



# Overview of U.S. Geological Survey Stream and groundwater monitoring

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*Michigan Commission of Agriculture and Rural Development  
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U.S. Department of the Interior  
U.S. Geological Survey

## U.S. Geological Survey

- The USGS serves the Nation by providing reliable scientific information to describe and understand the Earth; minimize loss of life and property from natural disasters; manage water, biological, energy, and mineral resources; and enhance and protect our quality of life.
- Founded in 1879
- Science agency within Department of Interior



## USGS Michigan Water Science Center

- *Mission:* collect, analyze and disseminate the impartial hydrologic data and information needed to wisely manage water resources for the people of the United States and the State of Michigan.
- Main Office in Lansing: studies of water resources including quantity and quality
- Field Offices in Lansing, Grayling and Escanaba: primarily field data collection
- Budget:
  - Joint Funding Agreements with state, local, and tribal agencies,
  - USGS appropriations including USGS Cooperative Water Program that provides matching funds for local projects,
  - Projects with other Federal Agencies including EPA and US Army Corps of Engineers.



## Hydrologic Studies

- Water resources evaluations: Ingham-Eaton-Clinton Counties, Kalamazoo County
- Water quality: Silver Lake, Bear Lake, harmful algal blooms, avian botulism and other microbial health studies, Great Lakes Restoration Initiative studies
- Flood inundation studies: Lansing
- Science support to water-withdrawal assessment process, Michigan Water Use Advisory Council, Council of Great Lakes Governors and other regional partners



## Streamgaging

- First streamgage just turned 125 years old
- Established on the Rio Grande River in 1889 in Embudo, New Mexico to evaluate potential for crop irrigation
- 'Rock House' gaging station built in 1912, just after NM became a state



Student hydrographers at Embudo, New Mexico. Members of the Irrigation Survey, a predecessor to USGS Water Mission Area, circa 1888



## What is a streamgage?

- Location where stream stage (water level) is measured at regular intervals – typically every 15 minutes
- Periodically hydrographers measure the streamflow at the location by measuring the velocity of water at many locations across the stream.
- Streamflow is then related to stream stage – called a rating curve for the streamgage



Satellite antenna

Transducer

Data collection platform

Battery

Bubble system

Gage house

Monitored stream

Plastic pipe

Inclined staff gage

Bubble orifice

Subsection

Width

Velocity

Depth

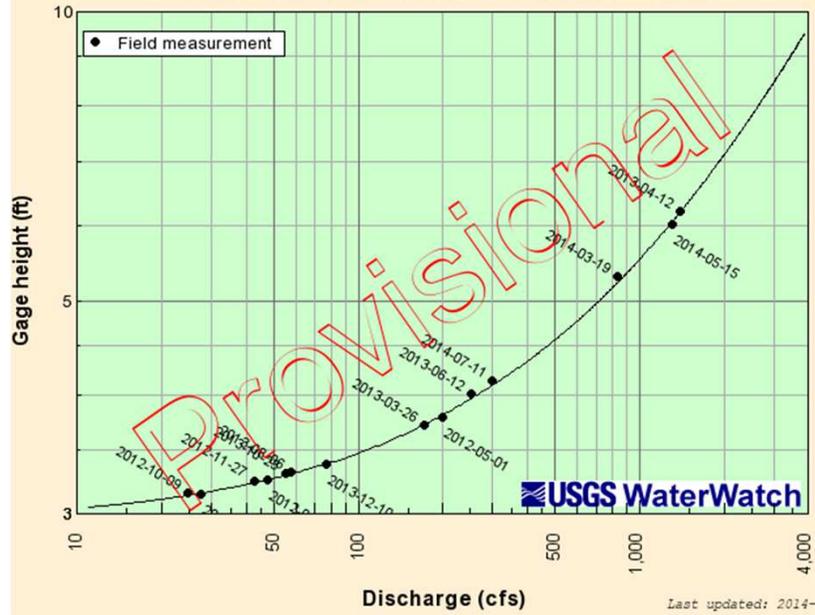
In each subsection:  
 $\text{Area} = \text{Depth} \times \text{Width}$   
 $\text{Discharge} = \text{Area} \times \text{Velocity}$

USGS

10.06.2004

Current-meter discharge measurements are made by determining the discharge in each subsection of a channel cross section and summing the subsection discharges to obtain a total discharge.

04112500 RED CEDAR RIVER AT EAST LANSING, MI



# Deliver

- Tradition
- Now data
- the internet

### SUMMARY STATISTICS

	Calendar Year 2012		Water Year 2013		Water Years 1902 - 2013	
Annual total	59,323		81,116		221	
Annual mean	162		222		431	
Highest annual mean					49.3 1964	
Lowest annual mean					3.0 Jul 31, 1931	
Highest daily mean	926	Mar 3	2,490	Apr 21	5,720	Apr 20, 1975
Lowest daily mean	18	Sep 2	25	Oct 7	3.0	Jul 31, 1931
Annual seven-day minimum	21	Aug 28	27	Oct 6	3.9	Jul 15, 1934
Maximum peak flow			2,550	Apr 21	5,940	Apr 20, 1975
Maximum peak stage			7.86	Apr 21	11.95	Apr 20, 1975
Instantaneous low flow			25	Oct 6 <sup>a</sup>	3.0	Jul 31, 1931
Annual runoff (cfs)	0.457		0.626		0.624	
Annual runoff (inches)	6.22		8.50		8.47	
10 percent exceeds	413		545		526	
50 percent exceeds	70		103		112	
90 percent exceeds	28		43		31	

<sup>a</sup> Also occurred Oct. 7, 8, 9, 10.

jh



USGS Current Water Data

Click to hide state-specific text

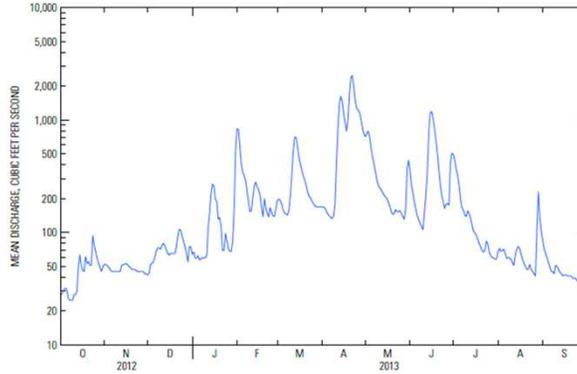
Daily Streamflow Conditions

Select a site to retrieve data and station information.

Explanation

- High
- > 90th percentile
- 75th - 90th percentile
- 25th - 75th percentile
- Low - 25th percentile

The colored dots on this map indicate streamflow conditions as a percentage, which is computed the period of record for the day of the year. Only stations with 30 years of record are shown. The grey circles indicate other stations that were not included.





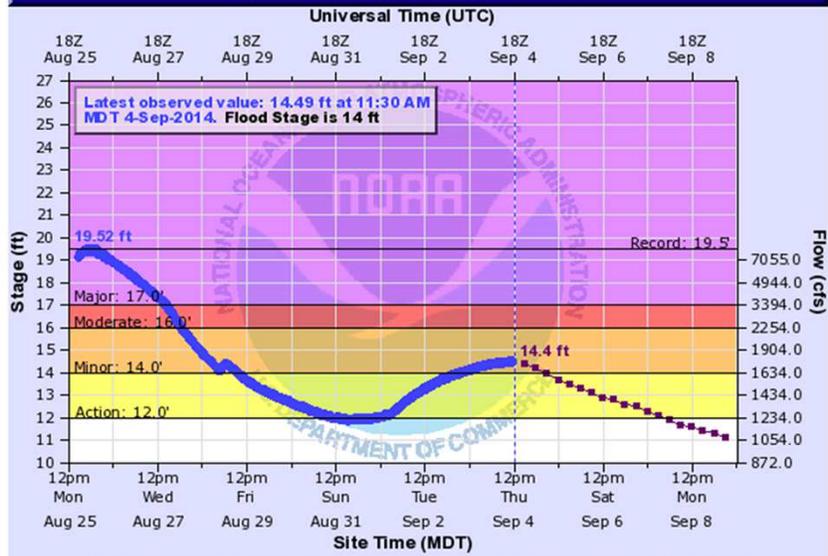
EXPLANATION	
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## How is streamgauge data used?

- Flood planning and warning, drought monitoring
- Design of bridges, roads, culverts, water treatment plants, navigation control structures
- Water-resource planning
  - Water budget – how much water is available?
  - How does the stream respond to climate and development?
- Operation of locks and dams
- Power production
- Water-quality assessment
- Habitat assessment
- Recreation



### BEAVER CREEK (MT) NEAR HINSDALE

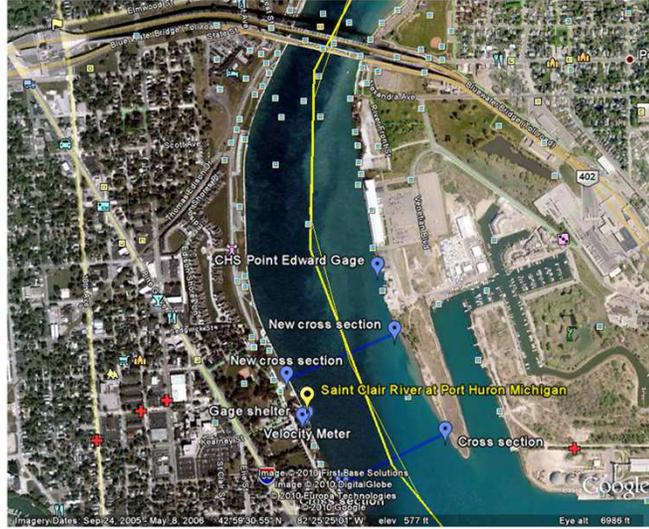


BCHM8(plotting HGIRG) "Gage 0" Datum: 2130'

Observations courtesy of US Geological Survey



# International streamgage



## St. Clair River Instrumentation

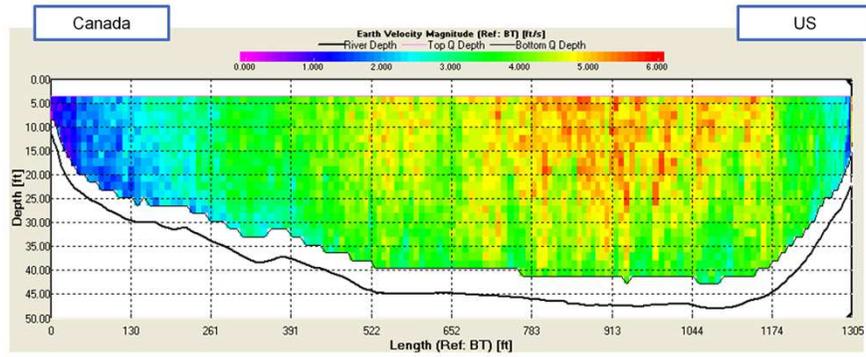
Instrument shelter on seawall  
and telemetry shelter on fence



Fixed track mounted on seawall  
with sliding mount and meter



St. Clair River Cross section  
192,000 ft<sup>3</sup>/s (5,437 m<sup>3</sup>/s)  
124,000 million gallons per day



## Baseflow estimation

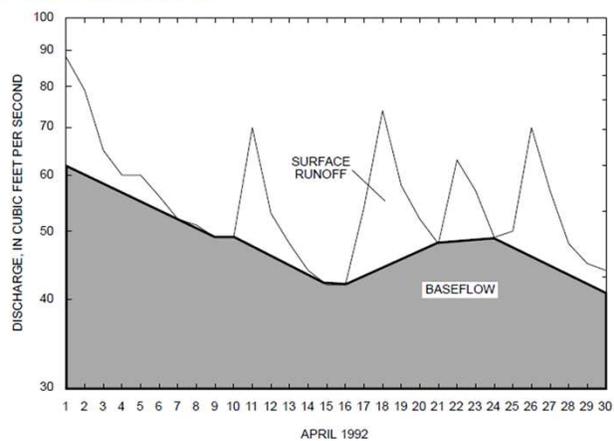


Figure 4. Hydrograph analysis using the local minimum method for French Creek near Phoenixville, Pa., April 1992.



From, Sloto, R.A. and Crouse, M.Y., 1996, HYSEP— A computer program for streamflow hydrograph separation and analysis: U.S. Geological Survey Water-Resources Investigations Report 96-4040, 46 p.

## Groundwater-level monitoring

- Simpler: direct measurement of depth to water in a well
- Can display in real-time like streamgage data
- Used to monitor conditions:
  - Drought
  - Flood
  - Water Quality
- Combine with other data to estimate water budget



**Current Conditions for Michigan**  
PROVISIONAL DATA SUBJECT TO REVIEW

Predefined displays: Michigan Groundwater Table

Group table by: no grouping

Customize table

Station Number	State
<b>Branch County</b>	
415602084593701	06S 06W 22CABA 01 BRAN
<b>Cheboygan County</b>	
454427084424002	39N 03W 29CBCB02 CHEBO
<b>Eaton County</b>	
424525084393401	EATON COUNTY DELTA 7 W
<b>Huron County</b>	
434103083130201	15N 11E 32BBCB 01 HURON
<b>Ingham County</b>	
423127084321901	04N 02W 16DAAA 01 INGH
423805084311801	03N 02W 23BCBD 01 INGH
424235084311201	04N 02W 26BDB 01 INGH
424424084340301	04N 02W 17ABAA 01 INGH
424502084331201	04N 02W 09BDDAD 01 INGH
<b>Kalamazoo County</b>	
42133208401901	03S 12W 11AD 01 KALAMA

USGS Current Conditions F...

Days (2473) GO

-- OF --

Begin date: 2007-10-01

End date: 2014-07-09

[Summary of all available data for this site](#)  
[Instantaneous-data availability statement](#)

**Depth to water level, feet below land surface**  
Most recent instantaneous value: 52.35 07-09-2014 07:30 EST

USGS 424502084331201 04N 02W 09BDDAD 01 INGHM CO (SEYMOUR)

Depth to water level, feet below land surface

Groundwater level above MGS 1029, feet

Legend:  
 - Depth to water level  
 - Period of approved data  
 ▲ Value exceeds "standard difference" threshold  
 - Period of provisional data

Add up to 2 more sites and replot for "Depth to water level, feet below land surface"

Add site numbers [Note](#)

GO

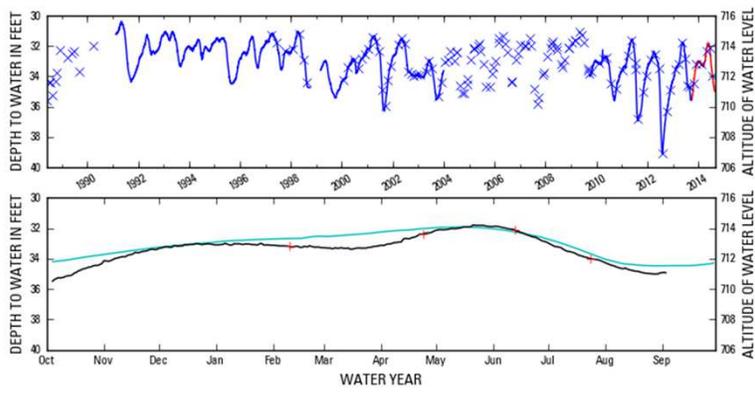
Create [presentation-quality](#) / [stand-alone](#) graph. Subscribe to [WaterAlert](#) P72019 0001 A(0)

[Share this graph](#) | [Facebook](#) | [Twitter](#) | [LinkedIn](#) | [Google+](#)

USGS

[Questions about sites/data?](#)

[Data Tips](#)

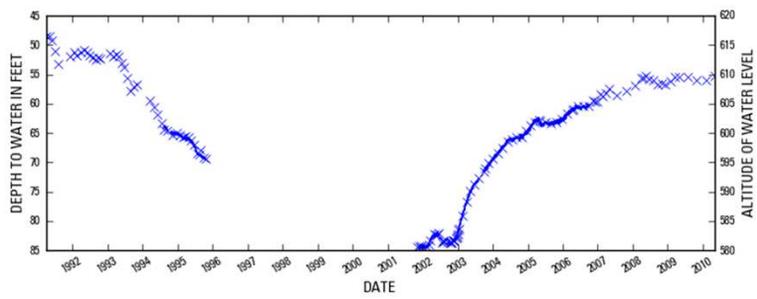


EXPLANATION

- APPROVED DAILY DEPTH TO WATER
- PROVISIONAL DAILY DEPTH TO WATER
- × TAPEDOWN DEPTH TO WATER
- AVERAGE DAILY MAXIMUM DEPTH TO WATER
- DAILY MAXIMUM DEPTH TO WATER CURRENT WATER YEAR
- + TAPEDOWN DEPTH TO WATER CURRENT WATER YEAR

USGS Site ID: 434103083130301  
 15N 11E 32BBCS 01 HURON CO (GRANT TWP, H2R WELL)  
 Altitude of Land surface: 746 Feet NGVD29, Depth of Well: 91 Feet  
 Local Aquifer Code: Sand Deposits  
 National Aquifer Code: Sand and gravel aquifers (glaciated regions)



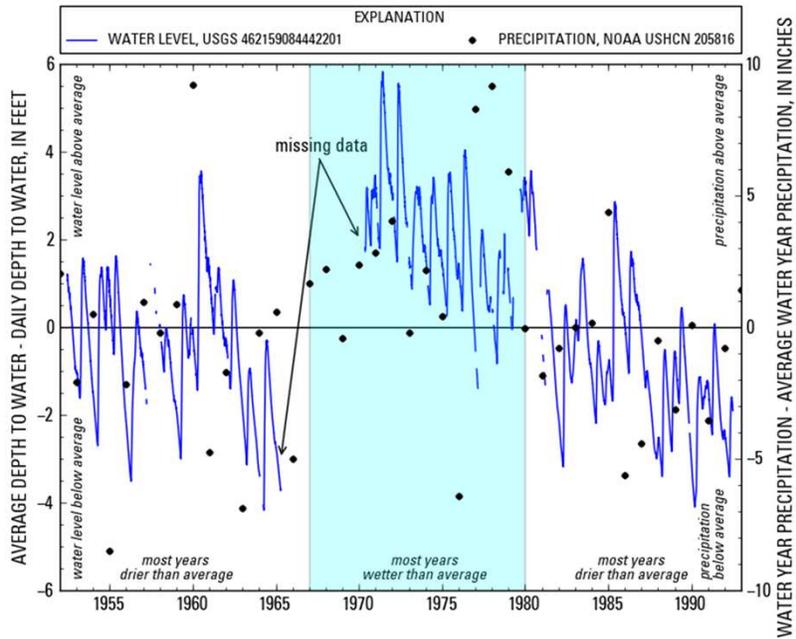


EXPLANATION

- APPROVED DAILY DEPTH TO WATER
- PROVISIONAL DAILY DEPTH TO WATER
- × TAPEDOWN DEPTH TO WATER

USGS Site ID: 420414083351501  
 05S 07E 10 ABB01 MONROE CO (WELL G-7)  
 Altitude of Land surface: 665 Feet NGVD29, Depth of Well: 95 Feet  
 Local Aquifer Code: Devonian-Silurian Systems  
 National Aquifer Code: Silurian-Devonian aquifers







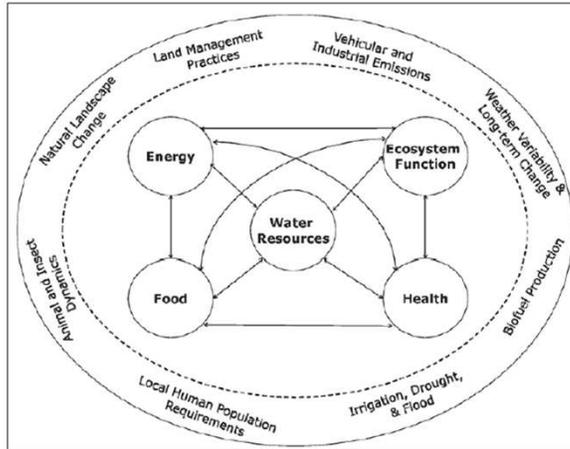


Fig. 1. The relationships among five key resources (water, food, energy, health, and ecosystem function). Outer ring shows a nonexhaustive list of stressors that affect availability or quality of the resources.

From: Hossain, Faisal, and others, 2011, *Making sense of water resources that will be available for future use*: *Eos*, v. 90, no. 17, p. 26.

