

# USGS Streamgages: Data Collection and Delivery

U.S. Geological Survey  
New Jersey Water Science Center  
West Trenton, New Jersey

Flood Warning User Forum  
Delaware River Basin  
Lambertville, New Jersey  
September 22, 2010

Bob Reiser  
Chief, Hydrologic Data Assessment Program



*Providing reliable, impartial, and timely data to  
assess the quantity and quality of our nation's water  
resources*

## History of Streamgaging

- Director John Wesley Powell establishes first gaging station in 1887
- First USGS streamgage data in New Jersey, Passaic River at Paterson & Delaware River at Lambertville in 1897
- Nationally the first USGS flood studies in Passaic River basin in 1902 & 1903
- Cooperative streamgaging program with State & local agencies established in 1921 at the NJ USGS office



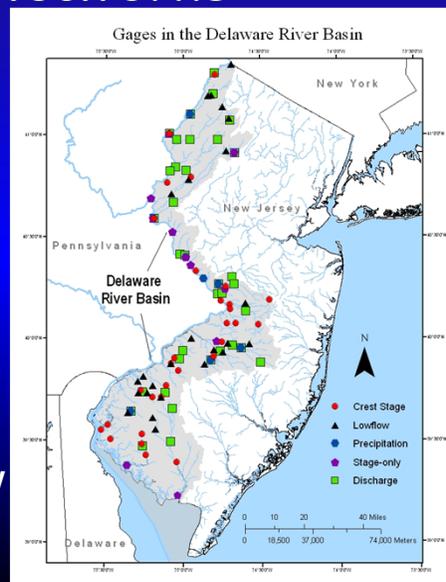
## Common uses of USGS streamflow data

- Flood forecasting and flood warning by National Weather Service and other emergency managers
- Estimate flood annual exceedance probabilities for designing bridges, dams, flood control structures & flood plain designation
- Determine stream discharge and water withdrawal limits for regulatory purposes
- Water supply planning & drought management
- Compute loads to develop water-quality standards and TMDL's
- Study trends in water quantity and quality
- Plan recreational activities



## Surface Water Networks

- Gaging stations, continuous-record discharge (35)
- Stage-only gages, continuous-record
  - tidal, non-tidal (11)
- Crest-stage gages
  - Tidal, non-tidal (29)
- Partial-record sites
  - Instantaneous low-flow measurements (25)
- Scour Monitoring



# Continuous-record Discharge Gaging Stations

35 active gages in New Jersey portion of Delaware Basin

Stage and Discharge Data collected

Cooperation

9 agencies

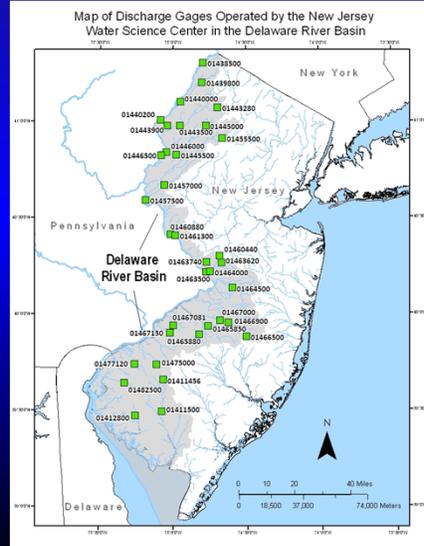
13 funding sources (projects)

Continuous Records

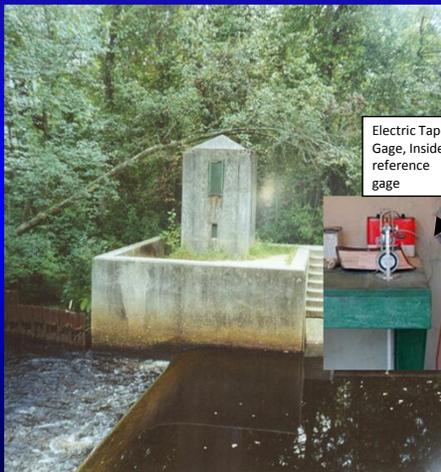
Musconetcong River since 1910

Del River at Riegelsville, 1906

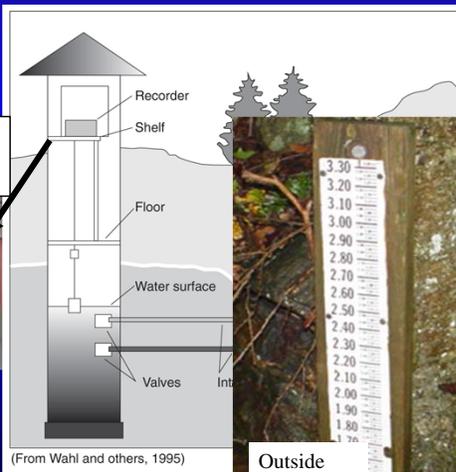
Del River at Trenton, 1913



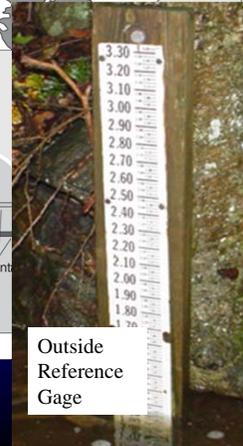
# Gaging Station Design



Electric Tape Gage, Inside reference gage



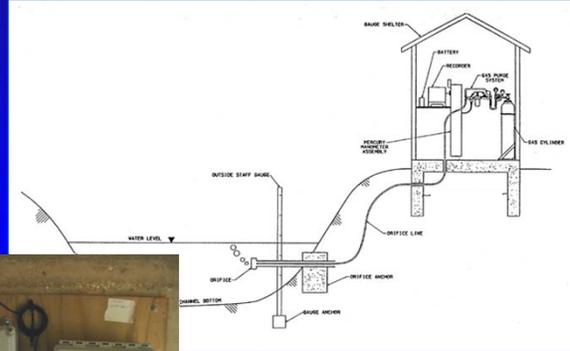
(From Wahl and others, 1995)



Outside Reference Gage

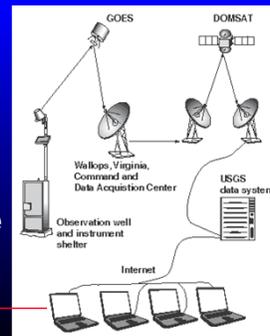


# New Gaging Station Design



# Satellite Telemetry

- **Geostationary Operational Environmental Satellite (GOES)**
  - Operated by NOAA (National Oceanic and Atmospheric Administration)
  - Reliable
  - Automatic switchover during primary failure
- Timed transmissions every hour
- Random transmissions when thresholds are exceeded
  - Stream reaches exceeds flood stage
- Data transmitted to computer base stations and USGS archival database



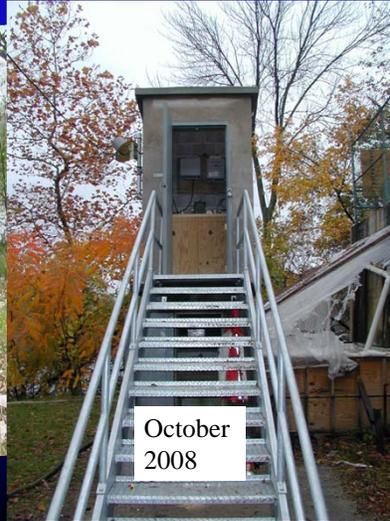
Your computer

## Flood Hardened Gages

01463500 Delaware River at Trenton, NJ



 USGS



## Flood Hardened Gages

01457500 Delaware River at Riegelsville, NJ



 USGS

## Radar Non-contact stage sensor

- Waterlog H-360 installed Oct. 5, 2005 Del River at Phillipsburg
- A microwave transmitter (9.5 – 10.5 GHz) and receiver aimed at water surface from bridge (2" to 115')
- Echo is received and evaluated to determine distance to water surface
- SDI-12 digital communication
- Sensor output is compatible with our DCPs
- Distance, elevation, and signal strength stored
- Accuracy  $\pm 0.01$  ft



## Flood Hardened Gages

01440200 Delaware River at Tocks Island, NJ



# Streamflow Data Collection

## Traditional Methods



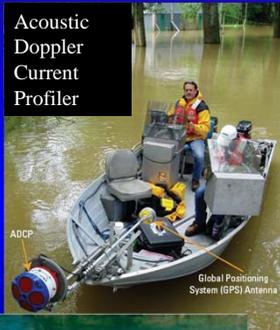
## Acoustic Methods

### Boat Mounted

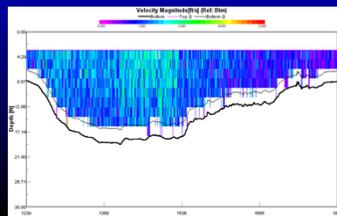
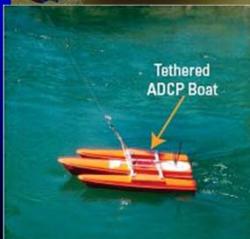
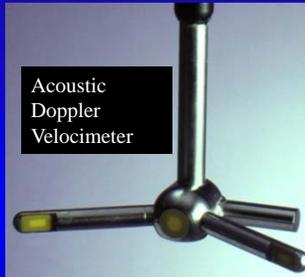
<http://pubs.usgs.gov/of/2001/ofr0101/text.pdf>

### Wading

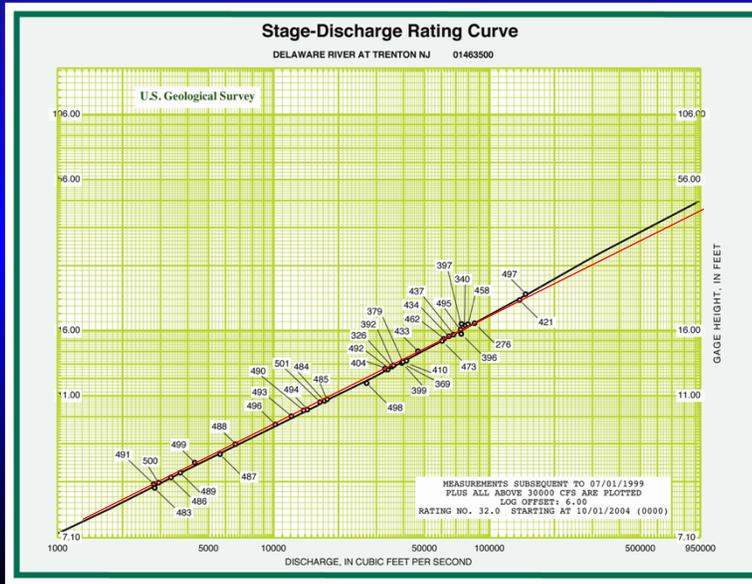
Acoustic Doppler Current Profiler



Acoustic Doppler Velocimeter

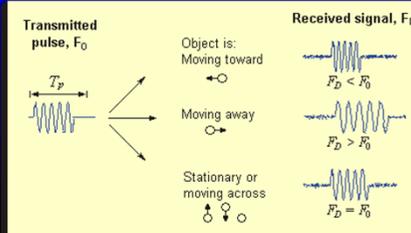
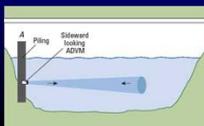


# Stage/Discharge Ratings



## Acoustics at Gages

- **Acoustic Velocity Meter**
  - Delaware & Raritan Canal at Port Mercer 1988-2010
- **ADCM**
  - installed summer 2010
- **Velocity**
  - Range:  $\pm 20$  ft/s
  - Resolution: 0.003 ft/s
  - Accuracy:  $\pm 0.015$  ft/s
- **2 horizontal Beam transducer**
  - Beam range: 1.6 – 66 ft
- **1.5 MHz signal**
- **Multi-cell current profiling**



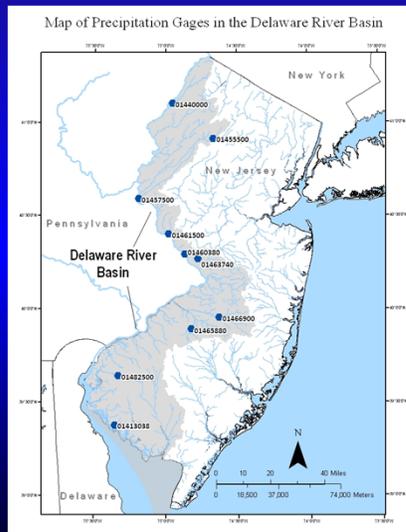
## Crest-stage Gages

- 23 non-tidal, 6 tidal in basin
- Records peak stage between visits
- Simple, reliable, economical, easy installation
- Used for regional studies of flood frequency to augment gaging station network
- Provide flood peak information at many sites at a reasonable cost.



## Precipitation Gages

- 10 gages – all have real-time data located on homepage <http://nj.usgs.gov/index.html>

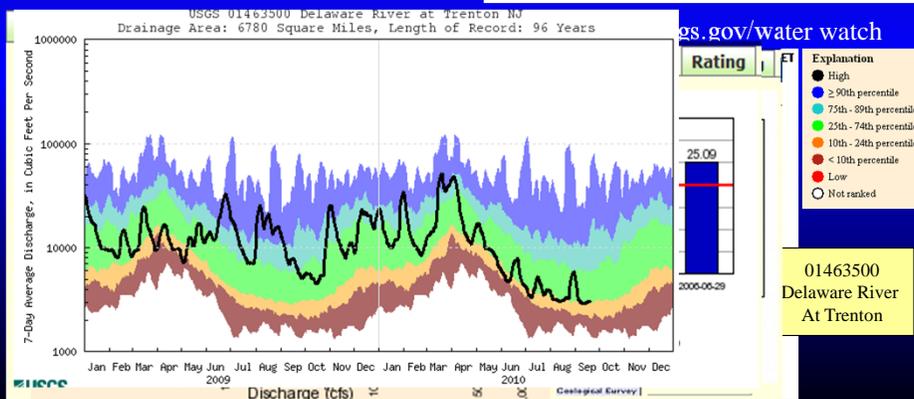
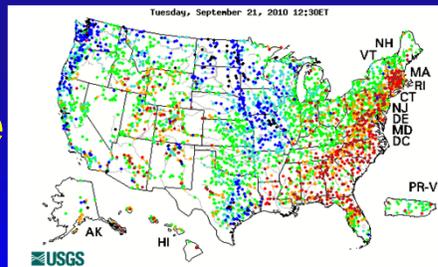


## Data Delivery Methods

- Real-time : Satellite & telephone telemetry
- Annual Water Data Report
- National Water Information System (NWIS WEB)
- Instantaneous Streamflow & Peak Data
- Ratings Depot
- Alert Systems: StreaMail & Water Alert
- Streamflow Statistics
- Flood Reports



## Water Watch Real-time Surface Water Data



## Annual Water Data Report

- National Reports since water year 2006  
<http://wdr.water.usgs.gov/>
- Mapper Interface  
<http://wdr.water.usgs.gov/adrgmap>
- New Jersey publishes it's own version online and on CD  
[http://nj.usgs.gov/publications/adr/adr2008/Main\\_Index.html](http://nj.usgs.gov/publications/adr/adr2008/Main_Index.html)



## National Water Information System (NWIS WEB)

- Much of the hydrologic data collected by the USGS is available through the NWIS Web interface
- Surface water - Water flow and levels in streams, lakes, and springs ,
- Ground water - Water levels in wells
- Water quality data - Chemical and physical data for streams, lakes, springs, and wells
- <http://waterdata.usgs.gov/nwis>
- <http://wdr.water.usgs.gov/nwisgmap>



## Instantaneous Data Archive

- Time-series discharge data now available online at the Instantaneous Data Archive (IDA)
  - <http://ida.water.usgs.gov/>
- Enter station # or get a list of gages by state
- Available for New Jersey gages back to October 1981



## Peak Streamflow Data

<http://nwis.waterdata.usgs.gov/nj/nwis/peak>

News: New Real-Time and Site Web Services! - updated August 26, 2010

### Peak Streamflow for New Jersey

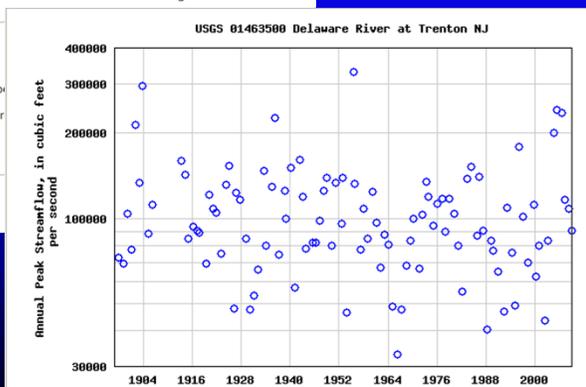
**ALL DATA ARE AT LOCAL TIME**

#### Choose Site Selection Criteria

Found 540 sites in New Jersey with peak streamflow data. Choose from the following criteria to constrain the number of sites selected.

Site	Site
-- Location --	-- Identifier --
<input type="checkbox"/> County	<input type="checkbox"/> Site Name
<input type="checkbox"/> Hydrologic Unit (by Code)	<input type="checkbox"/> Site Number
<input type="checkbox"/> Hydrologic Unit (by Name)	<input type="checkbox"/> Multiple Site Number
<input type="checkbox"/> Lat-Long box	<input type="checkbox"/> Agency Code
	<input type="checkbox"/> File of Site Number

[Questions about sites/data?](#)  
[Feedback on this web site](#)  
[Automated retrievals](#)  
[Help](#)



## Stage/Discharge Rating Data

- Expanded Base ratings, and latest shift-adjusted rating retrieved from all stage-discharge sites at 8 PM local time
- Available on web by site:  
[http://nwis.waterdata.usgs.gov/nwisweb/data/exsa\\_rat/xxxxxxx.rdb](http://nwis.waterdata.usgs.gov/nwisweb/data/exsa_rat/xxxxxxx.rdb)
- Tab delimited (rdb) format
- Detailed information on current variable stage shifts included



## Ratings Depot

- The development of a new interface (common gateway interface (cgi)) to allow targeted retrievals of depot files (by update period, station, type, etc.)

[http://waterdata.usgs.gov/nwisweb/cgi-src/get\\_ratings?help](http://waterdata.usgs.gov/nwisweb/cgi-src/get_ratings?help)

To view base rating

<http://waterdata.usgs.gov/nwisweb/data/ratings/base/USGS.01463500.base.rdb>

To view gage height corrections to current rating

<http://waterdata.usgs.gov/nwisweb/data/ratings/corr/USGS.01463500.corr.rdb>

To view current shift adjusted rating

<http://waterdata.usgs.gov/nwisweb/data/ratings/exsa/USGS.01463500.exsa.rdb>

- Ratings now available through WaterWatch website



```

// UNITED STATES GEOLOGICAL SURVEY      http://water.usgs.gov/
// NATIONAL WATER INFORMATION SYSTEM    http://water.usgs.gov/data.html
// DATA ARE PROVISIONAL AND SUBJECT TO CHANGE UNTIL PUBLISHED BY USGS
// RETRIEVED: 2010-06-28 20:46:12
// WARNING
// WARNING The stage-discharge rating provided in this file should be
// WARNING considered provisional and subject to change. Stage-discharge
// WARNING ratings change over time as the channel features that control
// WARNING the relation between stage and discharge vary. Users are
// WARNING cautioned to consider carefully the applicability of this
// WARNING rating before using it for decisions that concern personal or
// WARNING public safety or operational consequences.
// WARNING
// FILE TYPE="NWIS RATING"
// DATABASE NUMBER=1 DESCRIPTION=" Standard data base for this site."
// STATION AGENCY="USGS " NUMBER="01463500 " TIME_ZONE="EST" DST_FLAG=Y
// STA Trenton NJ
// DD e EDL/ # //FILE TYPE="NWIS RATING"
// PAR # //DATABASE NUMBER=1 DESCRIPTION=" Standard data base for this site."
// RAT DT# # //STATION AGENCY="USGS " NUMBER="01463500 " TIME_ZONE="EST" DST_FLAG=Y
// RAT E="ste # //STATION NAME="Delaware River at Trenton NJ"
// RAT # //DD NUMBER=" 5" LABEL="Discharge EDL/NEW DCP (cfs)"
// RAT # //PARAMETER CODE="00060"
// RAT 2" PAF # //PARAMETER CODE="00060"
// RAT PARAF # //RATING ID="32.0" TYPE="STGQ" NAME="stage-discharge" AGING=A
// RAT 0000 # //RATING REMARKS=""
// RAT 0000 # //RATING REMARKS=""
// SHI " BZOK # //RATING EXPANSION="logarithmic"
// SHI "-0.14 # //RATING OFFSET=0.600000E+01
// SHI " BZOK # //RATING_INDEP ROUNDING="222233332" PARAMETER="Gage height (ft)"
// SHI " BZOK # //RATING_DEP ROUNDING="222233332" PARAMETER="Discharge (cfs)"
// SHI " BZOK # //RATING_DATETIME BEGIN=19961203153000 BZONE=EST END=20071130235959 EZONE=EST AGING=A
// SHI " BZOK # //RATING_DATETIME BEGIN=20071201000000 BZONE=EST END=23821230190000 EZONE=EST AGING=W
// SHIFT NEXT COMMENT=" "
INDEP SHIFT DEP STOR
18M 16M 14M 12M 10M 8M 6M 4M 2M
7.29 -0.14 1000 1000 15M 15M
7.30 -0.14 1040 1040 15M 15M
7.31 -0.14 1040 1040 15M 15M
7.32 -0.14 1060 1060 15M 15M
7.33 -0.14 1070 1070 15M 15M
7.34 -0.14 1090 1090 15M 15M
7.35 -0.14 1110 1110 15M 15M
7.36 -0.14 1130 1130 15M 15M
7.37 -0.14 1150 1150 15M 15M
7.38 -0.14 1170 1170 15M 15M
7.39 -0.14 1190 1190 15M 15M
7.40 -0.14 1210 1210 15M 15M
7.41 -0.14 1230 1230 15M 15M
7.42 -0.14 1250 1250 15M 15M
7.43 -0.14 1270 1270 15M 15M
7.15 1000 15M 15M
7.50 1750 15M 15M
8.00 3100 15M 15M
8.25 3900 15M 15M
9.00 7000 15M 15M
10.50 16000 15M 15M
10.68 17000 15M 15M
12.03 28600 15M 15M
14.96 60390 15M 15M
17.00 88000 15M 15M
21.00 155000 15M 15M
27.00 280000 15M 15M
29.00 330000 15M 15M
46.00 950000 15M 15M

```

**Shift adjusted rating**

**Base rating**



## StreamMail

- Request, by email or cellphone text message, the most recent USGS river stage and streamflow data for streams in the United States.
- To use the system, send an email to "streamail@usgs.gov" and in the "Subject" line, put in a USGS station (site) number. Station numbers available at <http://waterdata.usgs.gov/usa/nwis/rt>
- An email will be sent back to you with the most recent stream stage and flow.



## Example of StreaMail Response

- U.S. Geological Survey (USGS) StreaMail:  
The latest river stage and streamflow values you requested from StreaMail. Site: 01463500  
Station name: Delaware River at Trenton NJ  
Date: 08/05/2010  
Time: 10:15:00  
Stage: 8.17 feet  
Streamflow: 3190 cubic feet per second (cfs)
- Link to charts for 01463500:  
Stage:  
[http://waterwatch.usgs.gov/wwapps/zchart.php?i=nwis2&vt=uv&cd=00065&site\\_no=01463500](http://waterwatch.usgs.gov/wwapps/zchart.php?i=nwis2&vt=uv&cd=00065&site_no=01463500)  
Streamflow:  
[http://waterwatch.usgs.gov/wwapps/zchart.php?i=nwis2&vt=uv&cd=00060&site\\_no=01463500](http://waterwatch.usgs.gov/wwapps/zchart.php?i=nwis2&vt=uv&cd=00060&site_no=01463500)
- The U.S. Geological Survey's (USGS) StreaMail system allows you to request, by email, the most recent USGS river stage and streamflow data for streams in the United States. To use the system, send an email to "streammail@usgs.gov" and in the "Subject" line, put in a USGS station (site) number. An email will be sent back to you with the most recent stream stage and flow.
- If you need help, contact Howard Perlman ([hperlman@usgs.gov](mailto:hperlman@usgs.gov))



## Water Alert

- Threshold notification system
- User selects station & desired notification settings; i.e. data type, threshold condition, and frequency
- Interactive map with search options
- Subscription form and Confirmation
- Text message or email sent to subscriber
- <http://water.usgs.gov/wateralert/>



# Water Alert

<http://water.usgs.gov/wateralert>

The screenshot shows the USGS WaterAlert Subscription Form in a Windows Internet Explorer browser window. The browser title is "USGS WaterAlert Subscription Form - Windows Internet Explorer". The page features the USGS logo and navigation links for "USGS Home", "Contact USGS", and "Search USGS". The form is titled "USGS WaterAlert Subscription Form" and includes a "State" dropdown menu with options for Nebraska, Nevada, New Hampshire, New Jersey, New Mexico, New York, North Carolina, North Dakota, Ohio, and Oklahoma. The "Site Info" section includes fields for Site Number (01463500), Site Name (Delaware River at Trenton NJ), Agency (USGS), and Transaction ID (2gTqk). The "Send Notification To" section has radio buttons for "My email address" and "My mobile phone", with an "email address" input field. The "Notification Frequency" section has radio buttons for "Hourly" and "Daily". The "Streamflow Parameter" section has radio buttons for "Discharge (cfs)" and "Gage height (ft)", with a "Recent value" field showing 3,130 for Discharge and 8.15 (NWS flood stage = 20) for Gage height. The "Threshold Condition" section has radio buttons for "Greater than (>)", "Less than (<)", "Outside a range (< or >)", and "Inside a range (> and <)", with a "Real-time value is greater than:" input field. A checkbox at the bottom indicates "I have read and acknowledge the Provisional Data Statement and Disclaimer."

## Water Alert's Email Response when threshold reached

- Streamflow of 3280 cfs is below subscriber threshold of 4200 at 2010-08-05 00:15:00 EDT  
01463500 00060 Delaware River at Trenton NJ  
Notification interval, no more often than: Daily
  - For Realtime Data at this station:  
[http://waterdata.usgs.gov/nwis/rtv/?site\\_no=01463500](http://waterdata.usgs.gov/nwis/rtv/?site_no=01463500)
  - To Delete this Specific Alert  
reply with Subject: SIGNOFF hni-CrY2s
  - To Pause this Specific Alert for 5 days  
reply with Subject: PAUSE hni-CrY2s
  - To List Settings  
reply with Subject: LIST hni-CrY2s
  - To List Settings for all Notifications of the Same Address  
reply with Subject: LIST ALL hni-CrY2s
  - For Help  
reply with Subject: HELP hni-CrY2s
  - To Sign up for New Notifications  
<http://water.usgs.gov/wateralert>
- To Modify a threshold, set a "new" notification with the same email address, site number and parameter



Send Questions to: [GS-W\\_RT-HNS\\_Feedback@usgs.gov](mailto:GS-W_RT-HNS_Feedback@usgs.gov)

## Flood Studies and Reports

- New Jersey Flood Watch web site  
<http://nj.usgs.gov/hazards/flood/index.html>
- Flood summary reports for major floods  
<http://nj.usgs.gov/hazards/flood/flood0310/>
- Flood Magnitude and Frequency of the Delaware River in NJ, NY and PA <http://pubs.usgs.gov/of/2008/1203/>
- Flood of April 2-4, 2005, Delaware River main Stem from Port Jervis, New York, to Cinnaminson, New Jersey  
<http://pubs.usgs.gov/sir/2007/5067/>
- Flood of July 12-13, 2004, Burlington and Camden Counties, South Central New Jersey <http://pubs.usgs.gov/sir/2006/5096/>
- Methodology for Estimation of Flood Magnitude & Frequency for NJ streams <http://pubs.usgs.gov/sir/2009/5167/>



## StreamStats New Jersey

[http://water.usgs.gov/osw/streamstats/new\\_jersey.html](http://water.usgs.gov/osw/streamstats/new_jersey.html)



- Interactive map-based web application available for public use
- Users can obtain flood-frequency statistics and basin characteristics for gaged and ungaged sites

Lowflow statistics through 2003 published: <http://pubs.usgs.gov/sir/2005/5105>

## Contact Information

- Bob Reiser, Chief, Hydrologic Data Assessment Program, USGS New Jersey Water Science Center
  - 609-771-3980 [rreiser@usgs.gov](mailto:rreiser@usgs.gov)
- USGS New Jersey Water Science Center Home Page
  - <http://nj.usgs.gov>
- Address:
  - USGS NJ Water Science Center  
810 Bear Tavern Road, Suite 206  
West Trenton, NJ 08628  
(609) 771-3900

