

## II.9.2-FFG-FFGUID FLASH FLOOD GUIDANCE COMPUTATION PROGRAM (FFGUID) PROCESSING INFORMATION

The Flash Flood Guidance (FFG) System Computation program (FFGUID) is used to:

- o define parameters used to compute FFG guidance values
- o compute guidance values using parameters

### Parametric Data Requirements

The associated data bases for the workstation are described in this section.

1. Each combination of location identifier and data type code forms a unique filename.
2. If not found a new filename is created when defining parameters. An existing file is updated if the filename is found.
3. Capability to define data type GRID for gridded threshold runoff values. The input for gridded threshold runoff definition is specified in Section VI.3.6A-SETUP-GRID [[Hyperlink](#)]. The contents of the parametric data base data type GRRO is specified in Section VI.3.6C-INFILE-GRID.
4. Capability to define data type INOB for intensity and for adjusting threshold runoff values for slightly over bankfull. The input for the intensity and overbank factor is specified in Section VI.3.6A-SETUP-INTEN. The contents of the parametric data base data type INOB is specified in Section VI.3.6C-INFILE-INTEN.
5. Capability to define data type HFFG for headwaters. The input for headwater definition is specified in Section VI.3.6A-SETUP-HEAD. The contents of the parametric data base data type HFFG is specified in Section VI.3.6C-INFILE-HEAD.
6. Capability to define data type AFFG for areal locations used to compute county and urban FFG. The input for areal FFG definition is specified in Section VI.3.6A-SETUP-AREA. The contents of the parametric data base data type AFFG is specified in Section VI.3.6C-INFILE-AREA.

### Time Series Requirements

Forecast flow time series may be used to adjust FFG for current flow. No changes are necessary to use the time series. The forecast flow time series must be defined in OFS if FFG is to be adjusted.

### Setup Function

The Setup sequence for the FFGUID program is as follows.

Select 'Grid' to define and redefine the gridded threshold runoff values (data type GRID). The sequence for 'GRID' is shown in Figure 1 and is described as follows:

1. Define the southwest corner of the user subset of the national HRAP grid by providing (1) the western most column, (2) number of columns, (3) the southern most row and (4) the number of rows.
2. The threshold runoff software will provide latitude, longitude (or perhaps row, column), time of duration and threshold runoff for each HRAP grid. These parameters may be in more than one ASCII file and input at different times.
3. Convert latitude and longitude at threshold runoff grid locations to user subset of national HRAP grid.
4. Store gridded threshold runoff in appropriate array depending on time of duration.
5. Repeat steps 2 to 4 for all ASCII files from the threshold runoff software. Only those grid points containing threshold runoff values in the ASCII file would be changed.
6. Write the three threshold runoff grid arrays to three files. Optional fourth and fifth file.

Select 'Intensity and overbank' to define and redefine intensity and overbank factors by basin boundaries (data type INOB). The sequence for 'INOB' is shown in Figure 2 and is described as follows:

1. Define intensity, overbank factor and basin boundary identifier for each basin boundary.
2. Store basin boundary identifier, intensity and overbank factors in a single array.
3. Write the array to a file.

Select 'Headwater' to define and redefine parameters for headwaters (data type HFFG). The sequence for 'HFFG' is shown in Figure 3 and is described as follows:

1. Define HFFG parametric data base record that covers the basin and the weight(s) to be applied to each.
2. Unit hydrograph peak for each duration.
3. Unit hydrograph peak times for each duration.
4. Flood flow (or get at execution time from Rating Curve file by specifying Rating Curve identifier).

5. Time series identifier and type from the Processed Data Base.

Select 'Area' to define and redefine parameters for counties and urban area (data type AFFG). The sequence for 'AFFG' is shown in Figure 4 and is described as follows:

1. Start with an area boundary for a zone, county or urban area defined in the basin boundary file; or
  - 1a. Start with a box defined by the latitude and longitude of the centroid of the area of interest along with  $\frac{1}{2}$  the width of the box in both latitude and longitude directions.
2. Write area identifier, boundary identifier (default same as area identifier), latitude and longitude of centroid, 1/2 width latitude, 1/2 width longitude and impervious area to a type AFFG record. Additional space is required in the type AFFG record to store the three FFG values for the three durations.
3. Repeat steps 1 and 2 for other zones, counties and urban areas.

#### Compute Function

The computational sequence for the FFGUID program is as follows:

1. Select 'Grid' to compute gridded FFG (Figure 5).
  - a. Read the threshold runoff grid files to fill the threshold runoff grid array.
  - b. Read the FFG parameter record from the Preprocessor Parametric Data Base. The parameter record contains the BASN identifier and the rainfall-runoff curve.
  - c. Read the BASN parameter record from the Preprocessor Parametric Data Base.
  - d. Process each grid point defined in the BASN parameter record:
    - get threshold runoff value
    - (optional) adjust threshold runoff for high base flow as percent of bankfull flow
    - (optional) adjust threshold runoff for intensity
    - compute FFG using the threshold runoff and linear interpolation in the rainfall-runoff curve
    - store FFG in output grid array
  - e. Repeat steps b, c and d for each duration.
  - f. Write the FFG output grid array to the files.
2. Select 'Area' using data type code AFFG to compute areal guidance (Figure 6).
  - a. Go through each grid point in area referenced by AFFG and

compute sum of FFG and number of points with non-missing values from the gridded FFG array.

- b. Compute areal FFG:  
$$\text{FFG} = \text{sum\_FFG} / \text{number\_of\_points}$$
  - c. Repeat steps a to b for each duration.
  - d. Store areal FFG for each duration in AFFG record.
  - e. Repeat steps a to d for each AFFG record.
  - f. Write the area name and FFG for each duration to the File.
3. Select 'Headwater' using data type code HFFG to compute headwater guidance (Figure 7).
- a. If option selected, get specified forecast flow time series based on time series ID, data type code and time interval. Use subroutine RPRDD to read time series from the Processed Data Base. Subroutine RPRDH is needed for the time series header to determine time of the contents. If the forecast flow option is not selected, go to step c.
  - b. For each duration determine the forecast flow at the time equal to time to peak after LSTCMPDY. If the time to peak is not a multiple of the time series interval, interpolate between the closest time series values.
  - c. Compute the threshold runoff for each duration using the forecast flows from step b (if option selected).  
$$\text{threshold runoff} = \frac{(\text{flood flow} - \text{forecast flow})}{\text{unit hydrograph peak}}$$

If the flood flow (flow at flood stage) is zero, then the values in the unit hydrograph peak fields are the threshold runoffs. This step is skipped.
  - d. (Option) adjust threshold runoff for intensity, as needed.
  - e. Read FFG record from Preprocessor Parametric Data Base using subroutine RPPREC for the rainfall-runoff curve.
  - f. Using linear interpolation and the threshold runoffs, compute FFG from the appropriate rainfall-runoff relation for each desired duration.
  - g. Apply the weight to the FFG values calculated in step e.
  - h. Apply weight to accounting model and snow model (if used) state variables.
  - i. Repeat steps e, f and g for each basin listed.

- j. Store FFG for each duration, accounting model operation type, snow model operation type and their state variables in the HFFG record.
- k. Write the headwater identifier, name, stream name, FFG for each duration, accounting model operation type, snow model operation type and the weighted state variables to the file.

Figure 1. Defining Gridded Threshold Runoff in FFGUID

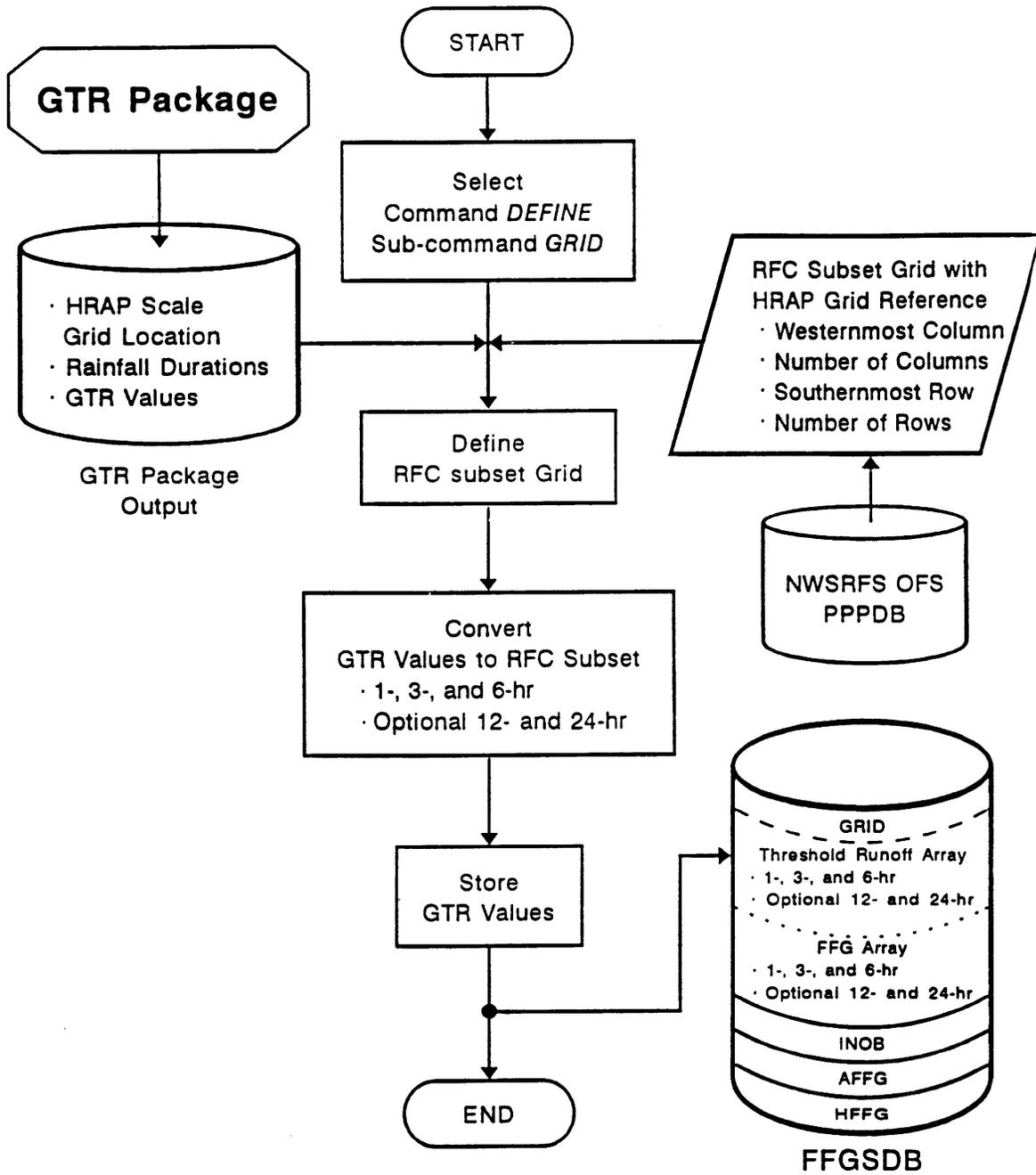


Figure 2. Defining Intensity and Overbank Factors in FFGUID

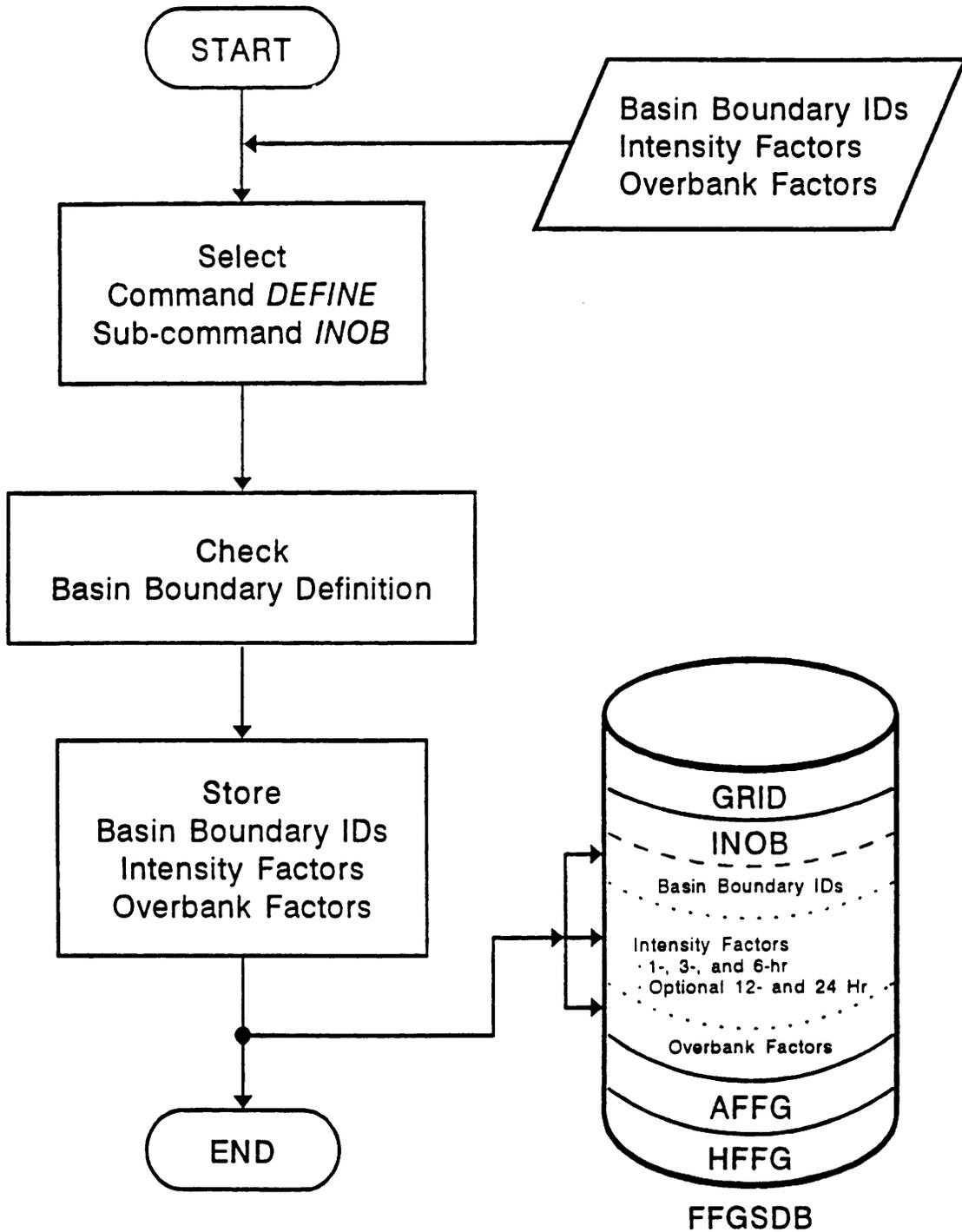


Figure 3. Defining Headwater Guidance Parameters in FFGUID

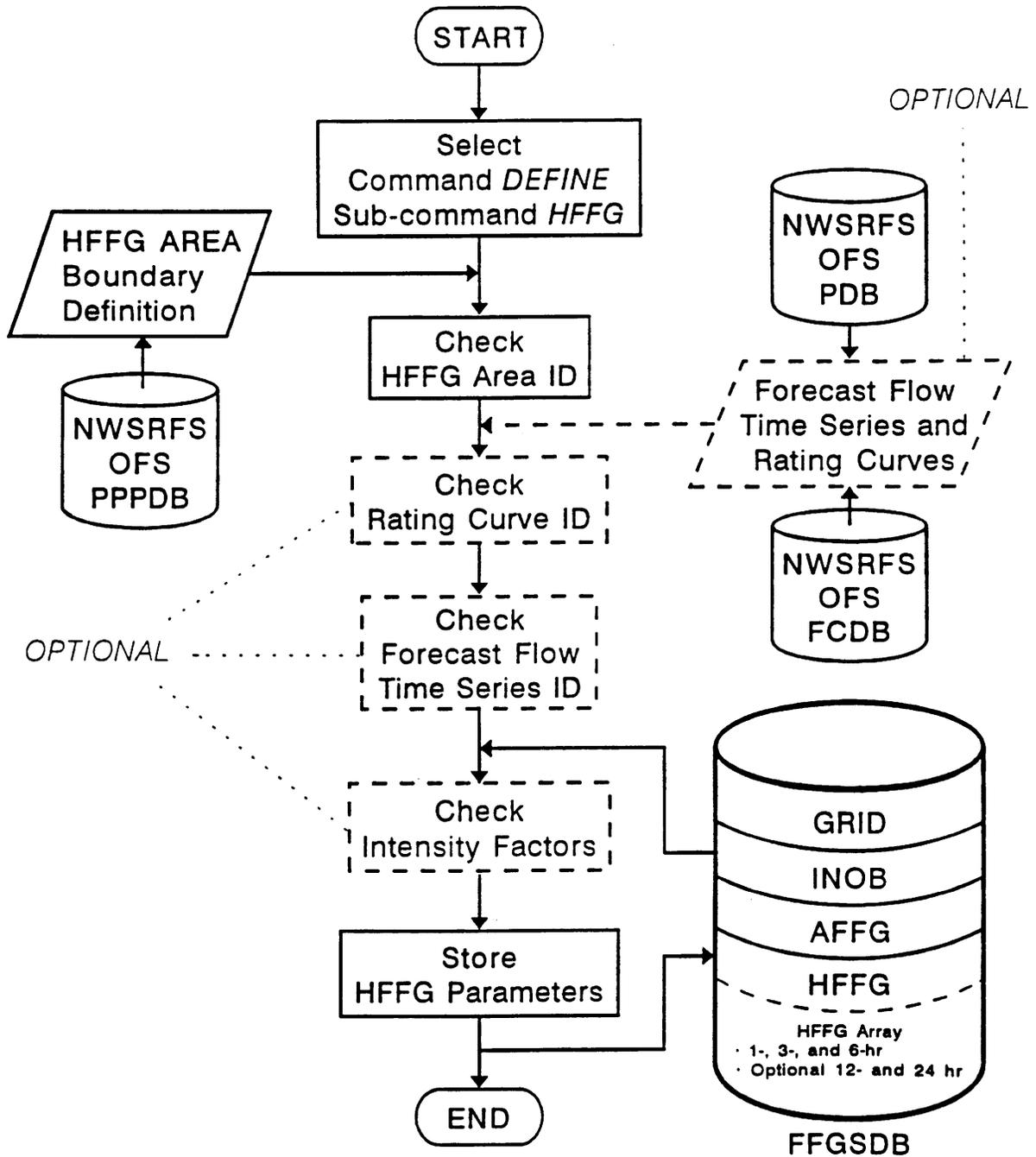


Figure 4. Defining Area Guidance Parameters in FFGUID

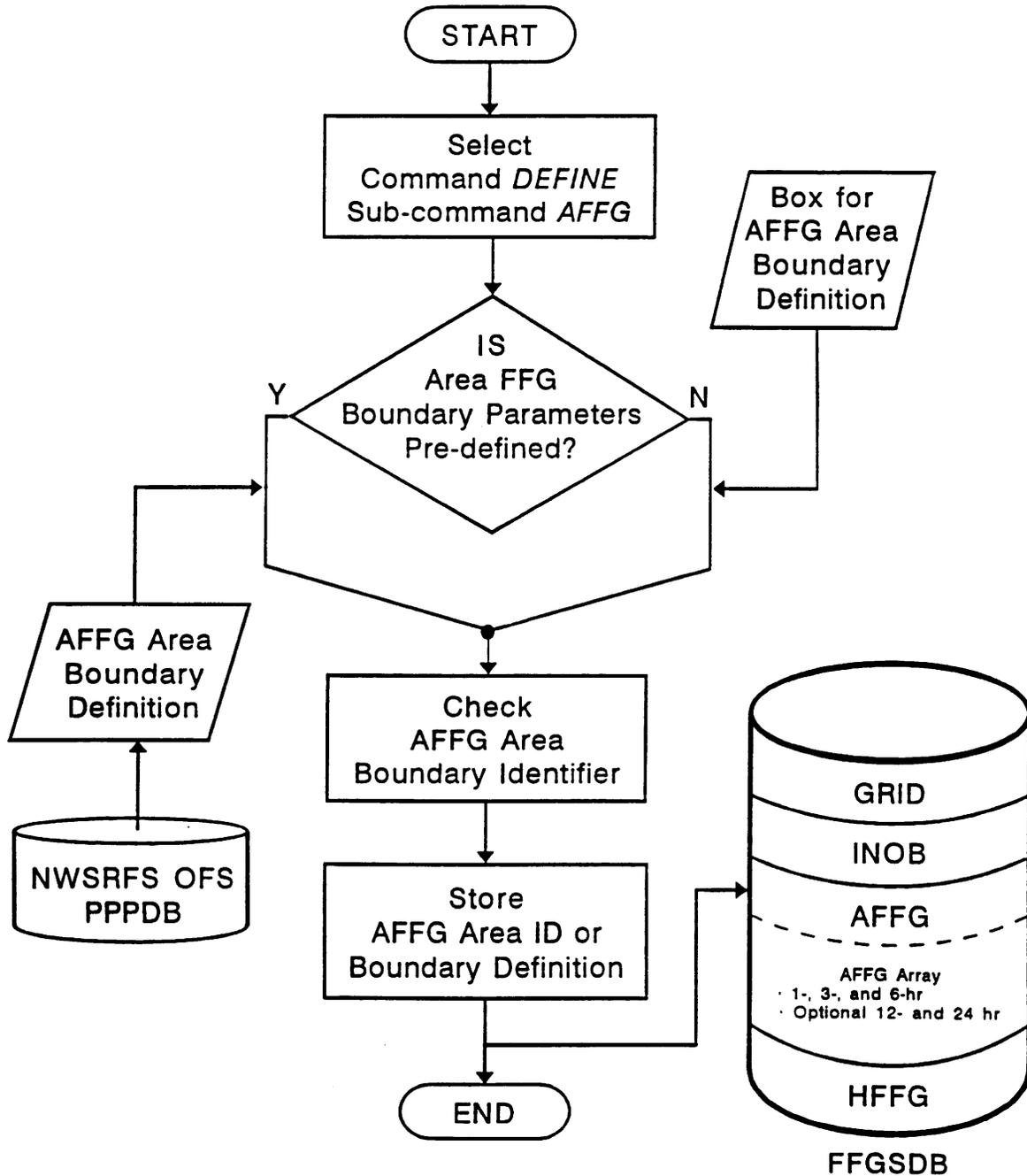


Figure 5. Computing Gridded Flash Flood Guidance in FFGUID

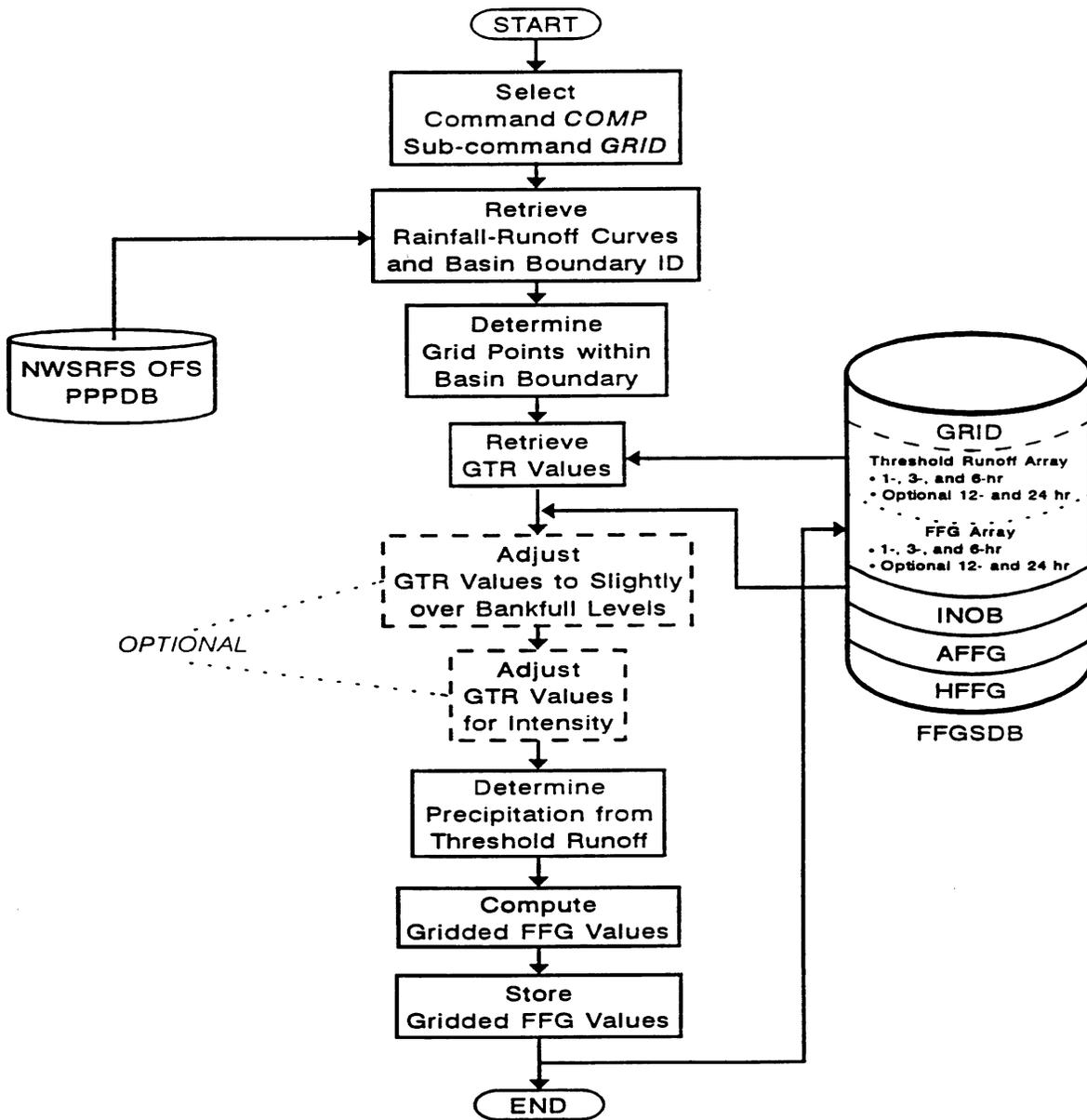


Figure 6. Computing Areal (Zone, County, Urban) Flash Flood Guidance Based on Pre-computed Gridded Guidance in FFGUID

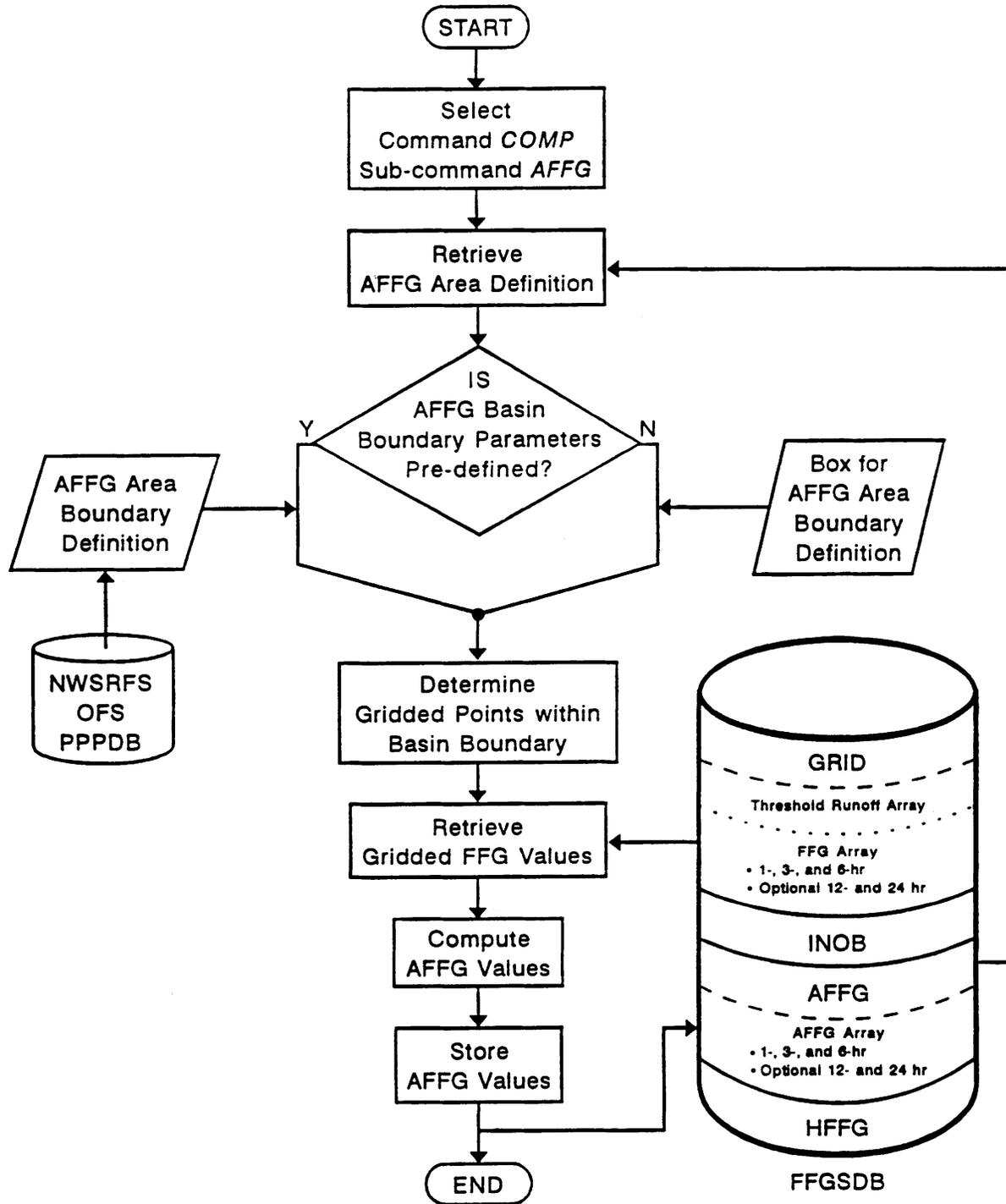


Figure 7. Computing Headwater Guidance in FFGUID

