# Harnessing the Power of Scalable Cloud Infrastructure for Hydrologic Data and Service Dissemination Through National Water Prediction Service (NWPS)

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## National Water Prediction Service

The National Water Prediction Service (NWPS) is the authoritative dissemination platform for hydrologic information from the National Weather Service (https://water.noaa.gov).

On March 27, 2024, NWPS replaced the legacy Advanced Hydrologic Prediction Service (AHPS) which had served the hydrologic community for over two decades.
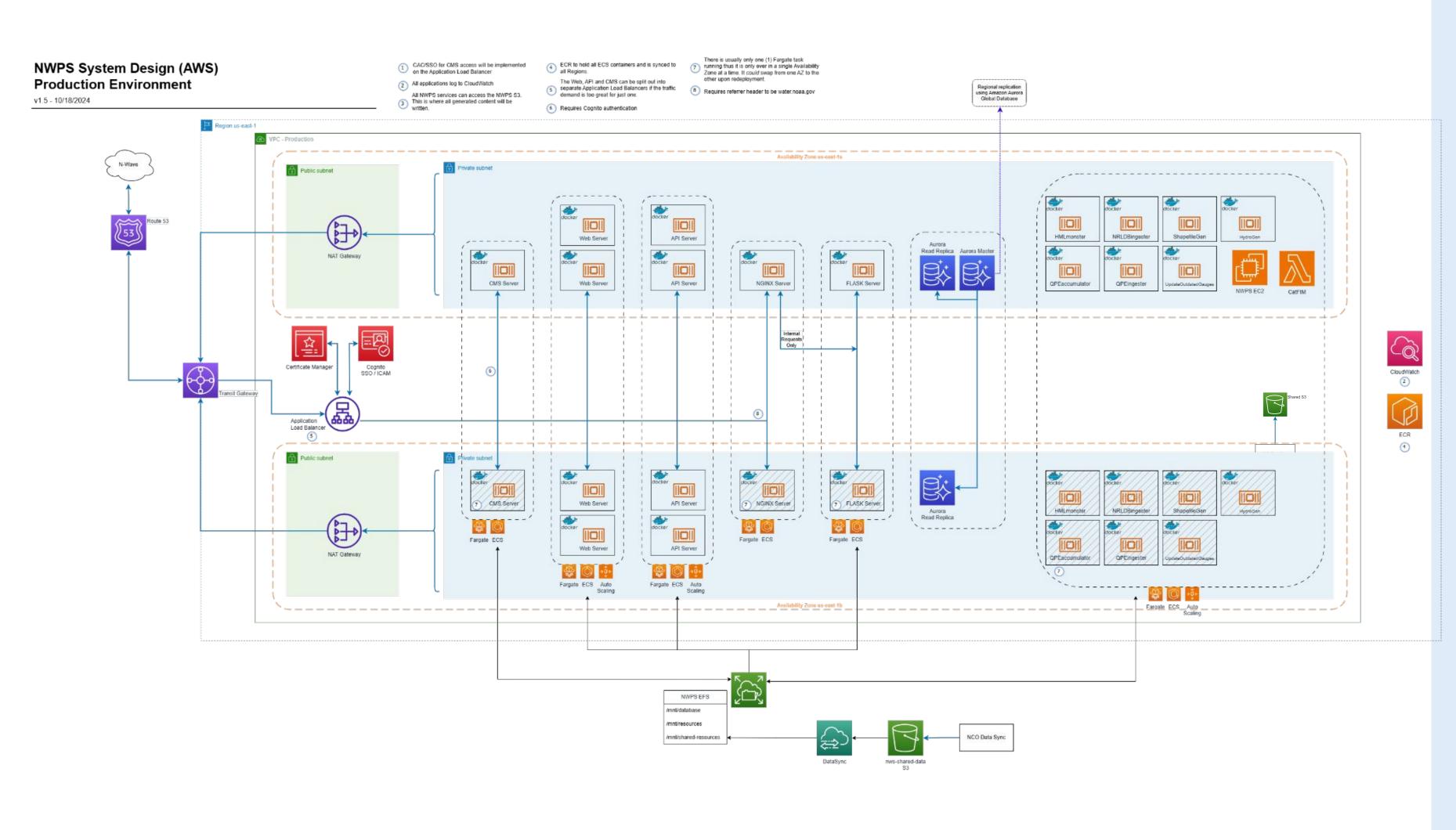
The design of NWPS emphasizes the dissemination of water resources information to support decision-making during high-impact flood events.

Examples of Improved Features in NWPS:
- Expanded map displays
  - Improved visualization of River Gauges
  - Quantitative Precipitation Estimates (QPE)
- Enhanced hydrograph controls of time period (legacy hydrographs still available)
- Interactive map overlay of NWS hazards (watch, warning, advisory)
- National Water Model (NWM) access - 3.4M miles from NHDplus network
- Application Programming Interface (API)- suite of data services to access source data
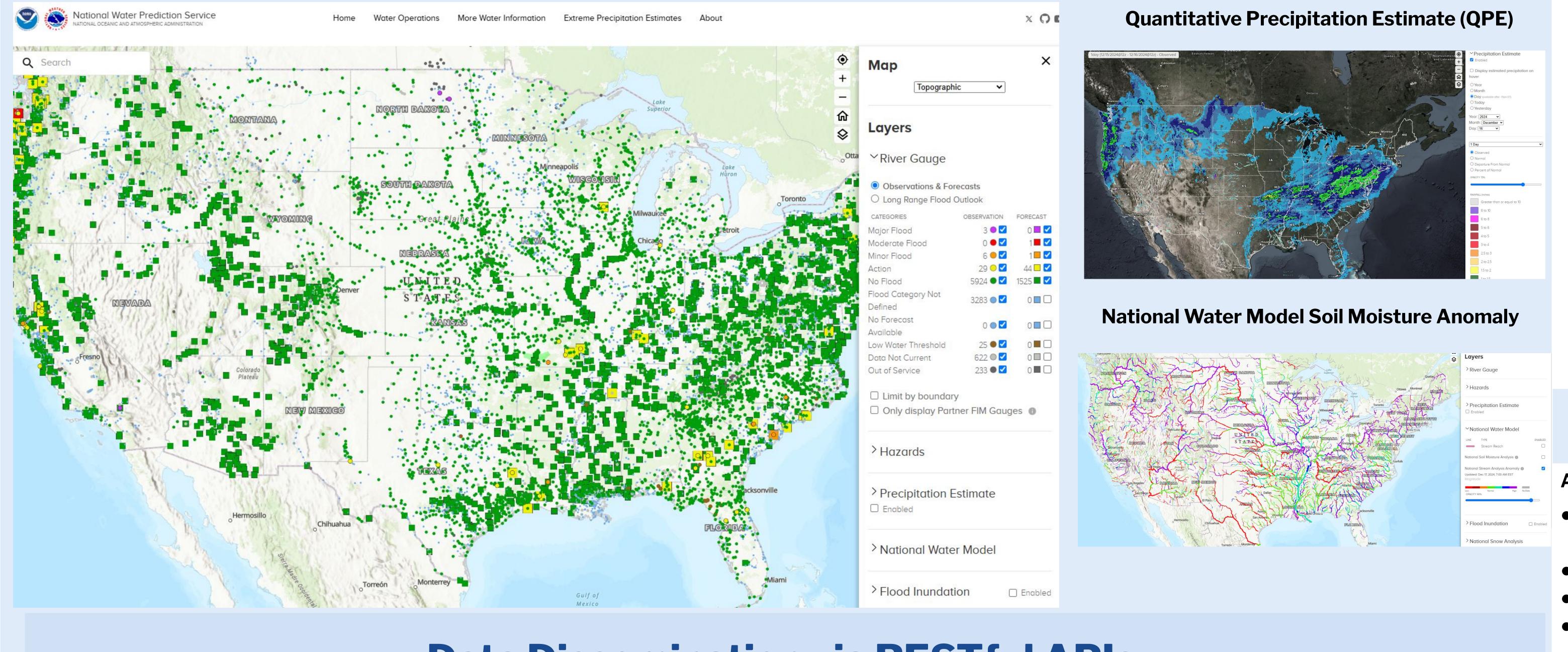- Flood Inundation Maps (FIM)

## NWPS Scalable Resilient System in Cloud

Designed to scale and handle the increased usage and demand. Increase integration with front end Web and API autoscaling based on user load.
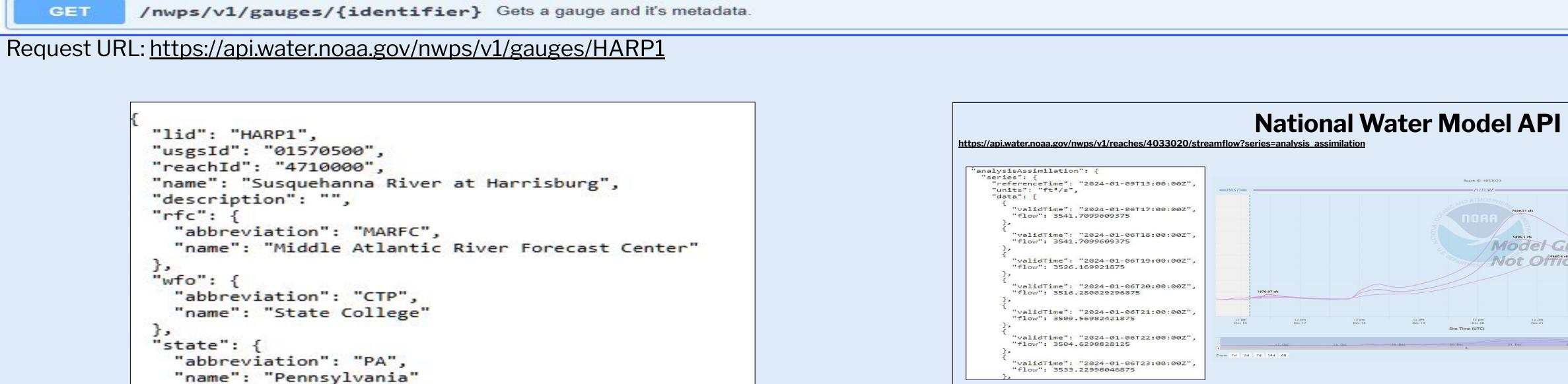


**NWPS Production System Architecture**

## Hydrologic Products on NWPS



**Quantitative Precipitation Estimate (QPE)**



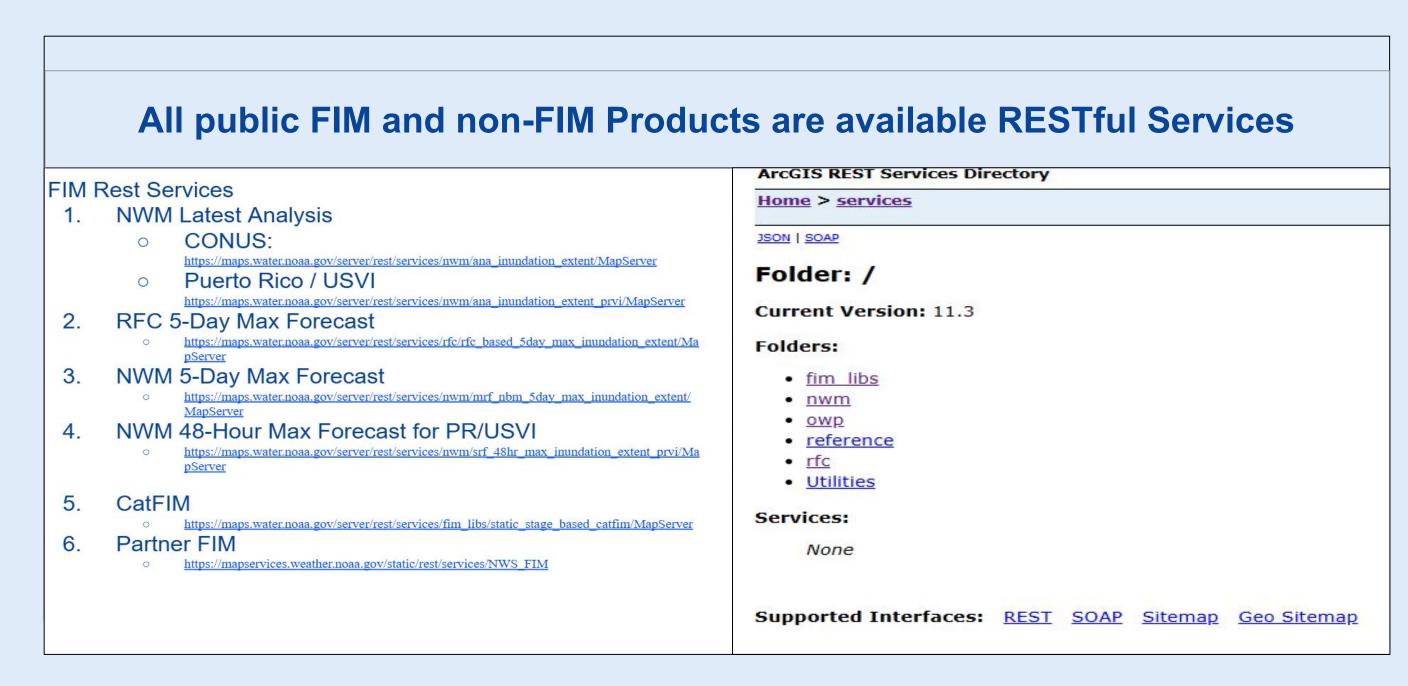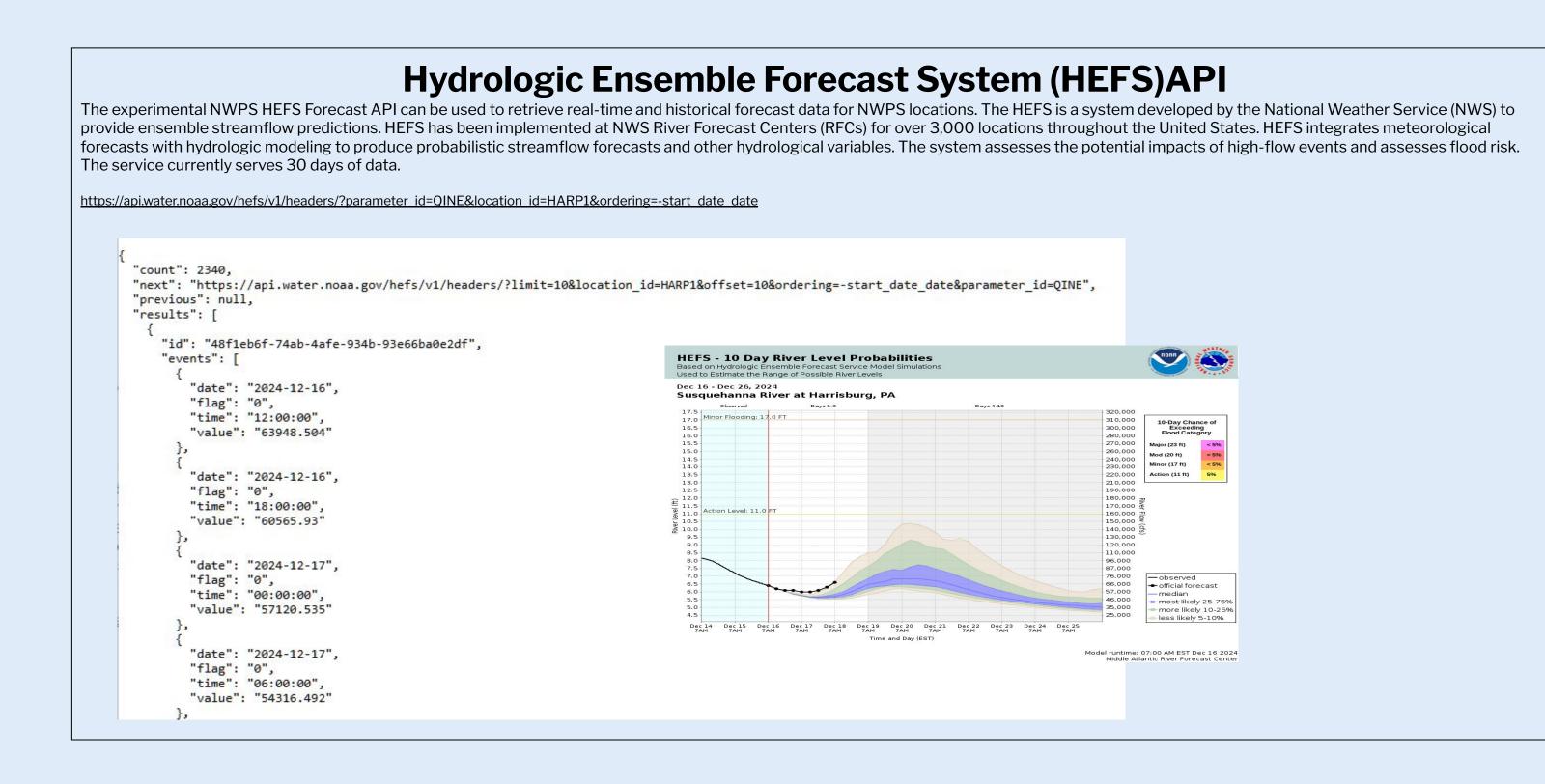**National Water Model Soil Moisture Anomaly**



## Data Dissemination via RESTful APIs

NWPS data are available via RESTful APIs (https://water.noaa.gov/about/api and https://maps.water.noaa.gov/server/rest/services)
NWPS API Examples – Building a Hydrograph: (https://api.water.noaa.gov/nwps/v1/docs/)
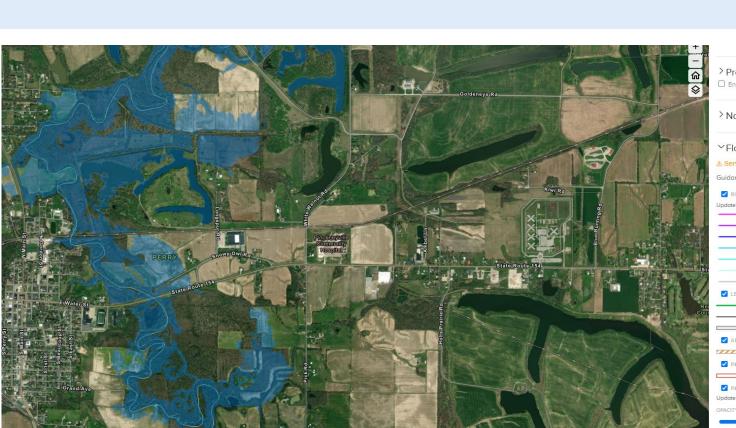*Workflow to build a stage hydrograph: 2 endpoints*

```
GET  /nwps/v1/gauges/{identifier}  Gets a gauge and it's metadata.
```
Request URL: https://api.water.noaa.gov/nwps/v1/gauges/HARP1

```
{
  "lid": "HARP1",
  "usgsId": "01570500",
  "reachId": "4710000",
  "name": "Susquehanna River at Harrisburg",
  "description": "",
  "rfc": {
    "abbreviation": "MARFC",
    "name": "Middle Atlantic River Forecast Center"
  },
  "wfo": {
    "abbreviation": "CTP",
    "name": "State College"
  },
  "state": {
    "abbreviation": "PA",
    "name": "Pennsylvania"
  },
```

**National Water Model API**



Model Guidance Not Official Forecast

## ArcGIS REST Services

### All public FIM and non-FIM Products are available RESTful Services

FIM Rest Services
1. NWM Latest Analysis
   - CONUS:
   - Puerto Rico / USVI
2. RFC 5-Day Max Forecast
3. NWM 5-Day Max Forecast
4. NWM 48-Hour Max Forecast for PR/USVI
5. CatFIM
6. Partner FIM

**ArcGIS REST Services Directory**
Home > services
2024 2024
Folder: /
Current Version: 11.3
Folders:
- firm_libs
- nwm
- owp
- reference
- rfc
- Utilities
Services:
- None

Supported Interfaces: REST SOAP Sitemap Geo Sitemap

**Hydrologic Ensemble Forecast System (HEFS) API**

The experimental NWPS HEFS Forecast API can be used to retrieve real-time and historical forecast data for NWPS locations. The HEFS is a system developed by the National Weather Service (NWS) to provide ensemble streamflow predictions. HEFS has been implemented at NWS River Forecast Centers (RFCs) for over 3,000 locations throughout the United States. HEFS integrates meteorological forecasts with hydrologic modeling to produce probabilistic streamflow forecasts and other hydrological variables. The system assesses the potential impacts of high-flow events and assesses flood risk. The service currently serves 30 days of data.
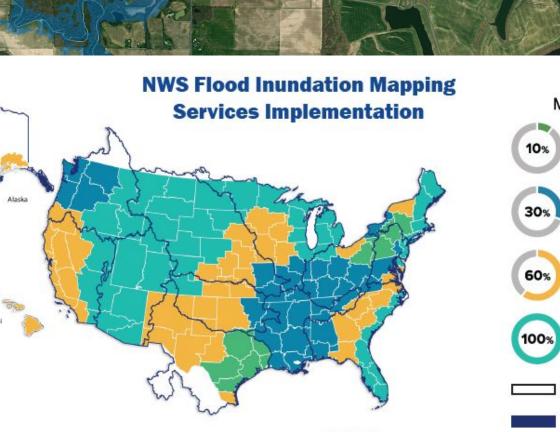


## Flood Inundation Mapping (FIM)



- Demand for event-driven flood inundation mapping (FIM) has surged, making it a vital tool for emergency and water resource managers to address flood impacts.
- NWS has developed high-resolution static and dynamic FIM products using the National Water Model and NWS RFC River Forecasts.
- Currently available for 30% of the nation, with full deployment by Sept 2026.
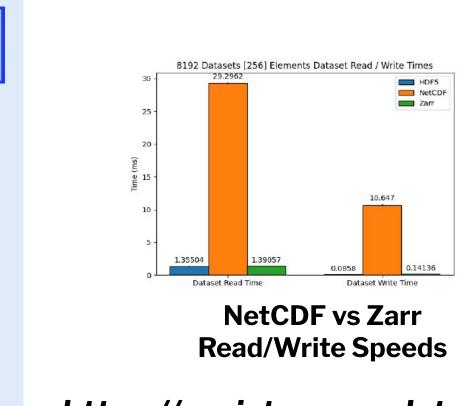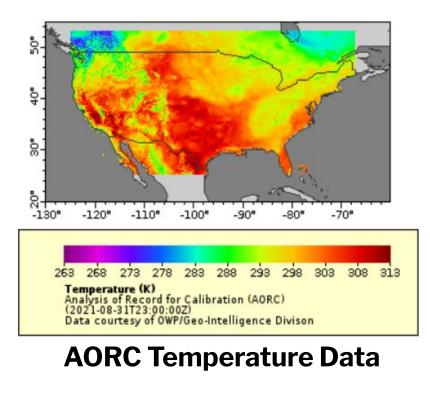- For more information see the QR code below for a FIM fact sheet.

**NWS Flood Inundation Mapping Services Implementation**



## Analysis Ready Cloud Optimized (ARCO) Data

**Analysis of Record for Calibration (AORC) v1.1**
- The AORC v1.1 dataset provides a continental-scale, climatology-constrained, multi-decade, near-surface weather record for the U.S.
- Consists of 8 variables and spans a time period of February 1979 to December 2023.
- The dataset's total size is 19TB with a yearly growth of 350GB / year.
- Variables in this data: Total precipitation, Air temperature, Specific humidity, Downward Short- and Long-wave radiation and flux.
- Why Zarr?
  - Zarr is a cloud-optimized data format specifically created for improving access to large N-Dimensional arrays allowing easy access to predefined chunks of data.
  - Read/write times are also significantly faster than working with netCDF.



**NetCDF vs Zarr Read/Write Speeds**

Zarr

**AORC Temperature Data**

https://registry.opendata.aws/noaa-nws-aorc/

## Future Direction

**NWPS Application Improvement Areas:**
- Mobile Experience
- Data Layer Management
- Search Capabilities
- Precipitation Estimate handling
- Implement Rivers-at-a-Glance tool

**Future NWPS APIs**
- NWS Stream Forecast API- Returns forecast ingested from RFC and WFO HML
- Stream Observation API- Return Observations ingested from RFC and WFO HML
- National Water Model (NWM) Streamflow and Total Water Level API
- Hydrologic Location Metadata API- Return metadata, crosswalks, rating curves, thresholds, and USGS/NWM recurrence flows
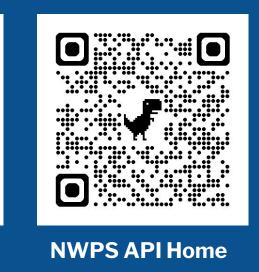
**105th AMS Annual Meeting**
**33rd Conference on Weather Analysis and Forecasting**
**29th Conference on Numerical Weather Prediction**

NWPS | FIM Factsheet | NWPS API Home | AORC v1.1 (Zarr) | NWPS API | HEFS API | NWC Operations

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