4. Unimpaired Flow Development

4.1 Need for Unimpaired Flows

Unimpaired flows are historically observed flows with human influences removed. Human influences considered in derivation of unimpaired flows include flow regulation by and net evaporation from large reservoirs, and water withdrawals and wastewater returns by municipal, industrial, thermal power, and agricultural water uses. Groundwater pumping is also considered to the extent surface water flows are reduced. The use of unimpaired flows, as opposed to historical observed flows, allows resource assessments to be founded on the "natural" hydrology of the stream network. This approach enables consistent, unbiased evaluation of the impact of past, present, and future water regulation and consumption activities on stream networks.

Unimpaired flows are the basic hydrologic time series input to the surface water availability modeling component of the Statewide Water Management Plan. The adopted period of record for unimpaired flows is 1939 through 2007, and the time step adopted for all water use, flow, and meteorological time series data applied is one day.

4.2 Unimpaired Flow Development Process

Development of unimpaired flow time series data proceeded along four tracks, involving steps listed below as follows:

Stream Flow Filling and Routing (Unregulated Incremental Flows)

- Statistical methods (Maintenance of Variance Extension Type 2, multiple linear regression, ordinary least-squares regression)
- Hydrologic routing and back-routing (Lag-K, variable Lag-K, coefficient method)
- Removal (addition) of reservoir effects, where applicable
- Calculation of reservoir inflows
- Scaling (flow and drainage area ratios)
- Local incremental flow calculation (difference in cumulative historical flows)

Reservoir Effects

- Holdout flows (reservoir inflows minus outflows)
- Pre- and post-reservoir net evaporation (evaporation minus precipitation, reservoir surface area runoff)

Water Use Inventory and Hindcasting

- Compilation, aggregation, and hindcasting of current monthly municipal and industrial water withdrawals, wastewater returns, and net water consumption from 1939 to the beginning of continuous records (in most cases from the mid 1990s to 2000)
- Compilation and aggregation of historical thermal water withdrawals, returns, and net water consumption
- Compilation and aggregation of historical agricultural surface water withdrawals (assumed to be equivalent to net water consumption for purposes of this study)
- Compilation, aggregation, and hindcasting of municipal, industrial, and agricultural groundwater withdrawals and resulting surface water flow depletions (groundwater effects)

Local and Cumulative Unimpaired Flows, Flow Adjustments, and Quality Control

- Removal (addition) of reach net water use (all categories)
- Removal (addition) of remaining reservoir effects (holdout and/or net evaporation flows) where applicable
- Removal of negative local incremental unimpaired flows (TSTool Adjust Extremes, average annual flow volume adjustment, period of record flow volume adjustment)
- Merger of extended (2002 to 2007) and existing (1939 to 2001) incremental UIFs (ACF and ACT study basins only because existing UIFs were available for these basins)
- Quality control (manual data adjustments, mass balance, double mass balance)
- Cumulative unimpaired flows (combining and routing of local incremental UIFs)

A process diagram for unimpaired flow time series data development is shown on Figure 4-1.

The unimpaired flow derivation process is documented in detail in the Georgia EPD Draft Unimpaired Flow Data Report.

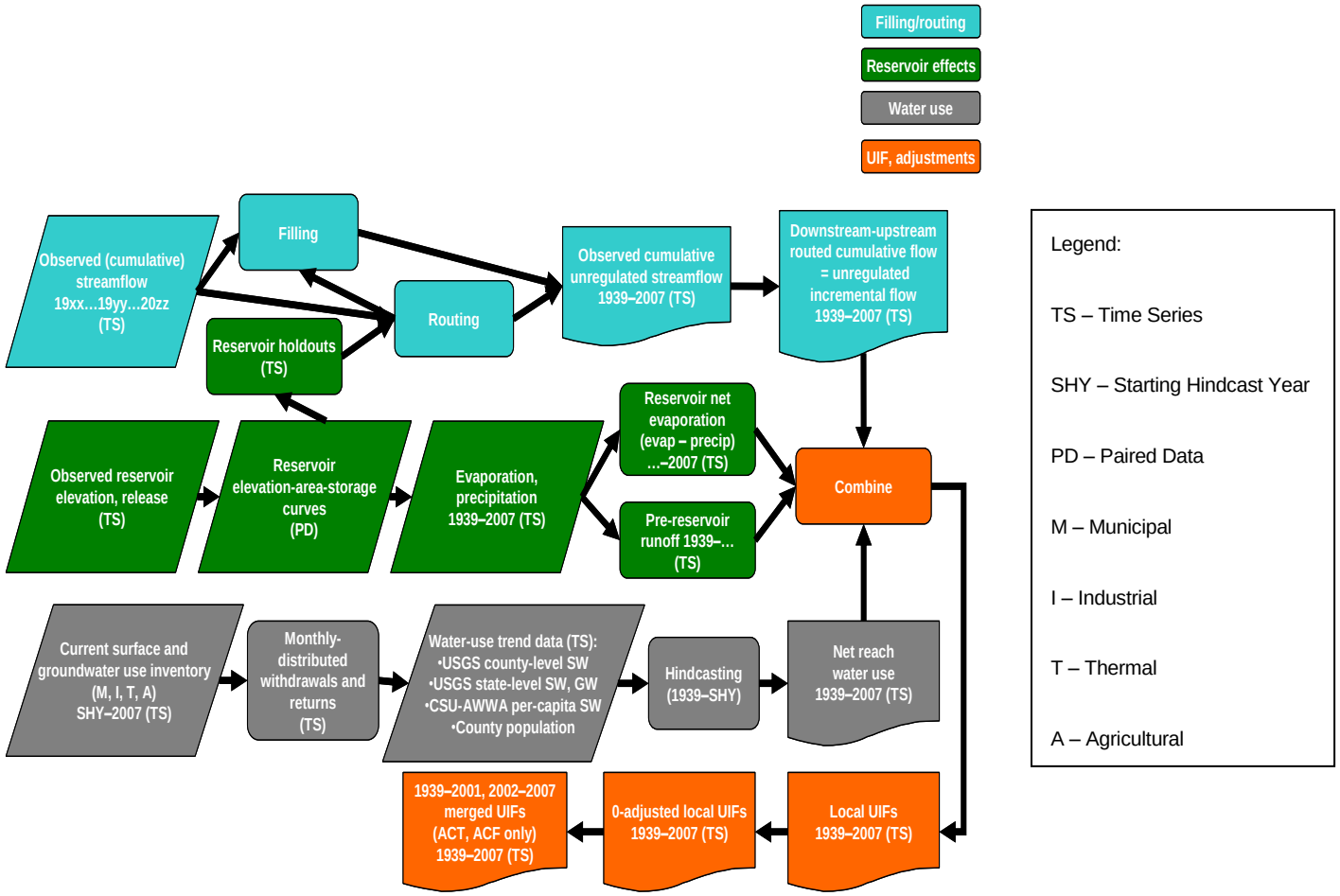

Figure 4-1 Unimpaired Flow Development Process Diagram