

**NATIONAL WEATHER SERVICE  
OFFICE of HYDROLOGIC DEVELOPMENT**

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**PROJECT PLAN**

**National Weather Service River Forecast System (NWSRFS)  
Reservoir Tools Enhancement**

**Version 3.5**

## Revision History

Date	Version	Description	Author
12/08/2006	2.1	Initial version for OHD review and distribution.	S. Malers (RTi)
12/18/2006	2.2	OHD comments	K Hsu/J. Gofus (OHD)
12/22/2006	2.3	Accepted OHD comments with clarifications where requested. Updated to conform to the current Project Plan template format.	S. Malers (RTi)
01/10/2007	2.4	Accepted HOSIP Admin changes and updated based on conference call on 01/04/2007.	S. Malers (RTi)
01/11/2007	2.4.1	HOSIP QA and revisions	J. Soler (OHD)
01/16/2007	2.4.2	OHD revisions	J. Gofus /K. Hsu (OHD)
01/16/2007	2.4.3	HOSIP QA/Revisions	J. Soler (OHD)
01/23/2007	2.5	HOSIP QA/Revisions	J. Soler (OHD)
02/09/2007	2.6	Respond to Gate 2 comments.	S. Malers (RTi)
02/13/2007	2.6.1	Respond to Gate 2 comments	K. Hsu/ J. Gofus (OHD)
2/14/2007	2.6.2	HOSIP QA and Edits	J. Soler (OHD)
2/23/2007	2.6.3	Updates to Resource tables and completion estimates.	J. Soler (OHD)
3/25/2007	3.1	Stage 3 version for OHD review.	S. Malers (RTi)
3/30/2007	3.2	Respond to OHD review comments.	S. Malers (RTi)
04/04/2007	3.3	HOSIP QA review/edits	J. Soler (OHD)
04/06/2007	3.4	HOSIP final QA for Gate 3 review	J. Soler (OHD)
04/25/2007	3.5	Update based on Gate 3 meeting comments.	S. Malers (RTi)

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# 1. IDENTIFICATION

Project Title: National Weather Service River Forecast System (NWSRFS) Reservoir Tools Enhancement

Project-ID: NID 05-051 SON 05-001

This Stage 3 document addresses work to be completed in Stage 4.

# 2. STAGE PLAN

## 2.1 Approach

<b>Stage 2 - Validation</b>
The work to be performed is well defined based on a previous project (Streamflow Regulation Accounting (SRA) Tools). Therefore Stage 2 efforts consist mainly of preparing the CONOPS and Project Plan documents for enhancements that have been identified. A Gate 2 meeting will be held to confirm approval of the requirements and approach.
<b>Stage 3 - Research &amp; Analysis</b>
<p>The requirements and initial approach presented in HOSIP Stage 2 documents focus on functionality and overall data concepts. The requirements identified in HOSIP Stage 2 will have been verified (and if necessary adjusted) during the Gate 2 review. The HOSIP Stage 3 effort will consist of reviewing existing NWSRFS code for RES-J and LOOKUP3 operations in order to determine appropriate solutions necessary to implement the required enhancements.</p> <p>The current code, containing previous regulation accounting enhancements, will be obtained from OHD. RTi engineers and software developers familiar with the software will then review the code and determine software files, subroutines, classes/methods, etc. to be modified during implementation. Technical problems that may have been overlooked previously will be brought to the attention of OHD and appropriate actions taken (e.g., conducting additional discussions). After review, a list of recommendations will be presented to the OHD project leader to confirm the approach. This information will then be incorporated into HOSIP Stage 3 documents for a Gate 3 review.</p>
<b>Stage 4 - Design &amp; Development</b>
<p>Stage 4 activities will focus on design and implementation of software features that:</p> <ol style="list-style-type: none"><li>1) enhance the LOOKUP3 operation to be able to access all parts of multi-value time series and utilize a date for lookups;</li><li>2) update the MAXSTAGE method in the RES-J operation to utilize the rating curve in the NWSRFS operational files via a curve identifier or rating table specified at the node, and allow a maximum discharge to be specified.</li></ol> <p>The specific requirements are documented in the CONOPS/Requirements document. The</p>

design activities will be relatively straightforward since the problem is well understood and has been solved in some form before (see the attached document “NWSRFS Reservoir Tools Enhancement (LOOKUP3, RES-J MAXSTAGE) Solution Evaluation”). The test plan and accompanying tests, as implemented in the Operational Forecast System (OFS) and MCP3 test frameworks, will be the primary focus of development. In particular, streamflow regulation modeling often requires a longer period of data to demonstrate functionality and therefore sufficient MCP3 tests must be defined, executed, and documented. The simulation period for MCP3 test cases shall be limited to below 2 years. If longer periods are necessary for specific tests, reasons for the need will be addressed. One or more long test cases (e.g., 50 years) will be included to verify that MCP3 correctly runs a long period. Existing MCP3 test cases will be used if available; otherwise, one or more new test cases will be defined.

Test results corresponding to the OFS and MCP3 test cases will be provided during hand-off to OHD. Software to be modified and tested includes FCINIT, FCST, MCP3, OPT3, ESP, and IFP. Development will utilize the lx8 NHDR machine using OB8.1 code and the OB8.1 development environment. The NWSRFS documentation will be updated to reflect changes in functionality and this documentation can be utilized by the NWS in updating training materials. The MBRFC will be the primary field tester and RTi will coordinate directly with the MBRFC to verify functionality. Testing at the MBRFC will occur using the standard OFS and MCP3 test frameworks, utilizing previously defined test cases and new test cases implemented during this project. These automated tests can help streamline verification. RTi will provide executables and test data to the MBRFC for use on a test copy of the calibration and forecast system, which will be isolated from operations. New test cases will be added by RTi if the MBRFC identifies operational conditions that are not represented in the test cases. Ideally, OB8.1 executables can be provided; however, environment details will be fully evaluated early in Stage 4. All software and tests provided to the MBRFC will also be provided to OHD. Two periods of testing at the MBRFC are proposed, followed by final acceptance testing by OHD.

## 2.2 Schedules and Milestones

<b>Stage 2 - Validation</b>	<b>Dates</b>
Complete CONOPS	01/10/2007
Complete Project Plan	01/10/2007
HOSIP Gate 2	02/07/2007
<b>Stage 3 - Research &amp; Analysis</b>	<b>Dates</b>
Complete CONOPS	02/21/2007
Complete Project Plan	02/21/2007
Research Results – Evaluation of Solution	02/21/2007
HOSIP Gate 3	04/18/2007
<b>Stage 4 - Design &amp; Development</b>	<b>Dates</b>
Draft Design Document	05/09/2007
Draft Test Plan and Procedures Document	05/09/2007
Final Design Document	05/23/2007
Final Test Plan and Procedures Document	06/20/2007

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NWSRFS Reservoir Tools Enhancement – Project Plan

Updated Software Documentation	06/20/2007
1 <sup>st</sup> Software and Testing at MBRFC (RTi will work with the MBRFC before this date to ensure that the testing framework is in place)	06/20/2007 – 07/11/2007
Revisions to Software, Documentation, Test Plan and Results at RTi	07/11/2007 – 07/25/2007
Final Software and Testing at MBRFC (if necessary)	07/25/2007 – 08/15/2007
Final Software, Test, and Test Results Delivery to OHD	08/22/2007
Integration Testing Support for OHD	08/22/2007 – 09/05/2007
HOSIP Gate 4 Meeting	10/10/2007

## 2.3 Roles, Responsibilities & Estimated Resource Requirements

### 2.3.1 RTi

Role/Name	Responsibility	Hours	Dollars (\$ (1)
<b>Stage 2 - Validation</b>			
RTi Principal in Charge , Jay Day	Monitor project delivery, and also provide insight on technical work.	8	680
RTi Task Manager and System Architect, Steve Malers	Coordinate the task’s completion and as System Architect will coordinate software evaluation and prepare HOSIP documents.	16	1615
RTi Project Engineers and scientists: Mark Woodbury, Shaun Carney	Provide insight into the current NWSRFS software design during the evaluation, and participate in the HOSIP Gate 2 meeting, as needed.	8 8	1730
	<b>Total</b>	RTi: 40	\$4025
<b>Stage 3 - Research &amp; Analysis</b>			
RTi Principal in Charge, Jay Day	Monitor project delivery, and also provide insight on technical work.	28	2390
RTi Program Manager, Saud Amer	Coordinate, monitor and report within the terms of the AHPS contract.	1	115
RTi Task Manager and System Architect, Steve Malers	Coordinate the task’s completion and as System Architect will coordinate software evaluation and prepare HOSIP documents.	40	4326
RTi Project Engineers and scientists: Mark Woodbury, James VanShaar Shaun Carney	Provide insight into the current NWSRFS software design during the evaluation, provide recommendations for the new design, and participate in the HOSIP Gate 3 meeting, as needed.	30 26 16	7270
Administrative Support, Laura Baker	Help prepare HOSIP documents and provide administrative support.	8	680
	<b>Total</b>	RTi: 149	\$14,781
<b>Stage 4 - Design &amp; Development</b>			
RTi Principal in Charge, Jay Day	Monitor project delivery, and also provide insight on technical work.	8	680
RTi Program Manager, Saud Amer	Coordinate, monitor and report within the terms of the AHPS contract.	6	690
RTi Task Manager and System Architect, Steve Malers	Coordinate the task’s completion and as System Architect will coordinate software enhancement and testing, prepare HOSIP documents, and coordinate software documentation updates. Utilize NWSRFS experience to complete technical tasks.	176	19,000
RTi Software Engineer, Darrin Sharp	Implement software changes necessary to meet the requirements (using the		

	NWSRFS development environment), implement tests in the OFS and MCP3 test frameworks, and contribute to HOSIP Stage 4 documents (Design, Test Plan and Results, and software documentation).	148	14,940
RTi Project Engineers and scientists: Mark Woodbury, James VanShaar Shaun Carney	Provide insight into the current NWSRFS software and proposed changes, help prepare, execute, and document OFS and MCP3 test cases, and participate in the HOSIP Gate 4 meeting, as needed.	8 40 96	14,540
Administrative Support, Laura Baker	Help prepare documents and provide administrative support.	8	680
	<b>Total</b>	490	\$50,540

(1) The project is fixed fee and the contractor is compensated by deliverable. Therefore, contractor costs shown are estimates, and actual hours are shown as the same as estimated.

### 2.3.2 Other NWS OHD Support

Role/Name	Responsibility	Hours	Dollars (\$)
<b>Stage 2 - Concept Exploration &amp; Definition</b>			
NWS OHD Project Area Lead, Joe Gofus	Provide general oversight of the project	8	923
NWS OHD Project Leader, Kuang Hsu	Review RTi deliverables and provide oversight of, and guidance to RTi	16	1616
HOSIP Admin, Jose Soler	Review and QA HOSIP documents and facilitate the HOSIP process	4	340
HSEB Chief, Jon Roe	Gate 2 Keeper	2	230
	<b>Total</b>	30	\$3109

<b>Stage 3 - Research &amp; Analysis</b>			
NWS OHD Project Area Lead, Joe Gofus	Provide general oversight of the project	8	923
NWS OHD Project Leader, Kuang Hsu	Review RTi deliverables and provide oversight of, and guidance to RTi	16	1616
HOSIP Admin, Jose Soler	Review and QA HOSIP documents and facilitate the HOSIP process	12	1024
Senior Scientist Pedro Restrepo,,	Gate 3 keeper	2	230
HSEB Chief, Jon Roe	Reviews HOSIP Documentation	2	230
	<b>Total</b>	40	\$4023

<b>Stage 4 – Operational Development</b>			
NWS OHD Project Area Lead, Joe Gofus	Provide general oversight of the project	30	3461
NWS OHD Project Leader,	Review RTi deliverables and provide	160	16,160



Kuang Hsu	oversight of, and guidance to RTi		
NWS OHD DSA, Gautam Sood, Hank Herr	System related software support	20	2020
MBRFC, Tom Gurss	Review and test RTi deliverables and provide guidance to OHD and RTi	72	7786
NWS OHD, Mike Smith	Provide scientific assistance and guidance on the SAC-SMA Model	16	1730
HOSIP Admin, Jose Soler	Review and QA HOSIP documents and facilitate the HOSIP process	4	340
<b>Total</b>		302	\$31,497

## 2.4 Critical Success Factors

No.	Stages:	2	3	4	All
1	Clearly identifying requirements based on user feedback.	x			
2	Acquiring access to current software that reflects previous regulation software changes.		x	x	
3	Fully identifying code components and technical issues relevant to the enhancements.		x	x	
4	Clearly documenting the approach in HOSIP Stage 3 and 4 documents.		x	x	
5	Determining a design and implementing specific code changes to meet the requirements.			x	
6	Implementing appropriate tests utilizing the NWSRFS development environment.			x	
7	Providing updated documentation and examples that allow users to take advantage of new features, and training materials to be updated.			x	
8	Providing tests and assisting in code delivery to minimize the effort spent by OHD staff in integrating the new features.			x	
9	Providing tests and software to MBRFC resulting in successful field-testing, prior to AWIPS integration.			x	

## 2.6 Risk Assessment and Mitigation

No.	Risk	Mitigation Plan
1	Project schedule overruns.	Timely reviews of all HOSIP-related documentation, and addressing high-risk work activities first. In order to more efficiently utilize resources, RTi has added Darrin Sharp to the team to allow Darrin to focus on development environment and technical tasks while others on the team focus on HOSIP documentation and assisting with testing.
2	Incomplete or outdated code and	RTi will work with OHD project management to ensure that the development environment supports this task.

No.	Risk	Mitigation Plan
	documentation. Uncertainties of source versions.	
3	Evolving requirements leading to new technical challenges.	The enhancements that have been identified are relatively straightforward. The HOSIP process will allow for stakeholder participation and document new requirements (if any). Requirements different from those addressed in the fixed-price scope will be discussed with OHD project management to determine whether adjustments to the project are necessary. An additional requirement was identified in Stage 2 (need for LOOKUP3 to utilize Julian day of year). Because this is a fixed price task, this additional requirement will be evaluated during Stage 3 and Stage 4 design but will only be implemented if other scoped activities can be completed first within the original resources. OHD management will be kept abreast of the impact of the new requirement so that additional decisions can be made during development.
4	Raytheon AWIPS Configuration Management (CM) process may require more resources.	The HSEB PAL, Joe Gofus, will coordinate with contractor regarding AWIPS process and provide RTi the necessary information needed for AWIPS. RTi is also gaining experience with the CM process on the ICP replacement project.
5	Software enhancements and tests may not be compatible with OHD development environment and OHD expectations.	RTi has dedicated resources on the team (Darrin Sharp) to understand and utilize the current NWSRFS development environment. This will allow software and test delivery to be consistent with OHD expectations. It is likely that close coordination with the OHD development system administrator (Gautam Sood) will be required to verify current development environment guidelines and procedures. RTi will also coordinate with the OHD Project Leader to coordinate software development and test implementation. RTi would prefer to provide one or more interim software and test case deliverables in order to confirm that the approach is consistent with OHD expectations, before final delivery.
6	RFC software requirements are not met in delivered software enhancements.	Requirements have been documented in the CONOPS and have been reviewed by the MBRFC, which will be a key user of the enhanced software. RTi will work with the MBRFC to confirm that the software meets the requirements in the CONOPS through testing at the RFC.
7	Software developed in the OHD development environment for OB8.1 is not compatible with the system installed at the MBRFC, resulting in technical issues in testing at the MBRFC.	RTi will work with the MBRFC to perform field testing prior to final delivery to OHD. The MBRFC is at OB7.2 whereas development is occurring at OB8.1. Ideally the OB8.1 executables can be run on an OB7.2 test system at the MBRFC (because changes between 7.2 and 8.1 were minor). This will also allow the previous Phase I SRA enhancements related to this task (now included in OB8.1) to be considered during testing. The final details of testing will be determined early in Stage 4 to identify risks and resolve testing issues. The MBRFC will be provided with executables, OFS, and MCP3 test cases and will be able to

No.	Risk	Mitigation Plan
		perform additional testing using the provided executables. The MBRFC will need to provide support to configure a test area separate from the operational system, which can utilize the new executables and OFS/MCP3 test frameworks.

## 2.7 Completion Estimates

Resources	Operations and maintenance support for this enhancement will be provided by the Application Support and Maintenance (ASM) organization of the AWIPS contractor. Maintenance for this enhancement is estimated to require about 4 staff-hours per year.
Estimated Funding Requirement	\$600
Completion Date	06/06/2007

## 2.8 HOSIP Stage Status

	Stage 1	Stage 2	Stage 3
<i>Planned Completion Date</i>	<i>11/02/2005</i>	<i>12/13/2006</i>	<i>03/28/2007</i>
<i>Actual Completion Date</i>	<i>11/02/2005</i>	<i>03/02/2007</i>	
<i>Comments</i>	<i>Approved</i>	<i>Approved</i>	

## 3. Appendices

### Appendix A – Table of Acronyms

AHPS	Advanced Hydrologic Prediction Service
ASM	Application Support and Maintenance
AWIPS	Advanced Weather Interactive Processing System
ESP	Ensemble Streamflow Prediction
FCEXEC	Forecast Execute
FCINIT	Forecast Component Initialization Program
FCST	Forecast Program
IFP	Interactive Forecast Program
MBRFC	Missouri Basin River Forecast Center
MCP3	Manual Calibration Program
NWS	National Weather Service
NWSRFS	National Weather Service River Forecast System
OHD	Office of Hydrologic Development
OPT3	Automated Optimization Program
RES-J	Joint Reservoir Regulation operation
RFCs	River Forecast Centers
RTi	Riverside Technology, inc.
SRA	Streamflow Regulation Accounting

## **Appendix B - Attachments**

NWSRFS Reservoir Tools Enhancement (LOOKUP3, RES-J MAXSTAGE) Solution Evaluation  
(see separate attachment)