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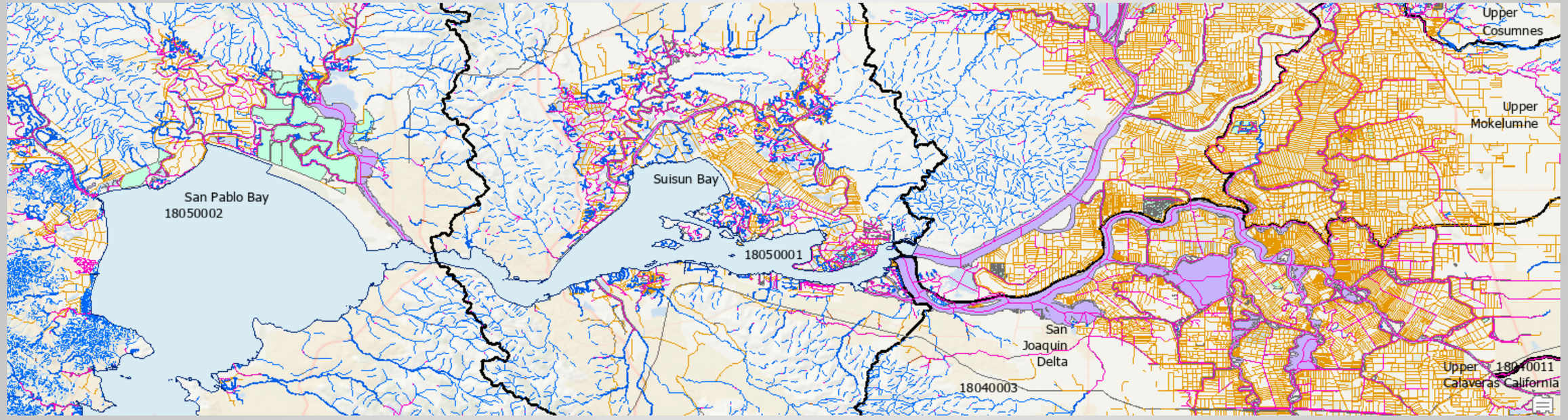
National Hydrography Dataset of the Future:
Changes are Coming – Users Input Needed

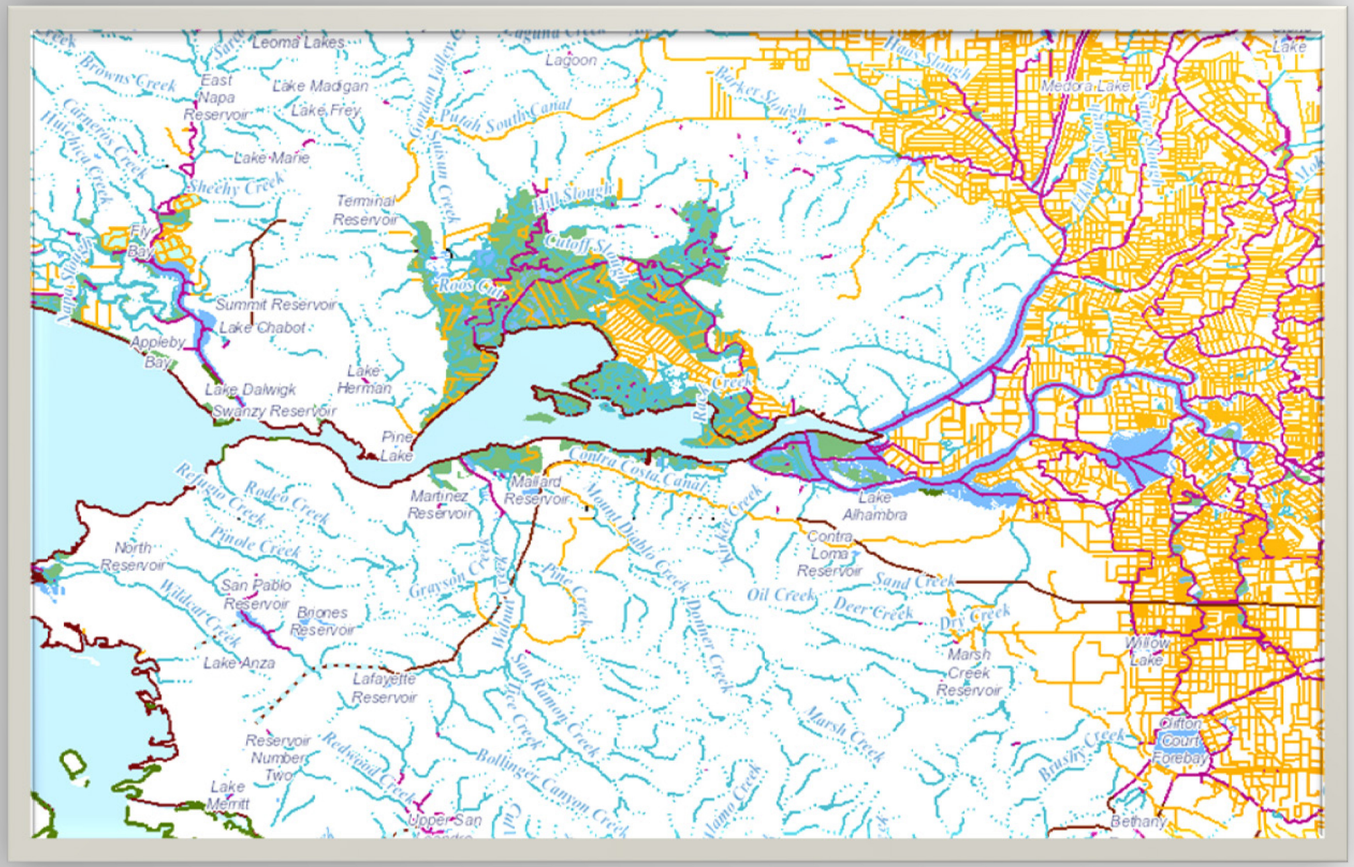
Statewide Community Call, July 21, 2022



SAVE OUR WATER

Jane Schafer-Kramer, Geographic Data Specialist

National Hydrography Dataset (NHD)



- Surface water component of the National Map at 1:24,000 scale
- File geodatabase* with geometric network of flow connectivity
- Maintained by US Geological Survey in partnership with States
- DWR assumed stewardship of California portion in FY 2016

**available for download as shapefiles and geopackage as well as the Esri file geodatabase format*

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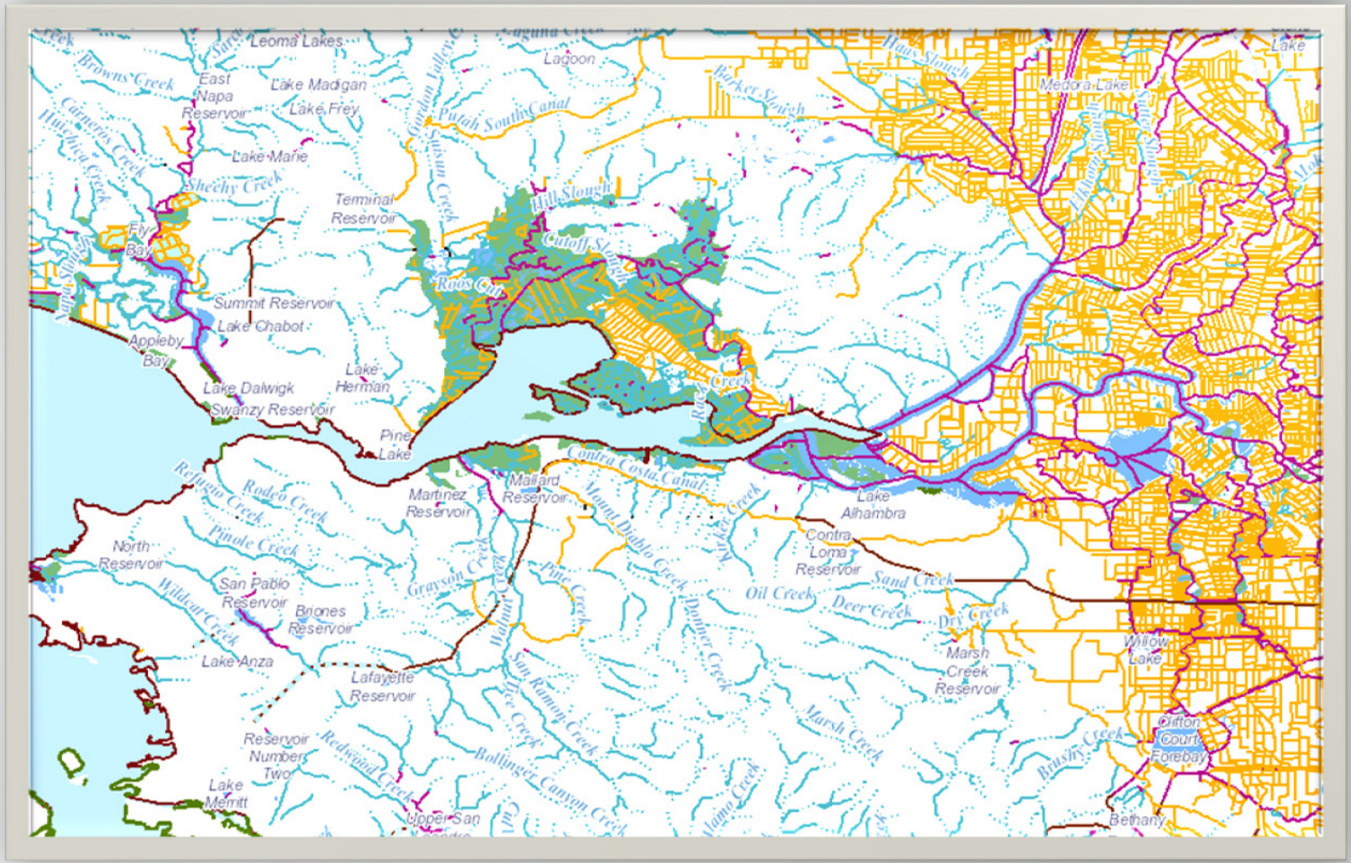
https://www.usgs.gov/national-hydrography/national-hydrography-dataset

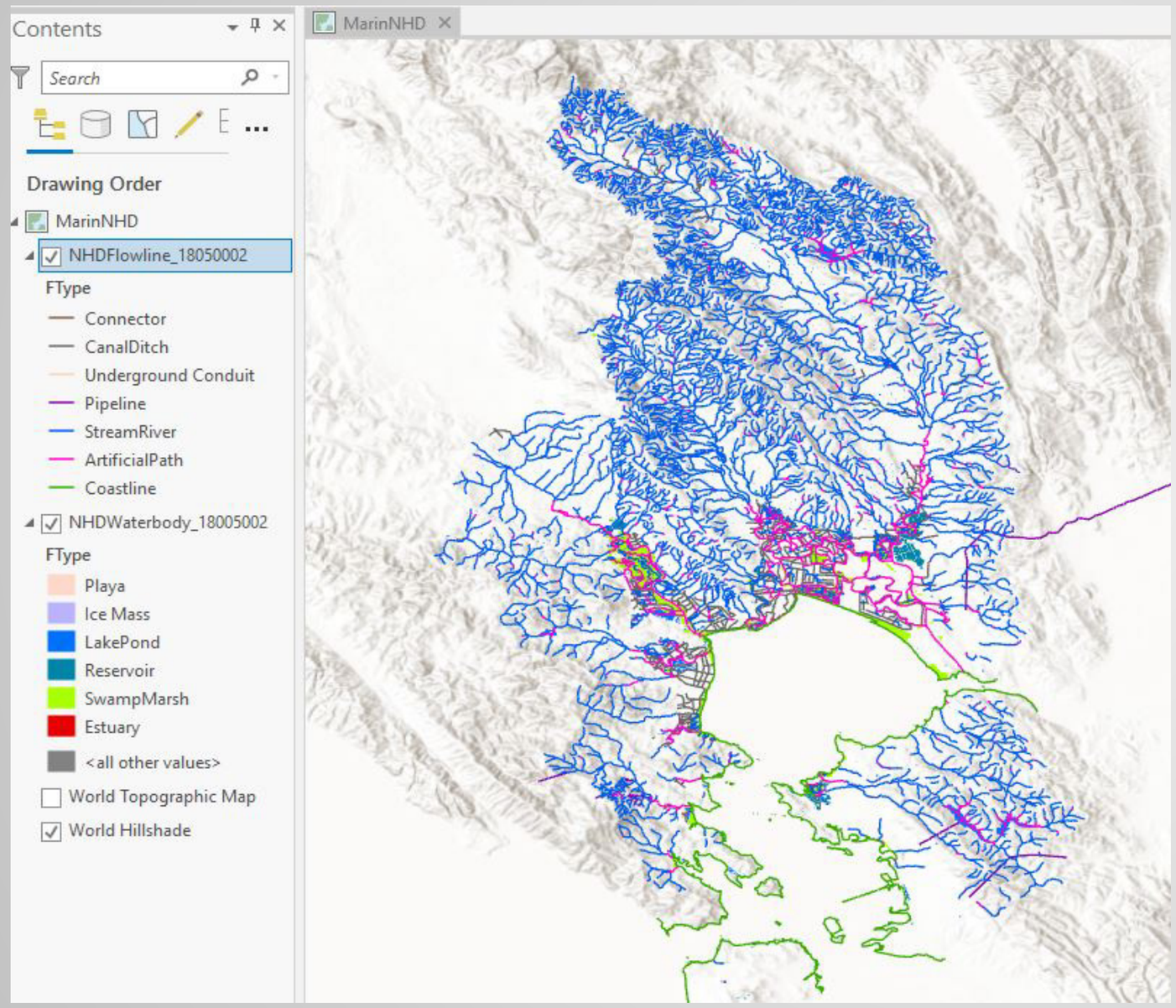
NHD…*as it is today*

- **NHDFlowline**
- **NHDWaterbody**
- **NHDArea**
- **NHDLine**
- **NHDPoint**
- **+ related tables**

…all this including subtypes and domains <u>and</u> linear referencing with a network address!



Core Content in the NHD



- **NHDFlowline Feature Types**
  - StreamRiver
  - CanalDitch
  - Pipeline
  - Underground Conduit
  - Artificial Path
  - Connector
  - Coastline

  Flowlines carry a seasonality attribute

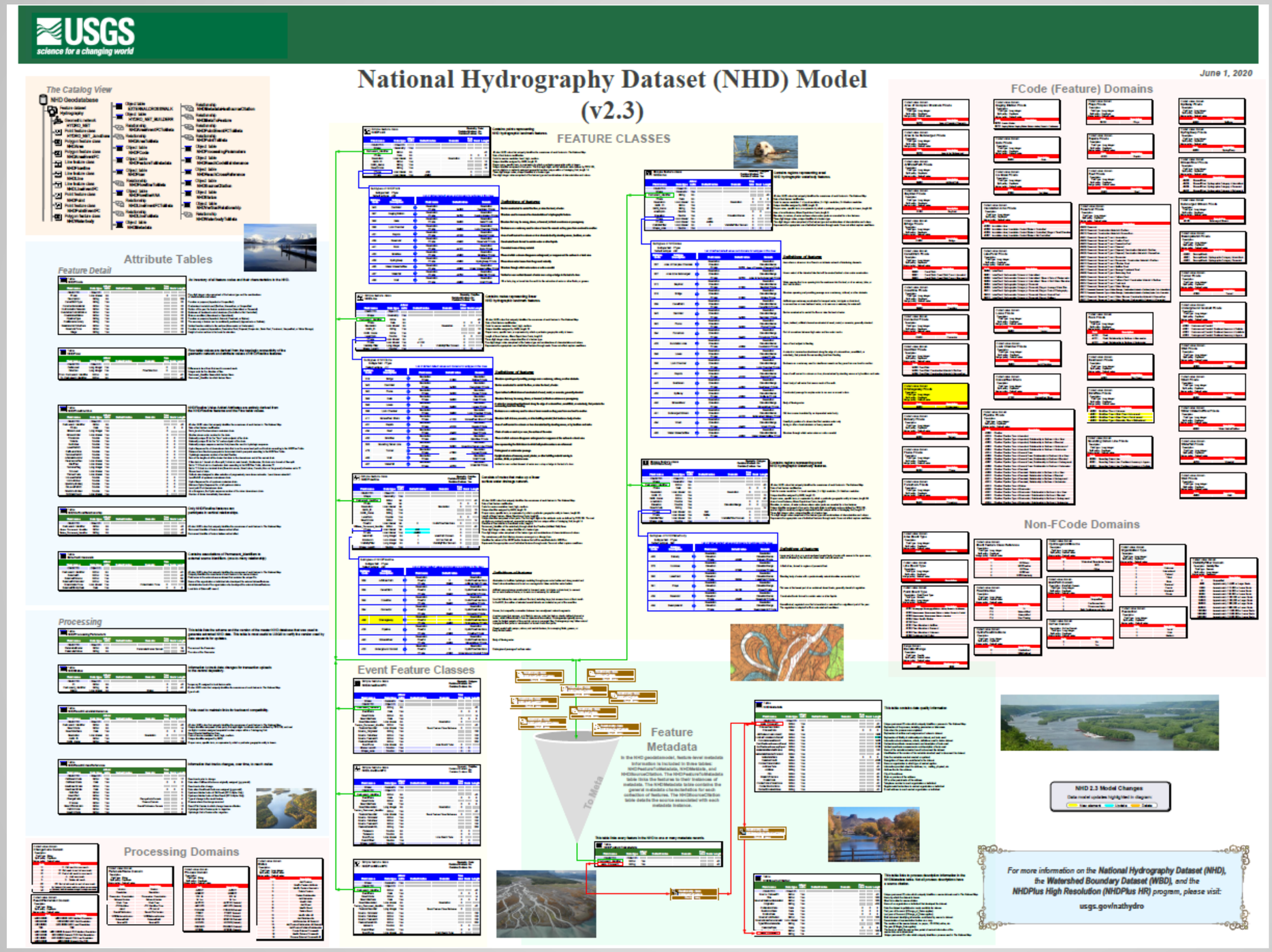
- **NHDWaterbody Feature Types**
  - LakePond
  - SwampMarsh
  - Reservoir
  - Playa
  - Ice Mass
  - Estuary

Ancillary Content in the NHD

NHDLine:
Bridge, DamWeir, Flume, Gate, Levee, Lock Chamber, Non-Earthen Shore, Rapids, Reef, SinkRise, Sounding Datum Line, Tunnel, Wall, Waterfall

NHDArea:
Area of Complex Channel, Area to be Submerged, BayInlet, Bridge, CanalDitch, DamWeir, Flume, Foreshore, Inundation Area, Levee, Lock Chamber, Rapids, SeaOcean, Spillway, StreamRiver, Submerged Stream, Wash, Water Intake/Outflow

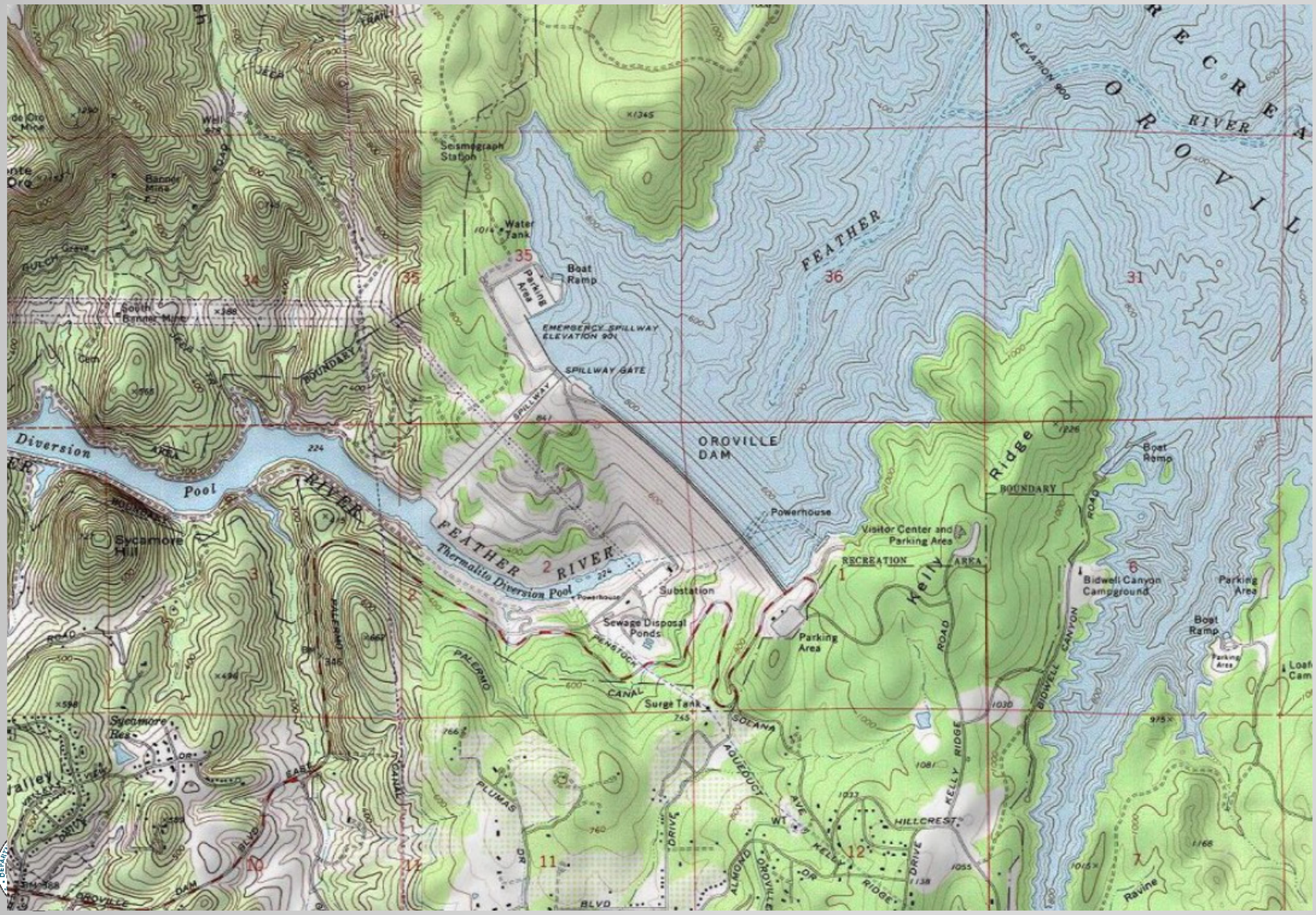
NHDPoint:
- DamWeir, Gaging Station, Gate, Lock Chamber, Rapids, Reservoir, Rock, SinkRise, SpringSeep, Waterfall, Water Intake/Outflow, Well



NHD Data Model Poster

Why does it have to be so complicated?

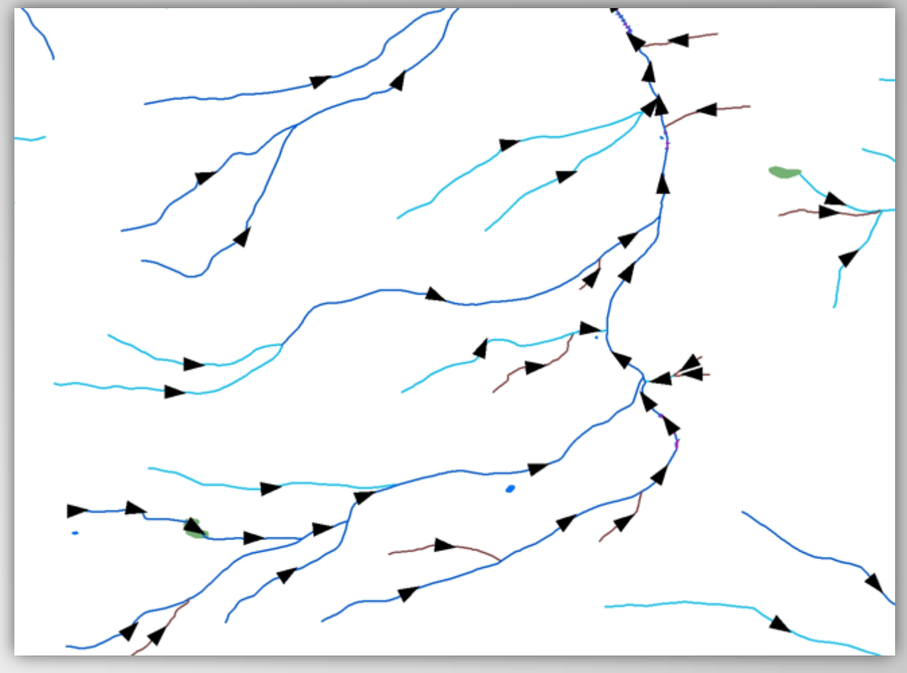
https://www.usgs.gov/media/files/nhd-v23-model-poster-06012020

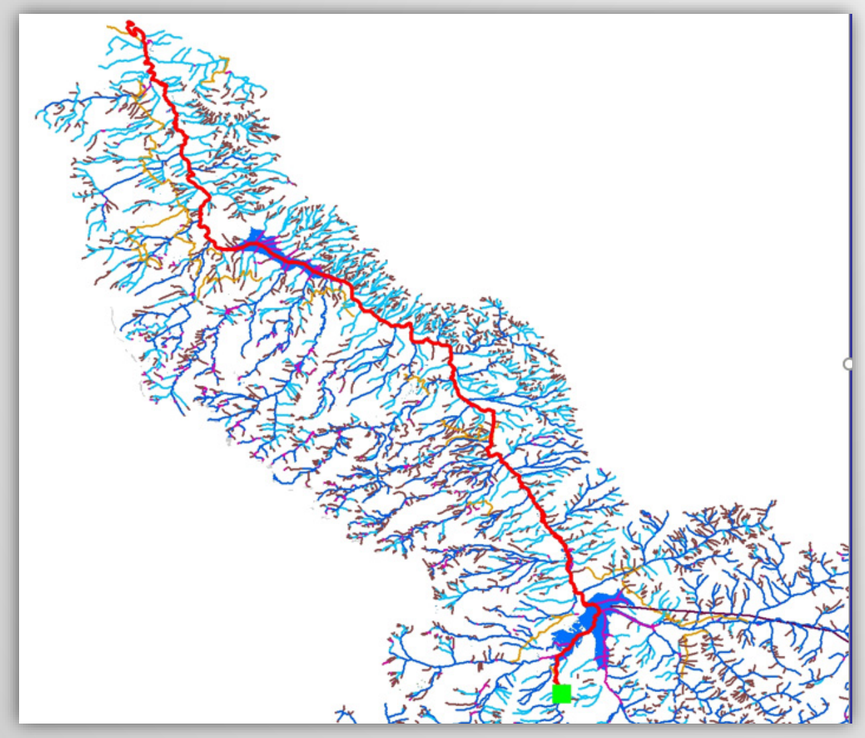


…Because it all started with Topo Maps

Geometric Network

- Flow Direction and Connectivity
- Allows for Flow Tracing, Navigation





<u>*Geoprocessing Tools*</u>

Geometric Network in ArcMap

Network Trace in ArcGIS Pro

Watershed Boundary Dataset (WBD)

Seamless nested hydrologic units representing area of landscape that drains to a portion of the NHD stream network

Courtesy of USGS

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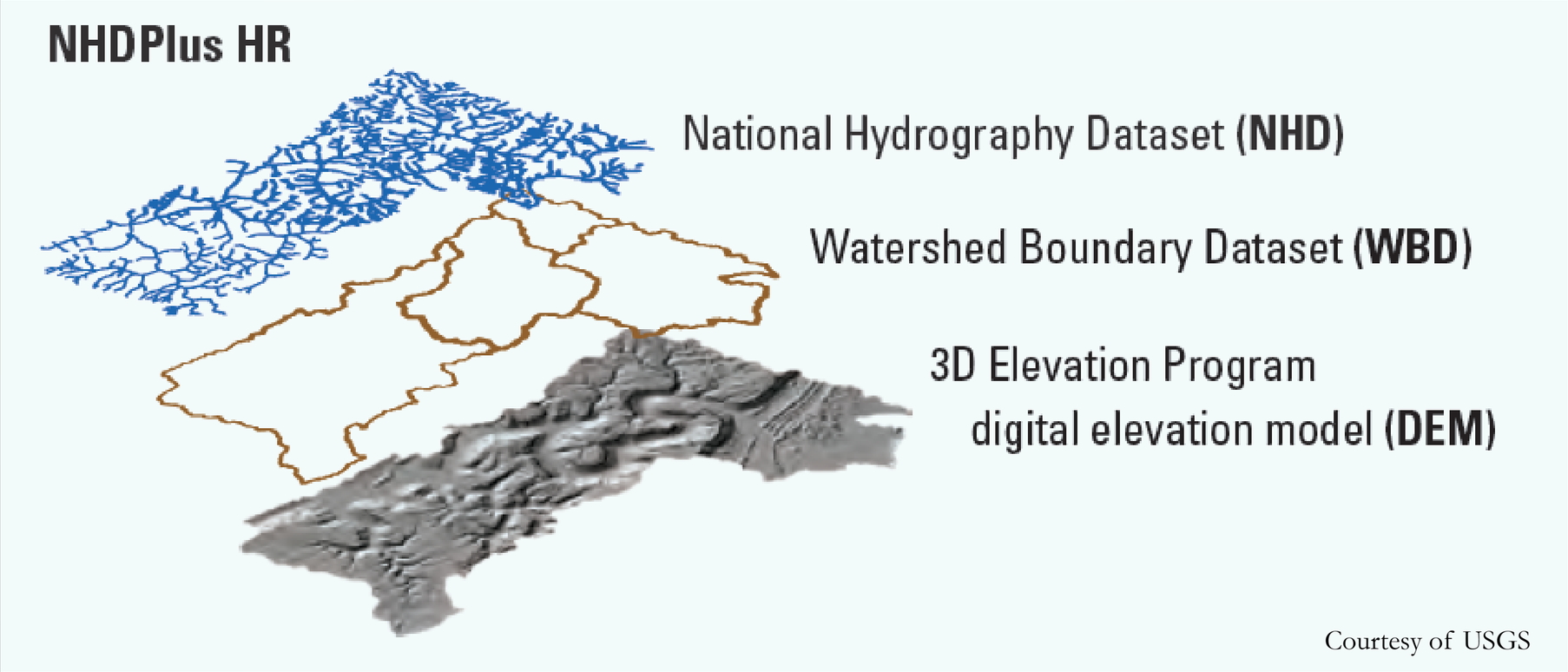
NHD Plus High Resolution

- Suite of vector, raster, and tabular datasets
- Includes Value Added Attributes
- 86% complete for the U.S.

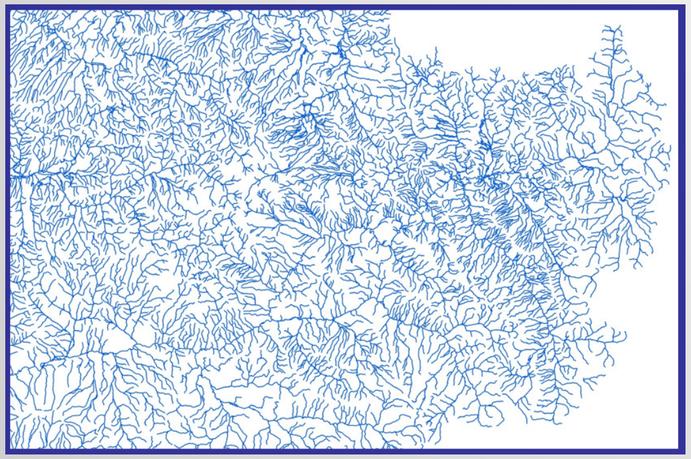


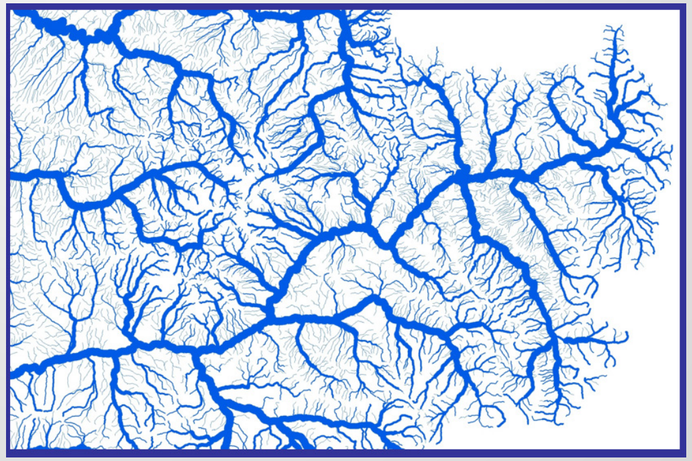
https://www.usgs.gov/national-hydrography/nhdplus-high-resolution

NHD Plus HR

- Snapshot in time of the NHD and WBD, last updated for CA in 2020
- Catchment areas that drain to each stream segment
  - Catchment characteristics including mean annual precipitation, mean annual temperature, and mean annual runoff, and more

NHD shows us where the water is





NHDPlus can show how much water is in the streams

Courtesy of USGS

NHD Stewardship Partners

Editing work is done via Interagency Agreements with sub-stewards

Geographical Information Center at CSU Chico

Center for Geospatial Science and Technology at CSU Northridge

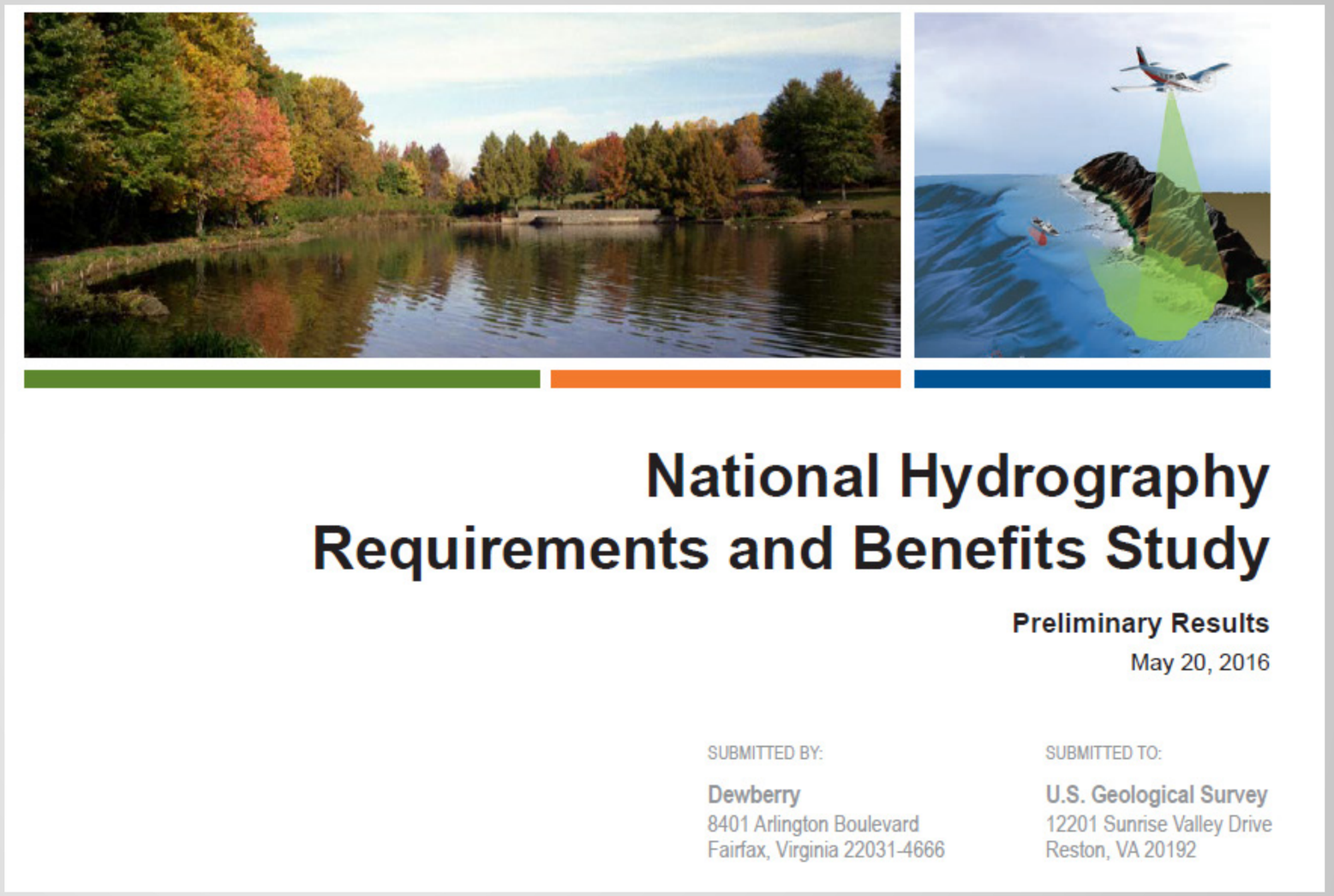
Other partners:

- Department of Fish & Wildlife
- U.S. Forest Service
- Los Angeles County Public Works
- Marin County Collaborative
- Redwood National and State Park

Users can report NHD and WBD errors in the USGS Markup App!

https://edits.nationalmap.gov/markup-app

“The Hydrography Requirements and Benefits Study (HRBS) was initiated to review and understand current and future user requirements and the associated benefits for improved hydro data. HRBS documented annual benefits of the current program at **$538M**, with the potential to increase to **$1.14B** if all user needs are met through the development of NHDPlus HR and the next generation of hydrography data.”



National Hydrography Requirements and Benefits Study

Preliminary Results

May 20, 2016

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Dewberry
8401 Arlington Boulevard
Fairfax, Virginia 22031-4666

SUBMITTED TO:

U.S. Geological Survey
12201 Sunrise Valley Drive
Reston, VA 20192

https://www.usgs.gov/national-hydrography/hydrography-requirements-and-benefits-study

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Hydrography Requirements and Benefits Study

"HRBS" to its friends

	Hydrography Requirements and Benefits Study (HRBS) content requirements met by 3DHP Datasets	% Mission Critical Activities required/ addressed
Level of detail	Highest level of detail available maintained, build generalization functionality	100%
Spatial accuracy	Spatial features horizontal positional accuracy - +/- 2 meters, 90 percent CE	64%
Elevation data integration	Elevation and hydrography integrated – 3DHP Datasets derived from 3DEP data	65%
More complete hydrologic cycle	Groundwater models linked to 3DHP Datasets	21%
	NWI wetland features data spatially aligned with 3DHP Datasets	64%
	Engineered hydrology (e.g. stormwater systems) connected (potentially generalized)	51%
	Culverts included / linked to 3DHP Datasets; bridges spatially aligned	55%
Streamflow permanence	Streamflow permanence attributed as modeled values that can be classed by users	51%
Network connectivity	On-network discovery supported (multiple requirements)	47-68%
	Network analysis supported (multiple requirements)	59-66%
Maintenance	Features reviewed / updated as needed on 4-5 year schedule (dependent on 3DEP)	41%
	Known errors corrected within 1-2 months from reporting	64%

3D Hydrography Program (3DHP)
A New Approach to Water Data

Photo Courtesy of DWR Pixel

- Combines NHD, WBD, and NHDPlus HR into one data product
- Improved spatial accuracy and feature density
- Simplified data model
- Hydrography derived from 3D Elevation Program (3DEP) data; partially automated workflow
- 3DHP Datasets will include new attributes and connections to other data such as the USFWS National Wetland Inventory, groundwater, and engineered hydrologic systems like stormwater networks.
- Accomplished with Public-Private Partnerships

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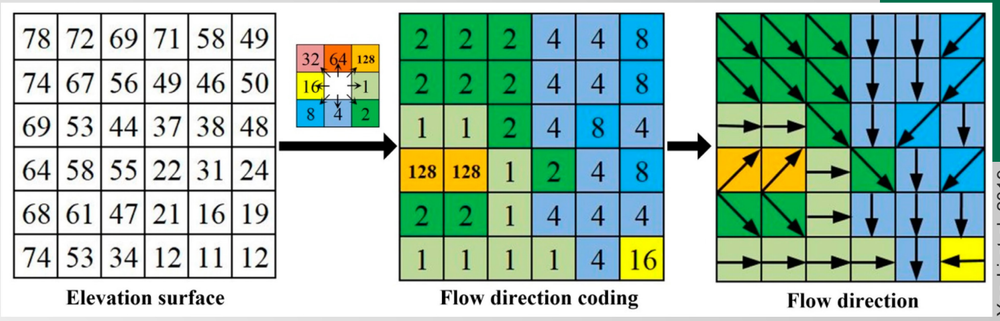
3DHP Datasets Overview

A stack of interoperable hydrography data that are aligned by virtue of being derived from a common elevation source

- Stream network, including waterbodies derived from 3DEP 1-m QL2 (or better) lidar DEMs with elevation z-values (IfSAR in AK)
- Hydrologic units, including catchments with Nested drainage areas created using the DEM and 3D stream network
- Raster surfaces such as Hydroenforced/conditioned DEMs
- Lighter, more simplified data model of stream network and hydrologic units that can be generalized to support use from the local to national-level
- Most current data available as individual data layer downloads and map services, with annual releases to support national-level applications



Yao Li et al, 2019

	PAST: NHD Medium Resolution	PRESENT: NHD High Resolution	FUTURE: Hydrography Derived from Lidar
Elevation source	30 meter	10 meter	1 meter (5 meter in AK)
Hydrography source	1:100,000-scale NHD	1:24,000-scale or better NHD	1:5,000-scale or better derived from lidar
Number of flowline features nationally	2.7 million	26 million	200-300 million

What does this mean for the users of the data?

- *Good question!*
- NHD, WBD, NHDPlus HR as we know it won't go away anytime soon
- 3DHP will happen over 9 years – ***if funded***
- Opportunities for input now
- Opportunities for partnerships all along the way

Help us connect with NHD Users

Please complete this survey and share it with NHD, WBD, and NHD Plus users in your organization

- https://forms.office.com/g/yJ5SENQEBb
- Opportunity for follow-up conversations
- Jane.Schafer-Kramer@water.ca.gov

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Additional Resources

Visit NHD on CA Natural Resources Agency Open Data
https://data.cnra.ca.gov/dataset/national-hydrography-dataset-nhd

Includes derivative products

- Major Rivers, Major Lakes and Reservoirs, CA Wild and Scenic Rivers, and more

USGS Channel on YouTube, National Hydrography Datasets Playlist
https://www.youtube.com/playlist?list=PLIxlFowAfHBCe2gYP5F9rIgzIij2Djfe6

Progress reports to the California GIS Council
https://cgia.org/cagiscouncil/workgroups/hydrography/

An aerial drone view of Lake Oroville near the west branch of the Feather River in Butte County, California on May 6, 2022. On this date, the storage was 1,935,247 reservoir acre-feet (AF), which is 55 percent of the total capacity. Photo by Kelly M. Grow / California Department of Water Resources

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