NATIONAL WEATHER SERVICE
NATIONAL DIGITAL FORECAST DATABASE PREPROCESSOR PROJECT

NATIONAL DIGITAL FORECAST DATABASE (NDFD) PREPROCESSOR

REQUIREMENTS

Version 1.7

Revision History

Date	Version	Description	Author
4/10/03	1.0	Initial version established by Requirements Team during training session in Silver Spring, MD.	NDFD Preprocessor Requirements Team
4/30/03	1.1	Additional Requirements added	Team Leader
5/05/03	1.2	Additional Requirements & Descriptive sections added	NDFD Preprocessor Requirements Team
5/14/03	1.3	Additional Requirements added by NDFD-to-NWSRFS preprocessor team	NDFD Preprocessor Requirements Team
5/15/03	1.4	Additional Requirements added by NDFD-to-NWSRFS preprocessor team	NDFD Preprocessor Requirements Team
5/16/03	1.5	Final editing by NDFD-to-NWSRFS preprocessor team prior to review by HSD Chiefs, RFCs, and OHD	NDFD Preprocessor Requirements Team
5/29/03	1.6	Editing by NDFD-to-NWSRFS preprocessor team following review by HSD Chiefs and RFCs	NDFD Preprocessor Requirements Team
5/30/03	1.7	Editing by NDFD-to-NWSRFS preprocessor team following Final review	NDFD Preprocessor Requirements Team

Table of Contents

Page

INTRODUCTION

1.1 Purpose of the Project

This document describes the software requirements for a National Digital Forecast Database (NDFD) preprocessor. This report is intended to be used by the NWS or NWS approved contractors to develop the software and documentation for the preprocessor

1.2 Project Background and Goals.

The NWS is making forecast grids of sensible weather elements available in the NWS National Digital Forecast Database (NDFD). The NDFD contains a seamless mosaic of NWS digital forecasts from NWS field offices working in collaboration with the NWS National Centers for Environmental Prediction (NCEP). The NDFD will be able to provide NWS River Forecast Centers (RFCs) and external organizations with increasing amounts of forecast information at time scales as small as hourly and space scales of a few kilometers. RFCs would like to use this data for their forecasting operations; however, tools are not yet available to format these data to be compatible with the National Weather Service River Forecast System (NWSRFS). A NDFD Preprocessor Requirements Team was formed to address this deficiency. The team's mission is to develop requirements for a preprocessor that will ingest NDFD grids, compute areal averages for river basins and find element values at points, and output time series of areal averages and point values in formats acceptable to NWSRFS and external user applications.

1.3 Project Scope

The NDFD preprocessor application will ingest NDFD grids, compute arithmetic averages of NDFD elements over geographic areas, derive element values at user specified points, and output areal average and point time series in various formats.

1.4 Project Features

1. Ingest any continuous gridded element from the NDFD on an on-demand or cron-scheduled basis
2. Generate time series of arithmetic averages of NDFD elements for user specific geographic areas
3. Generate times series of NDFD element values at user specified point locations
4. Produce time series in formats that are suitable for NWSRFS or external user applications
5. Transfer times series of arithmetic averages into the NWSRFS processed database
6. Transfer times series of element values at points into the Informix database

1.5 Project Scope and Limitations

1. Although it is outside the scope of this project, the team recommends that RFCs have the capability to gather, view, and edit NDFD grids before they are sent to the NDFD preprocessor. Some type of grid tool, such as the Graphical Forecast Editor (GFE), should be made available to RFCs for this purpose.
2. NDFD grid acquisition is a necessary part of the process but does not have to reside in the preprocessing program.
3. Distributed hydrologic modeling is outside scope of this project. The timeframe for the use of NDFD data in NWSRFS is shorter than the projected schedule for implementation of distributed models and the format for grids has not been established at this time. A future design consideration is to address distributed modeling.

1.6 Project Stakeholders

The primary users of the preprocessors will be the RFCs but, additional users of the preprocessor may include:

- WFOs, NCEP
- Federal Government Agencies such as USACE, USGS, BPA, NRCS, Bureau of Reclamation
- State and local government agencies
- University researchers

2.0 HOW THE CURRENT SYSTEM WORKS

The National Weather Service River Forecast System (NWSRFS) is a suite of computer models and databases used by NWS river forecasters to predict river, lake, and reservoir levels in the U.S. The NWSRFS ingests observed and forecast precipitation and air temperature data, which it uses to force its hydrologic computer simulations.

Currently the forecast data comes from a variety of sources including the National Centers for Environmental Prediction (NCEP) and local NWS Weather Forecast Offices (WFO). Gridded and point precipitation forecasts are initialized with the Hydrometeorologic Prediction Center (HPC) national precipitation forecasts. These forecasts are adjusted at the River Forecast Centers (RFC) as necessary based on the most current observed radar and satellite information. The resulting gridded or point forecasts are converted to basin average time series and written to a formatted text file. This file is used by an NWSRFS preprocessor to incorporate the time series into the NWSRFS processed database for use by the models.

Air temperature forecasts for many stations in an RFC area are generated at the RFC's using national model guidance and local forecasts from the WFO's. These point forecasts are ingested into NWSRFS and converted to basin average time series using another preprocessor within NWSRFS.

Precipitation and air temperature are two of the main variables driving the hydrologic simulations in NWSRFS. In the future it is probable that we will be utilizing more variables such as dewpoint temperature, wind speed, and wind direction. The NDFD will provide a single, up-to-date source of gridded forecast data for all of these elements and more.

3.0 CONCEPT OF OPERATIONS FOR PROPOSED SYSTEM

WFOs create the grids and include RFCs in the intersite coordination process (assumption: RFCs have GFE and collaboration tools). WFO grids go to the NDFD. RFCs get grids from the NDFD and run the preprocessor at RFCs to create time series and put them into the processed database in NWSRFS directly (basin averages) or to format them into a SHEF message to go through standard data ingest paths to end up in NWSRFS.

ASSUMPTIONS:

- The preprocessor will write areal average output directly into NWSRFS. For point locations, the preprocessor will generate a standard SHEF message.

- The external use of the preprocessor by organizations such as USACE is also envisioned. It is anticipated that the preprocessor will standalone outside NWSRFS as a downloadable utility capable of running on a local microcomputer.

- Grids will be ingested directly from NDFD or from grid editing software, if available.

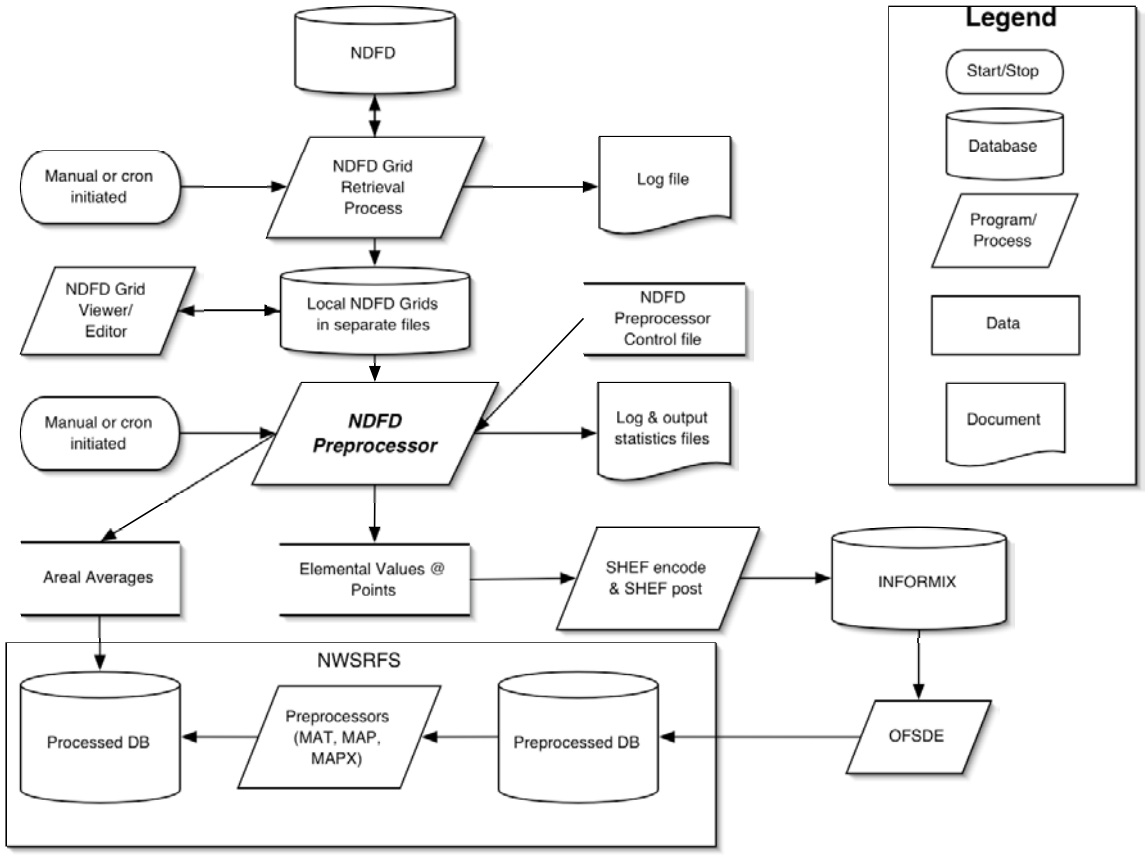

Figure 1 Schematic showing the flow of data from the NDFD, through the NDFD Preprocessor to the NWSRFS Processed database.

4.0 REQUIREMENTS DEVELOPMENT

The NDFD-NWSRFS Preprocessor Requirements Team is tasked with looking for an efficient way to transfer NDFD data to the NWSRFS via a preprocessor. The focus is on defining what goes into the preprocessor, what calculation it performs, and what it should do with the resulting time series. There are many technical issues the team must define to ensure the goals are met. Knowledge of the NDFD and River Forecast System models is very important.

A team charter was drafted which defined the overall scope and authority. The charter was used as guidance to move forward with a plan. Conference calls and a face-to-face team meeting were planned. The design of system requirements was dependent upon everyone sharing their knowledge and ideas in one setting, so the face-to-face meeting at National Weather Service Headquarters accomplished this. The agenda consisted of three main overviews: NWSRFS, NDFD, and setting requirements. This was followed by working sessions to define the initial requirements for the project.

The NWSRFS presentation focused on the hydrologic models, possible pathways and formats of feeding data into the models, and existing preprocessors. Weather parameters contributing to the River Forecast System were also discussed.

The NDFD presentation covered development issues, forecast elements, and future development plans with NDFD. The team focused on the quantitative precipitation forecast (QPF) and quantitative temperature forecast (QTF) elements for ingest into NWSRFS, and the RFCs ability to view or edit the grids before entering the preprocessor. The need to acquire additional NDFD forecast elements in the future, such as those needed to calculate potential evaporation and probabilistic grids was also discussed.

The presentation on requirements development gave all team members a common understanding of what requirements are, how they are developed, and how they are managed. This was followed by working sessions in which the team worked to complete the requirements document template, defining the project and identifying requirements. Decisions were made based on consensus in which all team members agreed on the issue at hand. Follow-up emails and conference calls were used to further refine the requirements document.

The document is currently ready for review by the regions. It contains the specific functional and technical requirements as agreed to by the team. After their comments are incorporated, it will be submitted to OHD who will then use it to guide the preprocessor development.

The identification of each NDFD preprocessor requirement, along with its priority level and qualification type follow.

5.0 REQUIREMENTS

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
1.0	**FUNCTIONAL REQUIREMENTS**		
1.1	**General**		
1.1.1	Ingest a sequence of NDFD continuous gridded element grids.	High	
1.1.2	Capability to temporally average, interpolate, aggregate, disaggregate data conforming to NWSRFS techniques based on time step	High	
1.1.2.1	Create time series of areal arithmetic averages with user specified time step and duration of time series for each geographic area.	High	
1.1.2.2	Create time series of data for grid cell corresponding to user specified point locations, time step, and duration of time series.	High	
1.1.2.3	Capability to specify : NDFD data element Geographic area or point location Time step (increments hours) Duration of time series Multiple output types (file, SHEF, or NWSRFS) Multiple output locations Log file location	High	
1.1.3	Have standard graphical user interface	High	
1.1.4	Capability to run preprocessor in batch or interactive execution mode	High	
1.1.5	Capability to acquire NDFD grids independent of preprocessor	High	
1.1.6	Capability to view NDFD grids independent of preprocessor	High	
1.1.7	Capability to edit NDFD grids independent of preprocessor	High	
2.0	**TECHNICAL REQUIREMENTS**		
2.1	**General**		

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
2.2	**Input Data**		
2.2.1	NDFD gridded data	High	
2.2.1.1	Acquisition of grids part of the process for RFCs (not necessarily in the preprocessor); see Requirement 10.1	High	
2.2.2	Area and point geographic data	High	
2.2.2.1	Obtain area and point data from NWSRFS geo_data files	High	
2.2.2.2	Obtain area and point data from standard GIS formatted file (ARC GIS shapefiles?)	Medium	
2.3	**Control Data**		
2.3.1	User specified time step	High	
2.3.2	User specified duration of time series	High	
2.3.3	User specified geographic data type and source (for areal averages)	High	
2.3.4	User specified point location (for point time series)	High	
2.3.5	User specified NDFD elements	High	
2.3.6	User specified output type (file, SHEF, or NWSRFS)	High	
2.3.7	User specified output location	High	
2.3.8	The control data (listed above) will be specified in a control file	High	
2.4	**Output Data**		
2.4.1	Output time series can be written to the NWSRFS Processed Database or to a formatted output file		
2.4.1.1	Format options for areal data		
2.4.1.1.1	NWSRFS Processed Database	High	
2.4.1.1.2	Standard text format file (to be defined)	Medium	
2.4.1.2	Format options for point data		
2.4.1.2.1	SHEF	High	
2.4.1.2.2	Standard text format file (to be defined)	Medium	

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
2.4.1.3	Output locations: User specified directory NWSRFS Processed Database	High	
2.4.1.3.1	If output type is specified as "NWSRFS", determine the target fileset from *apps_defaults* tokens	High	
2.4.1.3.2	If output type is specified as "SHEF", determine the target directory from *apps_defaults* tokens unless an output directory is specified in the control file	High	
2.4.1.3.3	If output type file, read from control file	High	
2.5	**System Processing**		
2.5.1	Create time series of arithmetic averages with user specified time step and duration of time series for each geographic area	High	
2.5.2	Create time series of arithmetic averages with user specified time step and duration of time series for each point location	High	
2.5.3	Preprocessor performance must be comparable to existing MAPX preprocessor performance in NWSRFS	High	
2.6	**System Internal Data**		
	No requirements at this time		
2.7	**System Environment**		
2.7.1	Must run on Linux 7.2 (or current AWIPS Operating System)	High	
2.7.2	Must run on HP-UX 10.2 (or higher)	Medium	
	Ability to run on Microsoft Windows	Low	
2.7.3	GUI should platform independent	High	
2.8	**Computer Hardware**		
2.8.1	Ability to run on AWIPS hardware	High	
2.9	**Computer Software**		

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
	No requirements at this time		
2.10	**Computer Communications**		
2.10.1	Capability to communicate with NDFD for grid acquisition process	High	
2.11	**508 Compliance**		
	GUI elements must adhere to NWS 508 Compliance Guidelines	High	
2.12	**System Quality Factors**		
	No requirements at this time		
2.13	**Personnel**		
	No requirements at this time		
2.14	**Documentation**		
2.14.1	User documentation on preprocessor use	High	
2.14.2	System documentation for preprocessor: Installation System configuration Error codes Trouble shooting	High	
3.0	**SECURITY AND PRIVACY REQUIREMENTS**		
3.1	**General**		
	No requirements at this time		
3.2	**Security Planning**		
	No requirements at this time		
3.3	**Access Control**		

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
	No requirements at this time		
3.4	**Firewall**		
	No requirements at this time		
3.5	**Virus Protection**		
	No requirements at this time		
3.6	**Intrusion Protection**		
	No requirements at this time		
3.7	**Stateful Inspection**		
	No requirements at this time		
3.8	**Physical Security**		
	No requirements at this time		
3.9	**Reporting and Staffing**		
	No requirements at this time		
3.10	**Certification and Accreditation**		
	No requirements at this time		
4.0	**INTERFACE REQUIREMENTS**		
4.1	Read NDFD grids	High	
4.2	Write to NWSRFS Processed database (for areal averages)	High	
4.3	Write to SHEF formatted text file (for point locations)	High	
4.4	Write to text file (option for either areas or points)	High	

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
4.5	Platform independent human graphical user interface	High	
5.0	**DATA MIGRATION REQUIREMENTS**		
	No requirements at this time		
6.0	**TRAINING REQUIREMENTS**		
6.1	Training requirements will be fulfilled with written examples in the documentation with accompanying digital data sets	High	
6.2	Training examples and accompanying data sets must demonstrate scenarios on: - Creation of preprocessor control file - Ingest of NDFD grids - Generation of areal average time series values that are written directly to the NWSRFS Processed database - Generation of areal average time series values that are written as standard ASCII text files - Generation of time series point values in SHEF formatted text file - Generation of point location time series values that are written as standard ASCII text files	High	
7.0	**DOCUMENTATION REQUIREMENTS**		
7.1	Written documentation provided in Adobe pdf format	High	
8.0	**REPORTING REQUIREMENTS**		
8.1	Preprocessor execution log, including: Start time End time Errors	High	

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
	Warnings Preprocessor options selected Success of major steps Number of warnings & errors		
8.2	Summary statistics report, including: Number of grid points List of points processed Time series Maximum & minimums by area (basin) of areal values Time series Maximum & minimums by location of point values Areal (basin) time series averages by area (basin) Point time series by location Average value by point location	High	
9.0	**Testing**		
9.1	Repeatable test for software evaluation by OHD for preprocessor acceptance using the data & scenarios describe in 6.2	High	
9.2	Repeatable test for NWS field office/user testing of proper software installation and configuration using the data & scenarios describe in 6.2	High	
10.0	**DESIGN CONSIDERATIONS**		
10.1	Grid acquisition		
10.1.1	Grid acquisition must be on demand (can be scheduled on a cron)		
10.1.2	For each weather element desired, the user specifies: Range of dates wanted Destination for each element		
10.2	Distributed hydrologic modeling data, specifically such issues as:		

IDENTIFICATION NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE
	Grid resampling Spatial data interpolation Coordinate transformation		
10.3	Future capability to specify time steps less than one hour		
10.4	Need for bias correction – not feasible for initial operating capabilities but should be considered for future		
10.4.1	Will need to archive processed data for future bias studies		