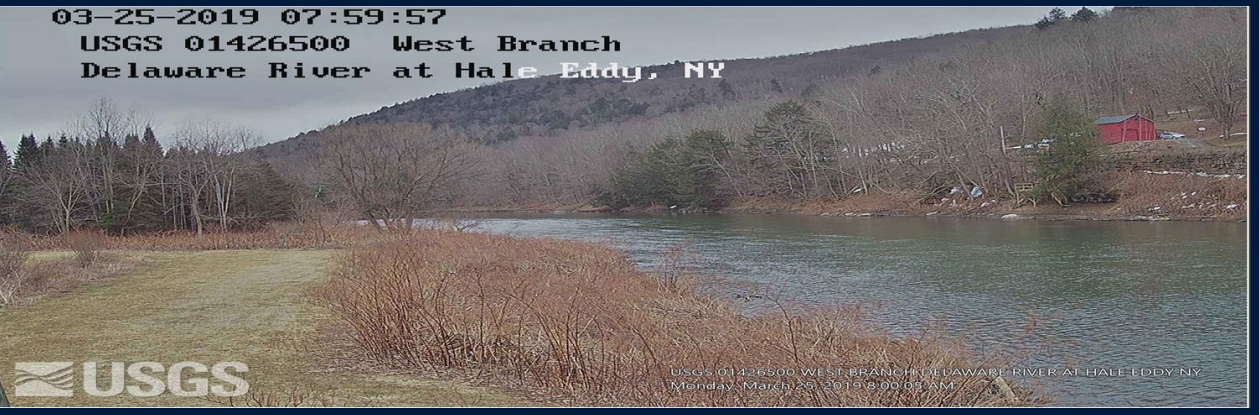
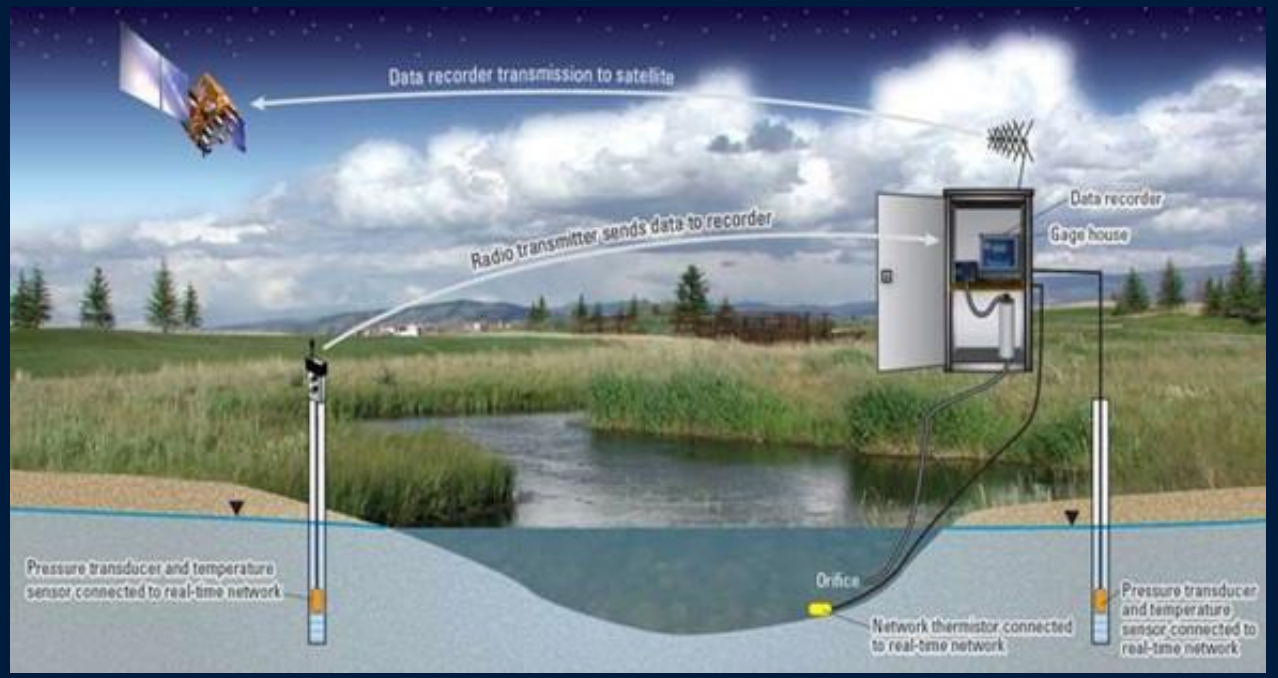
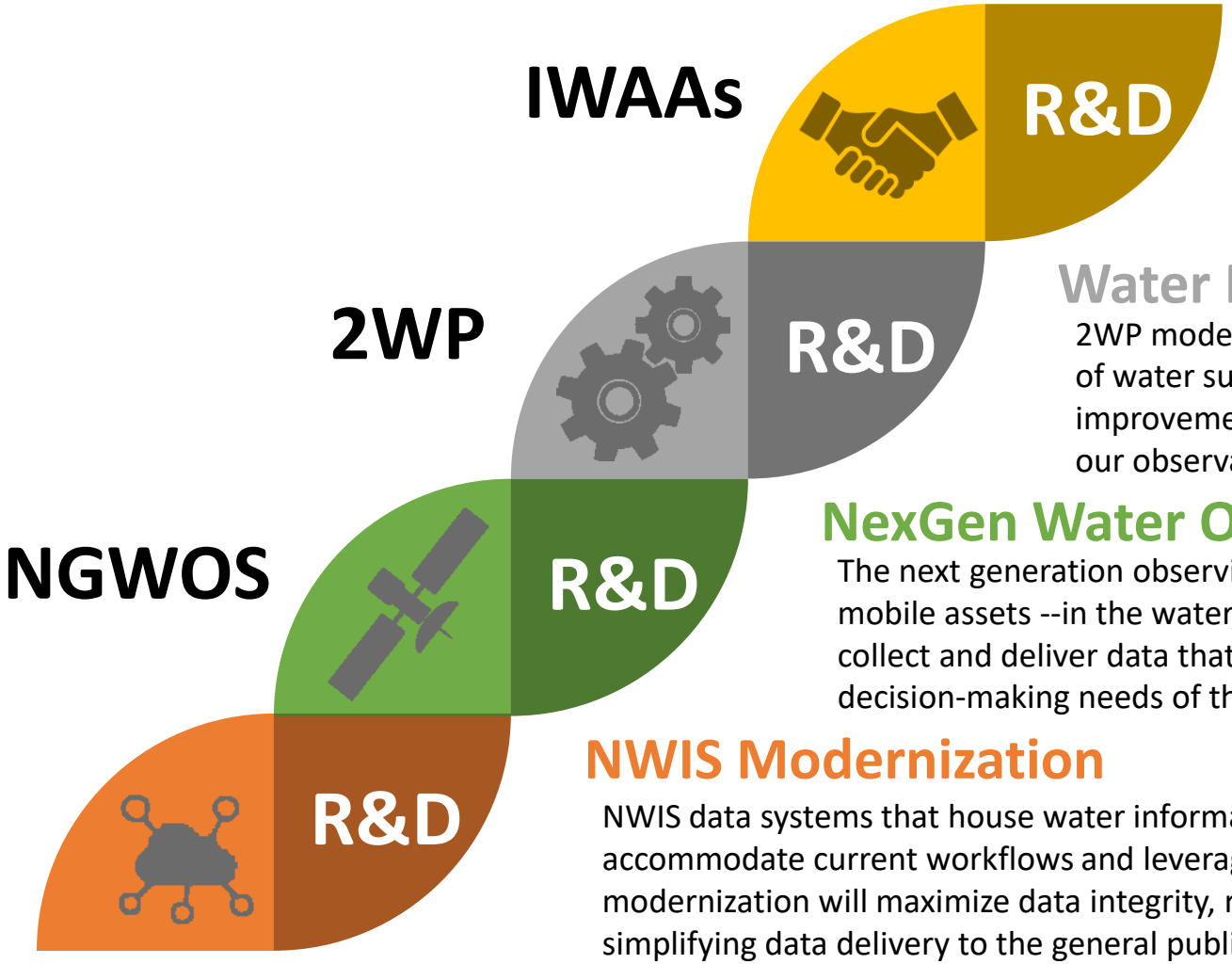
USGS
science for a changing world

Next Generation Water Observing System (NGWOS)





USGS Water Mission Area Priorities



Integrated Water Availability Assessments

IWAAs evaluate water availability in terms of the spatial and temporal distribution of water quantity and quality in both surface and groundwater, as related to human and ecosystem needs and as affected by human and natural influences.

Water Prediction Work Program

2WP model predictions will support daily to decadal forecast-based management of water supplies and infrastructure at a regional and National extent through improvement of existing tools and development of new capacity supported by our observational data and data collected by other monitoring organizations.

NexGen Water Observing System

The next generation observing systems (NGWOS) is an integrated set of fixed and mobile assets --in the water, on the ground and in the air-- that will measure, collect and deliver data that can help address water resource challenges and decision-making needs of the future.

NWIS Modernization

NWIS data systems that house water information will be modernized to accommodate current workflows and leverage latest technology. NWIS modernization will maximize data integrity, reliability, and accessibility while simplifying data delivery to the general public.

Presidential Memo on Western Water

Sec. 3. Improve Forecasts of Water Availability. To facilitate greater use of forecast-based management and use of authorities and capabilities provided by the Weather Research and Forecasting Innovation Act of 2017 (Public Law 115-25) and other applicable laws, the **Secretary of the Interior and the Secretary of Commerce shall convene water experts and resource managers to develop an action plan *to improve the information* and modeling capabilities related to water availability and water infrastructure projects.** The action plan shall be completed by January 2019 and submitted to the Chair of the Council on Environmental Quality.

III. Create a next-generation water observations system for the nation. USGS, Reclamation, and NOAA will collaborate to develop the Next Generation Water Observation System (NGWOS), informed by water experts and resource managers, to provide real-time data on water quantity and quality necessary to support modern water prediction and decision support systems for water emergencies and daily water operations……

Advanced Water Models Require High-Density Data

Nearly 30 million stream reaches in U.S.

USGS operates about 10,500 streamgages

(about 3/100 of one percent of reaches)

- Modern models require high-density data describing all of the major hydrologic characteristics that the models represent, such as streamflow, evapotranspiration, water storage in snowpack, soil and groundwater, and many others.

- The density of our current monitoring networks limit the ability to accurately understand and predict water-resource conditions with these advanced models (i.e. National Water Model)

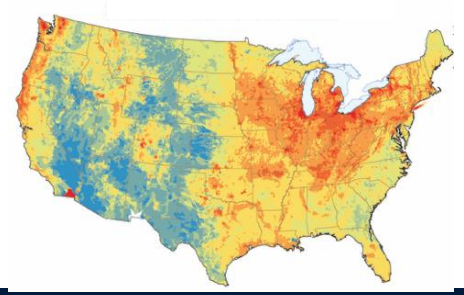
Linking Monitoring, Assessments, and Modeling

Identify water monitoring gaps and data needs for advanced modeling

Stakeholder Engagement

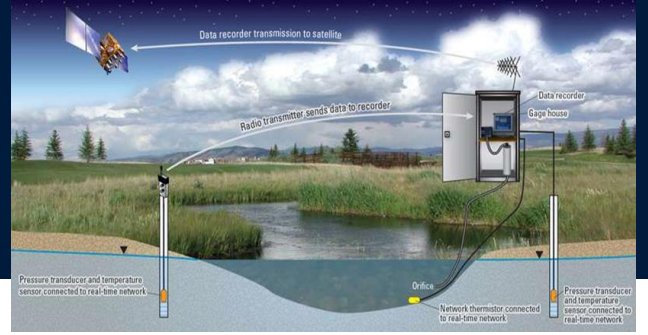
Integrated set of fixed and mobile monitoring assets in the water, ground, and air

Integrated delivery of water quantity, quality, and use data

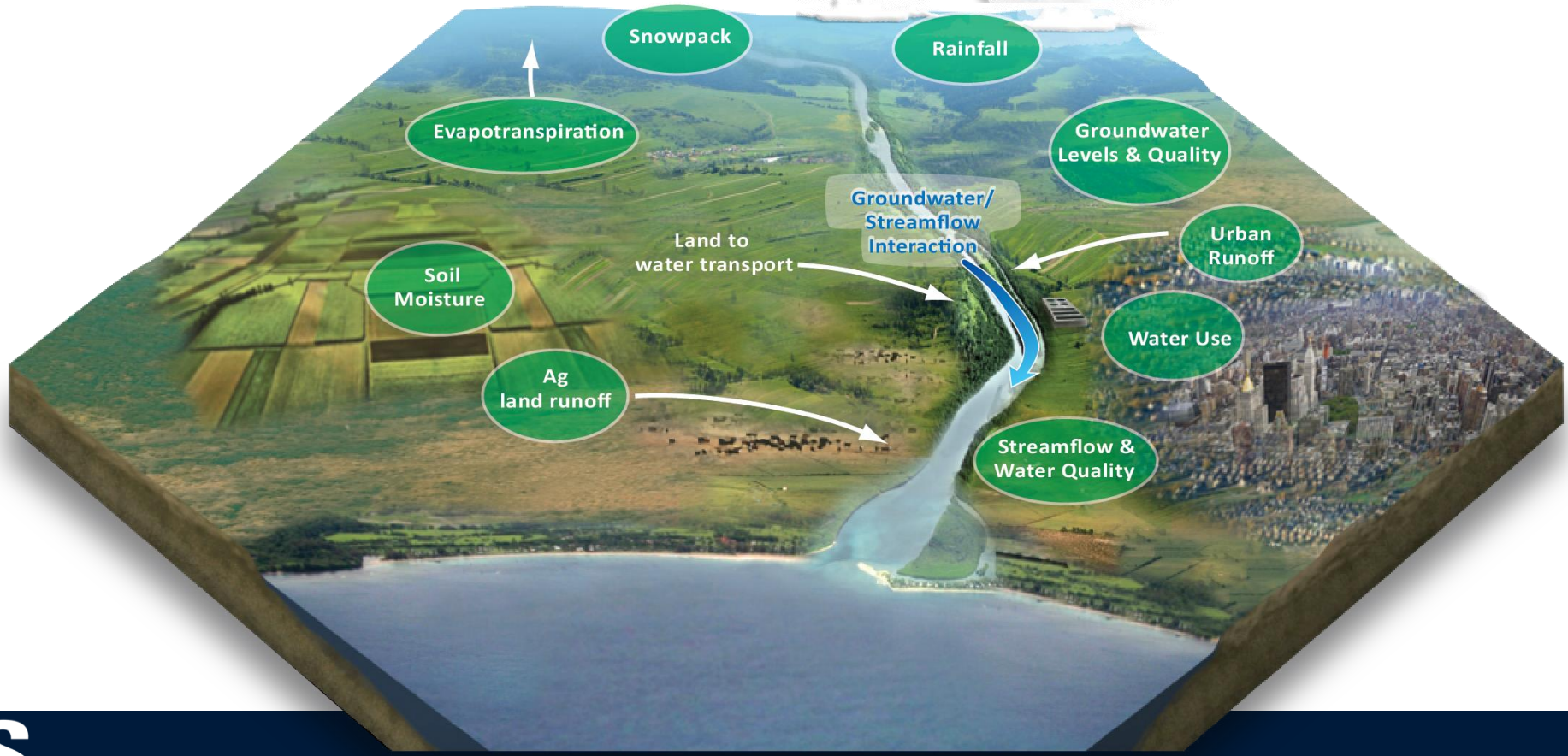


Inform modern water prediction and decision support systems

Next Generation Water Observing System (NGWOS)



When fully implemented, NGWOS will provide high temporal and spatial resolution real-time field and remote-sensing data on:



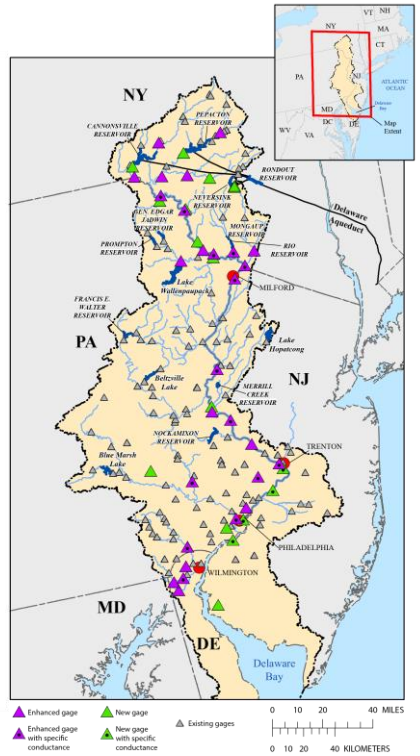
Questions data from NGWOS can help answer?

- What are the near-term and long-term risks of floods and droughts, and what scenarios change these risks?
- Are we in the early stages of a drought? How long will recovery take?
- How much water is stored in seasonal snow packs, and how will changes affect water supplies?
- How much does groundwater contribute to streamflow, or vice-versa?
- What is the quality of water and how does it change during wet/dry periods?
- How long will it take for a spill to reach a location?

NGWOS Design Strategy

- We can't afford to monitor everywhere…

- Implement NGWOS in ~10 medium-sized watersheds (approx. 10,000 - 20,000 mi^2 each) that are representative of larger water-resource regions and augment the existing streamgage network elsewhere in the region with more modest enhancements.



- Leads to more accurate predictions of streamflow, aquifer levels and water-quality conditions at unmonitored locations across the nation.

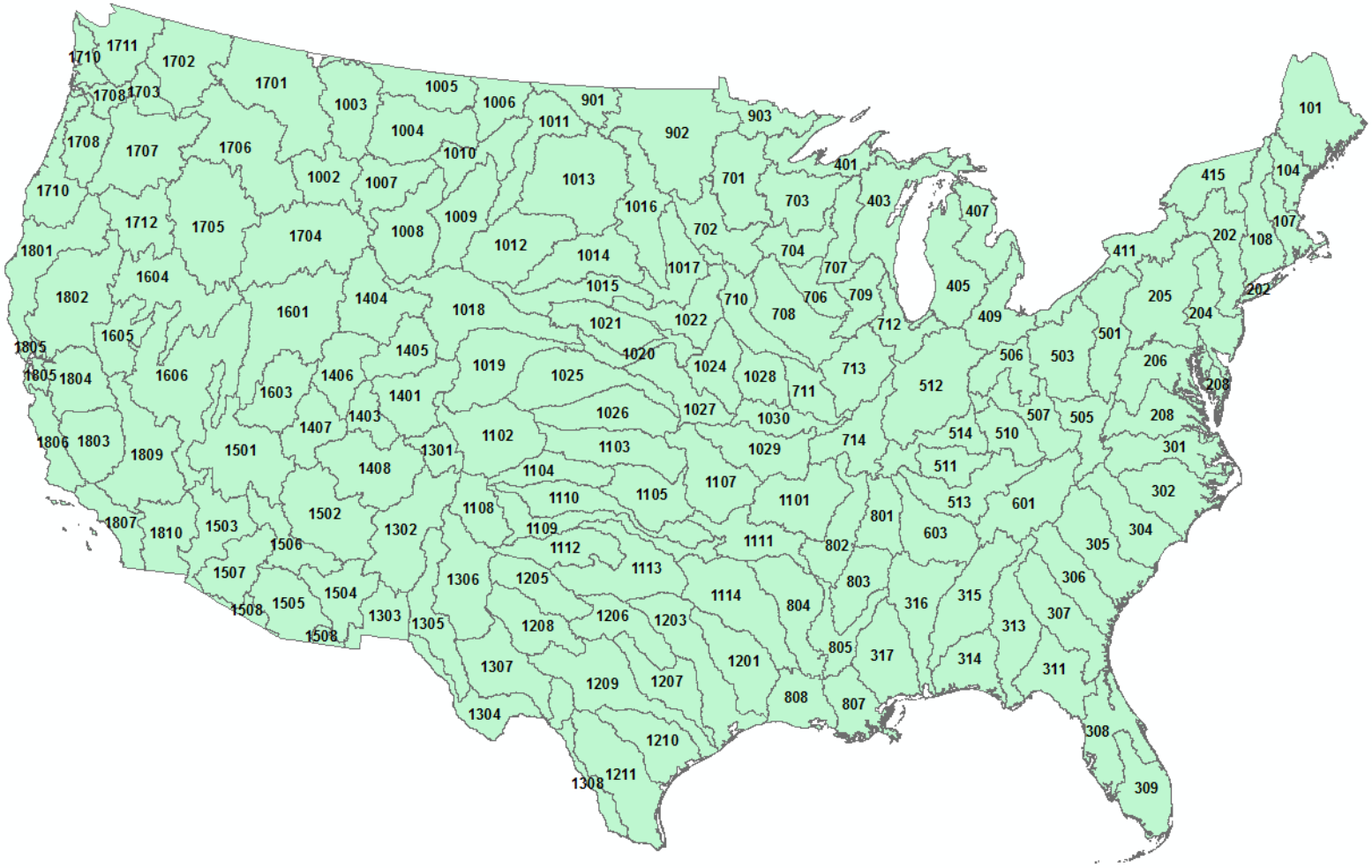
Draft – NGWOS Basin Selection Criteria

1. **Natural Factors:** the hydrologic region framework and modeling performance factors associated with it
2. **Anthropogenic Factors:** how intensive and diverse is the human foot print
3. **Importance of the Resource:** Within the basin and external, consider overall water balance – how important is this basin to all users?
4. **Current and Historical Monitoring and Modeling:** what is there to build on, evaluate trends, etc.
5. **Critical Monitoring Needs:** in what settings and issues can NGWOS fill especially important monitoring needs
6. **Feasibility:** where are we best positioned to succeed

*not all are of equal importance; one of our tasks it to weigh relative importance

Candidates based on HUC04s

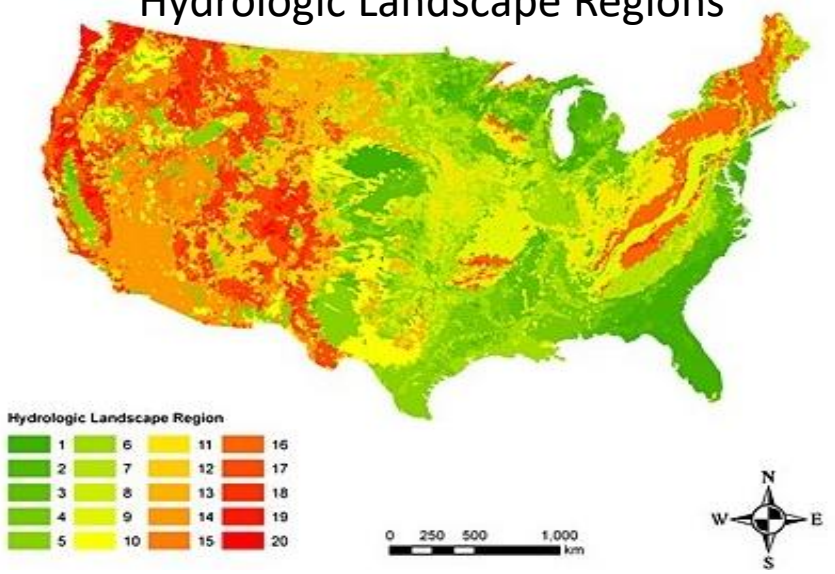
(202 CONUS HUC04s; 164 Candidate Basins (CBs))



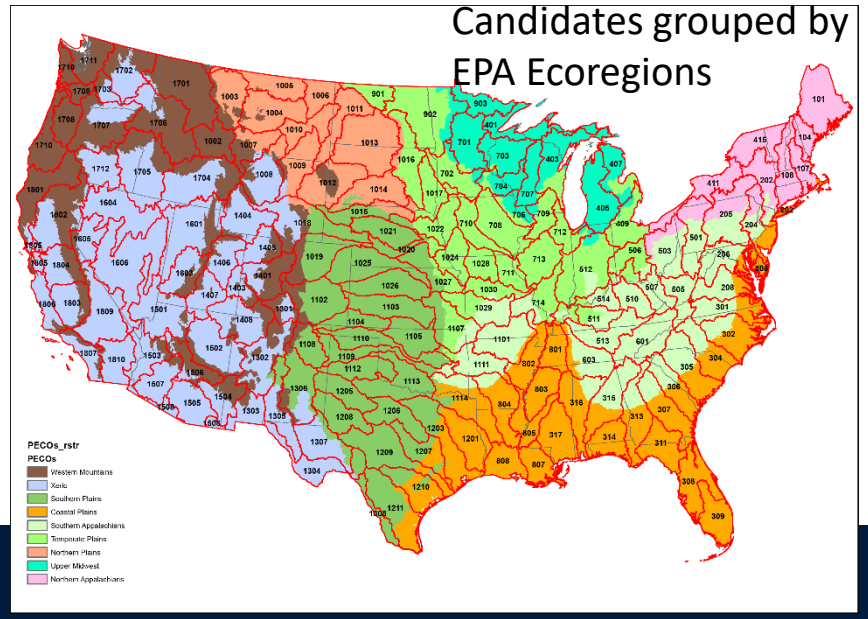
Regional Framework Options

Water Resource Regions

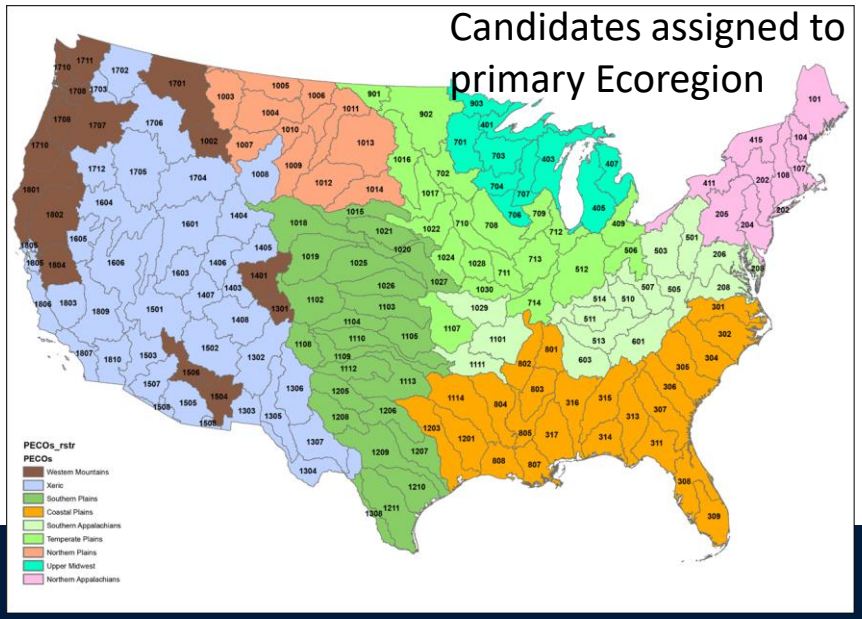
Hydrologic Landscape Regions



Candidates grouped by EPA Ecoregions



Candidates assigned to primary Ecoregion



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NGWOS Basin Winnowing Process

204 HUC04 basins will be the starting point for consideration for NGWOS. The Basin Selection Team is charged with developing the criteria for winnowing these to 50 Candidate Basins.

50 Candidate Basins will be put through a stakeholder engagement process to further refine the list for NGWOS deployment.

9 Basins will be selected for NGWOS deployment, and planning will then begin on specific instrumentation and system design.

NGWOS Budget Design

Dollars in millions	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Individual Watershed Costs
Delaware River Basin	$7.8	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$48.3
Western Basin		$7.8	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$43.8
Watershed 3			$7.8	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$39.3
Watershed 4				$7.8	$4.5	$4.5	$4.5	$4.5	$4.5	$4.5	$34.8
Watershed 5					$7.8	$4.5	$4.5	$4.5	$4.5	$4.5	$30.3
Watershed 6						$7.8	$4.5	$4.5	$4.5	$4.5	$25.8
Watershed 7							$7.8	$4.5	$4.5	$4.5	$21.3
Watershed 8								$7.8	$4.5	$4.5	$16.8
Watershed 9									$7.8	$4.5	$12.3
Watershed 10										$7.8	$7.8
Total Annual Cost	$7.8	$12.3	$16.8	$21.3	$25.8	$30.3	$34.8	$39.3	$43.8	$48.3	$280.5

NGWOS Budget and Outlook

NWIS Modernization: $0.5M FY18; $5.1M FY19

Delaware River Basin Pilot

- $1.0M in monitoring in FY18
- $3.4M in monitoring in FY19

FY20

- $3.7M* additional planned for Delaware River Basin
- Western NGWOS Basin will be selected and monitoring plan developed*

*based on availability of new funds

NGWOS Pilot – Delaware River Basin

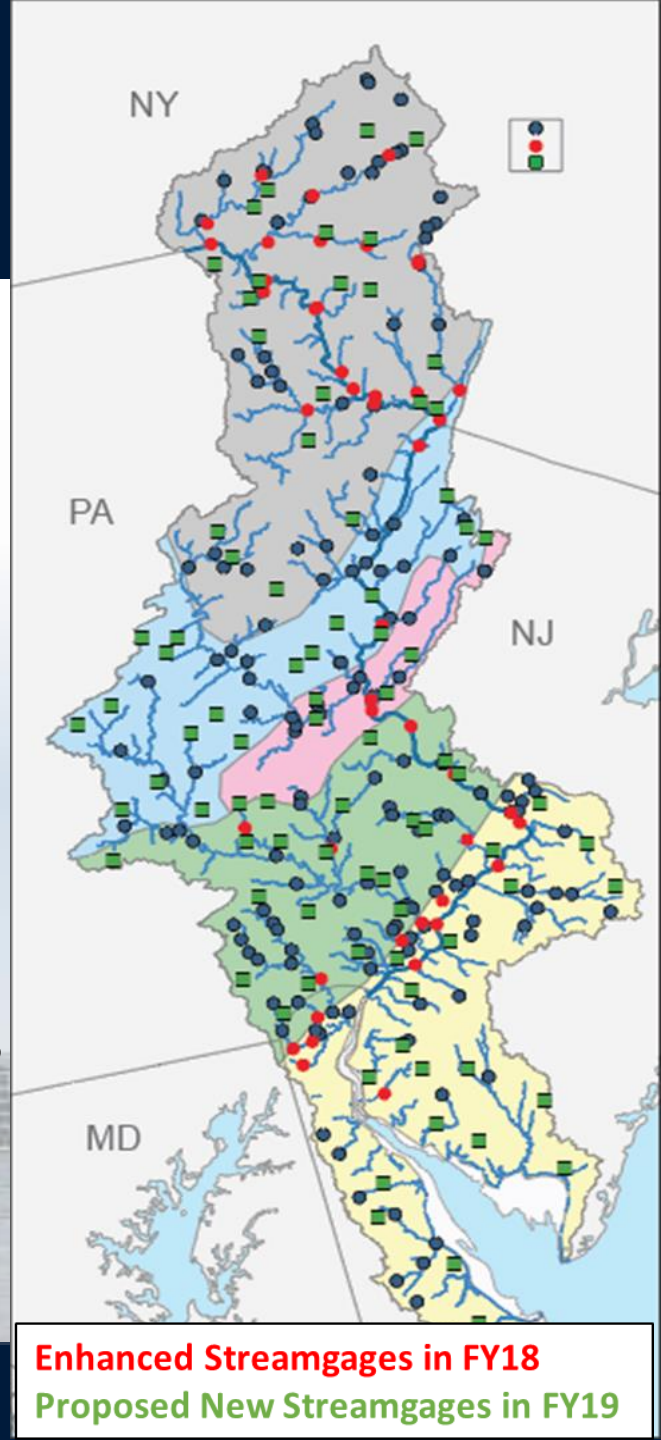
Enhanced Mainstem Monitoring

- Addition of temperature & salinity monitoring at more sites and new communication platforms

Small Stream Monitoring

- About 50 new gages in areas in basins less than about 50 mi^2 to characterize hydrologic dynamics and improve hydrologic and ecologic models;

- Current funding has allowed for ~ 57% of the planned FY19 needs for NWIS modernization and nearly 50% of the NextGen network in DRB



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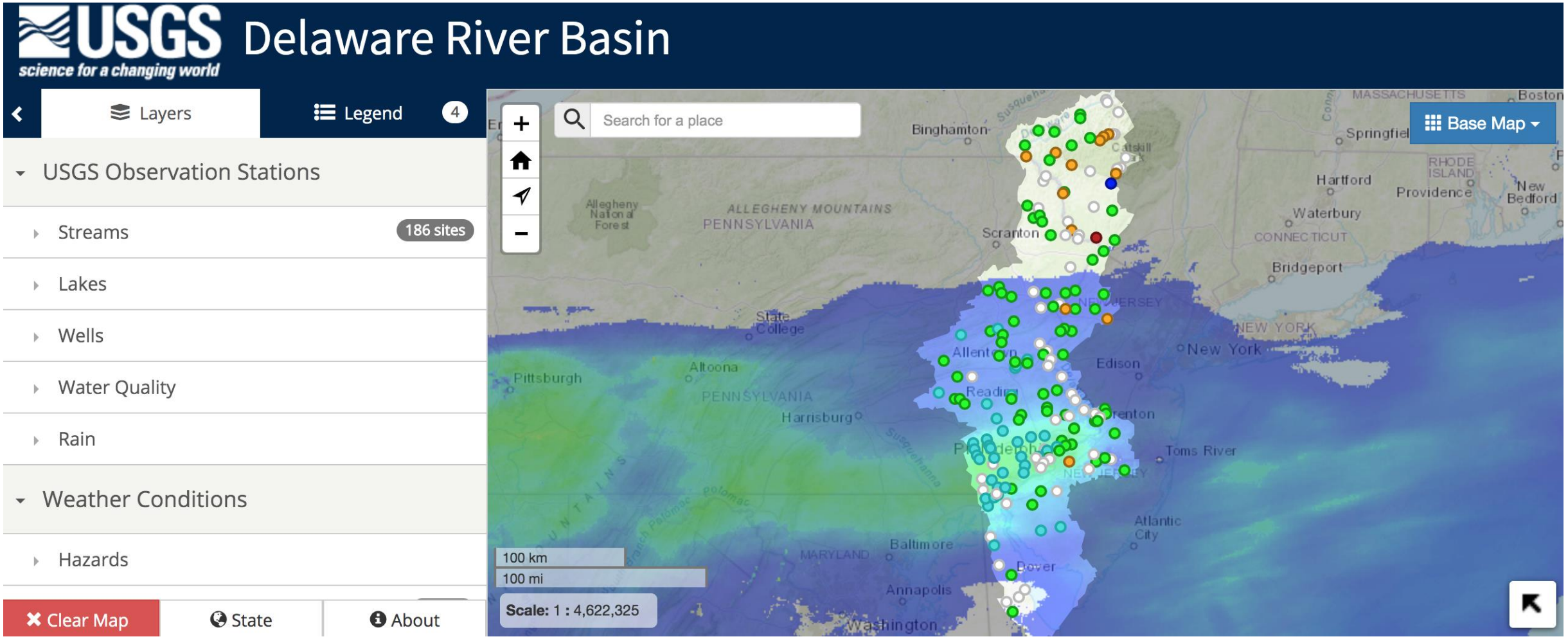
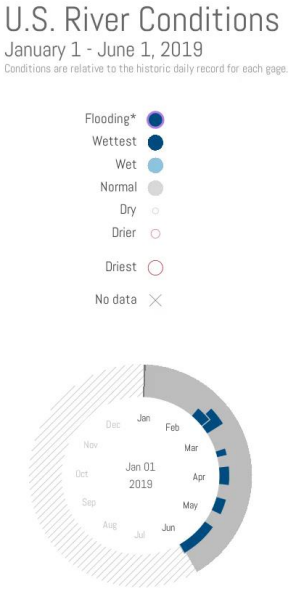
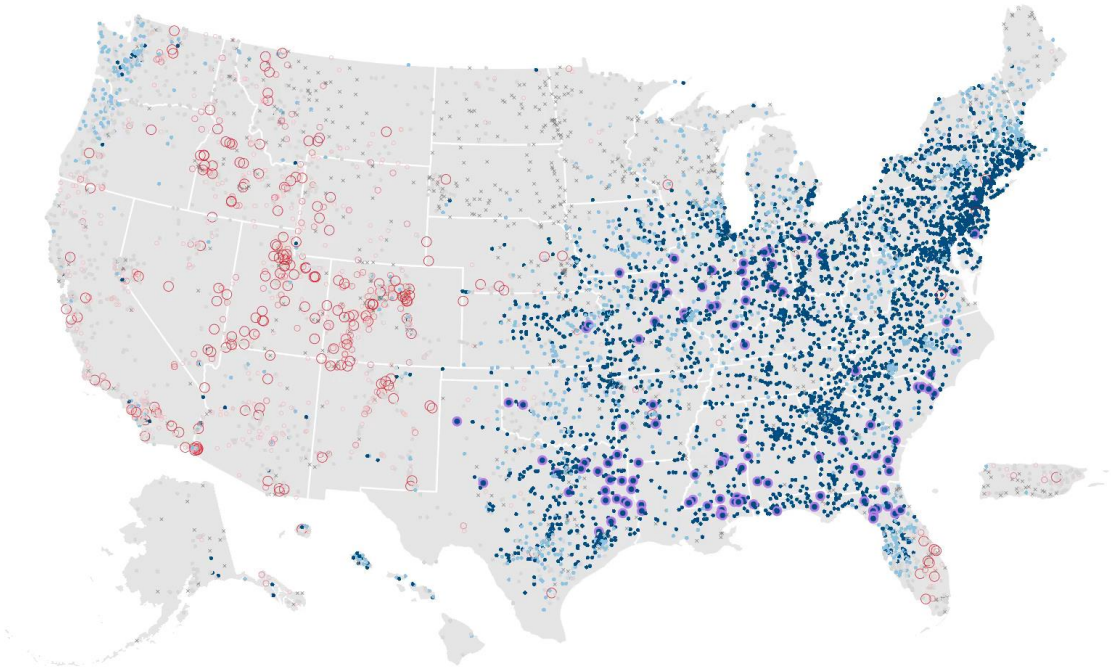
Integrated Data Delivery



Data Delivery

2019 Water Conditions (Jan-June)





USGS

USGS

* Both USGS gage height and National Weather Service flood stage levels are necessary to determine flooding conditions and were available for 38% of gages at the time this graphic was produced. We used only publicly available data from NWISWeb and some gages are missing gage height even when they have flow.

Next Generation Water Observing System

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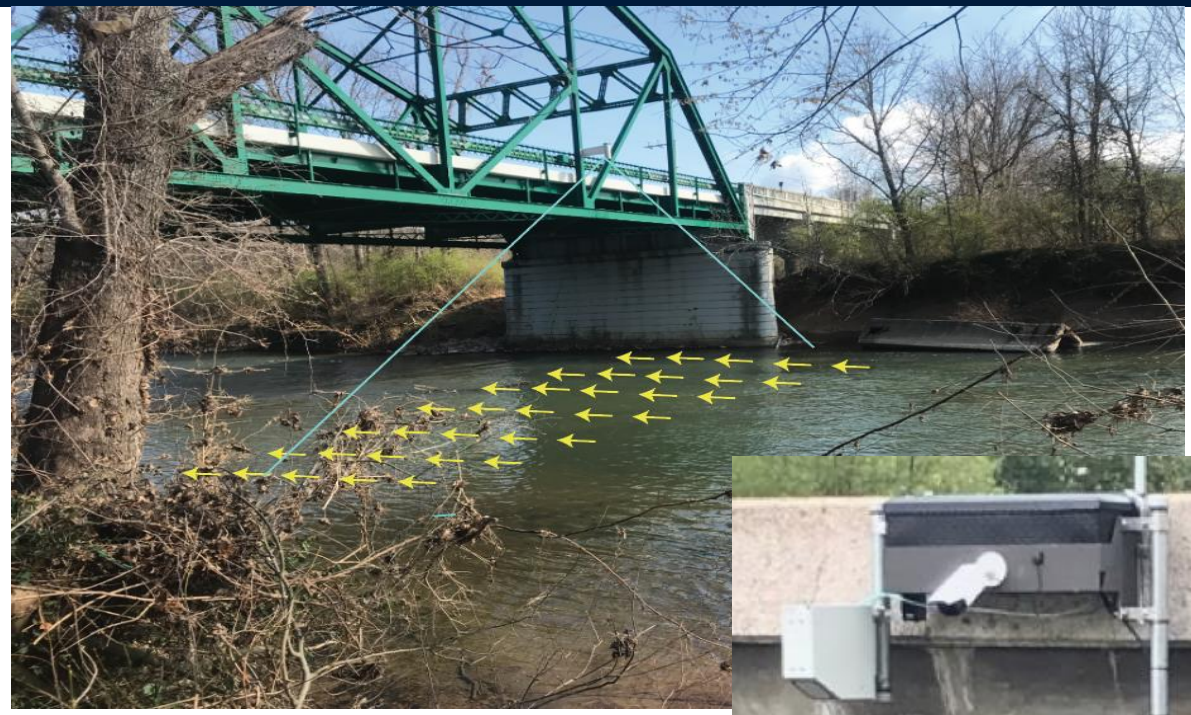
USGS Streamgages Instagram: https://instagram.com/usgs_streamgages/
Mobile Water Data: https://m.waterdata.usgs.gov
WaterAlert: https://water.usgs.gov/wateralert/parameters/
Water Watch: https://waterwatch.usgs.gov
GW Watch: https://groundwaterwatch.usgs.gov
Flood Event Viewer: https://stn.wim.usgs.gov/fev/
Flood Inundation Mapper: https://fim.wim.usgs.gov/fim

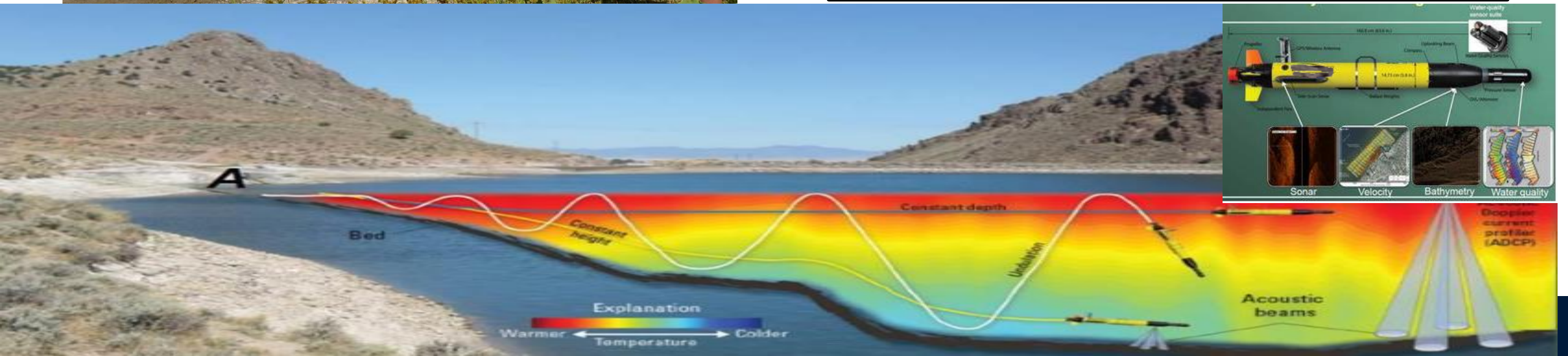
Water Level, Velocity, and Discharge from Radars and Video



Generating techniques and methods to monitor water level, velocity distributions, and streamflow:

- **More efficiently;**
- **In more detail;**
- **Understand changes in real-time**

Integration of Drones and Satellites to Monitor Water Quantity, Quality, and Use



FY19 GWSIP Budget

Total Program Funding – $82.7M (+$8.5M over FY18)

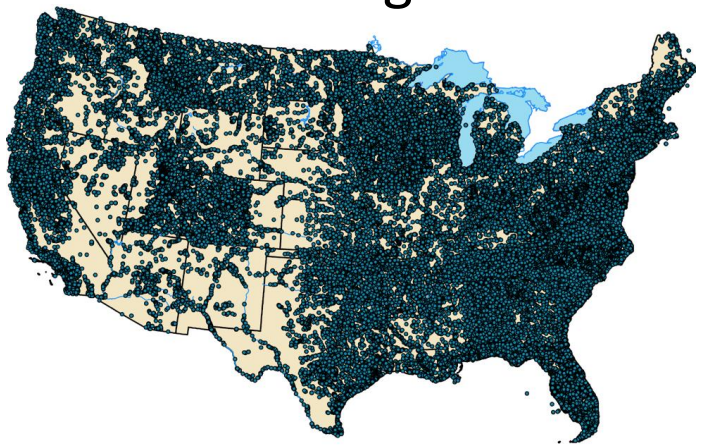
- Cooperative Matching Funds – $30.3M (+*$0*)
- Federal Priority Streamgages – $24.7M (+*$0*)
- National Groundwater Monitoring Network – $4.0M (+*$0*)
- NextGen Water Observing System – $8.5M (+*$7M*)
- US-Canada Transboundary Streamgages – $1.6M (+*$1.5M*)
- Natural Hazard Science for Disaster Response – $3.2M (+*$0*)
- Research and Development (i.e. remote sensing) – $2.5M (+*$0*)

Basin Selection Approach

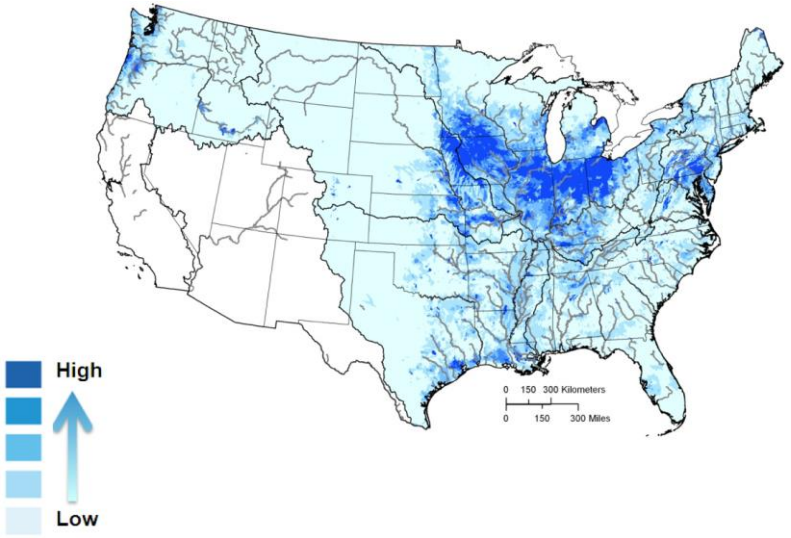
1. Document, with references, the technical basis for the NGWOS concept (focus basins in support of national models)
2. Establish ranking criteria—quantitative and qualitative
3. Identify candidate basins and regional framework(s)
4. Develop GIS and other supporting info
5. Define steps to quantitative ranking to winnow the field
6. Develop additional quant and qual info on short list of candidates
7. Write up results including narrative descriptions of pros and cons for candidates for final selection

NGWOS Basin Selection Criteria

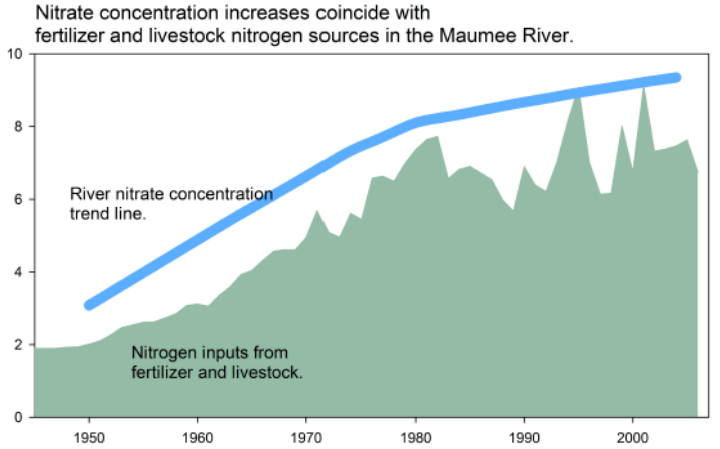
Monitoring Data



Model Estimates and Uncertainty

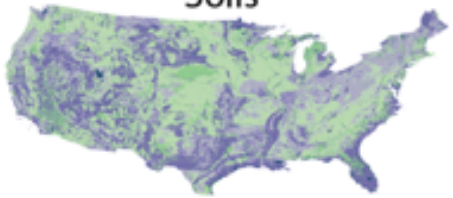


Trends



Stream & Reservoir Water Velocity

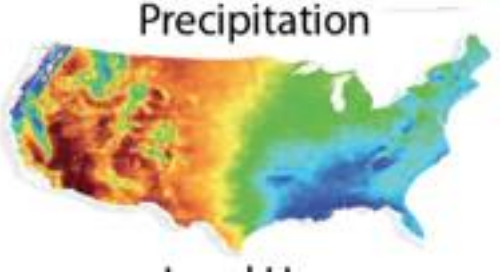
Soils



Land Use

Water Use

Precipitation

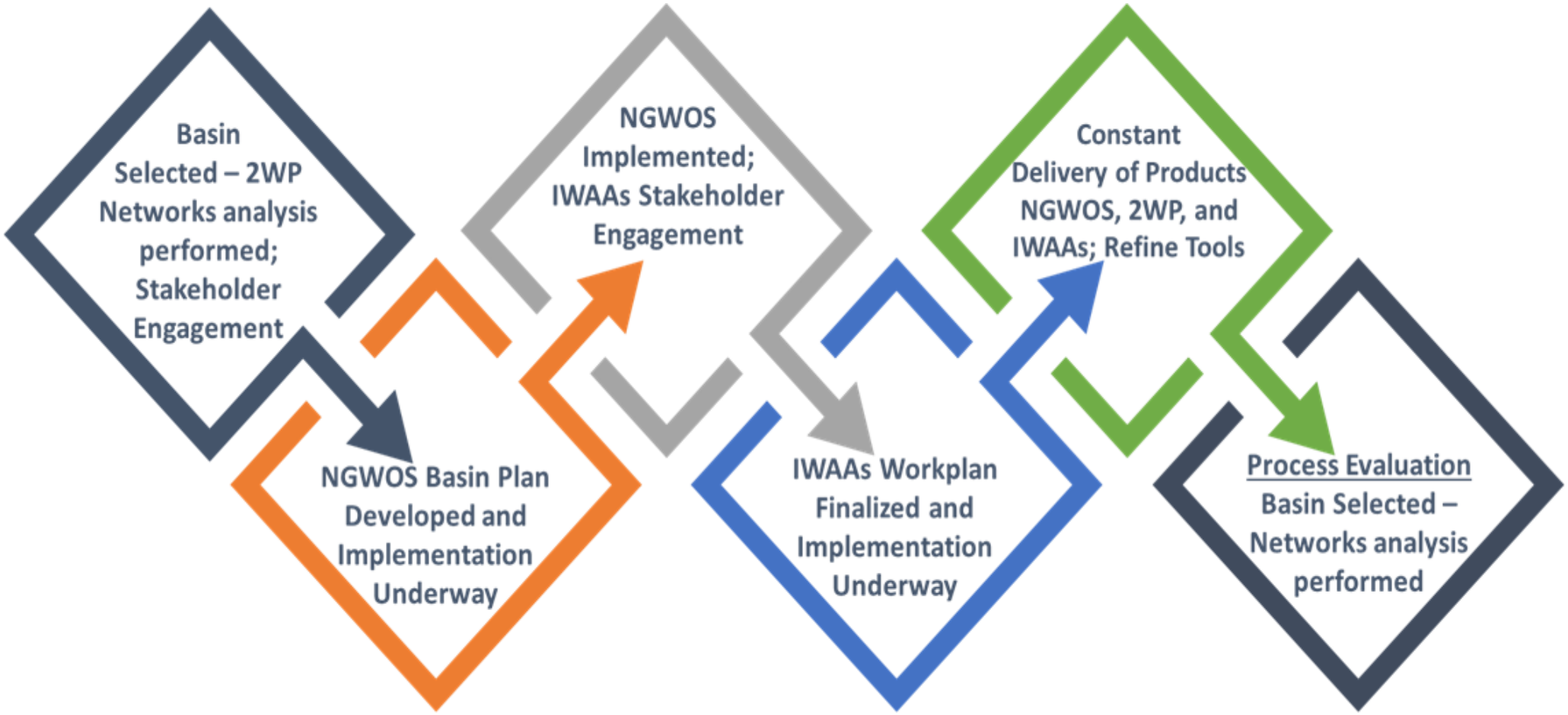


Practical NGWOS Applications

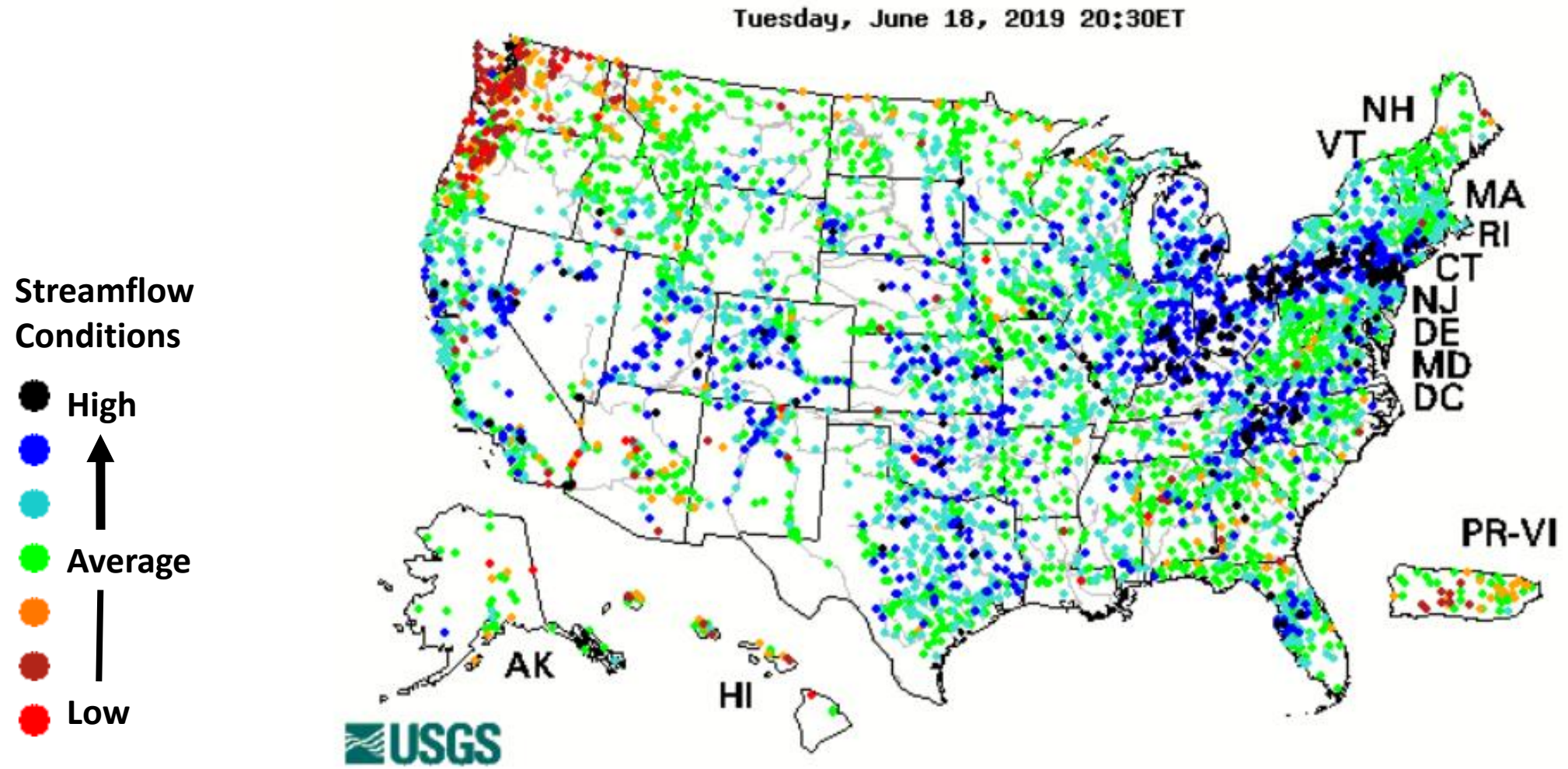
- Calibrate/validate the National Water Model and other advanced regional/national models to improve predictions;
- Characterize and reduce uncertainty in measurements and model prediction.
- These uncertainty estimates can also identify areas where additional streamgages are needed to reduce uncertainty.

This would allow for more strategic investment in long-term gages at key locations.

Implementation Process for NGWOS, 2WP and IWAAs

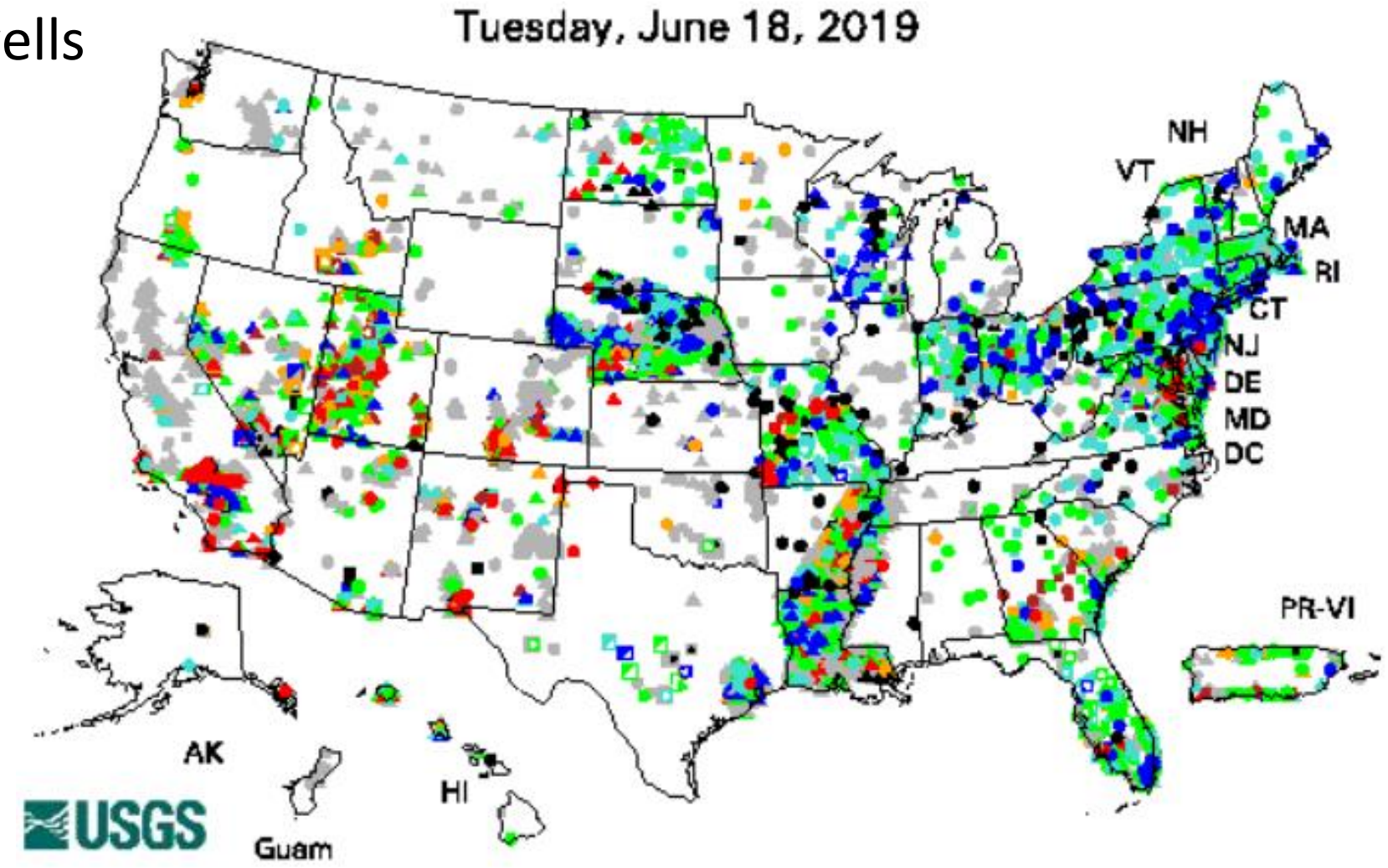


National Streamflow Network

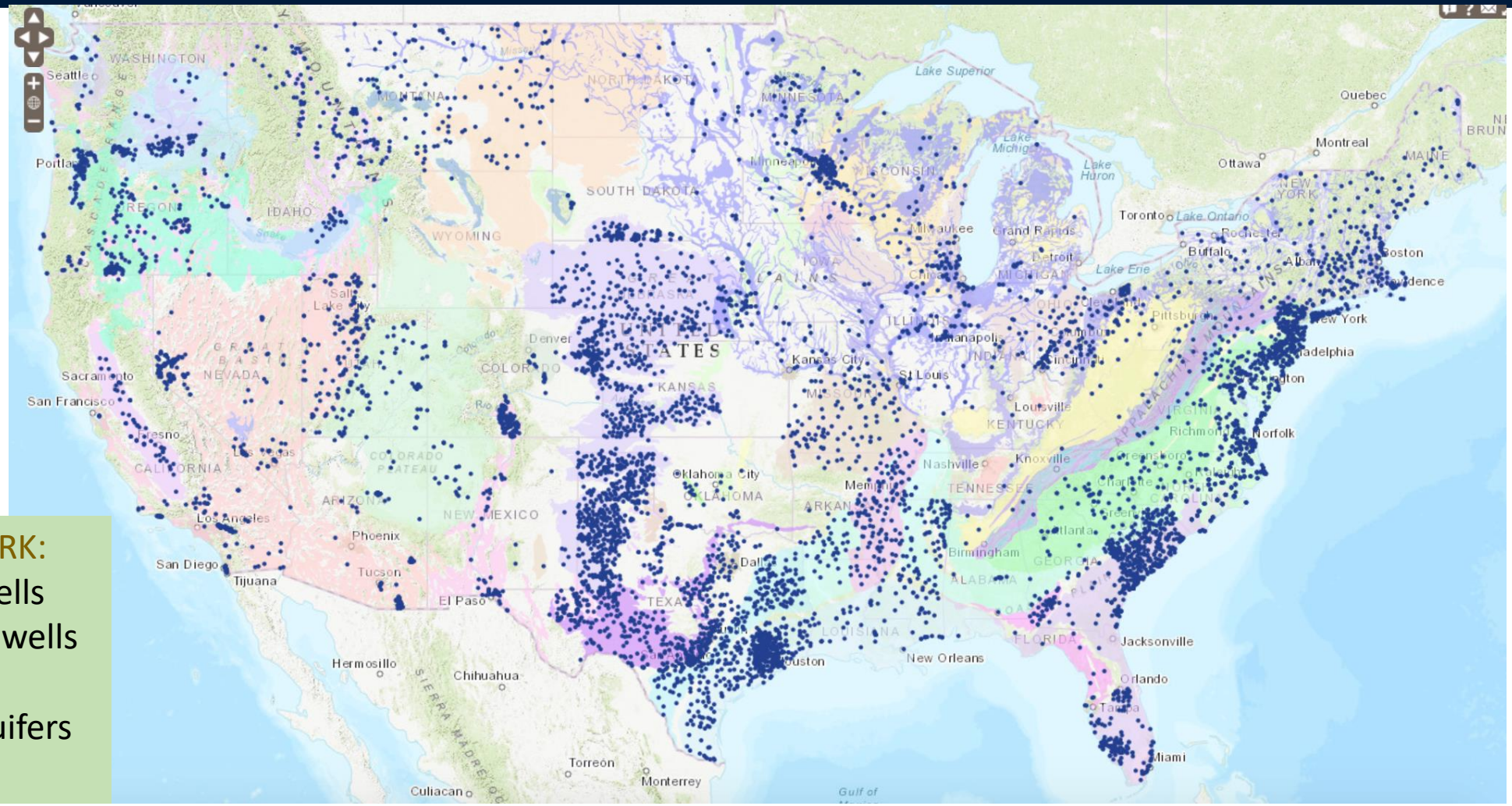


Groundwater Level Conditions

20,000 observation wells
1,675 real-time wells



National Groundwater Monitoring Network



CURRENT NETWORK:

7,000+ water-level wells

2,000+ water-quality wells

30+ data providers

62 of 67 principal aquifers

All 50 states

Improving Streamflow Measurements