NATIONAL WEATHER SERVICE
OFFICE of HYDROLOGIC DEVELOPMENT

Concept of Operations (CONOPS)

&

Operational Requirement Specifications Document

Enhancements to Hydrograph Generation (HydroGen)

Version 3.0

Revision History

Date	Version	Description	Author
03/16/2006	2.0	Initial Draft	M. Maxey
03/21/2006	2.1	Review & edit	M. Andre
03/29/2006	2.2	Revise project name as per recommendation from OSIP Gate review team	M. Andre
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05/12/2006	2.5	Apply gate 2 recommended changes. Remove Appendix C	M. Andre
06/12/2006	2.6	Operational Policies and Constraints section added	J. Soler
10/17/2006	3.0	Stage 3 revisions	M. Andre

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INTRODUCTION AND SCOPE

Taken from the Statement of Need (SON)

The National Oceanic and Atmospheric Administration's (NOAA) National Weather Service (NWS) has a need for enhancements to the HydroGen (short for *Hydro*graph *Gen*eration) application.

HydroGen is a suite of software programs that collect data from the Integrated Hydrologic Forecast System (IHFS) database and prepare eXtensible Markup Language (XML) files and hydrograph graphics (or simply "hydrographs") for the web. It was designed to replace the RivDat Hydrograph Generation Software**,** a local application. This software extracts river and other hydrologic data, formats it in XML, and transfers it to the regional web server where complementary software creates the time-series and other web-ready files for display via the Rivers tab in the www.weather.gov web page.

HydroGen was designed to be installed on the Advanced Weather Interactive Processing System (AWIPS). However, it was originally distributed on the Local Application Database (LAD). The HydroGen software was provided as part of the national AWIPS baseline during Operational Build version 6 (OB6). The LAD version the software was discontinued.

Prior to deployment, HydroGen was field tested in the Weather Forecast Offices (WFOs) in the Eastern, Southern and Western Regions. Version 1.0-18 of the HydroGen software contains modifications to the application that were subsequently made to address issues found in AWIPS during beta testing. However, to make the HydroGen application nationally consistent and easier to use, several additional enhancements to the software have been requested. These enhancements are a result of a survey of the River Forecast Centers (RFCs) and Weather Forecast Offices (WFOs) that was conducted via the Hydrologic Services Division (HSD) web link's requirements gathering process. The enhancements were captured as requirements and recorded in the *Requirements Specification* document. These requirements were prioritized by developers based on the needs expressed by the RFCs and WFOs**.** The requirements listed in Appendix B will describe in detail the enhancements that have been prioritized and proposed for OB8 and beyond.

1.1 Identification

Project Title: Enhancements to HydroGen (Hydrograph Generation)

HOSIP Project ID: H06-011 - SON 06-001 OSIP Project ID: 06-037

1.2 Document Overview

Please see *Non-AWIPS Maintenance & DR Project Documentation form* for additional information on this project.

1.3 General Description of Operational Capability

Taken from the Statement of Need (SON)

HydroGen makes use of a handful of Perl modules, plus a commercial package called ChartDirector. Both the data collection portion and the graphic generation component of HydroGen can be installed on non-AWIPS Linux systems. HydroGen collects data from the Integrated Hydrologic Forecast System (IHFS) database and runs within the AWIPS firewall. HydroGen includes software to transport files, once created, to a Local Data Acquisition and Dissemination (LDAD) computer, and then from LDAD to the web server. This two-step transfer process is still in place, but no longer necessary because of the new firewall configuration for AWIPS.

The following encrypted binary Perl programs are included in HydroGen:

- Graphic-generation component: This code generates the hydrographs and associated image maps.
- Data-gathering component: This collects the database information and formats the data into text output, including an eXtensible Markup Language (XML) formatted file which is read to produce the graphic.

In addition, five "bash-shell" UNIX scripts are included and act as wrappers to simplify crontab entries, or running commands manually.

HydroGen is typically run from a batch processing script supplied with the HydroGen package which is scheduled on the WFO cron. Within AWIPS, hydrographs can be generated automatically (on cron, etc.) or manually, perhaps to experiment with HydroGen's many configurable parameters, which are listed in the table spanning several pages at the end of the installation section.

All configurable parameters have hard-coded defaults that can be used in the event alternate values are not specified to override it. Hard-coded default values are overridden by parameters in the configuration file. These configuration file parameters are overridden by command-line switches, and the command-line switches are overridden by any query-string parameters (if HydroGen is running on a web server).

HydroGen's three forms of output (not including log files for each program) include XML data files, PNG hydrograph files, and an HTML image map files.

Because HydroGen is designed to create dynamic (on-the-fly) graphics when run on a web server, as well as to create static graphics, it creates output differently depending on whether it is running on a web server (default) or running as a stand-alone graphics generator. In dynamic mode (web server), the HydroGen writes the PNG hydrograph to disk temporarily (awaiting a second request from the client for the graphic) and sends an HTML image map directly to the "standard output stream". This is so the graphic (when called from a web page) will have clickable regions that can provide more information. The data collection part of the HydroGen application extracts river and other hydrologic data, formats it in XML, and transmits it to regional web servers for use in generating

graphics and other supplemental information for AHPS web pages. HydroGen accesses files in its home directory across the NFS mounts if running on any other platform than the DS or DX. Hydrogen also will access the IHFS database across the AWIPS LAN if run on any other platform other than the DS or DX.

Figure 1 provides a diagram of how the HydroGen application functions.

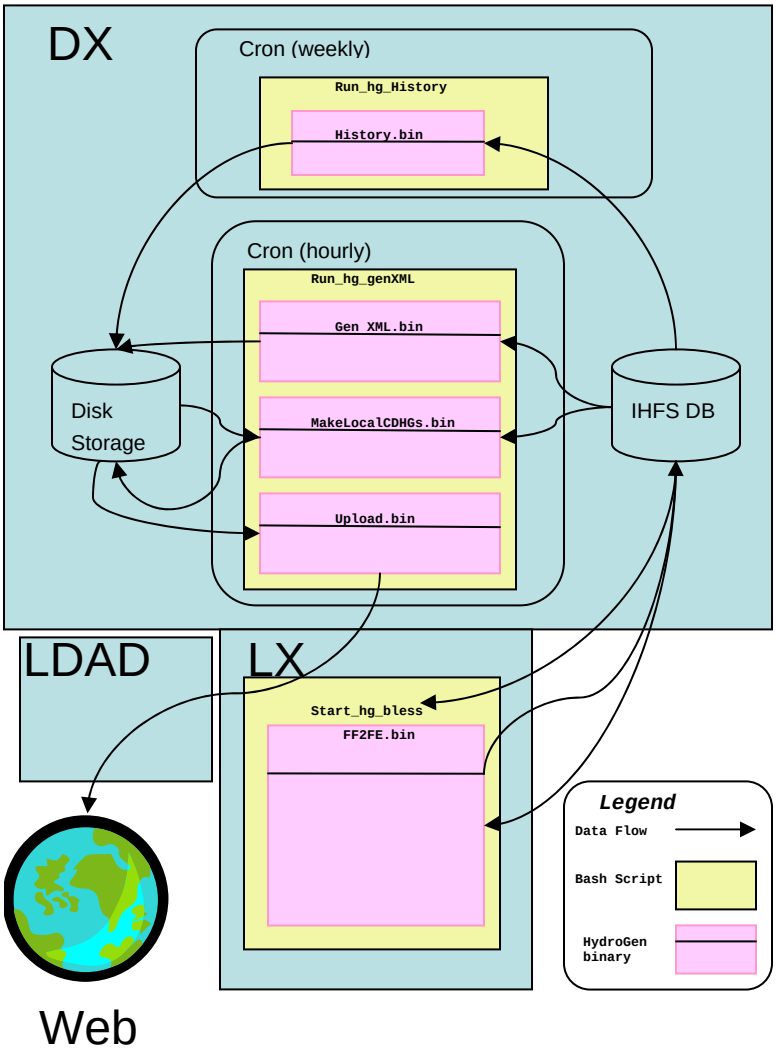

Figure 1. Software interaction diagram

1.4 Strategic Plan Element

Taken from the Statement of Need (SON)

This need directly addresses the National Oceanic and Atmospheric Administration (NOAA) Goal 3, to "Serve Society's Needs for Weather and Water Information," by creating dynamic (on-the-fly) hydrologic forecast graphics that can be viewed on the web.

Funding for this project was requested through Advanced Hydrologic Prediction Service

(AHPS). The project was approved by the AHPS Review Committee (ARC) and falls under the AHPS Operations & Service Improvement Process (OSIP) umbrella 05-015 as a high mission priority Statement of Need (SON). The recommendation is that this project be redirected to the Software Recommendations and Evaluation Committee (SREC) for OB8.

1.5 Requirements Development Methodology

A survey of the River Forecast Centers (RFCs) and Weather Forecast Offices (WFOs) was conducted and several additional modifications have been requested. These enhancements are all based on information collected via the Hydrologic Services Division (HSD) web link's requirements gathering process.

2. OPERATIONAL POLICIES AND CONSTRAINTS

2.1 Performance Impacts

After making the enhancements, performance will not be significantly affected.

2.2 Memory

After making the enhancements, memory needs will not be significantly affected.

2.3 Disk Storage Capacity

After making the enhancements, disk storage capacity needs will not be significantly affected.

3. USE CASES

The following are scenarios under which a user may need to use the HydroGen application:

Scenario 1: Build hydrograph for a location.

a. User determines the location for which hydrograph is to be generated.
b. User makes sure the HGStation table of the IHFS database includes the location.
c. User makes any adjustments to the configuration file that are necessary to generate the desired hydrograph.
d. User determines if XML file already exists for the hydrograph to be generate. If not, user generates XML using the HydroGen application.
e. User executes HydroGen application to generate PNG graphic from the XML file.

Scenario 2: Build XML file for a location, without generating graphic.

a. User determines the location for which hydrograph is to be generated.
b. User makes sure the HGStation table of the IHFS database includes the location.
c. User makes any adjustments to the configuration file that are necessary to generate the desired hydrograph.

d. User executes HydroGen application to generate XML file only.

Scenario 3: Build XML files and/or hydrographs on a routine basis for many locations

a. User determines all locations for which hydrographs are to be generated on a routine basis.
b. User makes sure the HGStation table of the IHFS database has the necessary entries.
c. User makes any adjustments to the configuration file that are necessary to generate the desired hydrographs.
d. User sets up cron to execute HydroGen application to generate XML files.
e. User sets up cron to execute HydroGen application to generate hydrographs.

4. REQUIREMENTS SPECIFICATIONS

All requirements are presented in tabular format, identified by a unique identifier and contain the planned verification method and priority. The requirements will be stored in the OHD Dynamic Object Oriented Requirements System (DOORS) database. The requirements describe the necessary functions that have to be performed to accomplish the objective. They will become a set of single verifiable elements that will be the basis for all design, coding during development and testing of the capability or system. The requirements tables are in Appendix B. These requirements were agreed to by the RFCs and WFO and are crossed referenced to a larger set of requirements that were gathered during the survey. Those requirements are listed in Appendix C.

APPENDICES

Appendix A – Acronym List

AHPS	Advanced Hydrologic Prediction Service
ARC	AHPS Review Committee
AWIPS	Advanced Weather Interactive Processing System
DOORS	Dynamic Object Oriented Requirements System
HSD	Hydrologic Services Division
HydroGen	Hydrograph Generation
IHFS	Integrated Hydrologic Forecast System
LAD	Local Application Database
NOAA	National Oceanic and Atmospheric Administration
NWS	National Weather Service
OB5	Operational Build - version 5
OB6	Operational Build - version 6
OB8	Operational Build – version 8
OSIP	Operations & Service Improvement Process
RFC	River Forecast Center
RS	Requirements Specifications
SREC	Software Recommendations and Evaluation Committee

SON	Statement of Need
WFO	Weather Forecast Office
XML	eXtensible Markup Language

APPENDIX B – Requirements Table

ID NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE	RELEASE
1.0	**FUNCTIONAL REQUIREMENTS**			
1.1	The HydroGen application shall toggle on or off to display "normals" for a site which is represented by three time series for the 10%, 50%, and 90% probability of exceeding levels at the site. The three lines shall be plotted and a legend shall be provided explaining these lines (See Appendix C - Requirement C.I.35)	Medium	Test	TBD
1.2	The HydroGen application shall make a link between the levels shown on the hydrograph and impacts, more visible (See Appendix C - Requirement C.IV.1.b)	Medium	Test	TBD
1.3	The HydroGen application shall provide the capability to depict a low water stage on the hydrograph (See Appendix C - Requirement C.IV.2.b)	Medium	Test	TBD
1.4	The HydroGen application shall provide information as to when next regularly scheduled update will be available for both observed data and forecasted data (See Appendix C - Requirement C.I.23)	Medium	Inspect	TBD
1.5	The HydroGen application shall provide the capability to plot forecast data from different SHEF sources at the same time, and edit legend appropriately. (See Appendix C - Requirement C.I.26)	Medium	Test	TBD
1.6	The HydroGen application shall provide the capability to automatically switch the data/forecast source (See Appendix C - Requirement C.I.27)	Medium	Test	TBD
1.7	The HydroGen application shall display the NOAA watermark graphic on all graphics (See Appendix C - Requirement C.II.4)	High	Inspect	OB8.1
1.8	The HydroGen application shall provide the ability to select (when available) the marker for the mean, median and 1, 5, 10, 25, 75, 90, 95 and 99 percentiles, maximum and minimum (for specified period of record), and normal (for standard period). Each line will include a label indicating what is plotted (See Appendix C - Requirement C.II.11)	Medium	Test	TBD
1.9	The HydroGen application shall place disclaimers on hydrographs (See Appendix C - Requirement C.III.3)	High	Test	OB8.1
1.9.1	The user shall be able to turn on or off the forecast portion of the hydrograph disclaimer and change its text	High	Test	OB8.1
1.10	When a hydrograph is unavailable, the HydroGen application shall provide	Medium	Test	TBD

Priority Level: *High, Medium, Low*
Qualification Type: *Test, Demo, Inspect, None*

ID NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE	RELEASE
	information about when hydrographs will be available. (See Appendix C - Requirement C.I.3)			
1.11	When a forecast is unavailable on the hydrograph, the HydroGen application shall provide *detailed* information about when forecasts will be available.	Medium	Test	TBD
1.12	The HydroGen application shall check for and remove outliers to assure reasonable scaling	Low	Test	TBD
1.13	The HydroGen application shall provide the capability to increase update frequency from hourly (15 or 30 minutes)	High	Inspect	OB8.1
1.14	The HydroGen application shall be able to generate a hydrograph for tide gauges	High	Test	OB8.1
2.0	**TECHNICAL REQUIREMENTS**			
2.1	The HydroGen application shall operate inside AWIPS architecture	High	Test	OB8.1
2.2	The HydroGen application shall operate under the control of LINUX Red Hat Enterprise 4 system	High	Test	OB8.1
2.3	The HydroGen application shall use Postgres relational database	High	Test	OB8.1
2.4	The HydroGen application shall have configuration management control using the AWIPS/RFC configuration management system	High	Inspect	OB8.1
3.0	**SECURITY AND PRIVACY REQUIREMENTS**			
3.1	The HydroGen application shall comply with AWIPS security requirements	High	Inspect	OB8.1
4.0	**INPUT REQUIREMENTS**			
4.1	The HydroGen application shall acquire data needed to generate hydrographs from the IHFS database.	High	Test	OB8.1
4.2	The HydroGen application shall be user configurable via a configuration file	High	Test	OB8.1
4.5	**OUTPUT REQUIREMENTS**			
4.5.1	HydroGen output shall be displayed in XML format	High	Test	OB8.1

Priority Level: *High, Medium, Low*
Qualification Type: *Test, Demo, Inspect, None*

ID NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE	RELEASE
4.5.2	HydroGen shall generate a hydrograph and output it to a file in PNG format	High	Test	OB8.1
4.5.3	HydroGen shall generate an HTML image map file	High	Test	OB8.1
4.5.3.1	The left-hand (primary) axis of the HydroGen hydrograph in the image map shall be clickable, displaying information about that axis when clicked	High	Test	OB8.1
5.0	**LOGISTICS REQUIREMENTS**			
5.1	The HydroGen application shall be deployed through the normal AWIPS process	High	Inspect	OB8.1
6.0	**PROCESSING & PERFORMANCE REQUIREMENTS**			
6.1	Processing and performance needs for the HydroGen application will be determined by OHD in consultation with OST.	High	Inspect	OB8.1
7.0	**INTERFACE REQUIREMENTS**			
7.1	**System/Component Interface Requirements**			
7.1.1	The HydroGen application shall use the same interface used in the previous release	High	Inspect	OB8.1
7.2	**DATA MIGRATION REQUIREMENTS**			
	There are no data migration requirements			
8.0	**TRAINING REQUIREMENTS**			
8.1	Training needs for the HydroGen application will be determined by OHD in consultation with OCWWS. OCWWS will coordinate training plans and programs	High	Inspect	OB8.1
9.0	**DOCUMENTATION REQUIREMENTS**			
9.1	The HydroGen application shall be documented using normal AWIPS Documentation guidelines	High	Demonstrate	OB8.1

Priority Level: *High, Medium, Low*
Qualification Type: *Test, Demo, Inspect, None*

ID NUMBER	REQUIREMENT	PRIORITY LEVEL	QUALIFICATION TYPE	RELEASE
10.0	**CONSTRAINTS**			
10.1	The HydroGen application shall operate within existing AWIPS computing environments	High	Test	OB8.1
10.1.1	The HydroGen application shall be operational for the release of AWIPS OB8	High	Test	OB8.1
10.1.1.1	The HydroGen application shall change the default database name to hd_ob8xxx	High	Test	OB8.1
10.2	The HydroGen application shall be operational at all RFCs and WFOs	High	Test	OB8.1

Appendix C – OSIP HydroGEN Requirements

ID NUMBER	REQUIREMENT
A.III.1	Ensure observed and forecast values on hydrographs are consistent. Match observed and forecast values at the point where they meet (and, in some cases, overlap) on the hydrograph
C.I.3	If no hydrograph available, have script with logic to provide information about when hydrographs will be available. Example: “Hydrograph will be made available when water levels are 50% of flood stage”.
C.I.4	If no forecast available on hydrograph, have script with logic to provide detailed information about when forecasts will be available. Example: “Forecasts will be available on the hydrograph when flows are forecast to reach xx feet. (where xx feet are the flood issuance level or action stage)
C.I.23	Provide information near hydrograph as to when next regularly scheduled update will be available for both observed data and forecasted data.
C.I.26	Capability to plot forecast data from different SHEF sources at the same time, and edit legend appropriately. This is to accommodate an agreement WR has with the California DWR. Example found at http://www.wrh.noaa.gov/cnrfc/graphical_rvf/clucl.html
C.I.27	Capability for the hydrograph software to automatically switch data/forecast source according to a user specified requirement. Example: If GOES data is not available, the software would automatically switch over to LARC data.
C.I.35	An optional functionality that can be toggled on or off to display "normals" for a site which are represented by three time series for the 10%, 50%, and 90% probability of exceeding levels at the site. The three lines shall be plotted with light shading between the outside lines. An additional legend shall be added explaining these lines.
C.II.4	Ensure identification that the NOAA watermark graphic is clearly visible on all graphics.

ID NUMBER	REQUIREMENT
C.II.11	When available, ability to select marker for the mean, median and 1, 5, 10, 25, 75, 90, 95 and 99 percentiles, maximum and minimum (for specified period of record), and normal (for standard period). These values will vary with time of year, ideally on a daily basis. (Default will normally be turned off. However, in areas there is extensive user demand, a consistent subset may be turned on as the default). Information will be plotted a black line connecting the values. Each line will include a label indicating what is plotted.
C.II.14	Hydrograph software will check for and remove outliers to assure reasonable scaling
C.III.1	Increase update frequency from hourly (15 or 30 minutes)
C.III.3	Allow current disclaimers to be placed on hydrograph for added visibility and emphasis
C.IV.1(b)	Make link between levels shown on hydrograph and impacts more visible: implement according to specifications
C.IV.2(b)	Add the capability to depict a low water stage on the hydrograph: implement according to specifications]