

# Overview of MARFC Probabilistic River Forecasts

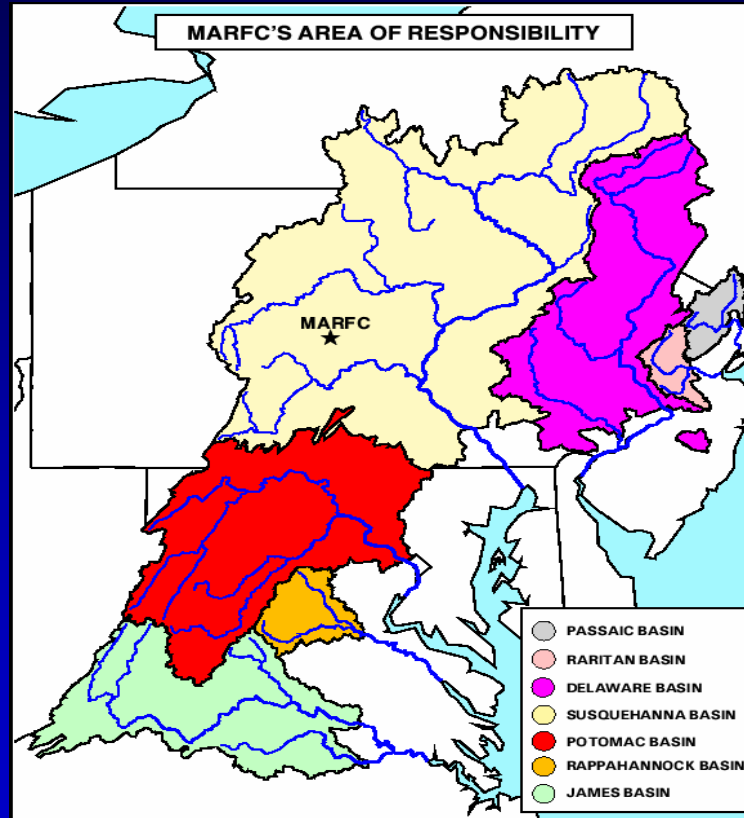
Ned Pryor

Joe Ostrowski

Middle Atlantic RFC

April 2004

# MARFC AREA



# Implementation Steps

- Calibrate basin with continuous model
- Set up Ensemble Streamflow Prediction (ESP) for each basin
- Use ESPADP software to analyze traces
- Automated mechanism to generate forecasts and graphics
- Transmit graphics to AHPS web site

# Calibration Status

- Continuous-API Model
- Snow Model
- Routings
- Clean Precip/Temp Data Sets
- Approximately 160 basins
- 1<sup>st</sup> Round of Calibrations just completed
- Operational Benefits

# Longer Term Probabilistic Forecasts

- Traditional 30-day ESP forecasts
- 100 Basins-mostly Susquehanna and Delaware (150 total)
- 14 Reservoir inflow forecasts (18 total)
- Generated weekly
- “Basic” AHPS requirement
- Spring Flood Outlooks

# Shorter Term Probabilistic Forecasts

- 7-day probabilistic river forecasts
- PQPF/PQTF
- Demonstration of short-term approach
- Juniata & Schuylkill Basins
- 18 points issued daily
- 6 additional points coming

# Implementation Schedule

- 30-day forecasts for Potomac, Shenandoah and NJ basins - Q4 FY2004
- 30-day forecasts for James and Appomattox Basins – Q1 FY2005
- 7-day PQPF forecasts for 7 additional basins – Q3 FY2004

# MARFC Home Page

National Weather Service - Middle Atlantic River Forecast Center - Microsoft Internet Explorer

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Address <http://www.erh.noaa.gov/er/marfc/> Go

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River Forecasts  
Significant Flood Outlook  
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Hydromet Discuss.  
Flash Flood Guidance

**Our Rivers**  
Current Stages  
River Basins/  
Forecast Points  
Historic Floods  
Flood Frequency  
Climatology  
What is Hydrology?

**Maps**  
Current Radar  
Departures  
Forecasted Precip.  
Observed Precip.  
Avg. Precipitation  
Snow Maps  
Water  
Temperatures  
Multisensor Maps  
Java/non-Java

**Water Supply**  
Biweekly Statement  
Drought Information

**The MARFC**  
About Us  
Vision & Mission

**Contact Us**  
marfc.webmaster@noaa.gov

**Winter is Coming!**

Learn how to protect your family, pets, and property from hazardous winter weather. Winter storms are deceptive killers, because most deaths related to the storm are caused by traffic accidents on icy roads or hypothermia from prolonged exposure to cold. Before winter sets in, take this opportunity to get ready for the upcoming winter season by preparing emergency survival kits for your home and car. Make sure your family has a disaster plan for handling severe winter weather. [Details...](#)

Information on damage caused by Hurricane Isabel can be found [here](#) and [here](#).

**Current River Conditions**  
November 07 2003 07:52 AM EST

- Major Flooding
- Moderate Flooding
- Minor Flooding
- High Flow, Below Flood Stage
- Normal Flow
- Low Flow

Click on image for more detailed information

Middle Atlantic River Forecast Center

Internet



# NWS AHPS Page

Advanced Hydrologic Prediction Service - National Weather Service - Microsoft Internet Explorer

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www.nws.noaa.gov

National Oceanic and Atmospheric Administration  
**National Weather Service**  
WORKING TOGETHER TO SAVE LIVES

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Weather Forecasts  
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Facts  
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How are we doing?  
Feedback

## AHPS Advanced Hydrologic Prediction Service

This map provides a convenient summary of river conditions. To obtain more information click on the dot. It will initially take you to a detailed map and then to the actual location.

**Advanced Hydrologic Prediction Service**  
Updated 08:10 AM CST Oct 31 2003

- 1490 Gauges Below Flood Stage
- 18 Gauges Near Flood Stage
- 5 Gauges Above Flood Stage
- Data Greater Than 12 Hours Old

AK HI PR

NATIONAL WEATHER SERVICE  
NARR  
NATIONAL OCEANOIC AND ATMOSPHERIC ADMINISTRATION  
U.S. DEPARTMENT OF COMMERCE

<http://www.crh.noaa.gov/cgi-bin/ahps.cgi?oax> Internet

# WFO BGM AHPS Page

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Address http://ahps.eh.noaa.gov/cgi-bin/ahps.cgi?bgm

www.nws.noaa.gov

National Oceanic and Atmospheric Administration  
Advanced Hydrologic Prediction Service

Search All NWS search Go

Weather Forecast Office Binghamton, NY

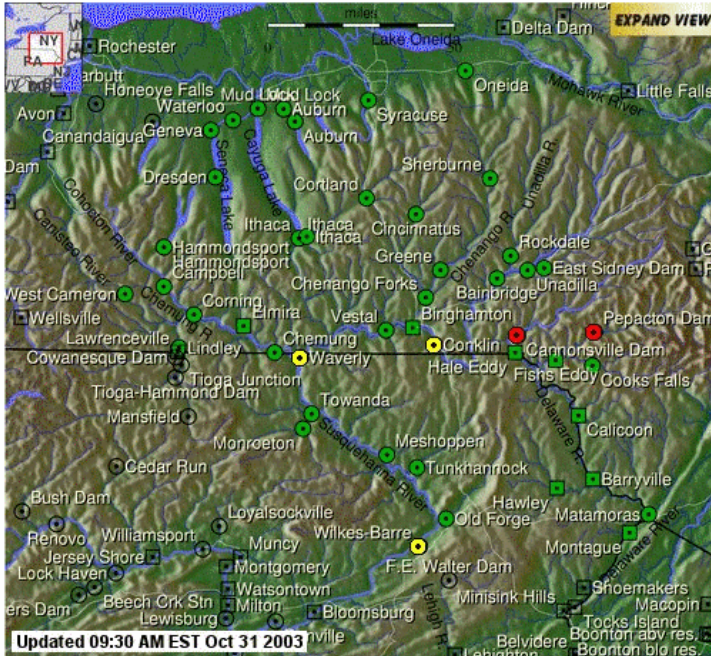
Local weather forecast by "City, ST"  
City, ST Go

National Conditions  
Rivers  
Satellite  
Climate

Local Conditions  
Warnings  
Weather Forecast  
Radar

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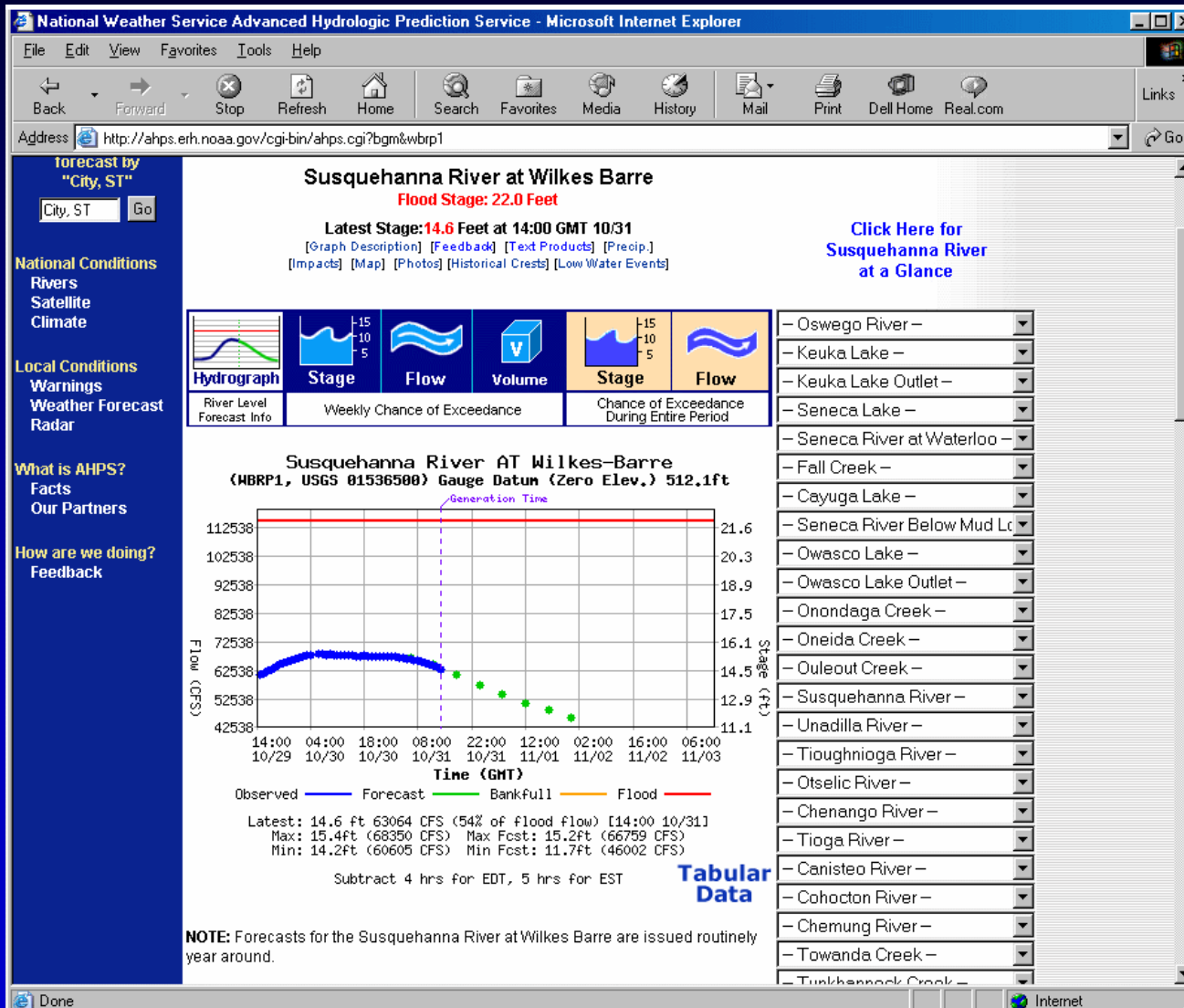
Updated 09:30 AM EST Oct 31 2003

Map Legend

Click on a point or river on the map or select from the menus below.

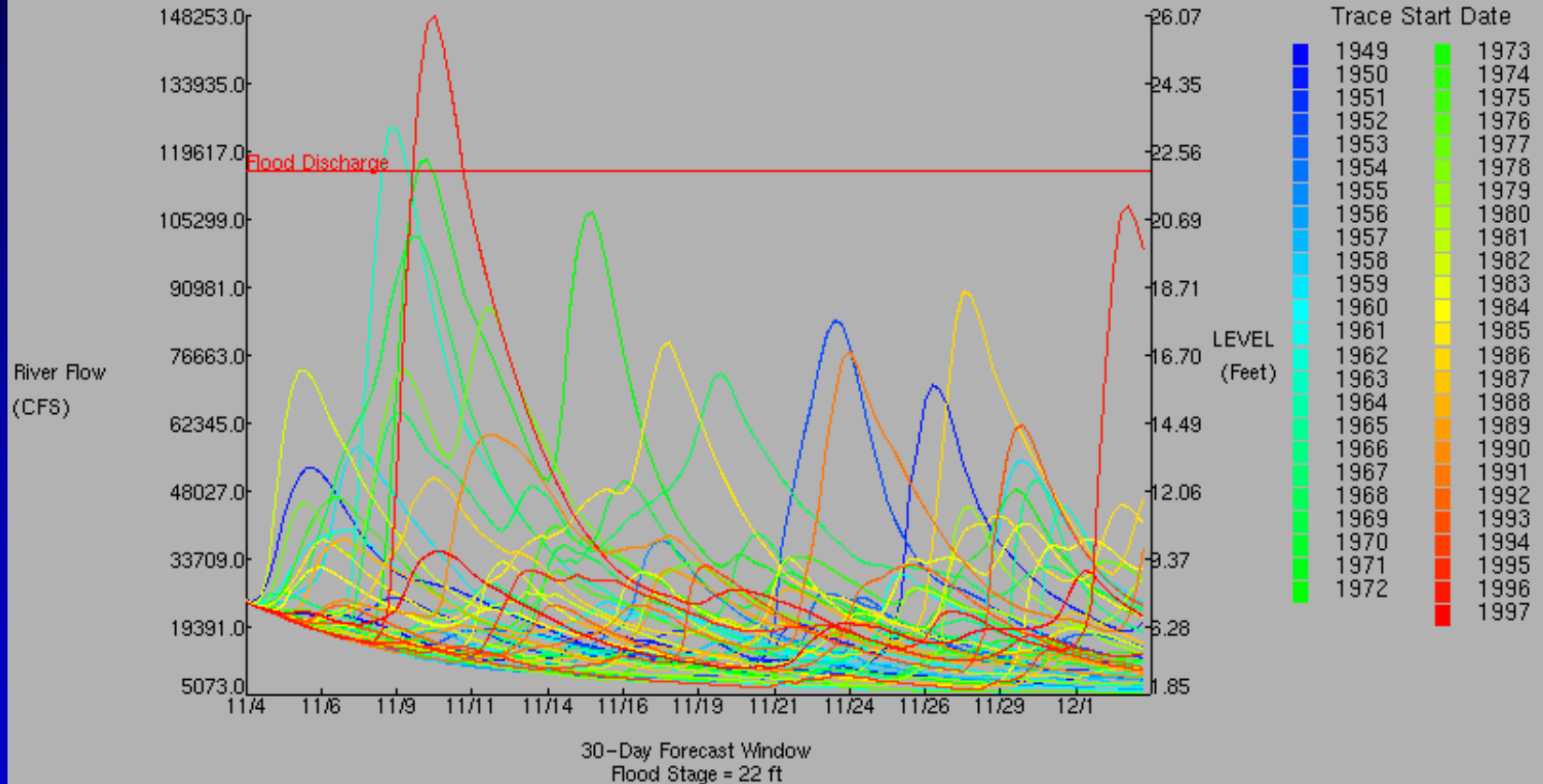
- Oswego River -
- Keuka Lake -
- Keuka Lake Outlet -
- Seneca Lake -
- Seneca River at Waterloo -
- Fall Creek -
- Cayuga Lake -
- Seneca River Below Mud Lc
- Owasco Lake -
- Owasco Lake Outlet -
- Onondaga Creek -
- Oneida Creek -
- Ouleout Creek -
- Susquehanna River -
- Unadilla River -
- Tioughnioga River -
- Otselic River -
- Chenango River -
- Tioga River -

# Wilkes-Barre, PA

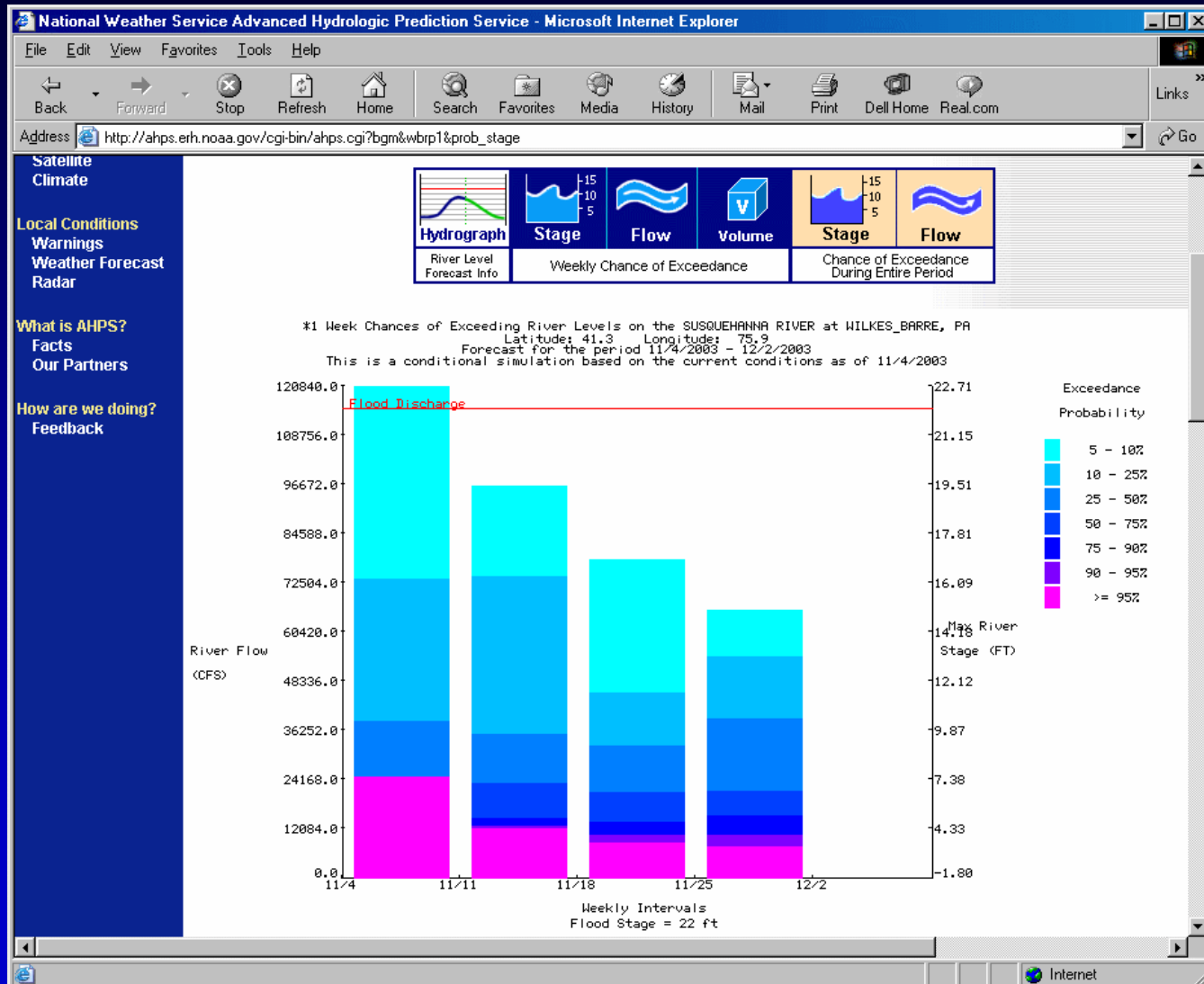


# 30-Day River Traces

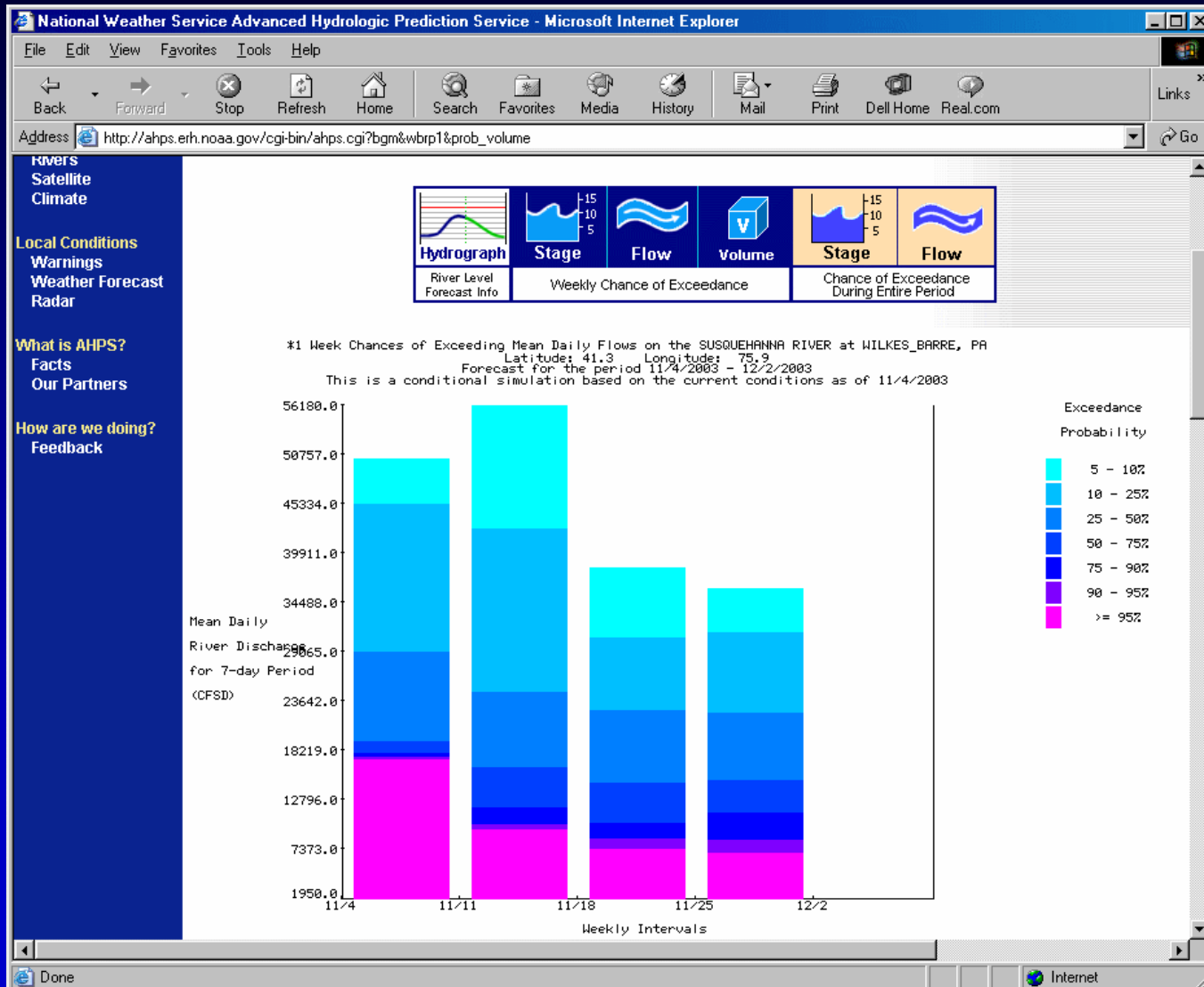
ESP Trace Ensemble of SUSQUEHANNA RIVER at WILKES-BARRE, PA  
Latitude: 41.3 Longitude: 75.9  
Forecast for the period 11/4/2003 6h - 12/3/2003 24h  
This is a conditional simulation based on the current conditions as of 11/4/2003



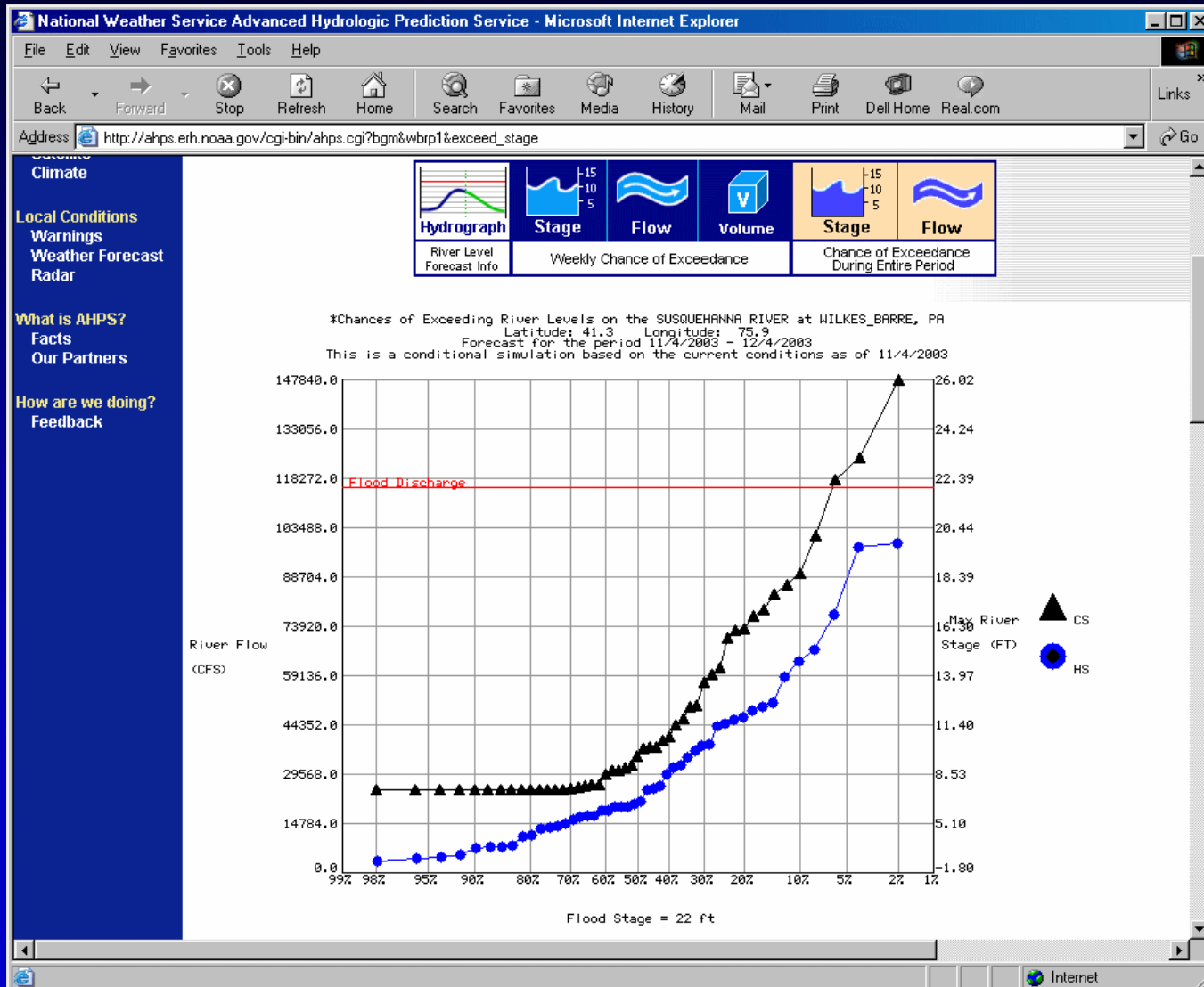
# Weekly Exceedance-Stage



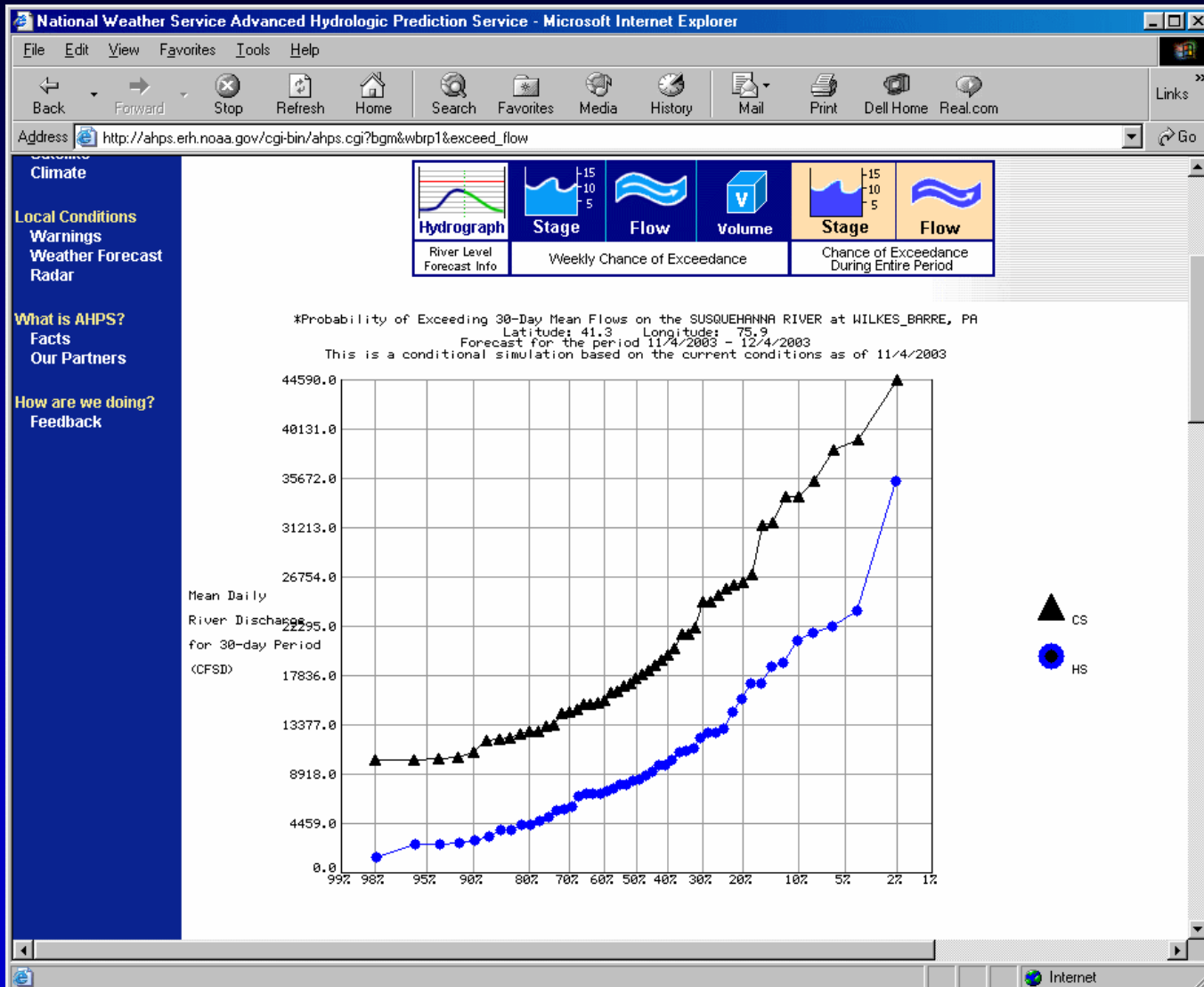
# Weekly Exceedance-Volume



# Exceedance Probability-Stage



# Exceedance Probability-Flow





# Inflows to Water Supply Reservoirs

- Most widely used product
- Inflows to 12 COE multi-purpose reservoirs
- Inflows to 2 New York City water supply reservoirs
- NYC DEP uses product operationally

# BGM AHPS Page

National Weather Service Advanced Hydrologic Prediction Service - Microsoft Internet Explorer

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Address <http://ahps.erh.noaa.gov/cgi-bin/ahps.cgi?bgm> Go

Search Enter Search Here Go

**Local weather forecast by "City, ST"**

City, ST  Go

**National Conditions**  
Rivers  
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Climate

**Local Conditions**  
Warnings  
Weather Forecast  
Radar

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**How are we doing?**  
Feedback

**Map Legend**

- or ■ at or above Flood Stage
- or ■ high water, below Flood Stage
- or ■ below Flood Stage
- A square indicates that hydrograph information is available
- A circle indicates that both probability and hydrograph information is available

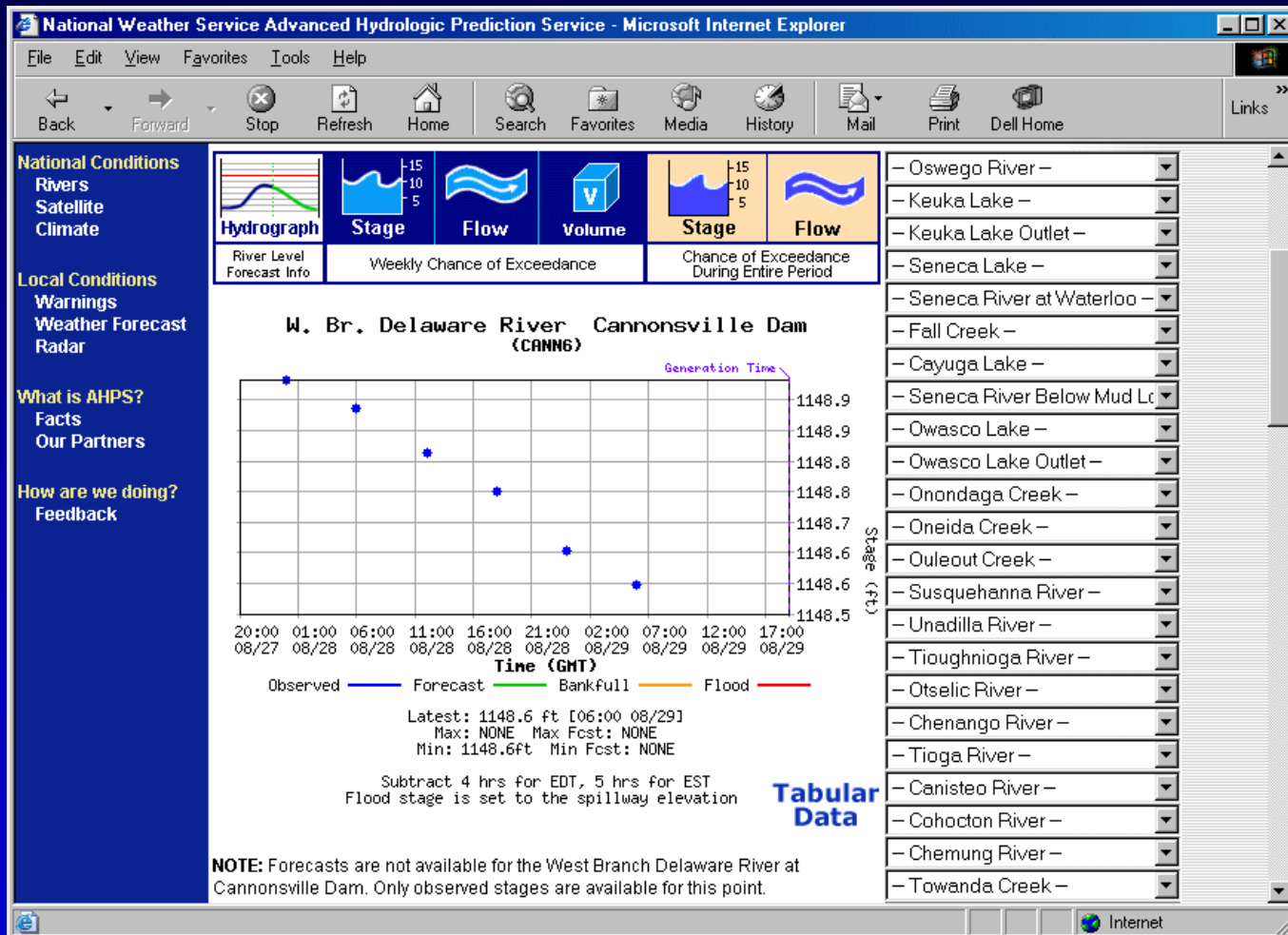
Click on a point or river on the map or select from the menus below.

- Oswego River –
- Keuka Lake –
- Keuka Lake Outlet –
- Seneca Lake –
- Seneca River at Waterloo –
- Fall Creek –
- Cayuga Lake –
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- Tioughnioga River –
- Otselic River –
- Chenango River –
- Tioga River –
- Canisteo River –
- Cohocton River –
- Chemung River –

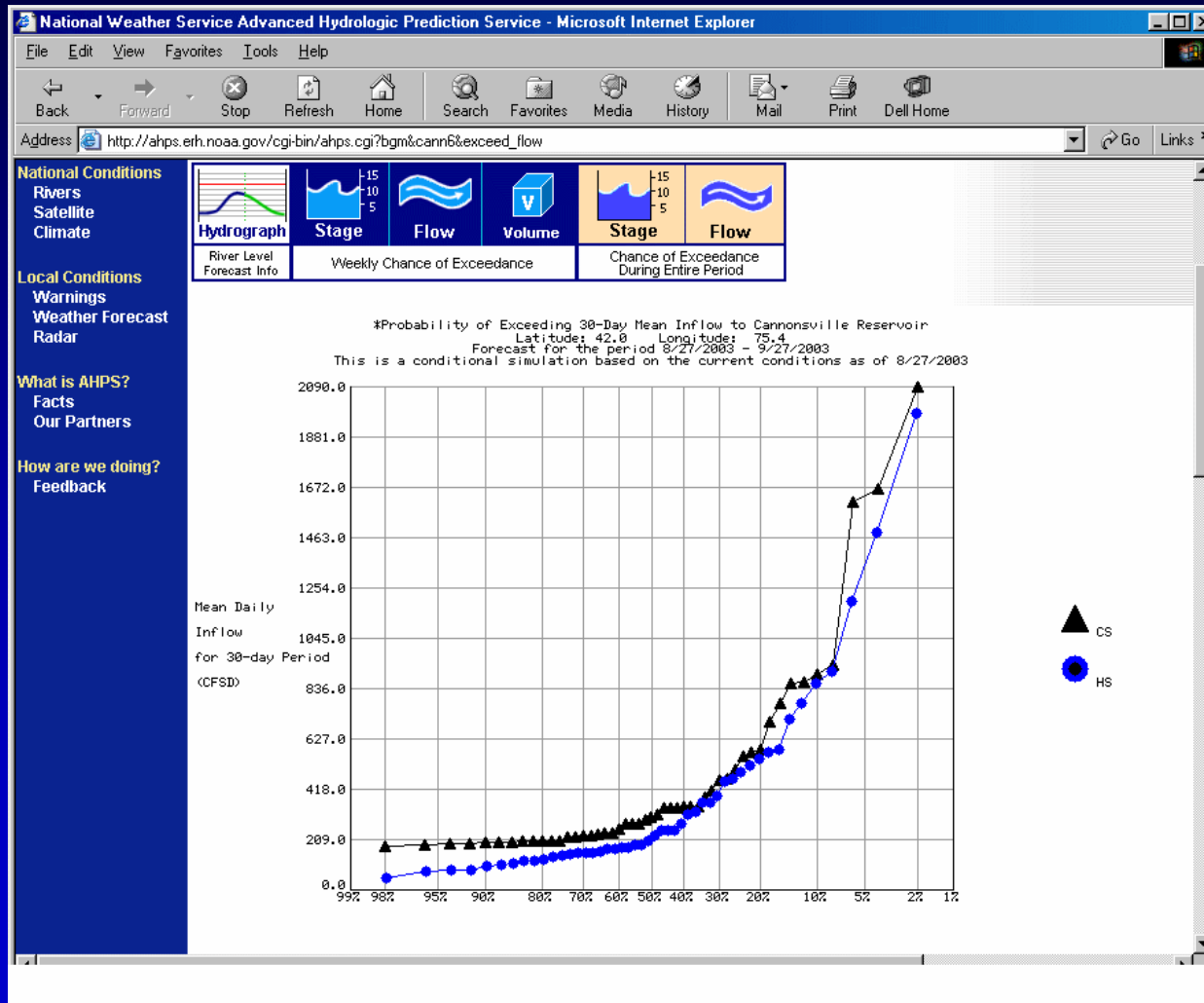
Updated 03:30 PM EDT Aug 27 2003

<http://ahps.erh.noaa.gov/cgi-bin/ahps.cgi?bgm&stowp1> Internet

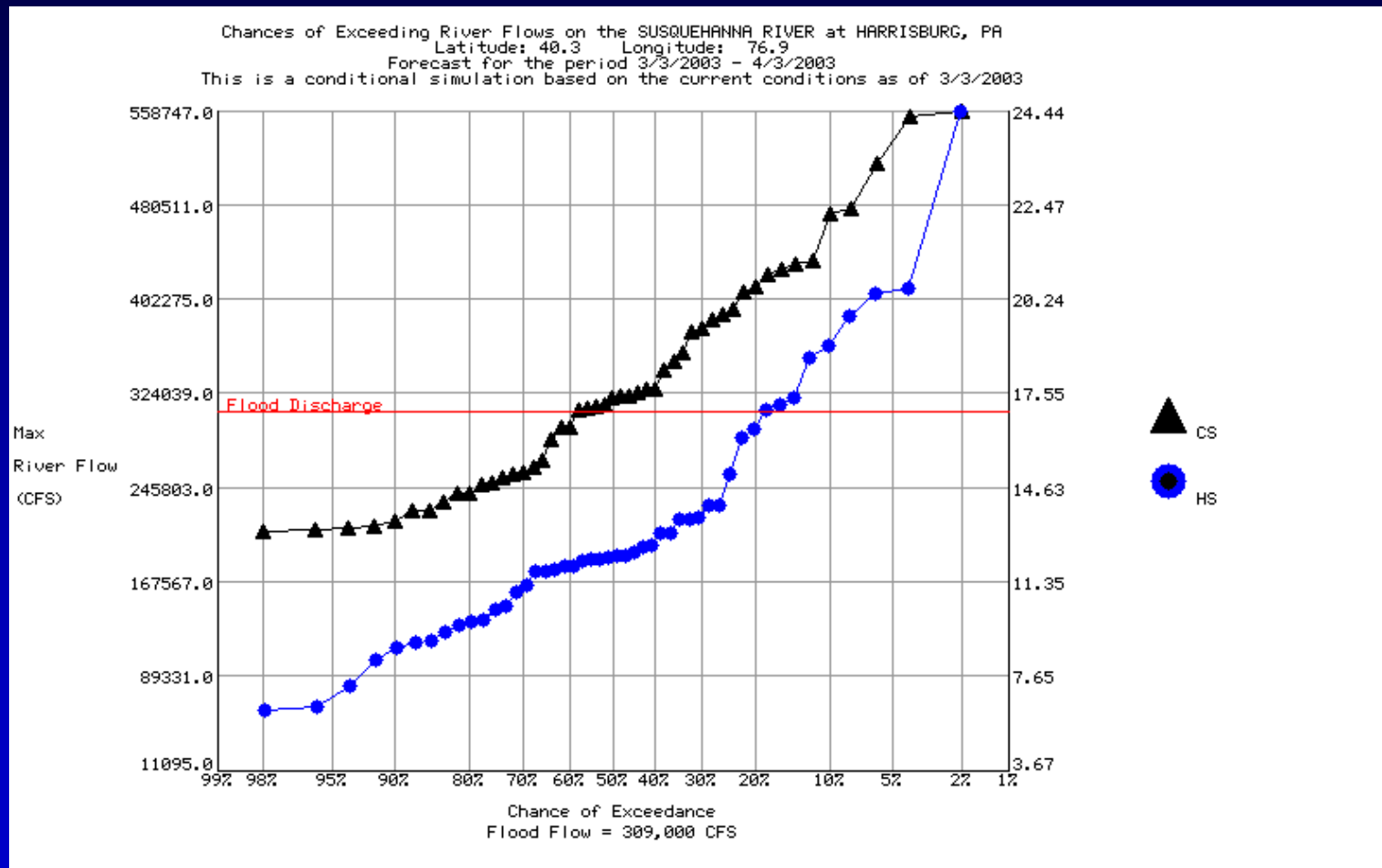
# NYC Cannonsville Reservoir



# Exceedance Probability-Flow



# Spring Flood Potential Outlook



# 7-Day Probabilistic River Forecasts

- Current Basin Conditions
- Short term probabilistic precipitation and temperatures (PQPF/PQTF)
- 24-hour PQPF merged with 6 days of climo
- QPF scenarios based on comparison of historic forecast and observed MAPs
- 3 graphics generated daily for 18 basins in PA-Juniata (CTP) and Schuylkill (PHI) Basins

# Operational Steps

- Automated process run off cron on Linux workstation
- Transfer mods from operational FGROUP to test FGROUP
- Save Carryover
- Determine and insert start/end dates in PQPF control file

# Operational Steps (cont'd)

- Run `fcst_ens_compu` script to generate PQPF/PQTF time-series
- Run FSCT/ESP for the FGROU
- Generate 3 ESPADP graphics for each segment using ESPADP in batch mode
- Transfer graphics to LDAD->ER AHPS server
- Archive



# WFO CTP AHPS Page

National Weather Service Advanced Hydrologic Prediction Service - Microsoft Internet Explorer

Address: <http://ahps.erh.noaa.gov/cgi-bin/ahps.cgi?ctp>

Search

**Local weather forecast by "City, ST"**

**National Conditions**  
 Rivers  
 Satellite  
 Climate

**Local Conditions**  
 Warnings  
 Weather Forecast  
 Radar

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 Feedback

**ALERT!!** A Urban And Small Stream Advisory is in effect for portions of the area. [View all valid statements/warnings](#) or choose a specific point or river to get the details for that location.

Updated 12:30 PM EDT Aug 27 2003

Click on a point or river on the map or select from the menus below.

- Tioga River -
- Cowanesque River -
- West Branch Susquehanna
- First Fork Sinnemahoning C
- Sinnemahoning Creek -
- Kettle Creek -
- Bald Eagle Creek -
- Pine Creek -
- Loyalsock Creek -
- Frankstown Branch Juniata f
- Little Juniata River -
- Juniata River -
- Raystown Branch Juniata Ri
- Aughwick Creek -
- Susquehanna River -
- Penns Creek -
- Sherman Creek -
- Conodoguinet Creek -
- Yellow Breeches Creek -
- Swatara Creek -
- Conestoga River -
- Conewanna Creek -

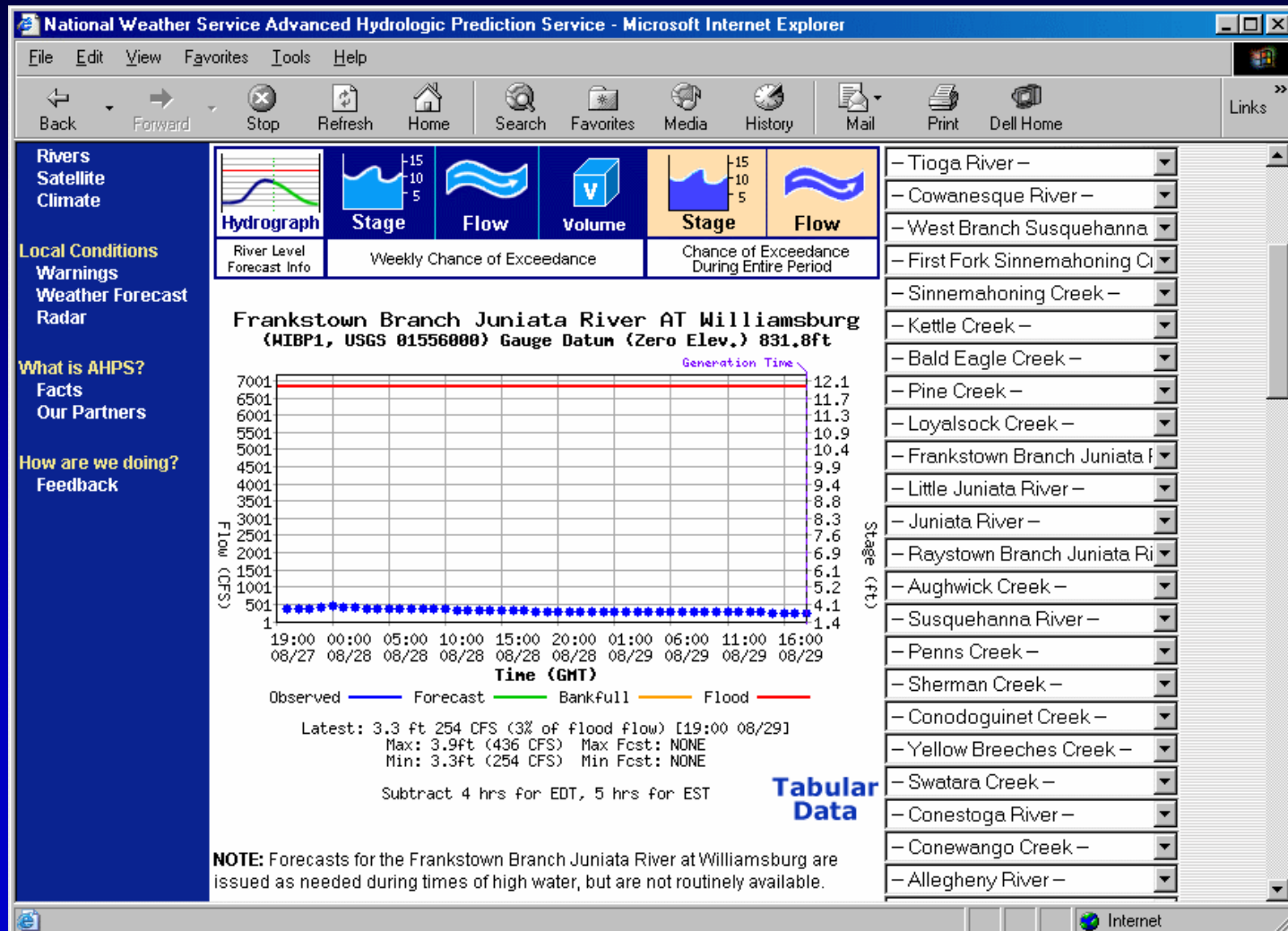
**Map Legend**

- or ■ at or above Flood Stage
- or ■ high water, below Flood Stage
- or ■ below Flood Stage
- or ■ observation more than 12 hours old
- or □ neighboring area point
- A square indicates that hydrograph information is available
- A circle indicates that both probability and hydrograph information are available

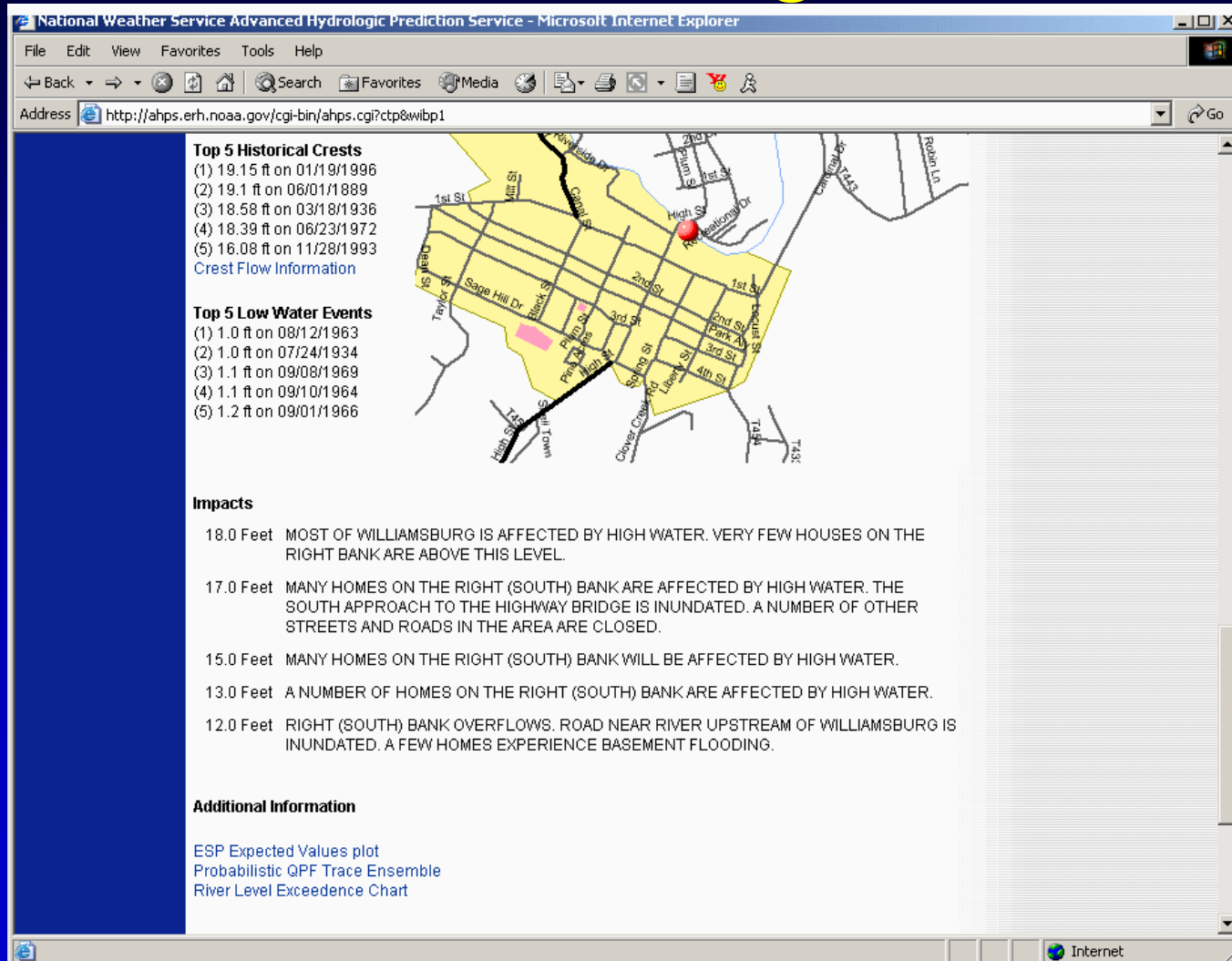
EXPAND VIEW

Internet

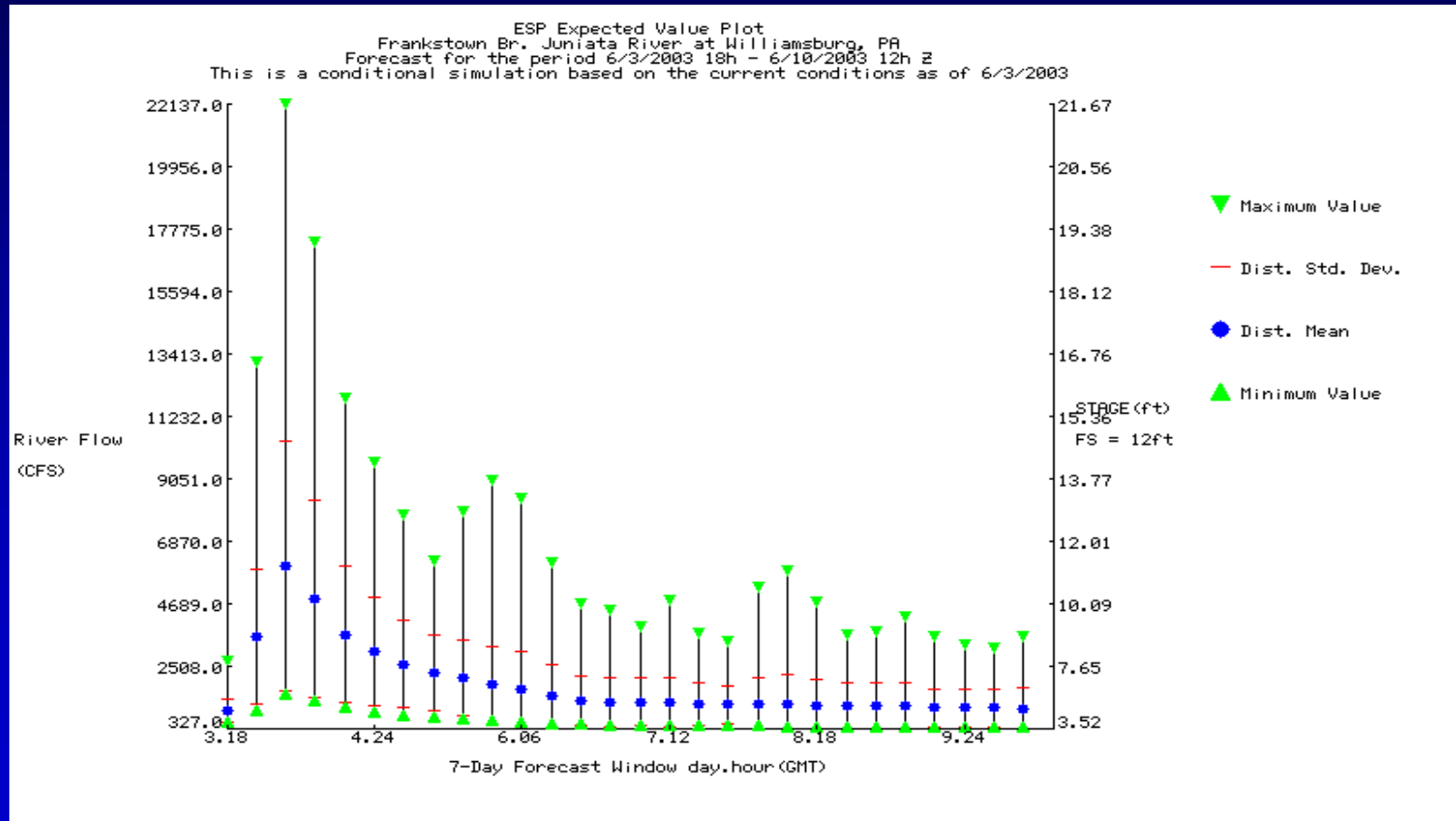
# Frankstown Br. Juniata River at Williamsburg, PA



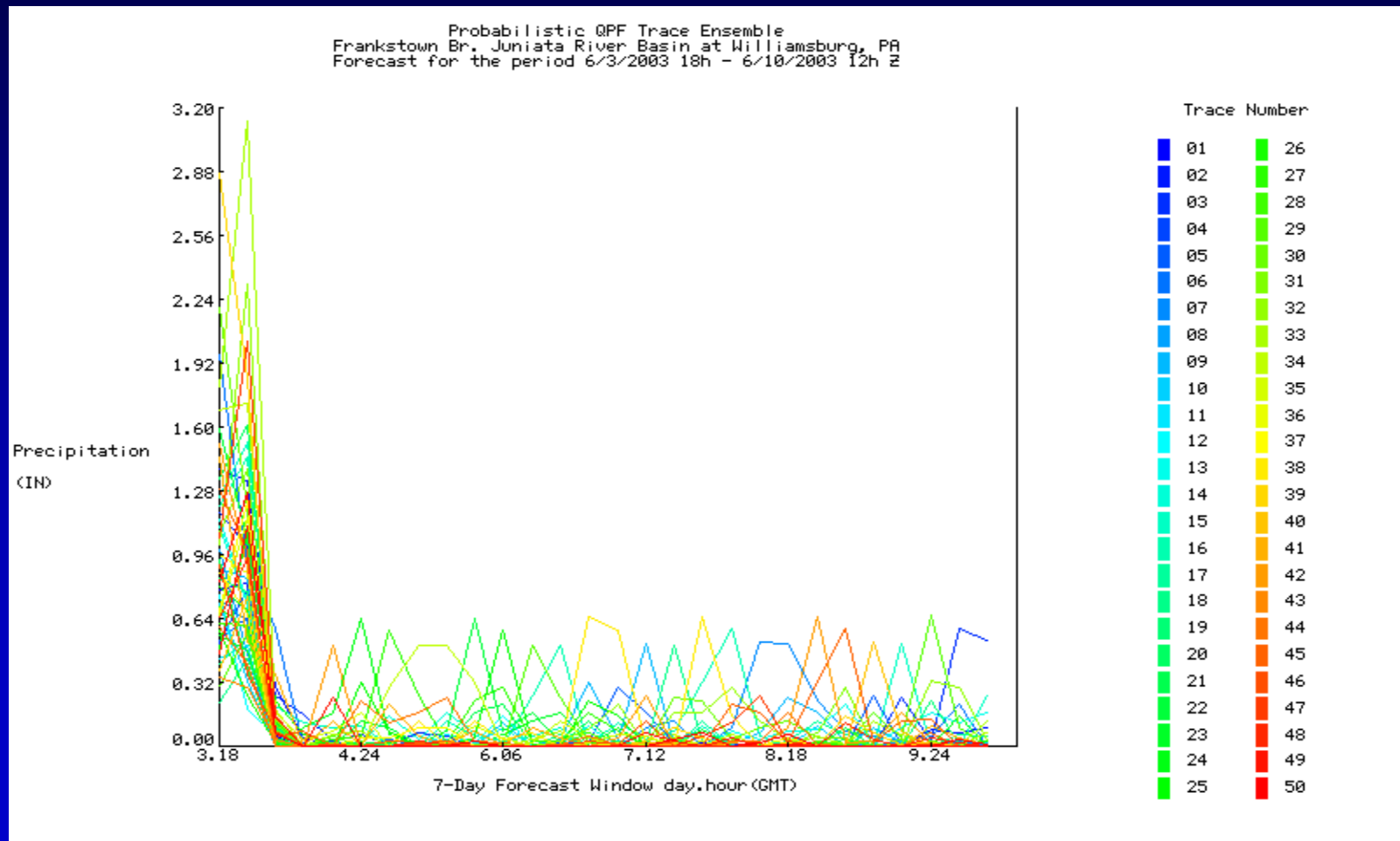
# Frankstown Br. Juniata River at Williamsburg, PA



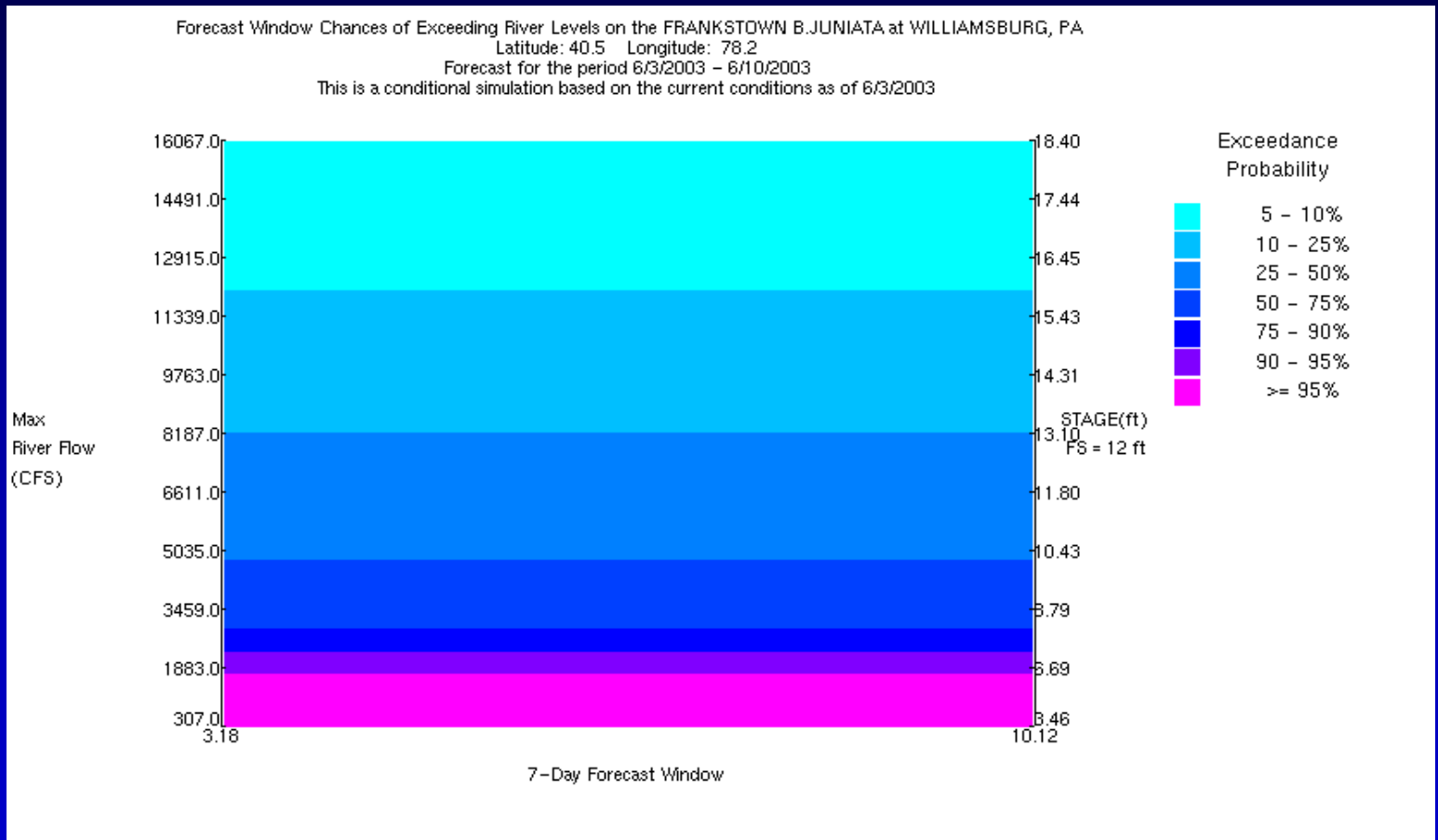
# 7-Day Expected Value Plot



# 7-Day PQPF Traces



# 7-Day Exceedance Histogram



# Additional Projects

- Complete “Basic” AHPS Q1-FY2005
- Expand PQPF program to other basins/HSAs
- Use 48-hour QPF to drive PQPF
- Plot deterministic forecast on the expected value plot for comparison

# Additional Projects (cont'd)

- Continue to solicit feedback from users
- Assist HSAs with explanation of product content and utility
- Verification
- Incorporate probability info into text products



# Lessons Learned

- User feedback-SRBC sponsored users group meetings
- 30-day reservoir inflow forecast most used probabilistic forecast
- Beneficial input to Spring Flood Potential Outlooks
- Enhanced relationships with cooperators (U.S.COE, USGS, NYC DEP)

# Lessons Learned

- 7-day PQPF forecasts are good contingency forecasts
- Describe a range of outcomes that help address HSA questions...“What if..”
- Wide range of potential river responses is not always pleasing...depicts difficulty in forecasting precipitation

# Lessons Learned

- Need capability to run in background
- Requires clean historical data and dependable software
- Weak link is transfer to AHPS web site
- Short-term products unique – hard to find in current AHPS web site

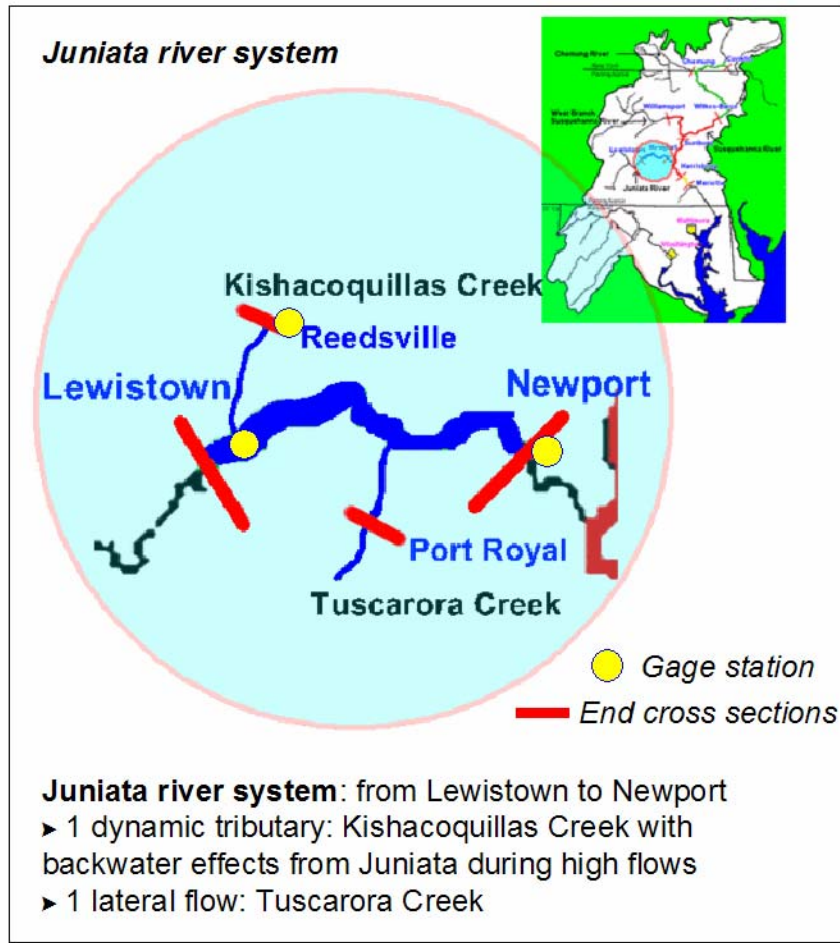
# Flood Mapping

- Provide areal extent of flooding referenced against well-understood markings (streets, structures, landmarks) for water elevation forecasts
- At multiple locations along river reach

# Flood Mapping Implementation

- SRBC funds/OHD support
- Water surface profile
  - NWS FLDWAV (SHRT?)
    - Data collection
    - Calibration
    - Verification
    - Routine generation
      - deterministic
      - probabilistic

# Test Area



# Web-based Image Generation

- Internet map service
- Peaks in forecast period
- User interaction
  - User selectable layers
  - Zoom
- Prototype site:
  - <http://nwshqfld.nws.noaa.gov>
  - Autodesk plug-in required



# FLDIMS

Today is  
April 20, 2004

Probabilistic  
Forecast Period  
Apr 20 to Apr 27

Probabilistic  
Forecast

- |      |                       |                                  |
|------|-----------------------|----------------------------------|
|      | ON                    | OFF                              |
| 02 % | <input type="radio"/> | <input checked="" type="radio"/> |
| 10 % | <input type="radio"/> | <input checked="" type="radio"/> |
| 50 % | <input type="radio"/> | <input checked="" type="radio"/> |
| 75 % | <input type="radio"/> | <input checked="" type="radio"/> |
| 90 % | <input type="radio"/> | <input checked="" type="radio"/> |

Deterministic  
Forecast Period  
Apr 20 to Apr 25

Deterministic  
Forecast

- |      |                       |                                  |
|------|-----------------------|----------------------------------|
|      | ON                    | OFF                              |
| peak | <input type="radio"/> | <input checked="" type="radio"/> |

### Layers

- |              |                                  |                                  |
|--------------|----------------------------------|----------------------------------|
|              | ON                               | OFF                              |
| Rivers       | <input checked="" type="radio"/> | <input type="radio"/>            |
| Streams      | <input checked="" type="radio"/> | <input type="radio"/>            |
| Roads        | <input type="radio"/>            | <input checked="" type="radio"/> |
| Railways     | <input type="radio"/>            | <input checked="" type="radio"/> |
| Aerial Photo | <input checked="" type="radio"/> | <input type="radio"/>            |

### Historical Floods

- |      |                       |                                  |
|------|-----------------------|----------------------------------|
| 1999 | <input type="radio"/> | <input checked="" type="radio"/> |
| 1996 | <input type="radio"/> | <input checked="" type="radio"/> |
| 1984 | <input type="radio"/> | <input checked="" type="radio"/> |
| 1972 | <input type="radio"/> | <input checked="" type="radio"/> |

Animate!

<!-- Note: This is an experimental application. All data represented should be used solely for testing and development purposes. -->



Welcome to the Flood IMS prototype for Lewistown, Pennsylvania.

[open frame in a new browser window](#)

To navigate around the FLD IMS site, use the





# FLDIMS

Today is  
April 20, 2004

Probabilistic  
Forecast Period  
Apr 20 to Apr 27

Probabilistic  
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- |      |                                  |                                  |
|------|----------------------------------|----------------------------------|
|      | ON                               | OFF                              |
| 02 % | <input checked="" type="radio"/> | <input type="radio"/>            |
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Deterministic  
Forecast Period  
Apr 20 to Apr 25

Deterministic  
Forecast

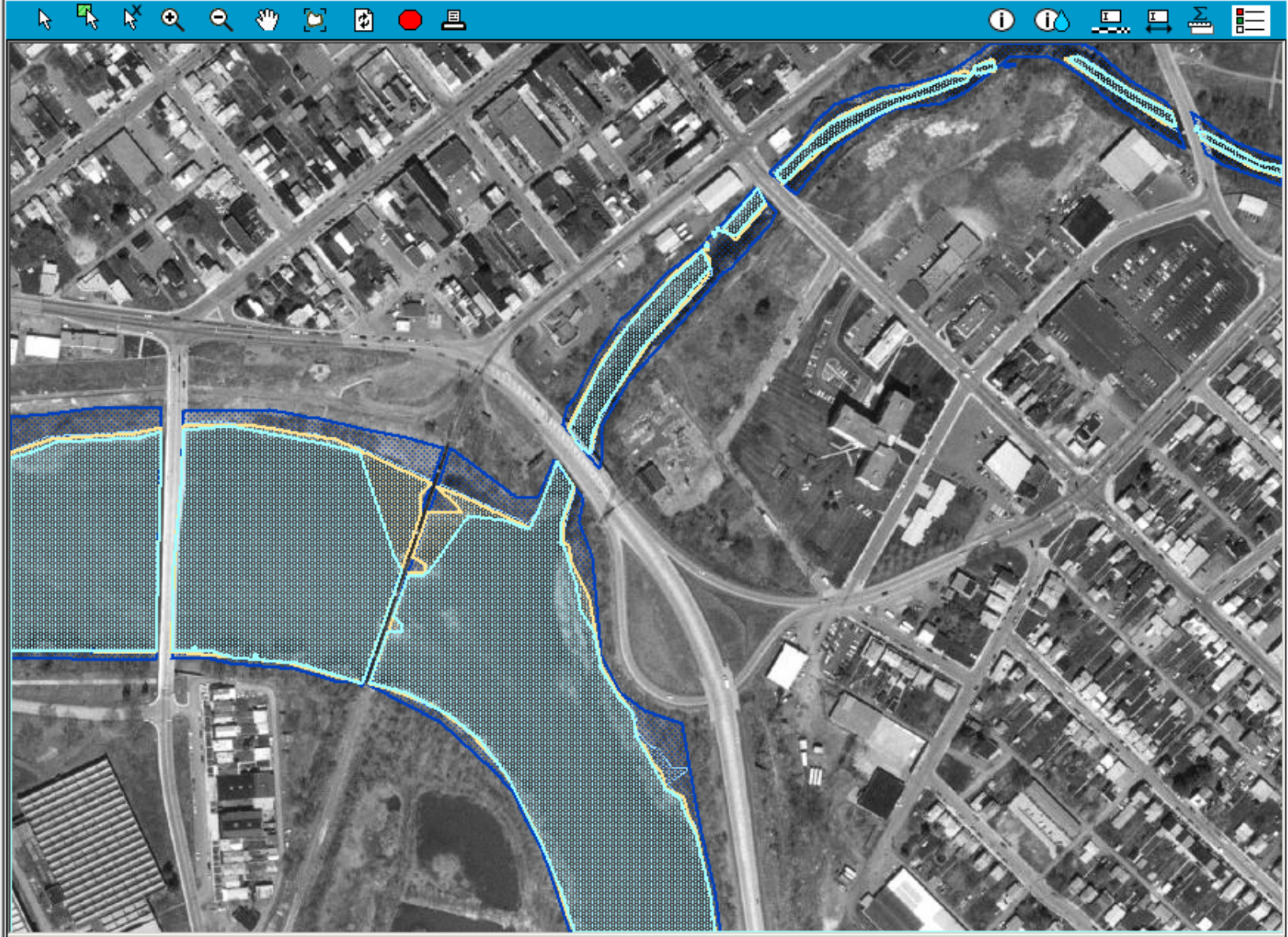
- |      |                                  |                       |
|------|----------------------------------|-----------------------|
|      | ON                               | OFF                   |
| peak | <input checked="" type="radio"/> | <input type="radio"/> |

## Layers

- |                   |                                  |                                  |
|-------------------|----------------------------------|----------------------------------|
|                   | ON                               | OFF                              |
| Rivers            | <input type="radio"/>            | <input checked="" type="radio"/> |
| Streams           | <input type="radio"/>            | <input checked="" type="radio"/> |
| Roads             | <input type="radio"/>            | <input checked="" type="radio"/> |
| Railways          | <input type="radio"/>            | <input checked="" type="radio"/> |
| Aerial Photo      | <input checked="" type="radio"/> | <input type="radio"/>            |
| Historical Floods |                                  |                                  |
| 1999              | <input type="radio"/>            | <input checked="" type="radio"/> |
| 1996              | <input type="radio"/>            | <input checked="" type="radio"/> |
| 1984              | <input type="radio"/>            | <input checked="" type="radio"/> |
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# FLDIMS

Today is

April 20, 2004

Probabilistic Forecast Period

Apr 20 to Apr 27

Probabilistic Forecast

ON OFF

02 %  ON  OFF

10 %  ON  OFF

50 %  ON  OFF

75 %  ON  OFF

90 %  ON  OFF

Deterministic Forecast Period

Apr 20 to Apr 25

Deterministic Forecast

ON OFF

peak  ON  OFF

Layers

ON OFF

Rivers  ON  OFF

Streams  ON  OFF

Roads  ON  OFF

Railways  ON  OFF

Aerial Photo  ON  OFF

Historical Floods

1999  ON  OFF

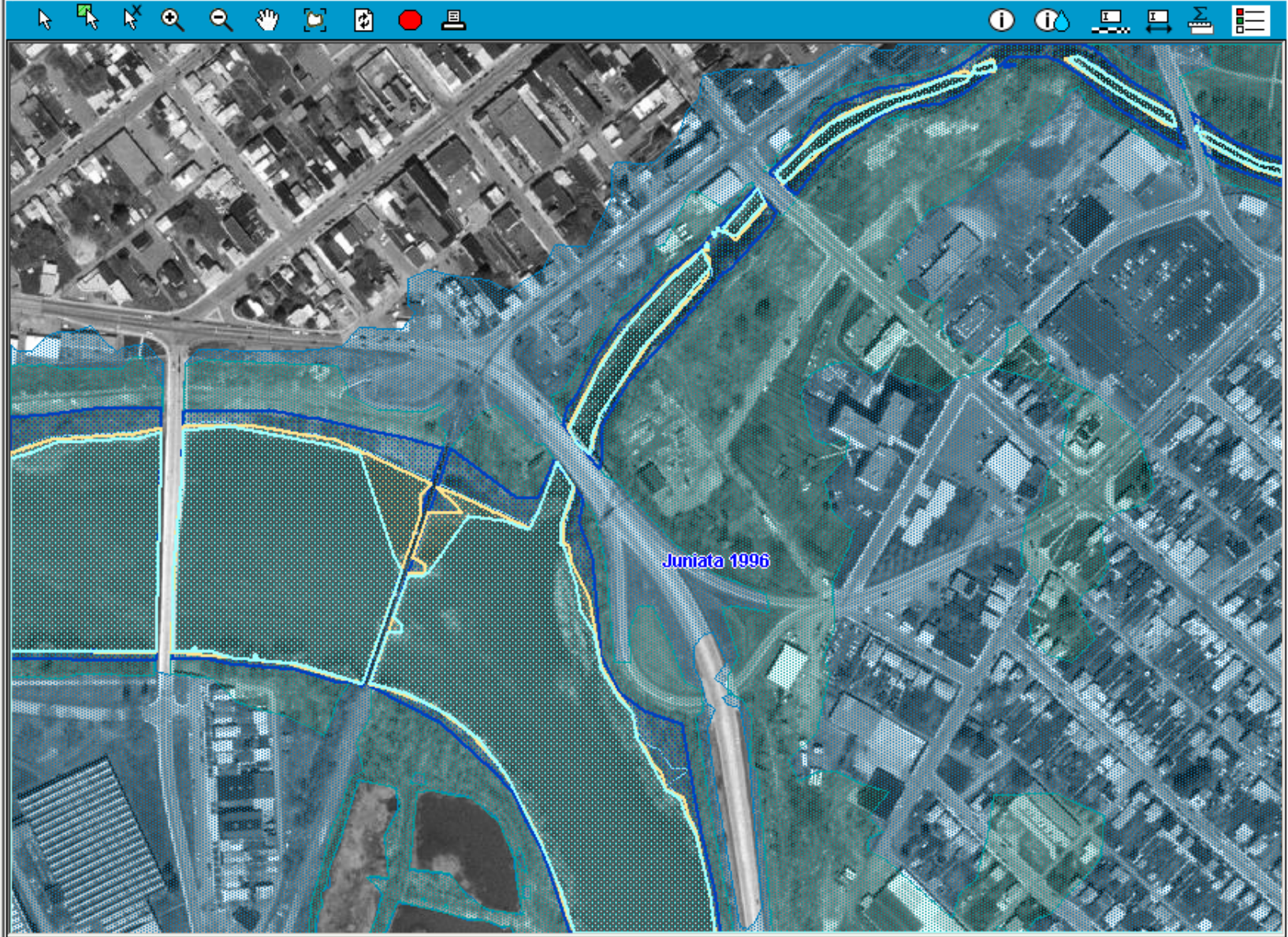
1996  ON  OFF

1984  ON  OFF

1972  ON  OFF

Animate!

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Welcome to the Flood IMS prototype for Lewistown, Pennsylvania.

[open frame in a new browser window](#)

To navigate around the FLD IMS site, use the

# Status

- Single location
  - Lewistown on Juniata River
- Daily Background processing
  - After routine operations
  - Cron initiated
  - FLDWAV on Linux
  - FLDVIEW on HP WS

# Stats

- FLDWAV performance - Linux
  - Deterministic, entire Susq. – few seconds
  - Probabilistic, 7 day PQPF – 35+ seconds
  - Probabilistic, 30 day - ~ 3 minutes
- FLDVIEW performance – HP WS
  - Fully automated
  - 7+ minutes deterministic (one layer)
  - 35+ minutes, 5 layer probabilistic

# Lessons Learned

- FLDVIEW implementation concerns
  - RFC KSAs
- FLDWAV concerns
  - Calibration
  - Monitoring
  - SHRT?
- GIS performance
  - NWS GIS Future
  - Fragile automated process
  - No true background capabilities

# Lessons Learned

- User issues for web access
  - Plug-in
- User feedback on map service
  - Design
  - Performance
  - User-friendliness