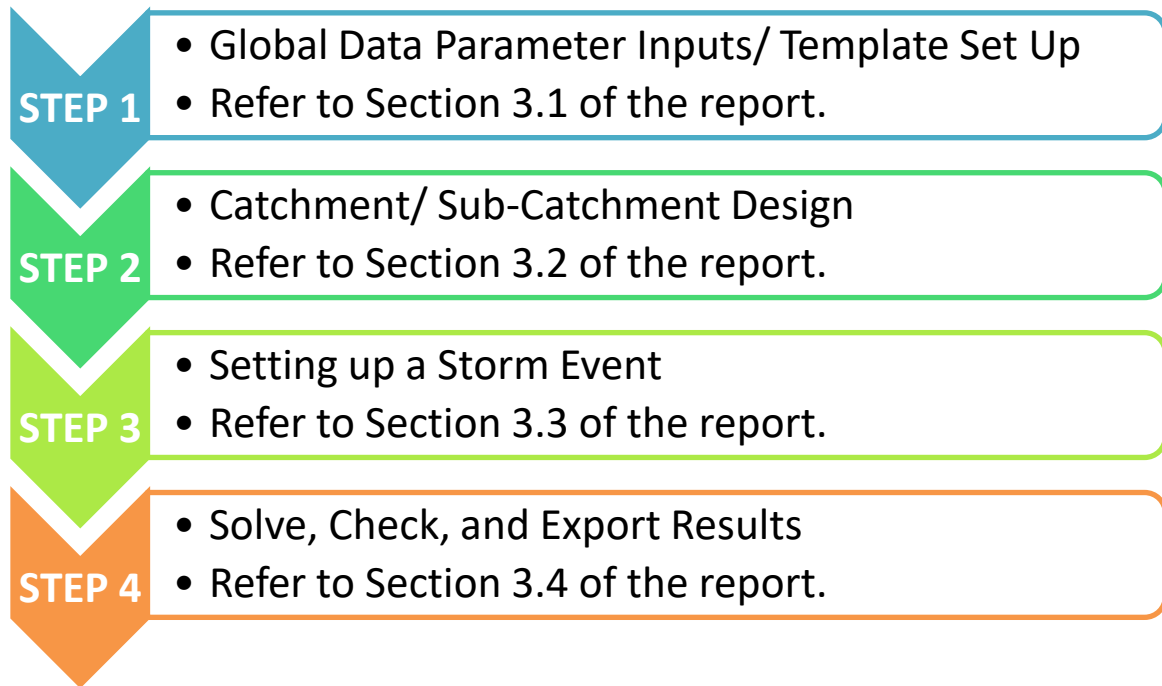


Figure 1: 4 Major Steps for XPRAFTS Modelling

*Note: It is recommended to have the **XPRAFTS - GETTING STARTED MANUAL** open while following the steps outlined in this report for a better understanding of all the definitions, assumptions and methodologies used.*

3.1 STEP 1: Global Data Parameter Inputs/ Template Set Up

The following input parameters needs to be set up first in the “*Global Data*” under the “*Configuration*” icon in the menu bar before modelling a catchment or simulating any storm events in XPRAFTS.

3.1.1 Temporal Patterns

Create a Temporal Pattern. LSC uses an “*ARR Standard*” approach in the creation of a Temporal Pattern which can be found in Book 2 – Section 2 of Australian Rainfall & Runoff (ARR) 1987.

3.1.2 IFD Coefficients

Create an “Intensity-Frequency-Duration” (IFD) unique to the chosen location from this link provided. (<http://www.bom.gov.au/hydro/has/cdirswebx/cdirswebx.shtml>).

3.1.3 Rafts Storms

Create a new file under *Rafts Storms*.

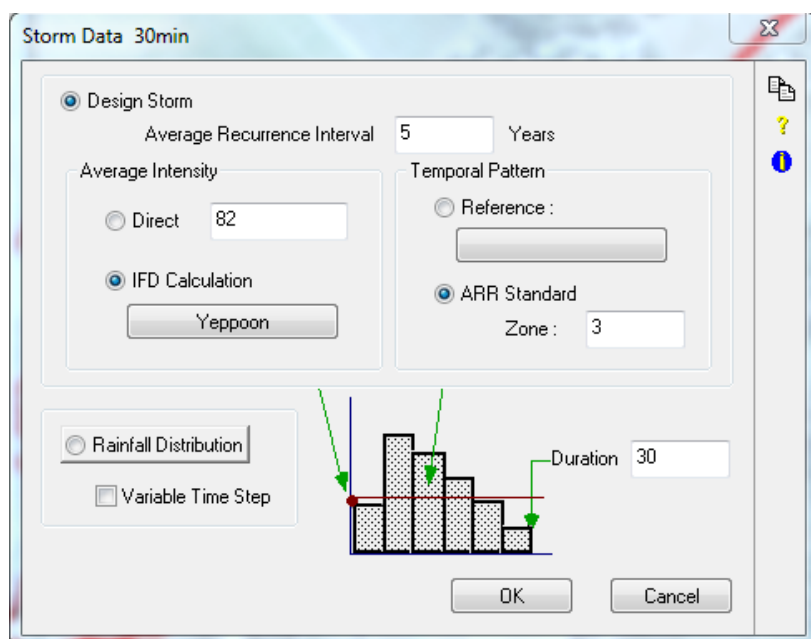


Figure 2: Filling up a Rafts Storms table in XPRAFTS

3.1.3.1 Average Recurrence Interval

Input the *Average Recurrence Interval (ARI)* in years, which, on average, the storm re-occurs.

3.1.3.2 Average Intensity

The input for *Average Intensity* can either be directly inputted (units in mm/hr) or automatically inputted by choosing the *IFD Calculation (Section 3.1.2)*. The latter method is more ideal to use.

3.1.3.3 Temporal Patterns

Input Temporal Pattern.

3.1.3.4 Duration

Enter duration of storm in minutes.

3.1.4 Initial / Continuing Losses

Create a new file under *Init. / Cont. Losses*.

Figure 3: Initial/ Continuing Losses Table

As a standard set up for common projects, the following *Initial and Continuing Losses* are to be used:

- For Q10 storms and below: Initial Loss = 5; Continuing Loss = 2.
- For Q20 storms and above: Initial Loss = 0; Continuing Loss = 2.

3.2 STEP 2: Catchment/ Sub-Catchment Design

Having a background image is recommended for ease of work. The available file formats supported by XPRAFTS are AutoCAD *.dwg, and *.dxf files, ESRI *.shp files, and image files such as *.bmp, *.tiff, *.jpg, etc.

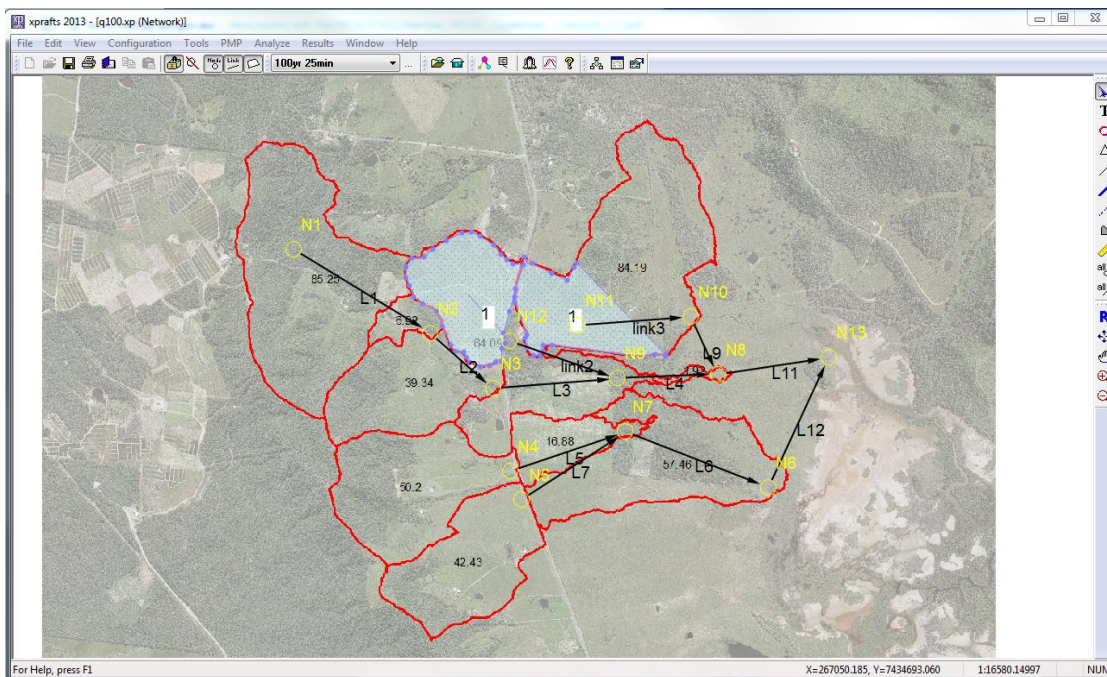


Figure 4: Example of XPRAFTS file with a background image

3.2.1 Creating Catchment/ Sub-Catchments

Create a Sub-Catchment.

Note: A full step by step procedure of creating a catchment can be found in page 46 of the “XPRAFTS - “Getting Started Manual””.

3.2.2 Setting up Catchment/ Sub-Catchment Parameters

Set up the Sub-Catchment by inputting its properties on a chosen node.

3.2.3 Initial/ Continuing

Refer back to Section 3.1.4 of the report.

3.2.4 Total Area

There are various ways to get the total area (preferably in hectares) of a Sub-Catchment. LSC prefers to use ArcGIS 10.5 in obtaining this information.

3.2.5 Impervious

Below is a table of values that can be used for input in the “*Impervious*” section of the sub-catchment properties window. The table below is taken from *Chapter 6 of Urban Storm Drainage Criteria Manual Volume 1*.

Land Use or Surface Characteristics	Percentage Imperviousness
Business:	
Downtown Areas	95
Suburban Areas	75
Residential Lots (lot area only)	
Single Family	
2.5 acres or larger	12
0.75 – 2.5 acres	20
0.25 – 0.75 acres	30
0.25 acres or less	45
Apartments	75
Industrial	
Light Areas	80
Heavy Areas	90
Parks, cemeteries	10
Playgrounds	25
Schools	55
Railroad yard areas	50
Underdeveloped areas:	
Historic flow analysis	2
Greenbelts, agricultural	2
Off-site flow analysis (when land use not defined)	45
Streets:	
Paved	100
Gravel (packed)	40
Drive and walks	90
Roofs	90
Lawns, sandy soil	2
Lawns, clayey soil	2

Table 1: Recommended Percentage Impervious values - Taken from Chapter 6 of Urban Storm Drainage Criteria Manual Volume 1

3.2.6 Vectored Slope

Use equal area slope or a 3rd party software such as ArcGIS to calculate slope of the catchment as XPRAFTS does not have a method of calculating catchment slopes in the software itself.

3.2.7 Manning's 'n'

As per XP Solution's guide, see attached link:


http://xpsolutions.com/webhelp/Manning_s_N_Roughness_Coefficients_Open_Channel.htm

3.3 STEP 3: Setting up a Storm Event


LSC generally uses an "**Automatic Storm**" event in XPRAFTS. This is done by going to "**Automatic Storm Generator**" in the "**Job Control**" option window.

3.4 STEP 4: Solve, Check, and Export Results

3.4.1 Solve (F5)

From the Analyse menu, select "**Solve**"  or just press **F5**.

3.4.2 Results (F7)

Click the "**Review Results**" icon  from the Results menu bar or just click on a node you wish to review and press **F7**.

3.4.3 Save File and Export (As a Hydrograph or as a Hyetograph)

Before saving and exporting the file into TUFLOW's "**bc_dbase**" folder, the user must first identify if the file to be exported is to be used in a flood model (save as a hydrograph) or in a rainfall model (save as a hyetograph).

3.4.3.1 Saving as a Hydrograph File

If the file is to be used in a flood model in TUFLOW, save the file in XPRAFTS as a hydrograph file. To do this, go to the "**Job Control**" window and click "**Hydrograph Export**" tab.

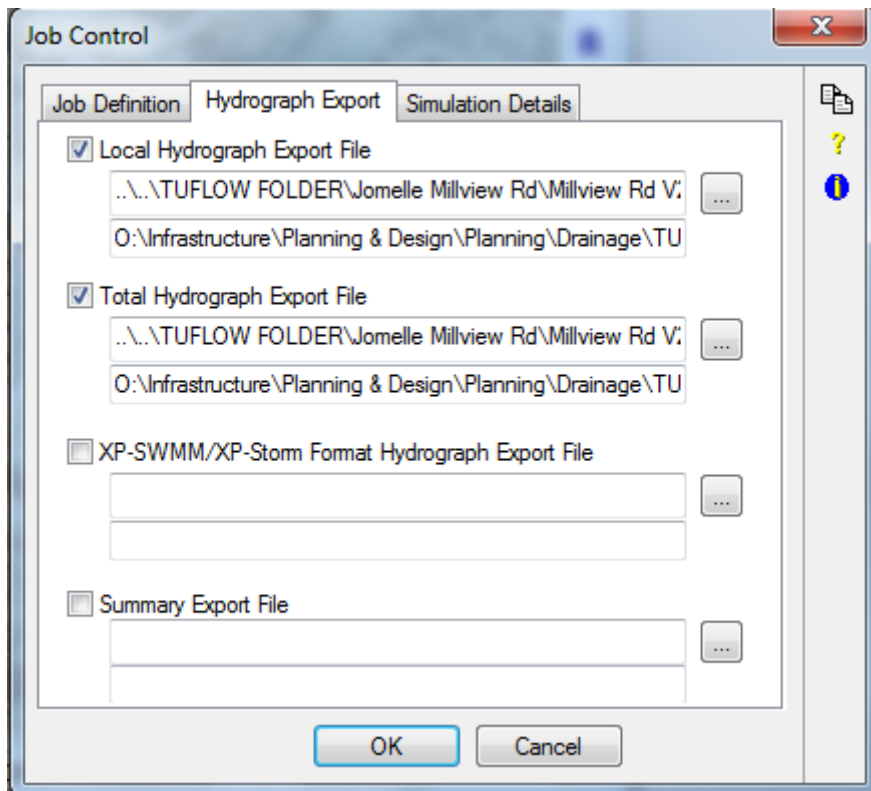



Figure 5: Saving a Hydrograph file in the Hydrograph Export Tab

Ensure that the “**Local Hydrograph Export File**” and “**Total Hydrograph**

Export File” are ticked. Click  and make sure that the file path of both local and total hydrograph export is that of the “**bc_dbase**” folder of the TUFLOW model. When saving the file names, also make sure that the extension names are included, “**.loc**” for local hydrograph export files and “**.tot**” for total hydrograph export files.

3.4.3.2 Saving as a Hyetograph File

If the file is to be used in a rainfall model in TUFLOW, save the file in XPRAFTS as a hyetograph file. To do this, go to “**Results**” in the menu bar and click “**Export Time Series Results**” or just simply press **F8**.

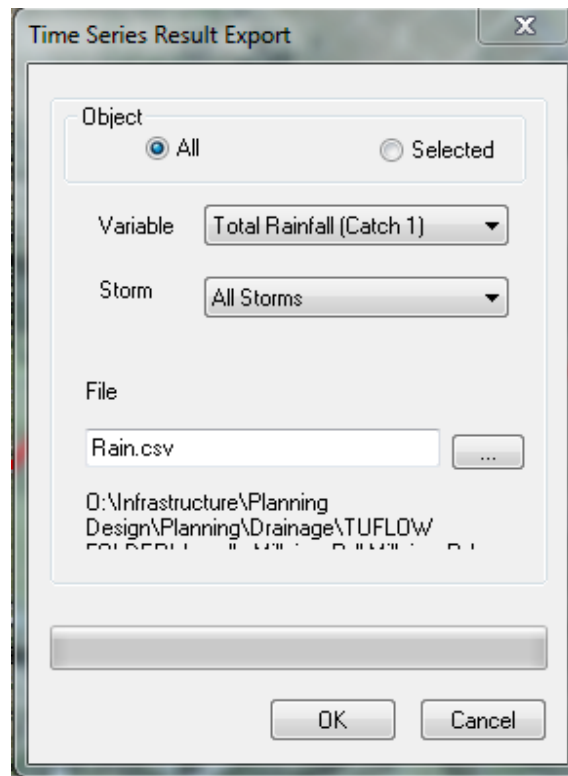


Figure 6: Saving a Hyetograph file in XPRAFTS

Change the file path to TUFLOW/bc_dbase folder and save the file with the desired file name. Ensure that *Variable* is set to “**Total Rainfall (Catch 1)**” and set Storm to “**All Storms**”. Click OK and the file is successfully exported to the TUFLOW/bc_dbase for use.

4.0 References

Atiken, A. (1973). Hydrologic Investigation and Design in Urban Areas – A Review. Canberra.

Commonwealth of Australia , Bureau of Meteorology. (n.d.). Welcome to the Rainfall IFD Data System.

Urban Drainage and Flood Control District. (2017, March). *USDCM: Volume 1 - Chapter 6*. Retrieved from http://udfcd.org/wp-content/uploads/uploads/vol1%20criteria%20manual/06_Runoff.pdf

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