Chehalis River Flood Warning System – Phase 2 Scope of Work

Background

On April 2, 2010, WEST Consultants, supported by Engineered Monitoring Solutions and HDR, submitted a report entitled *Chehalis River Basin Early Flood Warning Program: Phase 1 Conceptual Design* for the Chehalis River Basin Flood Authority. The report presented the results of a stakeholder needs assessment for flood warning improvements in the Chehalis Basins. Identified needs included

- A comprehensive basin-wide flood warning system interface to collect, manage, and display flood information that could be accessed by Flood Authority jurisdictions and the public,
- River level forecast improvements,
- Precipitation monitoring improvements,
- Snowpack monitoring improvements,
- River and stream level monitoring improvements,
- Flood warning notification improvements,
- Improved communications with reservoirs owners and Washington Department of Transportation.

Planning level cost estimates to implement the reported stakeholder needs were on the order of $500,000.

The Phase 1 report suggested that the next phase of the Flood Warning Program produce a detailed design to implement the needed improvements. In preparing the scope of work and anticipated costs for completing a detailed design for flood warning improvements, it became clear that the cost of completing a full detailed design study would nearly exhaust available funding, leaving little or no available funds to implement any improvements.

Therefore, WEST Consultants concluded that an alternative Phase 2 approach was needed. Instead of completing a costly study to provide a complete design to implement all perceived needs, WEST proposes to maximize what can be implemented and made operational within the constraints of the currently available funding. Having a baseline operational system for the Flood Authority jurisdictions and the general public to use will not only provide immediate flood warning benefits but the experience will help clarify the importance of the remaining perceived needs. The Flood Authority may determine through its own experience that some of the perceived needs are confirmed, some might be eliminated, and new needs/approaches may emerge.

Phase 2 Approach

In any set of proposed flood warning system improvements, three elements will be present:

1. A comprehensive basin-wide flood warning system interface,
2. Data monitoring improvements,
3. Flood warning signage.

The first priority should be to implement the comprehensive basin-wide flood warning system interface to consolidate currently available flood information and make the information easily available to the Flood Authority jurisdictions. The interface provides immediate benefits to all of the Flood Authority stakeholders and the general public.

The second priority is to improve the data monitoring capabilities in the watershed to help improve flood forecast accuracy by the National Weather Service and to aid interpretation of existing data.

Basin-wide Flood Warning System Interface

The Phase 1 report proposed a conceptual design for the flood warning system interface called RFLOWS (River Flood Level Observation and Warning System, See Phase 1 Report Figure 3-1). Since the submission of the Phase 1 report, WEST Consultants determined that a commercially available service is available that performs nearly all of the functionality of the proposed RFLOWS. The service can be implemented at a fraction of the RFLOWS design, development, implementation, and operational costs.

The commercial service, called Contrail Web, is operated by OneRain, Inc. Contrail has been in use for serveral years by local flood warning agencies throughout the country, the State of North Carolina, and the Bureau of Reclamation among others. The Bureau of Reclamation uses Contrail to monitor Dam Safety for its dams on tribal lands throughout the western US.

Contrail is hosted by OneRain's Contrail® Enterprise and is a high-availability information system containing live data from about 27,000 sensors across the U.S., of which more than 10,000 are rain gauges. Operated on a 24/7-supported basis, Contrail® adds about 15,000,000 new data records each month in real time. Data are integrated from local data collection systems, along with federal and state agency data collection systems such as USGS, METAR, HADS, Orbcomm, Satellite or any other platform. Users have access to their data any time, from anywhere on the Internet. Agencies often choose an architecture that combines their local software with hosted data – they can be integrated seamlessly to create very high reliability.

For the past six weeks, a demonstration Contrail website has been operating for the Chehalis Basin collecting data from more than 30 USGS stage gages and four weather stations. The website is easily customizable to reflect a "look and feel" similar to the current Flood Authority website. The Contrail website can become the "portal" for flood information for the Flood Authority and the public. Precipitation, weather, stream level, and other data types can be displayed on maps, charts, and tables. Simple and complex alarm conditions can be set to send out alerts and warnings when monitoring conditions reach critical levels. The Flood Authority can provide the latest news and other flood information to users through Contrail. Links to other agencies such as the NWS, USGS, USACE,

Washington DOT, for example, can be provided to make the site a “one stop shop” for flood information in the Chehalis watershed. Information from Contrail can even be displayed on PDAs and smart phones with Internet access.

Contrail can be made operational for the Flood Authority immediately upon notice to proceed. The following screen captures, provide a small sample of the displays currently running on the Chehalis Contrail demonstration site.

Guest [login]

Demonstration Site

WEST CONSULTANTS, INC.

Menu

- Home
- Maps
- Sites
- Graphs
- News
- Help

Links

- Washington DOT
- USGS Washington
- NWS Precip Forecast
- NWS Chehalis Forecast
- NWS Weather

Contrail Enterprise 24/7

Rainfall Visualization & Decision Support

Welcome to OneRain's 24/7 portal for real-time visualization of rainfall events. This interface allows authorized users to set sensor alarms and notifications to alert you when threatening conditions are observed.Historical data is available from the OneRain Harbor, OneRain's national sensor database and information service, for export into your favorite analysis program.Use the GIS features of available maps to drill down to detailed sensor data.

This demonstration site has been configured for the **Chehalis Basin**.

Rainfall Map	1 hr	3 hr	6 hr	12 hr	24 hr	48 hr	Water Map	Current Levels

Contrail Web links DIADvisor and other real-time data feeds providing anytime, anywhere access to decision support information.Contrail Web delivers gage data, radar rainfall and third party data (USGS, RAWS, etc) to you in real time through high quality maps with many GIS features, including user-elected layers such as roads, water ways and political boundaries.

One Stop. One Solution. OneRain

OneRain The Rainfall Company

Contrail Web Interface System Features:

- High quality maps
- Geo-referenced map locations
- Drill down to sensor data
- View last 24 hours of historical data
- All historical data in user-defined time frames
- Export to Excel or other applications
- Display sensor state: Active, Normal, Valid, and Alarm.
- User definable alarms notification via pager, cell phone, and e-mail
- Seamless integration of data from multiple sources (DIADvisor, ALERT-SDX, USGS, RAWS)
- Radar rainfall data displays

For support please contact: contrail.support@onerain.com (303) 774-2033
Times are displayed in US/Pacific

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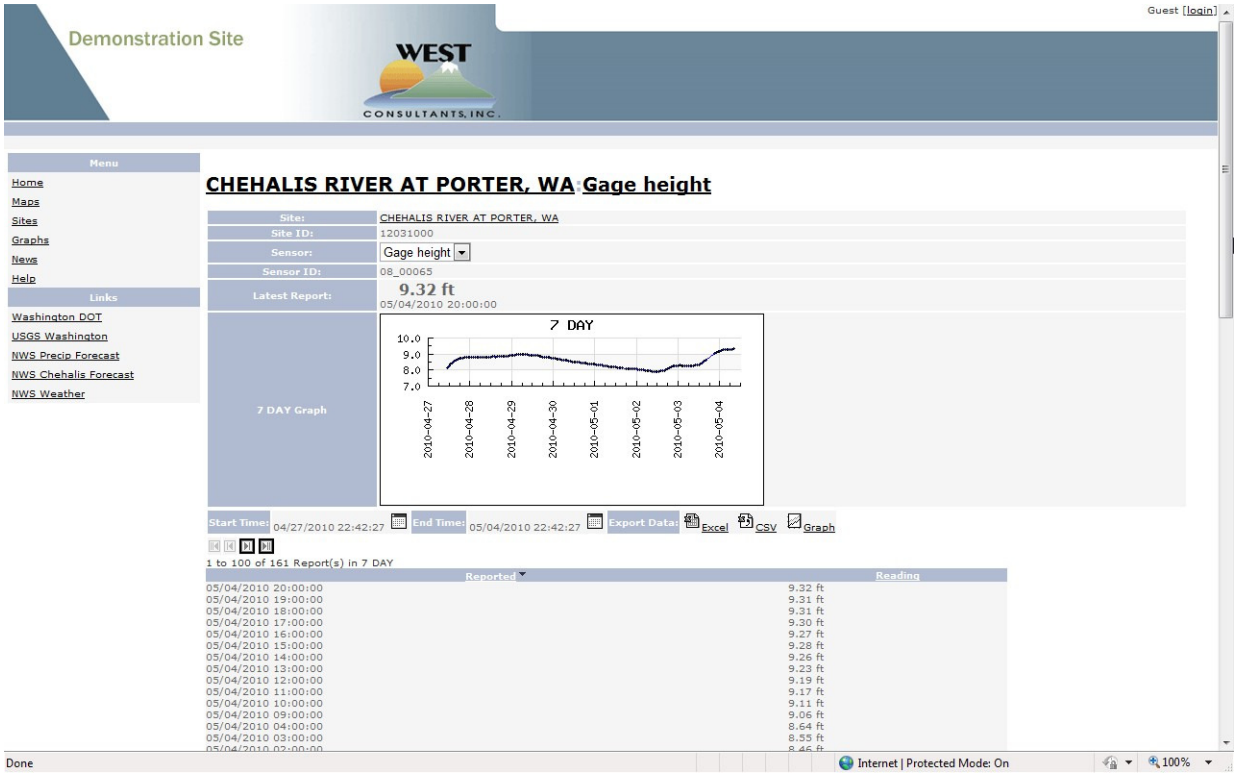
Internet | Protected Mode: On 100%


Demonstration Site
WEST CONSULTANTS, INC.
Guest [login]
Menu
Home
Maps
Sites
Graphs
News
Help
Links
Washington DOT
USGS Washington
NWS Precip Forecast
NWS Chehalis Forecast
NWS Weather
CHEHALIS RIVER AT PORTER, WA Gage height
Site: CHEHALIS RIVER AT PORTER, WA
Site ID: 12031000
Sensor: Gage height
Sensor ID: 08_00065
Latest Report: 9.32 ft
05/04/2010 20:00:00
7 DAY Graph
7 DAY
10.0
9.0
8.0
7.0
2010-04-27
2010-04-28
2010-04-29
2010-04-30
2010-05-01
2010-05-02
2010-05-03
2010-05-04
Start Time: 04/27/2010 22:42:27
End Time: 05/04/2010 22:42:27
Export Data: Excel CSV Graph
1 to 100 of 161 Report(s) in 7 DAY
Reported
Reading
05/04/2010 20:00:00 9.32 ft
05/04/2010 19:00:00 9.31 ft
05/04/2010 18:00:00 9.31 ft
05/04/2010 17:00:00 9.30 ft
05/04/2010 16:00:00 9.27 ft
05/04/2010 15:00:00 9.28 ft
05/04/2010 14:00:00 9.26 ft
05/04/2010 13:00:00 9.23 ft
05/04/2010 12:00:00 9.19 ft
05/04/2010 11:00:00 9.17 ft
05/04/2010 10:00:00 9.11 ft
05/04/2010 09:00:00 9.06 ft
05/04/2010 04:00:00 8.64 ft
05/04/2010 03:00:00 8.55 ft
Done
Internet | Protected Mode: On
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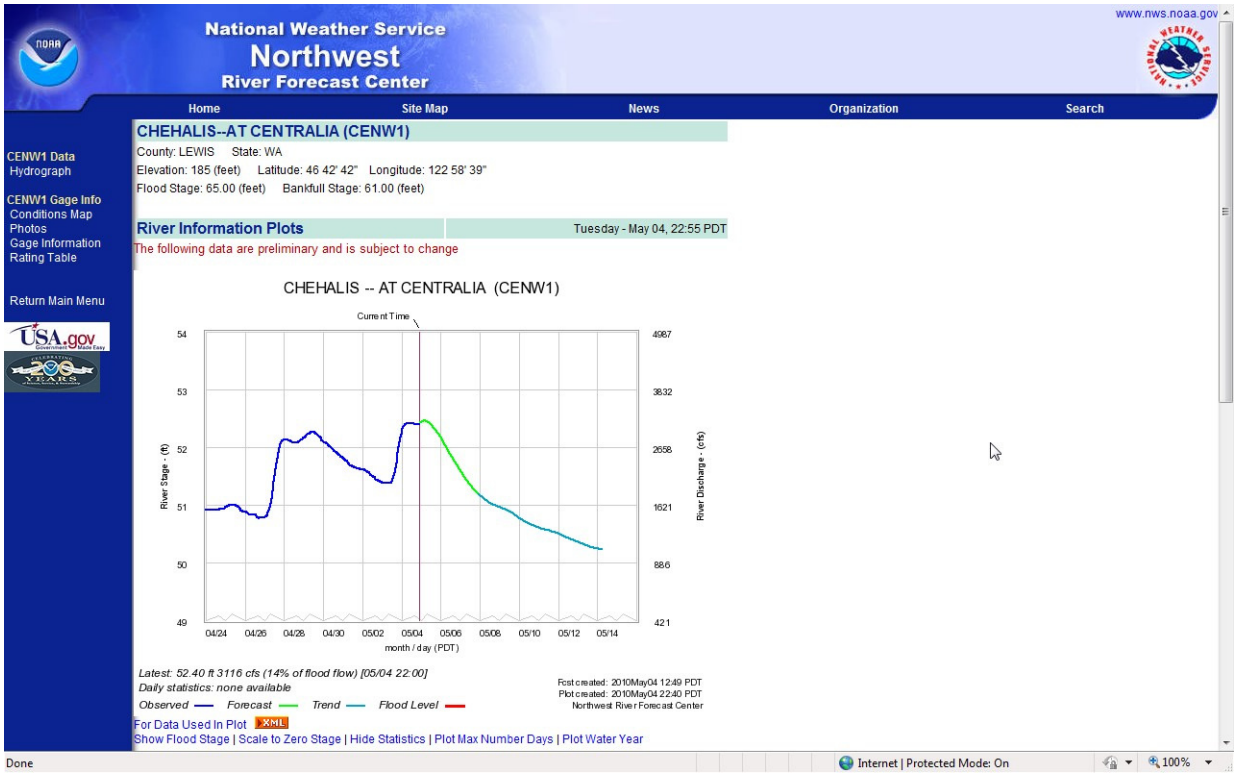
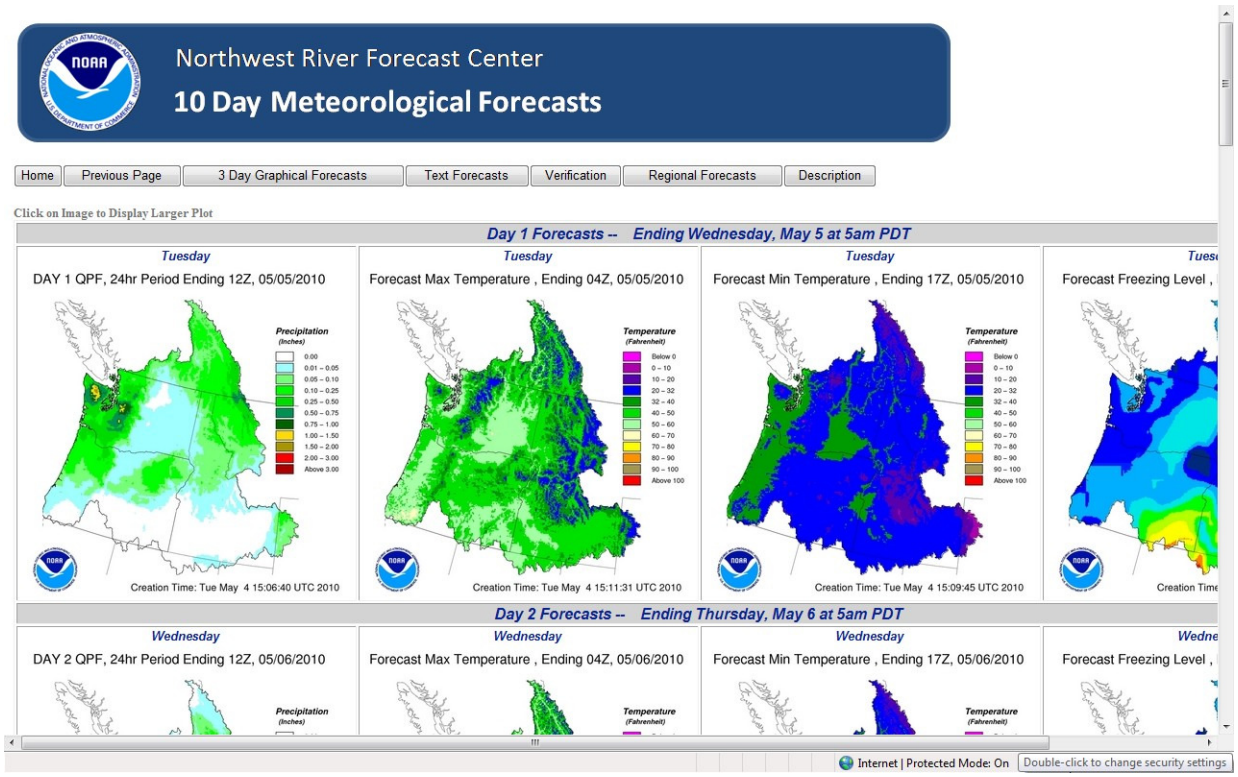
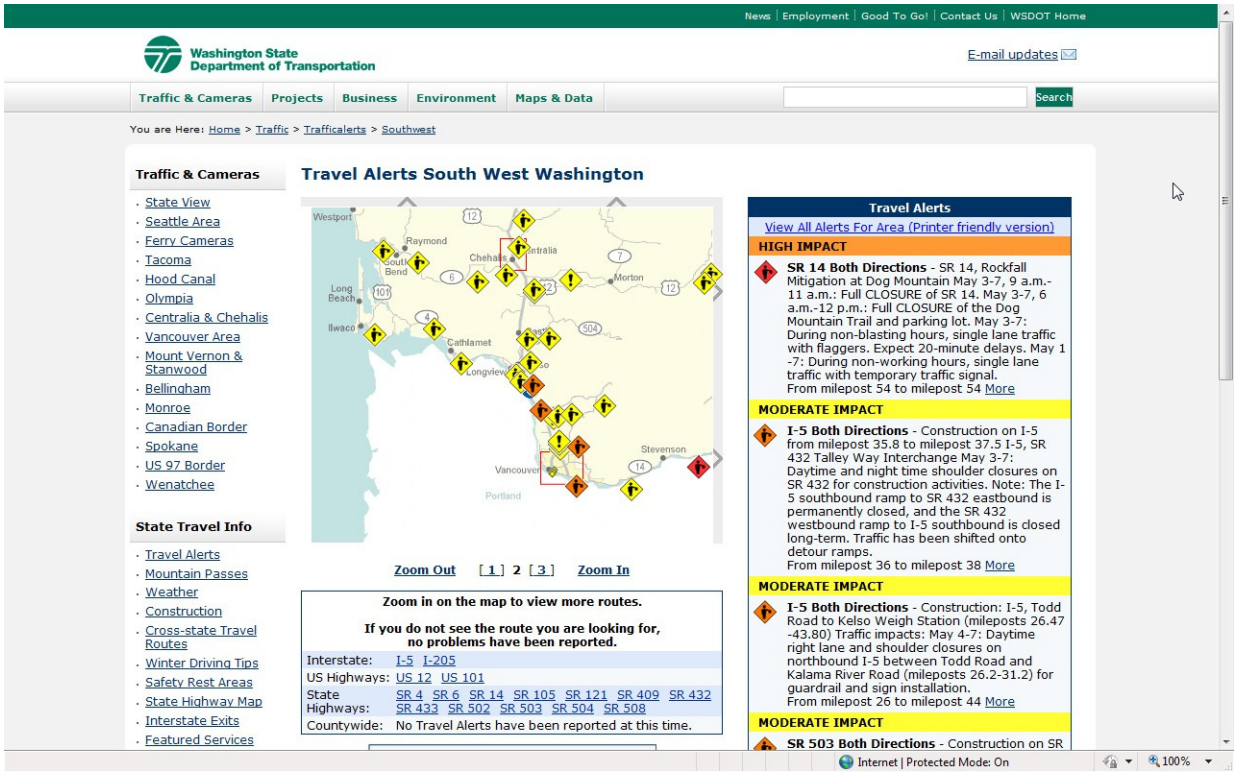

National Weather Service
Northwest
River Forecast Center
www.nws.noaa.gov
Home
Site Map
News
Organization
Search
CENW1 Data
Hydrograph
CENW1 Gage Info
Conditions Map
Photos
Gage Information
Rating Table
Return Main Menu
CHEHALIS--AT CENTRALIA (CENW1)
County: LEWIS State: WA
Elevation: 185 (feet) Latitude: 46 42' 42" Longitude: 122 58' 39"
Flood Stage: 65.00 (feet) Bankfull Stage: 61.00 (feet)
River Information Plots
Tuesday - May 04, 22:55 PDT
The following data are preliminary and is subject to change
CHEHALIS -- AT CENTRALIA (CENW1)
Current Time
River Stage - (ft)
River Discharge - (cfs)
54
53
52
51
50
49
4987
3832
2658
1621
886
421
04/24
04/26
04/28
04/30
05/02
05/04
05/06
05/08
05/10
05/12
05/14
month / day (PDT)
Latest: 52.40 ft 3116 cfs (14% of flood flow) [05/04 22:00]
Daily statistics: none available
Observed Forecast Trend Flood Level
Fcst created: 2010May04 12:49 PDT
Plot created: 2010May04 22:40 PDT
Northwest River Forecast Center
For Data Used In Plot XML
Show Flood Stage | Scale to Zero Stage | Hide Statistics | Plot Max Number Days | Plot Water Year
Done
Internet | Protected Mode: On
100%


Northwest River Forecast Center
10 Day Meteorological Forecasts
Home
Previous Page
3 Day Graphical Forecasts
Text Forecasts
Verification
Regional Forecasts
Description
Click on Image to Display Larger Plot
Day 1 Forecasts -- Ending Wednesday, May 5 at 5am PDT
Tuesday
DAY 1 QPF, 24hr Period Ending 12Z, 05/05/2010
Precipitation (Inches)
Creation Time: Tue May 4 15:06:40 UTC 2010
Tuesday
Forecast Max Temperature , Ending 04Z, 05/05/2010
Temperature (Fahrenheit)
Creation Time: Tue May 4 15:11:31 UTC 2010
Tuesday
Forecast Min Temperature , Ending 17Z, 05/05/2010
Temperature (Fahrenheit)
Creation Time: Tue May 4 15:09:45 UTC 2010
Forecast Freezing Level ,
Day 2 Forecasts -- Ending Thursday, May 6 at 5am PDT
Wednesday
DAY 2 QPF, 24hr Period Ending 12Z, 05/06/2010
Wednesday
Forecast Max Temperature , Ending 04Z, 05/06/2010
Wednesday
Forecast Min Temperature , Ending 17Z, 05/06/2010
Forecast Freezing Level ,
Internet | Protected Mode: On
Double-click to change security settings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Traffic & Cameras
State View
Seattle Area
Ferry Cameras
Tacoma
Hood Canal
Olympia
Centralia & Chehalis
Vancouver Area
Mount Vernon & Stanwood
Bellingham
Monroe
Canadian Border
Spokane
US 97 Border
Wenatchee
State Travel Info
Travel Alerts
Mountain Passes
Weather
Construction
Cross-state Travel Routes
Winter Driving Tips
Safety Rest Areas
State Highway Map
Interstate Exits
Featured Services
Travel Alerts South West Washington
Westport
Raymond
South Bend
Chehalis
Centralia
Morton
Long Beach
Ilwaco
Cathlamet
Longview
Stevenson
Vancouver
Portland
Zoom Out [1] 2 [3] Zoom In
Zoom in on the map to view more routes.
If you do not see the route you are looking for, no problems have been reported.
Interstate: I-5 I-205
US Highways: US 12 US 101
State Highways: SR 4 SR 6 SR 14 SR 105 SR 121 SR 409 SR 432 SR 433 SR 502 SR 503 SR 504 SR 508
Countywide: No Travel Alerts have been reported at this time.
Travel Alerts
View All Alerts For Area (Printer friendly version)
HIGH IMPACT
SR 14 Both Directions - SR 14, Rockfall Mitigation at Dog Mountain May 3-7, 9 a.m.-11 a.m.: Full CLOSURE of SR 14. May 3-7, 6 a.m.-12 p.m.: Full CLOSURE of the Dog Mountain Trail and parking lot. May 3-7: During non-blasting hours, single lane traffic with flaggers. Expect 20-minute delays. May 1-7: During non-working hours, single lane traffic with temporary traffic signal.
From milepost 54 to milepost 54 More
MODERATE IMPACT
I-5 Both Directions - Construction on I-5 from milepost 35.8 to milepost 37.5 I-5, SR 432 Talley Way Interchange May 3-7: Daytime and night time shoulder closures on SR 432 for construction activities. Note: The I-5 southbound ramp to SR 432 eastbound is permanently closed, and the SR 432 westbound ramp to I-5 southbound is closed long-term. Traffic has been shifted onto detour ramps.
From milepost 36 to milepost 38 More
MODERATE IMPACT
I-5 Both Directions - Construction: I-5, Todd Road to Kelso Weigh Station (mileposts 26.47-43.80) Traffic impacts: May 4-7: Daytime right lane and shoulder closures on northbound I-5 between Todd Road and Kalama River Road (mileposts 26.2-31.2) for guardrail and sign installation.
From milepost 26 to milepost 44 More
MODERATE IMPACT
SR 503 Both Directions - Construction on SR
Internet | Protected Mode: On
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Data Monitoring Improvements

Data monitoring improvements include improving existing gages or adding new gages to the Chehalis watershed. In addition, data monitoring value can be enhanced by improved use of existing data.

The addition of new rain gages and stream gages at key locations within the Chehalis River watershed were important needs suggested by stakeholders in the Phase 1 report. As a practical matter, the available budget constrains the number of new gages possible. As noted in the Phase 1 report, the cost to design, procure, configure and install new precipitation gages with a temperature sensor is about $15,000 per site. Similarly, stream gages costs are expected to be on the order of $20,000 per site. Additional leverage is obtained by combing sensors at monitoring sites. (i.e. adding temperature sensors to a precipitation site and adding precipitation and temperature to stream gage sites.) Our goal in Phase 2 is to add a combination of 10 new precipitation gages, 10 temperature sensors, and two stream gages.

Several stakeholders also indicated the need to have river stage and forecast information at potential damage points that are between official National Weather Service river forecast points. However, the National Weather Service, for several reasons as indicated from stakeholder meetings, is unlikely to add or change river forecast points on the Chehalis in the short term. The question then becomes how to leverage information from existing National Weather Forecasts to the best advantage of local stakeholders.

One method to leverage existing National Weather Service river forecasts is to provide information that links the official forecast locations to intermediate points. Flood inundation maps using hydraulic computer models could be prepared that show areas of inundation at intermediate points based on the river levels forecast for the official locations. Users can see how NWS forecasts relate to their specific location.

Details of the scope of work efforts are included below:

Task 2.1 WEB-BASED DATA PLATFORM

We will meet with the Board Advisory Committee (BAC) and present the Contrail demonstration system. We will then discuss potential changes to the "look and feel" of the website, and other information that can be added to the system. We will then implement these changes, and ask the BAC to review the modified system.

Task 2.1 Deliverables: Draft and final Contrail web-based information system.

TASK 2.2 INUNDATION MAPPING

We will obtain the latest FEMA flood insurance model of the Chehalis River, and develop inundation maps at 1-2 ft intervals references to the nearest National Weather Service forecast location. This information will be added to the Contrail information system.

Task 2.2 Deliverables: (1) inundation maps, and (2) undated Contrail information system showing these maps.

TASK 2.3 INSTALLATION OF GAGES

The WEST team will evaluate the placement of 10 precipitation gages, 10 temperature sensors and two stream gages. The proposed locations and mix of sensors will be discussed with the BAC. We will assume that the Flood Authority will seek and provide all needed permissions to access potential and proposed sites. Once the sites and equipment have been agreed to, we will install the equipment, ensure operation, and link the data feeds to the Contrail information system. Gage installation will be guided by the findings of the Phase 1 report and National Weather Service input on where new gages will be most effective in improving river forecasts at the existing ten National Weather Service forecast points in the Chehalis watershed.

Task 2.3 Deliverables: (1) memo finalizing proposed equipment configuration and location, (2) updated Contrail information system.

TASK 2.4 AGENCY COORDINATION

We will talk to appropriate State and Federal agencies to (1) discuss the placement of additional gages and their data streams, (2) potential funding sources for equipment purchases, installation, and maintenance, and (3) discussions and purchase of flood warning signage. Agencies contacted will include the National Weather Service (NWS), the Department of Ecology (Ecology), FEMA, NRCS, USGS, the Washington Military Department, and local agencies. Agency coordination will begin immediately and continue in parallel throughout the majority of the Task 2.3: Installation of Gages. Agency coordination will also include discussions regarding the purchase and deployment of mobile and/or fixed signs alerting motorists of flooded highway conditions per findings of the Phase 1 report.

Task 2.4 Deliverables: memo discussing agency contacts and findings.

TASK 2.5 REPORT AND MEETINGS

The WEST Team proposes to meet with the Flood Authority and BAC three times. The first meeting will be to discuss the information included in the Contrail system and approach to new gage installation. The second meeting will present the modified Contrail information system and finalize new gage sites and equipment. The third meeting will provide the finalized Contrail information system and discuss the status of the flood warning program. Before the final meeting, we will prepare a draft report summarizing the study and identifying additional program elements if funding becomes available. The report will be finalized after comments from the BAC and Flood Authority.

SCHEDULE

Task	Title	Completion from start
2.1	WEB-BASED DATA PLATFORM	Week 4
2.2	INUNDATION MAPPING	Week 12
2.3	INSTALLATION OF GAGES	Week14
2.4	AGENCY COORDINATION	Week 12
2.5	REPORT AND MEETINGS	Week 20

Proposed Fees

Chehalis River Basin Flood Authority - Early Flood Warning System - Phase 2 Program Design

		WEST					HDR			
	DESCRIPTION	Program Manager	Lead Hydrologist	Staff Engineer	GIS Technician	Clerical	Senior Engineer	Support staff	Total Task Hours	ITEM COSTS
	HOURLY RATE	$184.57	$123.93	$89.72	$62.40	$44.14	$160.00	$70.00		
TASK	**ITEM DESCRIPTION**									
2	**Program Upgrades**									
2.1	Web-based data platform	16							16	$2,953
2.2	Inundation mapping	16		50	400				466	$32,399
2.3	Installation of gages	8	180	180					368	$39,934
2.4	Agency coordination	24					80		104	$17,230
2.5	Report and meetings	40	8	32					80	$11,245
	Task 2 Subtotal	**104**	**188**	**262**	**400**	**0**	**80**	**0**	**184**	**$103,761**
	Direct Costs									
	mileage				1000	miles at	$0.50			$500
	Per diem days				25	days at	$135.00			$3,375
	Contrail system (OneRain)									$18,000
8	Precip/temperature stations								$ 6,000	$48,000
2	Precip/temp/stream stations								$ 17,500	$35,000
	Signage/Communications									$25,000
										$0
										$0
	Misc. Expenses									$1,000
	Subtotal									**$130,875**
	Total for all Tasks									**$234,636**

FUTURE MAINTENANCE

The new gages and the Basin-Wide Flood Warning System Interface (i.e. Contrail) will require service and maintenance. Contrail is a subscription service and the Flood Authority can expect an annual fee on the order of $5,000. Precipitation/temperature gages should cost approximately $3,000 per site annually to maintain. Precipitation/temperature/stream gages should cost approximately $9500 annually including all site visits for maintenance, discharge measurements, ratings, ongoing review of real-time data, and at the end of each water year finalizing data and providing annual data reports. Precipitation/temperature/stream gage site maintenance could drop to around $5000 per year if discharge measurements were not required.

For gage maintenance, the Authority generally has three options:

1. Flood Authority handles all maintenance internally,
2. Sign a Memorandum of Understanding with an agency partner (e.g. USGS, NWS, WA Department of Ecology) and pay them to maintain the gages, or
3. Contract with a private firm to conduct on-going maintenance.