National States Geographic Information Council

3DHP For the Nation Info Forum

California's Approach to 3D Hydrography Stewardship

May 17, 2023

CALIFORNIA DEPARTMENT OF WATER RESOURCES

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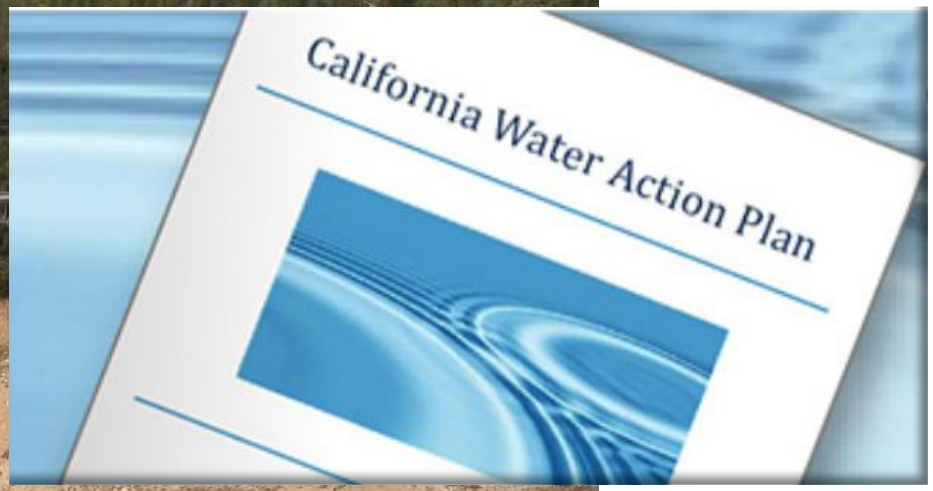
“Fund and revive the National Hydrological *(sic)* Dataset for California to improve high-quality framework geospatial data and the precision and accuracy of mapping and scientific studies. “



Aerial view of Lake Oroville's Enterprise Bridge on October 23rd, 2015 showing the water level at 48 percent of historical average or 29 percent of total capacity.
photo credit: Zack Cunningham, DWR
https://pixel-ca-dwr.photoshelter.com

Funding WIN!

STATE OF CALIFORNIA
Budget Change Proposal - Cover Sheet
DF-46 (REV 02/15)

Fiscal Year	Business Unit	Department	Priority No.
2016-17	3860	Water Resources	

Budget Request Name	Program	Subprogram
3860-006-BCP-DP-2016-GB	3230	

Budget Request Description

California Water Action Plan Implementation – CA National Hydrography Dataset and Critical Safety Improvements for Stream Gages

Budget Request Summary

Specifically, this proposal requests $1.1 million annually in General Funds to support 4 existing positions for stewardship for the National Hydrography Dataset; a one-time support appropriation of $1.4 million in FY 2016-17 needed to update National Hydrography Dataset data and support 4.2 additional existing positions to fix safety hazards on 15 surface water monitoring sites; and a one-time appropriation of $625,000 in FY 2017-18 to support 4.2 existing positions to fix safety hazards on 15 remaining surface water monitoring sites.

NHD Stewardship Partners

Editing work is done via Interagency Agreements with sub-stewards

Geographical Information Center at California State University, Chico

Center for Geospatial Science and Technology at California State University, Northridge

Other partners, *to date*:

- CA Department of Fish & Wildlife – *Funding to add CA Streams and CA Lakes to NHD*
- CA State Water Resources Control Board – *Linked Water Rights & Water Quality Data to NHD*
- U.S. Forest Service – *Trained editors improved data for USFS lands*
- Los Angeles County Public Works – *Added stormwater connectors to fill urban area void*
- Marin County Collaborative – Funded LiDAR, Imagery, Veg Mapping, and Elevation-Derived Hydrography
- Redwood National and State Park – Trained interns as editors to add density and accuracy

https://data.cnra.ca.gov/dataset/national-hydrography-dataset-nhd

NHD Stewardship Reports to the California Geographic Information ...
The National Hydrography Dataset (NHD) is the authoritative surface water component of...

California Business Rules for Updating the National Hydrography ...
This document describes the rules that our editors of California's portion of the NHD should...

NHD Major Rivers and Creeks Shapefile
Major Rivers and Creeks in California selected from the NHD in a zipped shapefile format....

NHD Major Rivers Shapefile
Major Rivers in California selected from the NHD in a zipped shapefile format. Resource last...

NHD Major Lakes and Reservoirs Shapefile
Major lakes and reservoirs in California selected from the NHD in a zipped shapefile format....

How to Use the NHD Visibility Filter in a GIS
The NHDFlowline feature class of the NHD now has an attribute field name VisibilityFilter which...

Reference Data Used in Updating the California NHD
This is a spreadsheet used to record the datasets used for reference in the updating of the...

NHD Data Model v2.3 Poster
A pdf intended for poster-sized printing that provides a graphical depiction of the geodatabase...

NHD Major Features Derivative Products
This resource contains some cartographic products in shapefile and geopackage format along with...

National Hydrography Dataset Playlist on YouTube
A collection of recordings of presentations and meetings by U.S. Geological Survey on the...

Memorandum of Understanding between USGS and DWR
Document: The Memorandum of Understanding between the United States Department of the Inter...

Slides from NHD of the Future presentation 7/21/2022
On July 21, 2022, Jane Schafer-Kramer presented a webinar for California NHD users on changes...

USGS Letter re: End of NHD Editing
DWR received this letter on September 30, 2022 from the Director of the USGS National Geospatia...

USGS science for a changing world

NATIONAL HYDROGRAPHY

The 3D National Topography Model Call for Action - Part 1: The 3D Hydrography Program

United States Department of the Interior
U. S. GEOLOGICAL SURVEY
12201 Sunrise Valley Drive
Reston, Virginia 20192

In Reply Refer to
Mail Stop 511

September 30, 2022

Dear Ms. Schafer-Kramer -

On behalf of the U.S. Geological Survey National Geospatial Program, I want to thank you for your support and stewardship of the National Hydrography Dataset (NHD). With the significant contributions of the Stewards over the last 25 years, the NHD has become the most complete and comprehensive inventory of the Nation's surface water resources, supporting science and management applications across the country.

Much has changed since we started building the NHD. Advances in computing technology have enabled more detailed and sophisticated modeling applications like the National Water Model. Advances in airborne lidar technology have enabled the collection of high-resolution digital elevation models (DEMs) that were unimaginable when we were still using 1-arc second DEMs. In fact, today the Nation has more than 84 percent of the Nation with 3D Elevation Data available or in progress. These advances along with new capabilities in geospatial software technology necessitate a strategic shift towards the next generation of hydrography data.

Over the course of the next year, we will transition from maintaining the NHD, the Watershed Boundary Dataset, and NHDPlus High Resolution to developing the 3D Hydrography Program (3DHP). 3DHP will be easier to maintain, based on a modern data model and architecture, and better meet the requirements of users that were documented in the Hydrography Requirements and Benefits Study (2016). Given resource constraints, the transition to the 3DHP database and tools requires us to close Steward and internal editing of the NHD database. As you may have heard through our outreach on this transition, job check-ins should be

Though we are ending this chapter in our hydrography program, we anticipate continuing roles for Stewards. 3DHP will require coordination in your local user community, reviewing corrections submitted through markup, and other roles to be defined during the transition.

Thank you again for your support of the NHD, and we sincerely appreciate your ongoing collaboration as we work together to build 3DHP to meet the next generation of user needs and applications.

Sincerely,

Michael Tischler, Ph.D.
Director, National Geospatial Program

Relationship with CA DWR and NHD

Project	Center	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
NHD Update Pilot Project	*CGST*											
DLCC NHD Update Project	*CGST*											
USFS Region 3 NHD Update Project	*CGST*											
CA DFW NHD Update Project	*CGST/GIC*											
CA DWR NHD Update Project 1	*CGST/GIC*											
CA DWR NHD Update Project 2	*CGST/GIC*											
CA DWR NHD Update Project 2A	*CGST/GIC*											
CA DWR NHD Update Project 2B	*CGST/GIC*											
CA DWR NHD Update Project 2C	*CGST/GIC*											

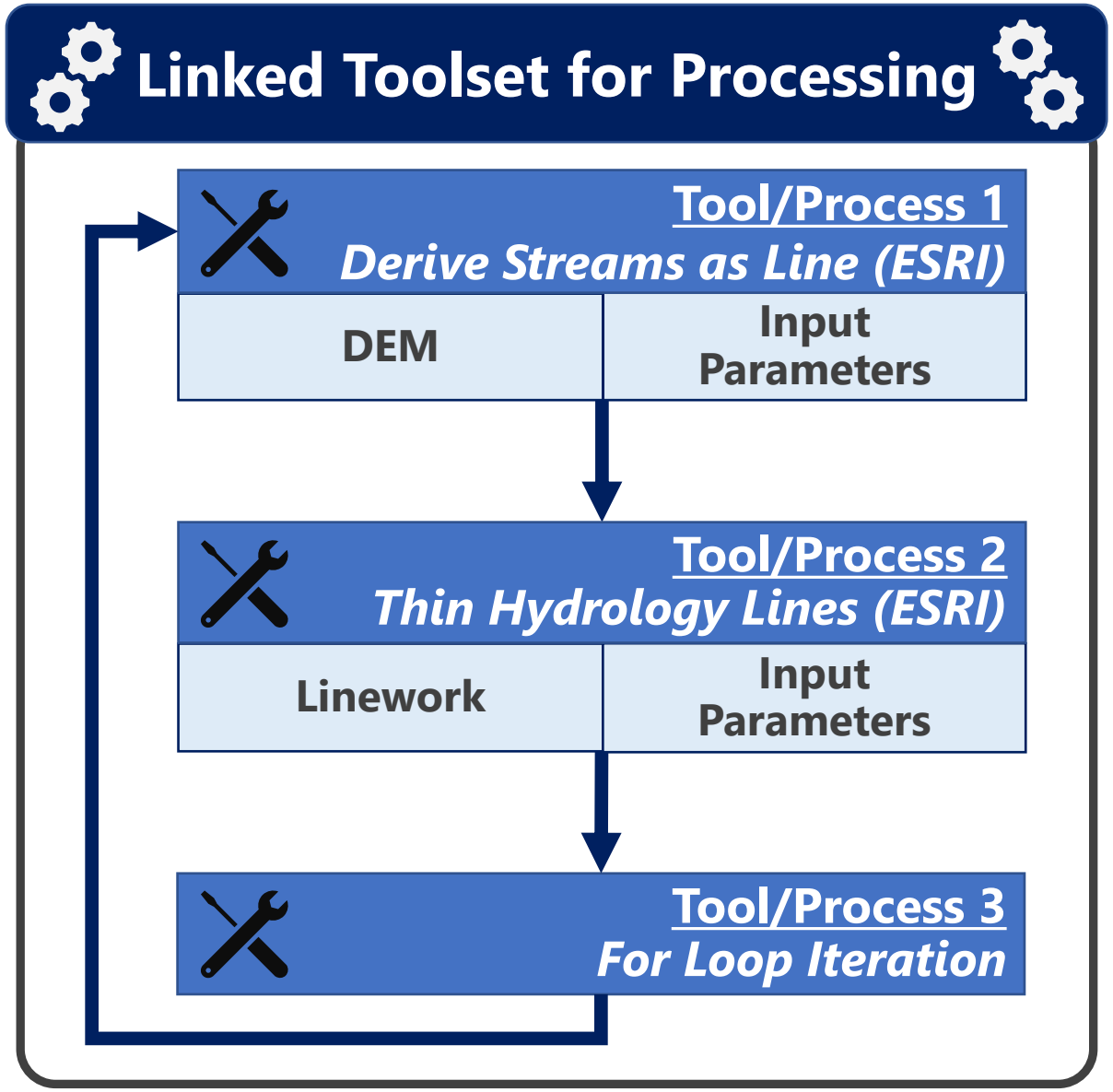
- NHD substewards since 2013
- Multiple partnerships and NHD projects
- CA DWR partnership and NHD stewardship since 2016
  - Main Goals:
    - ✓Statewide comprehensive updates
    - ✓Awareness and engagement

- Expertise in California hydrography and hydrographic representation in geospatial data
  - Authored and implemented hydrographic editing business rules for NHD in CA
    - ✓USGS and USFS-supported
    - ✓Collaborated with many, many stakeholders to get their local knowledge and input into the NHD
- Moving away from NHD and toward 3DHP

LA County EHD Project: Overview

Overarching Goals

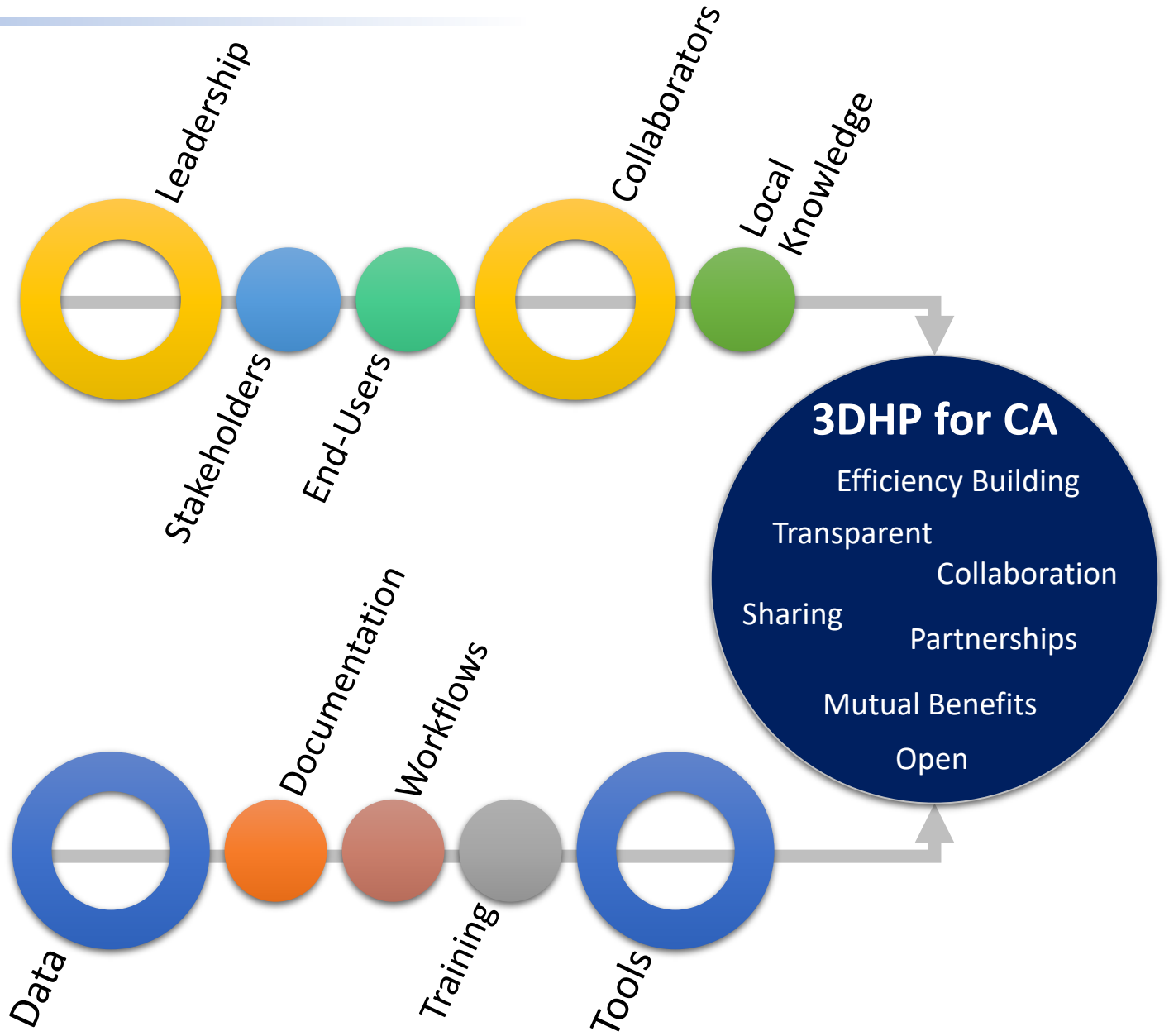
- Develop EDH Workflows
- Develop EDH Toolsets
  - ✓ Building New Efficiencies
  - ✓ Incorporating Customization
- Develop Documentation
- Produce EDH
  - ✓ USGS EDH Compliance
  - ✓ 3DHP Compliance
- NHD GeoConflation



LA County EHD Project: Overview

Overarching Goals (cont'd)

- Leveraging established expertise from NHD Program
  - ✓ Parallels between NHD and 3DHP
  - ✓ Knowledge of the state's hydrography
  - ✓ Quality and consistency beyond common standards
- Share all deliverables with DWR and the public
- Engage with stakeholders and partners
  - ✓ LA County Public Works
  - ✓ ESRI Water Resources Contacts
  - ✓ USGS
- Assist CA DWR to transition their NHD Program to a 3DHP Program



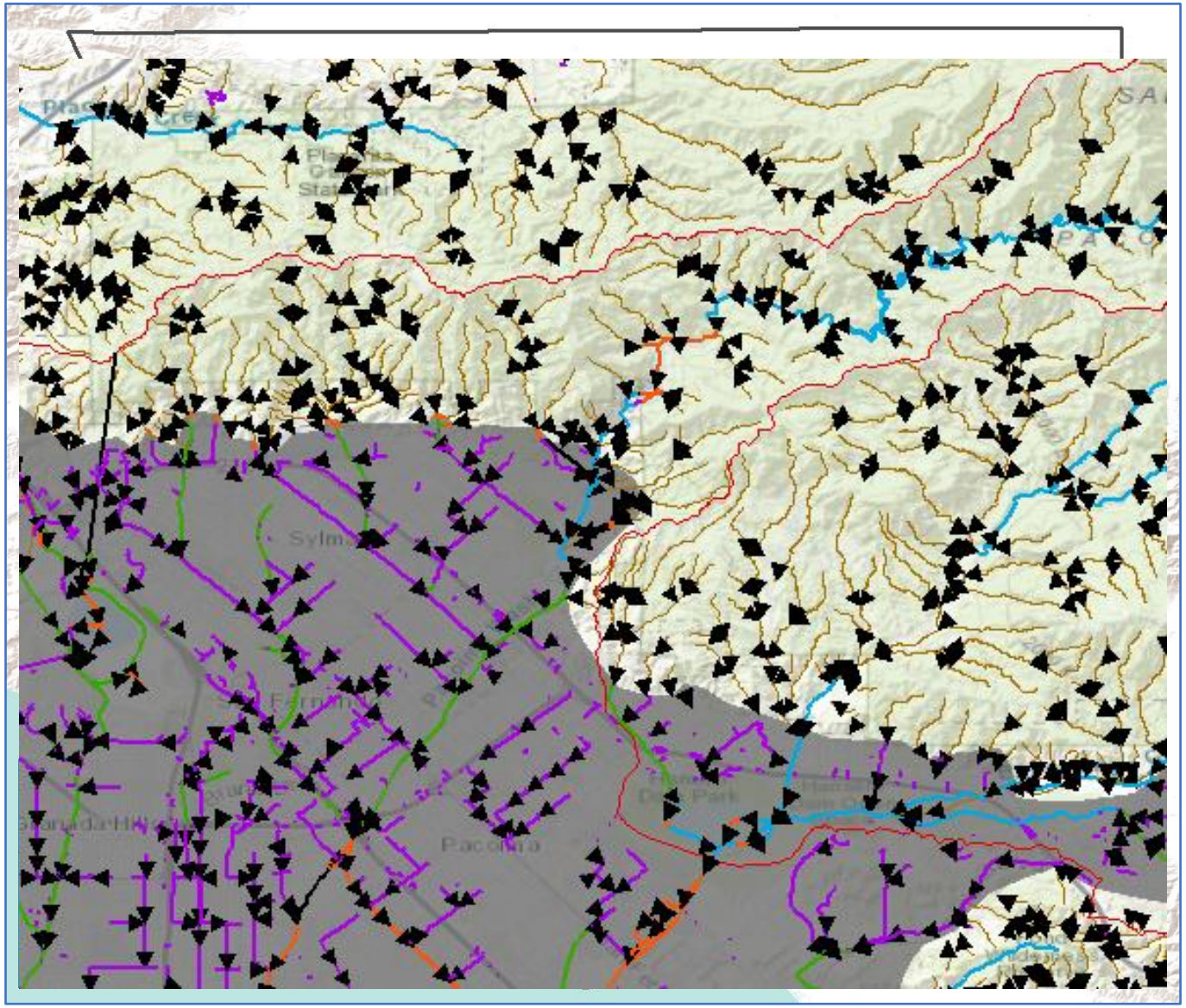
Project Area

- 8 participating HUC10 watersheds
- Wildland/forest area focus
- Dense urban areas excluded
- ~1,050 sq. km total area

Participating HUC10 Watersheds:	
1807010602	1807010603
1807010604	1807010605
1807010606	1807010700
1807020307	1809020804

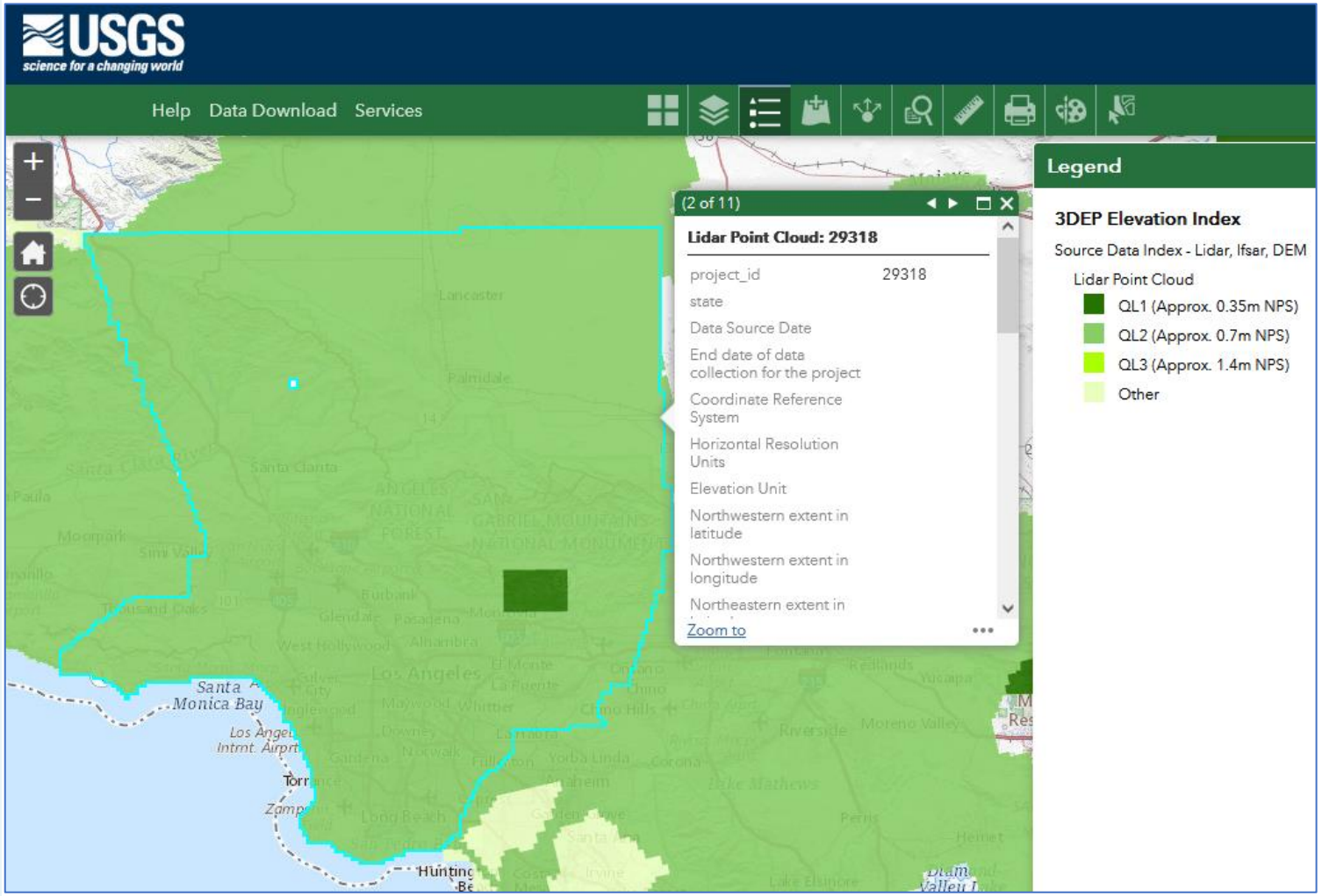
→ ***More challenging areas will be included in future work!***

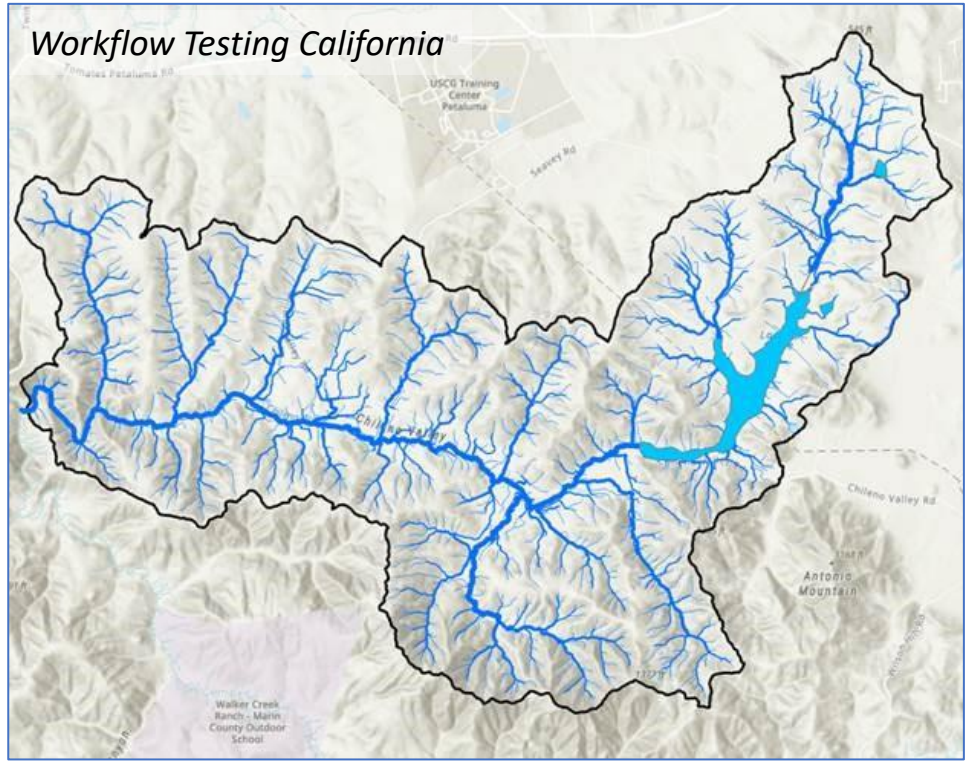
- ✓Areas with high tree canopy cover
- ✓Flat areas with agriculture
- ✓Arid areas

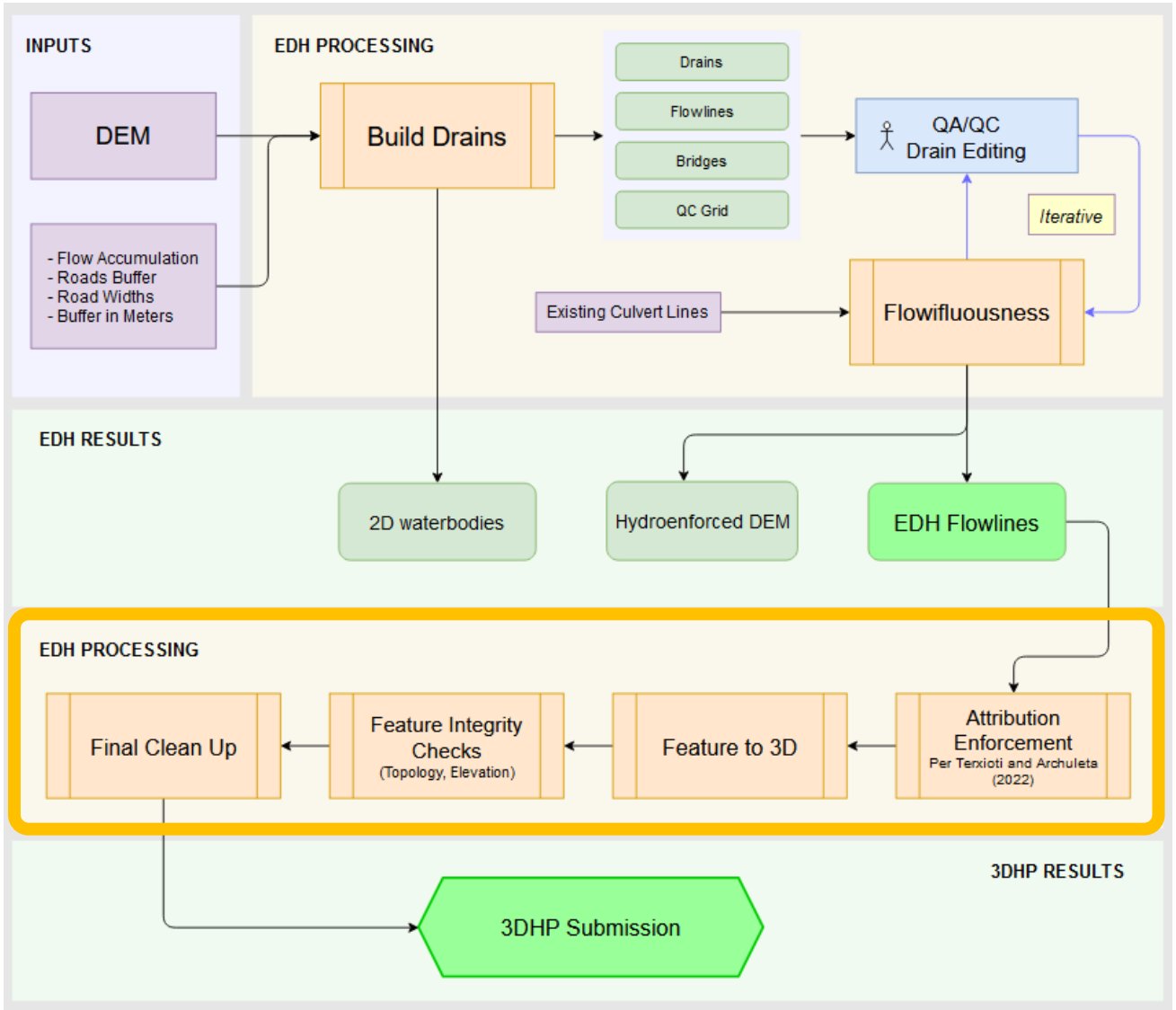


EDH Process: Overview

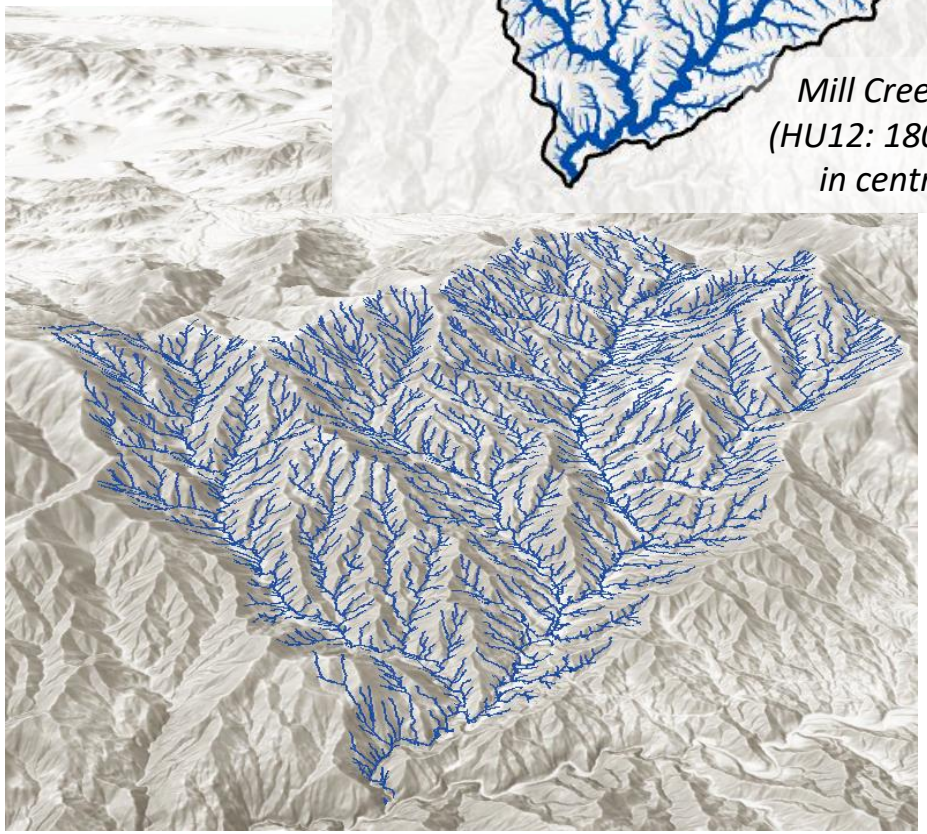
QL1 or QL2 LiDAR *3DEP (USGS)* → Raw DEM → Hydro-Conditioned DEM → Extracted Hydro Features



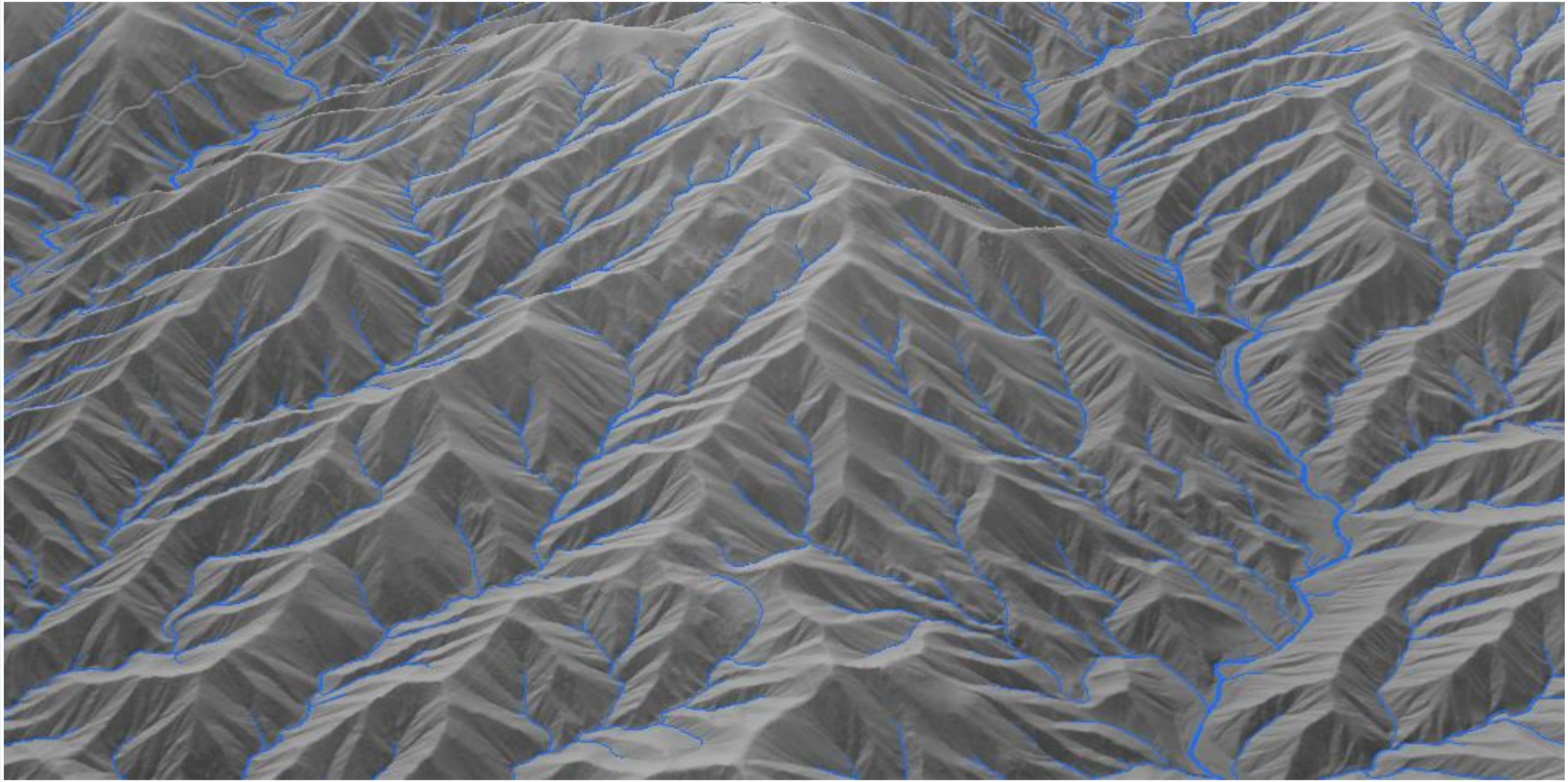




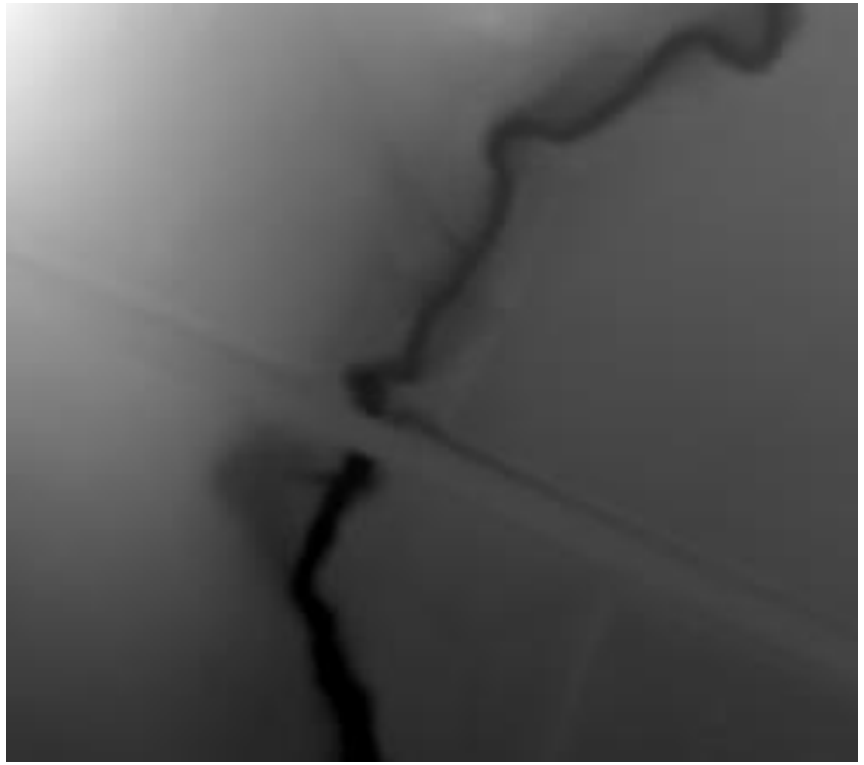
Mill Creek Watershed
(HU12: 180701050102)
in central LA County



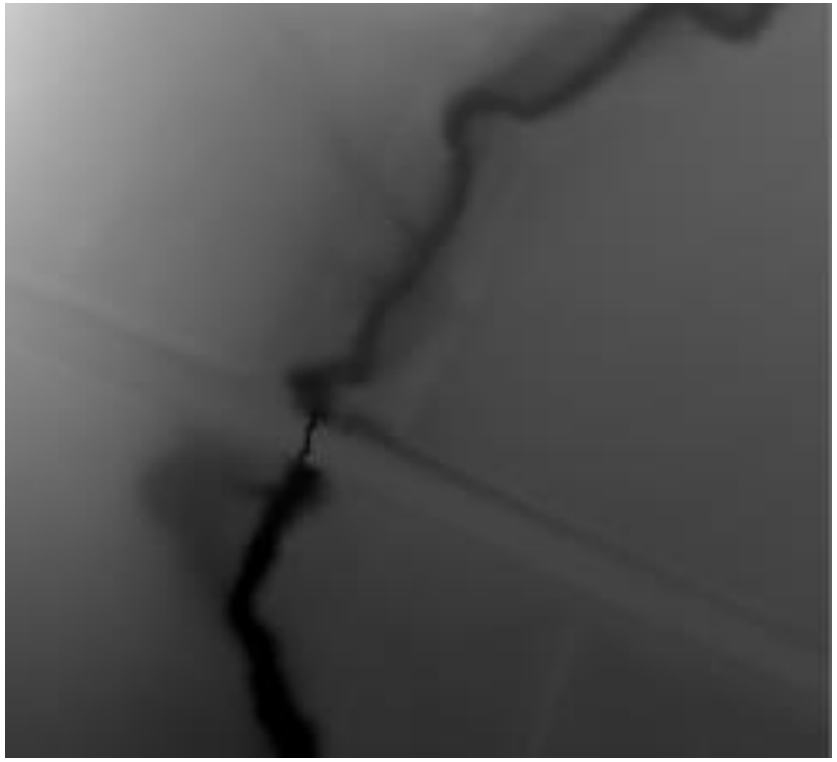
Elevation Derived Flowlines



Hydro-Conditioning

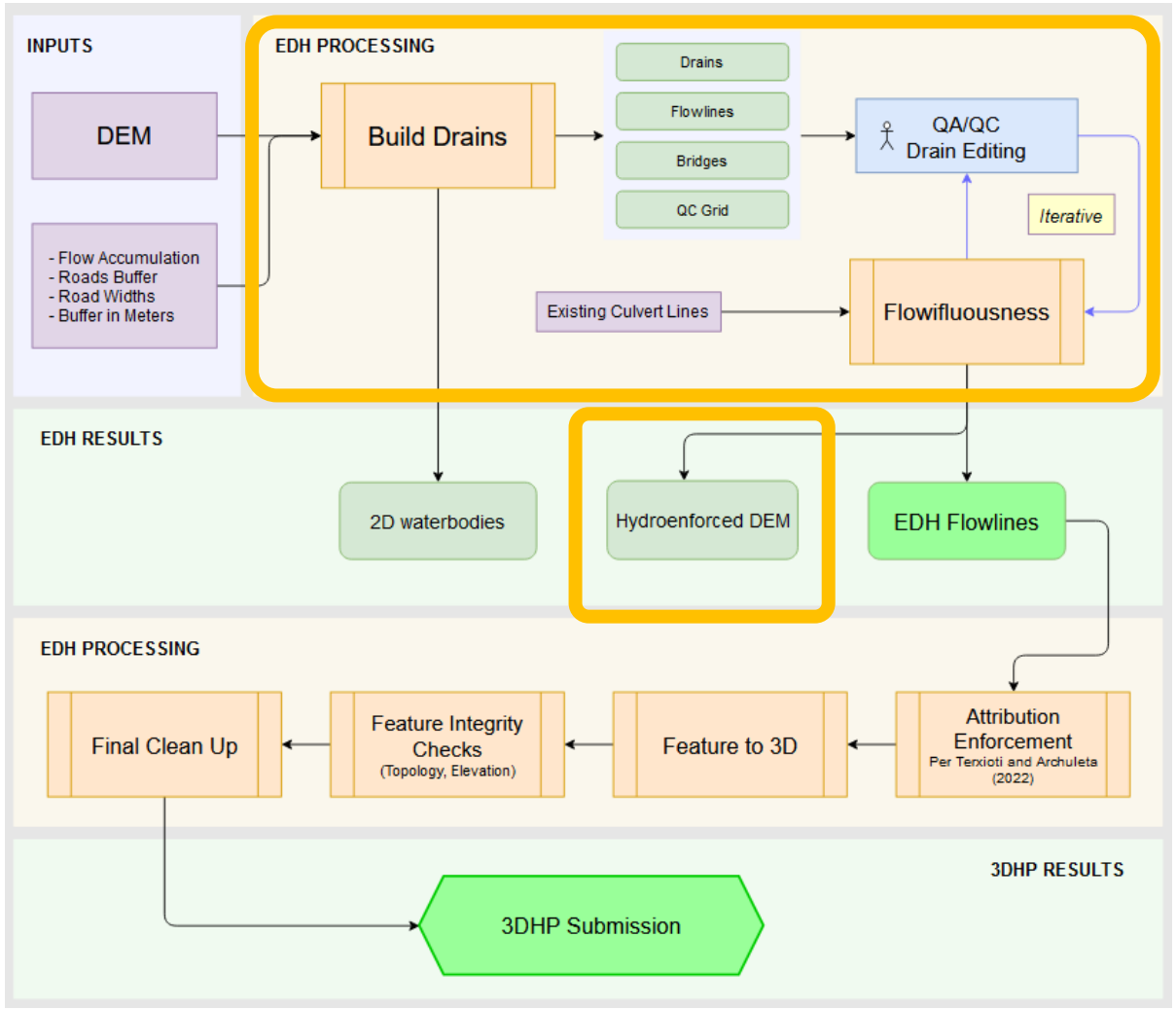


Raw DEM



Hydro-Conditioned DEM

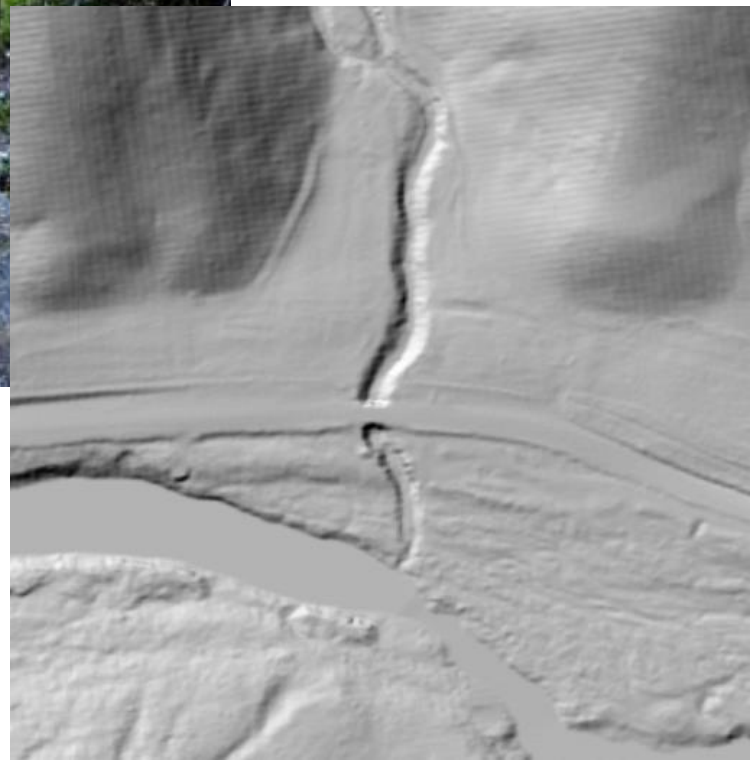
Solving for Barriers



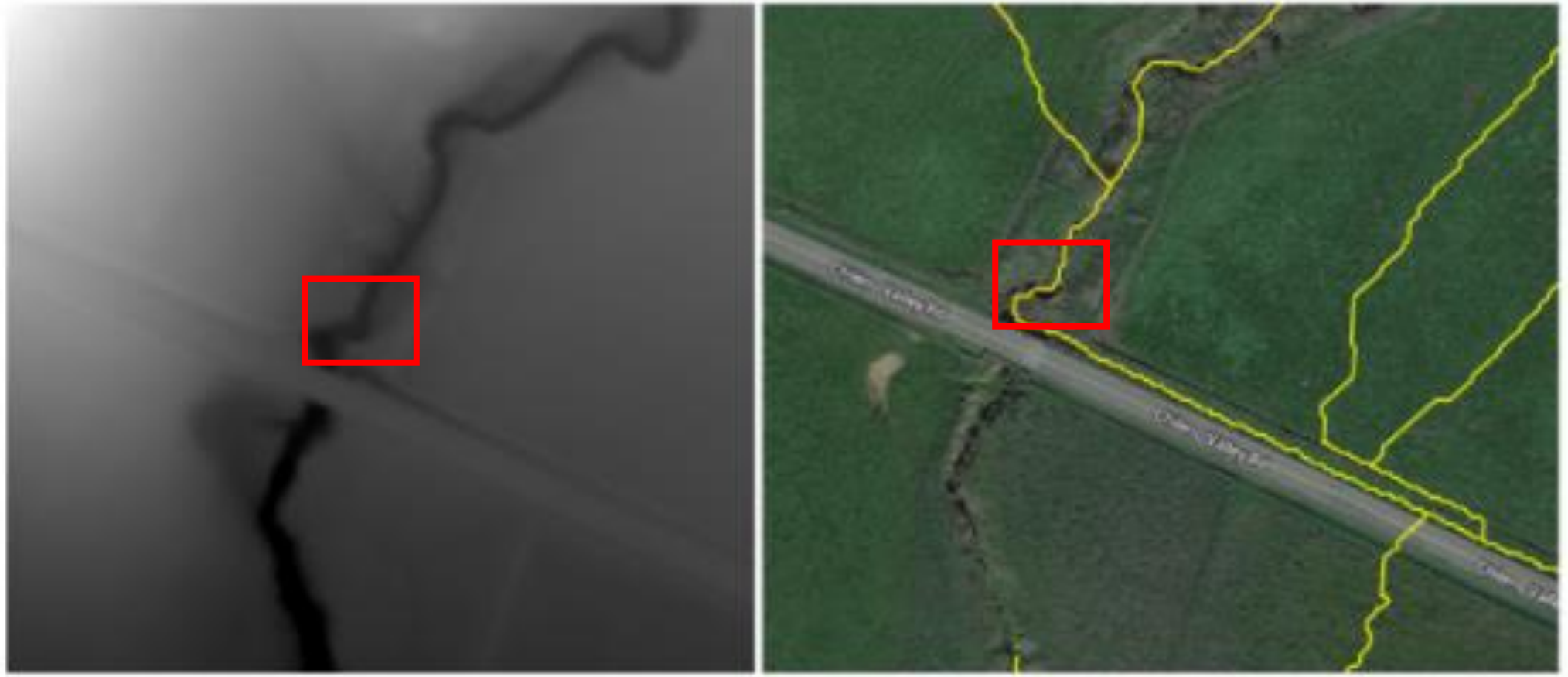
Common Barriers

- Barriers can include
  - Roadbeds/Culverts
  - Dams (small and large)
  - Very small bridges (rare)

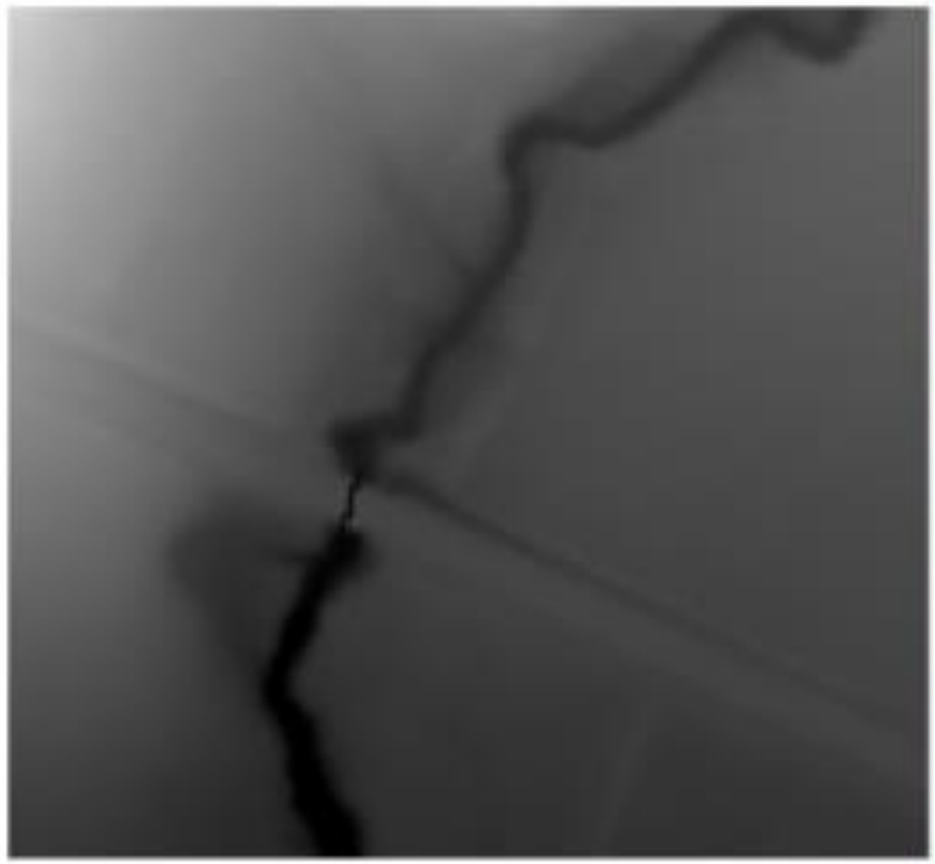
*Credit: After Wildfire NM



Automation to Solve for Barriers

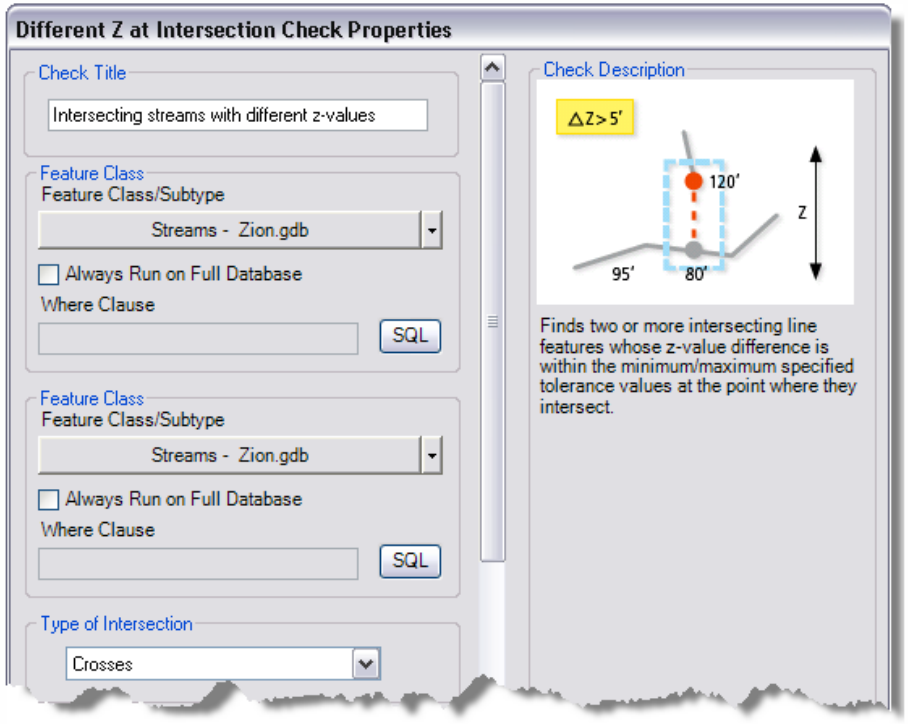


Automation to Solve for Barriers



Extracting Z Values

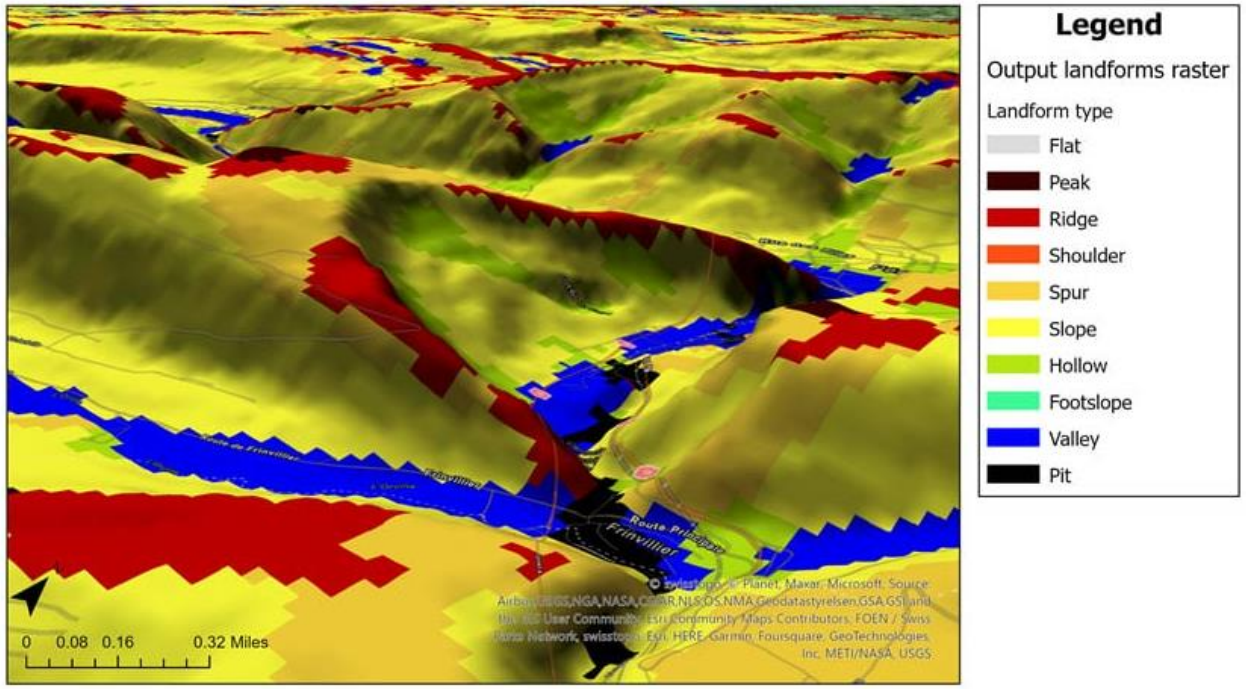
- Points collected in 3D point, pointZ
- Lines collected in 3D line, polylineZ
  - Stream/river lines shall have a downstream gradient with each vertex having the same or lower elevation value than the preceding vertex.
- Polygons collected in 3D polygon, polygonZ
  - Lake/ponds and reservoirs shall be flat and level with a single elevation value for every shoreline vertex



*Credit: ESRI

Quality Control

- **QC Process**
  - ✓Takes advantage of our previously trained NHD editors that know and understand NHD features and rules for manual QC
  - ✓Implement automated QC that flags potential issues for manual review
  - ✓Use Geomorphons for omission/commission
  - ✓Pourpoint check and enforcement



*Credit: ESRI

Next Steps for the Project

- ✓Deliver Provisional EDH data and build toward meeting 3DHP hard requirements
- ✓Continue engagement and outreach in collaboration with DWR
- ✓Additional projects in varied topography types
- ✓Continue working with ESRI regarding tool improvement and process enhancements
  - ➢Deep learning for better roadbed capture
  - ➢Build out utility to automate the use Geomorphons
- ✓Present results at ESRI UC in July
- ✓Continue to provide experience and training for students in EDH

More to come!

Tool Suite Building

Innovation

- *More Efficient QA/QC Methods*
  - *Geomorphon Integration*
- *Deep/Machine Learning Methods*
- *Further Engagement with USGS and ESRI*

Presentations

- *ESRI UC: July, 2023: San Diego, CA*

Thank you!

Jane Schafer-Kramer

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Thanks!

A drone view of water levels at the Enterprise Bridge located at Lake Oroville in Butte County, California.
On this date, the water storage was 2,658,184 acre-feet (AF), 75 percent of the total capacity. Photo taken March 8, 2023.

Florence Low / California Department of Water Resources.

https://pixel-ca-dwr.photoshelter.com/