Arc Hydro: Self and Esri Training Opportunities

Christa Campbell & Dean Djokic

Connecting with Esri Water Resources

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Gina O'Neil

Christine Dartiguenave

Zichuan Ye

Ezra Bosworth-Ahmet

Paul Burgess

Training Services…

Conferences

Esri's hydro experts will be supporting several events this year with an exhibit and / or presentations.

- National Mitigation of Ecosystem Banking, May 2 - 6
- Association of State Floodplain Managers Conference, May 15 - 19
- AWRA Geospatial Water Technology Conference, May
- AWRA Annual Water Resources Conference, November 7 - 9

Connect with our team to ask questions and share your work.

Navigating Esri Web Sites

Finding information on Esri websites

- Water Resources
- Arc Hydro

Water Resources web page

Arc Hydro web page

Esri Water Resources Community

Connecting with industry professionals

- Online Q&A
- Bogs
- Videos
- Technical documents

Water Resources Community

Water Resources Office Hours (Virtual)

Esri's hydro experts host virtual office hours to discuss common water resources workflows and answer questions.

- April 21, 2022
- June 16, 2022
- August 18, 2022
- September 15, 2022

Join us to ask questions, contribute to the community, and vote on Office Hour topics.

Esri Water Meetup

Esri UC: Hydro Meeting (In person)

Save the Date – Sunday, July 10, 2022

Topics will include:

- Hydrology tools in Spatial Analyst
- Hillslope tools
- Hydro content in the Living Atlas…and more

Esri Water Meetup

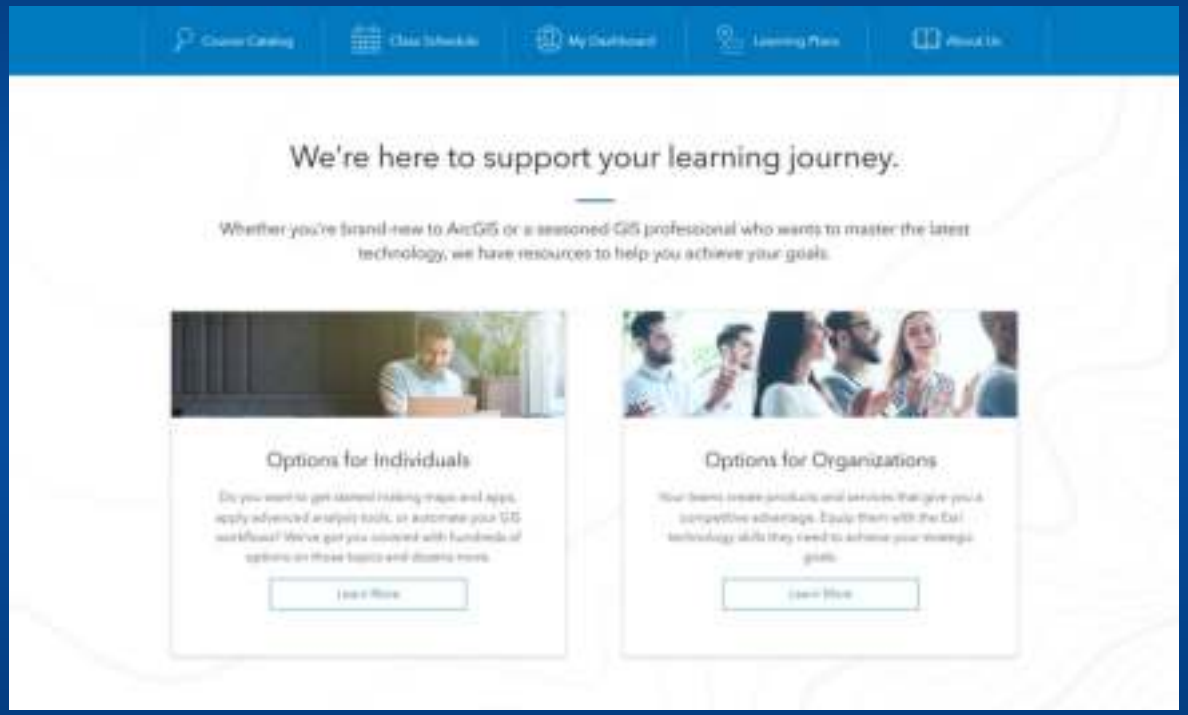
Stay Connected with Esri's Water Team

@EsriWater

Esri Water Resources

Esri Water Meetup

Esri Water eNewsletter



Esri Training

Christa Campbell

esri.com/training

Customized Training for You & Your Organization

Work with Esri training consultants to identify training needs

Build a training plan based on those needs

- Individual plans
- Team plans

E-Learning options

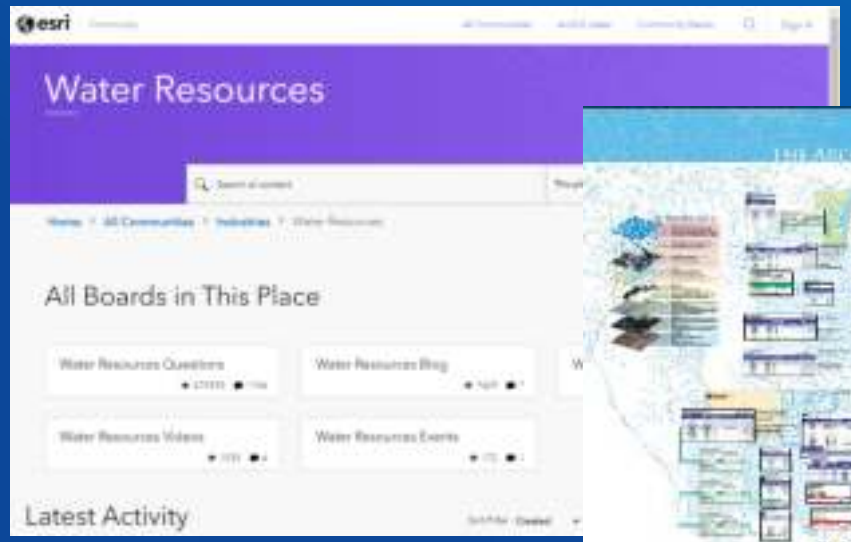
Training

Arc Hydro: GIS for Water Resources Hydrologic, and Hydraulic Modeling with GIS

Dean Djokic

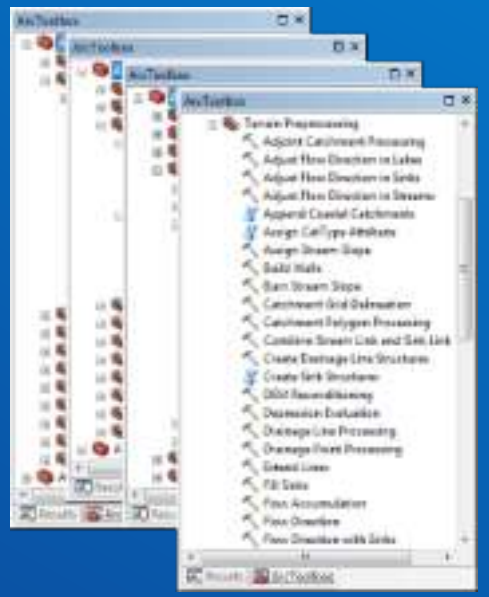
Arc Hydro: Vision

"Provide practical GIS framework for development of integrated analytical systems for water resources market."

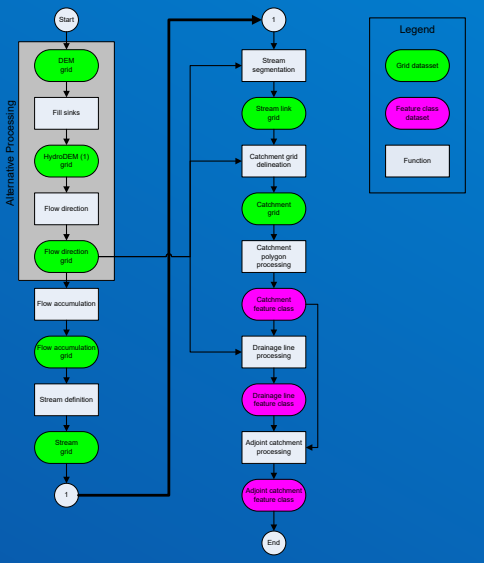


Community

Data Model



Tools



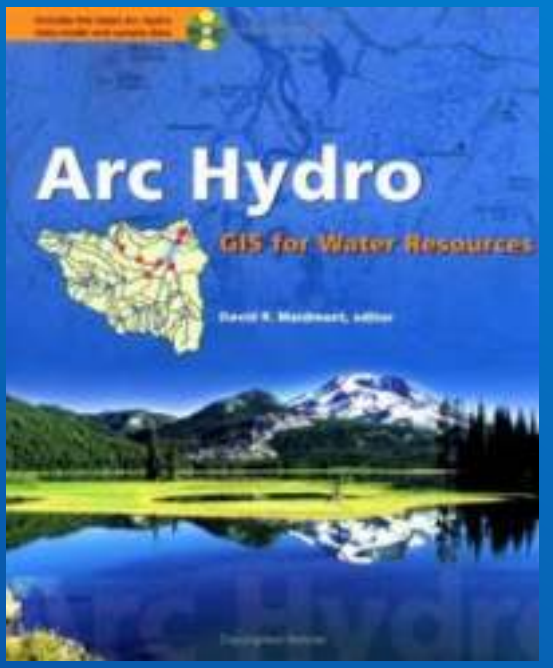
Workflows

Brief History

… and why it is important

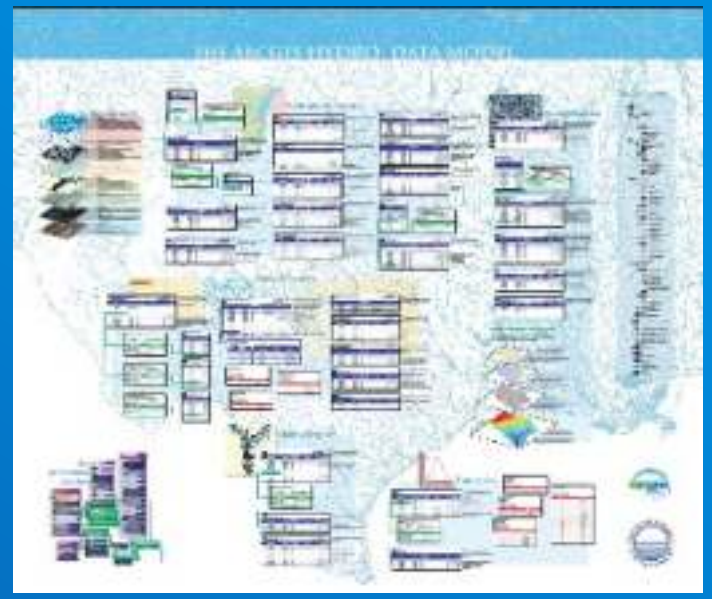
1999 – 2002

- Project to demonstrate geodatabase capabilities in water resources.
- Worked with Dr. David Maidment at the University of Texas.
- Focused on the Arc Hydro Data Model.
- Released in 2002 as a data model, a toolset, and an Esri Press book (Arc Hydro).
  - Initial set of ~ 30 tools (8.3) developed by Esri (PS) as a complement to the data model.



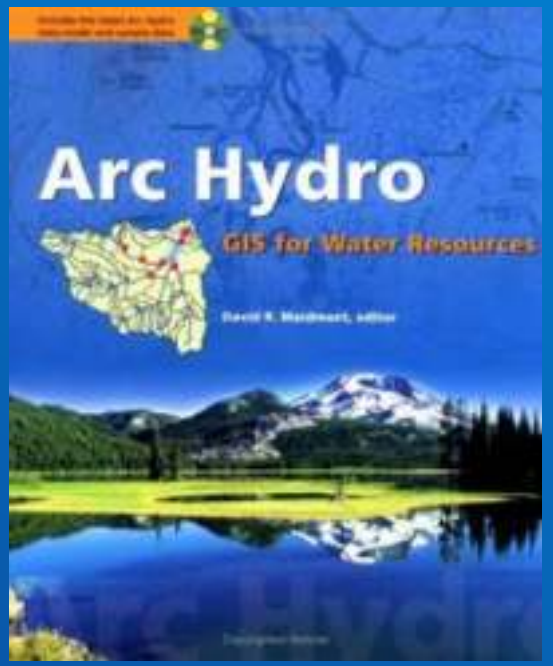
Brief History

… and why it is important



Since 2003:

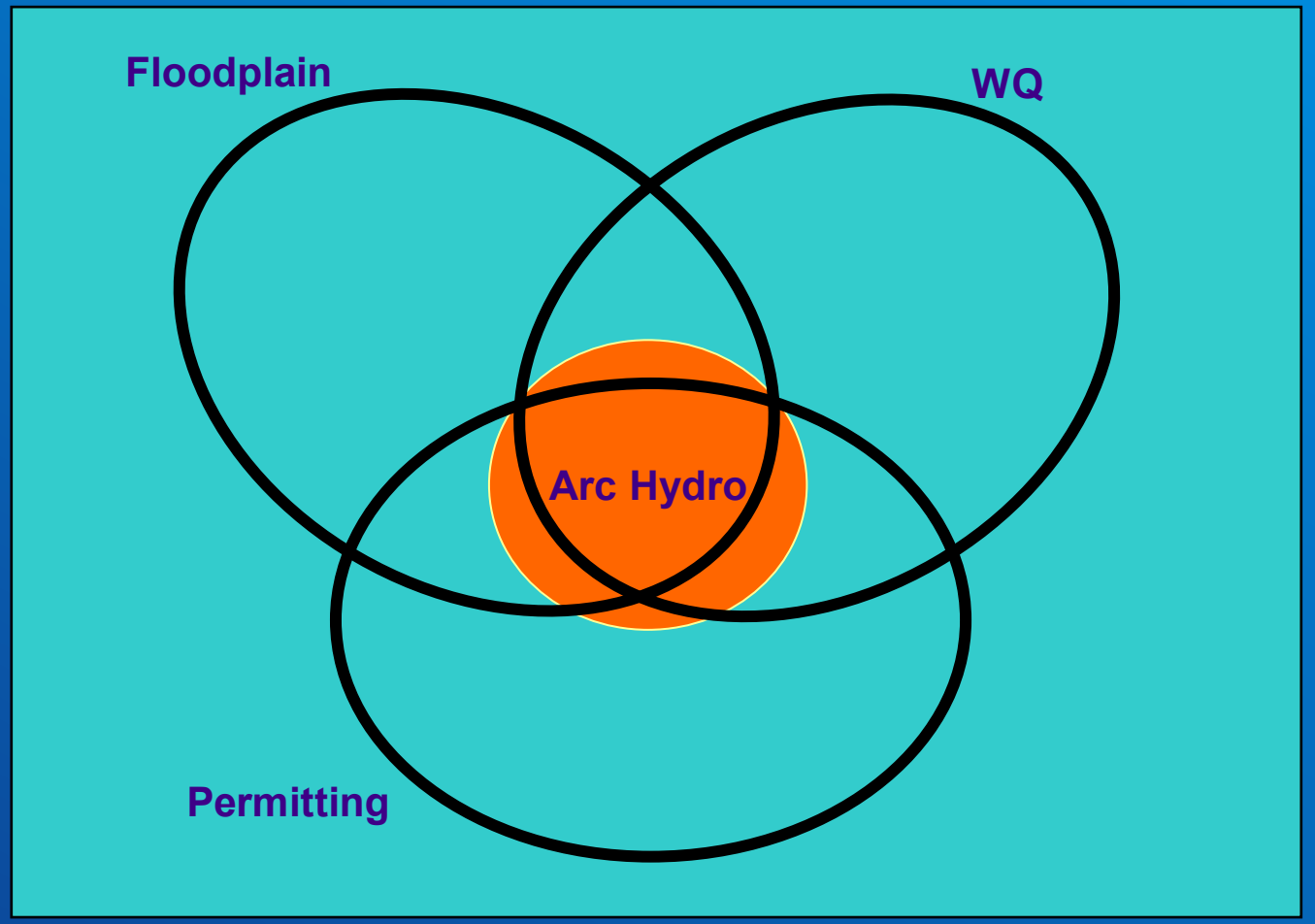
- Arc Hydro tool development through projects.
  - This added ~300+ tools over the years.
  - Development of specific workflows.
  - Minimal change to the core data model (besides Arc Hydro Groundwater).
- Training classes (managed as standard Esri training and are delivered by PS).
  - Started in 2004.
  - Over 1,600 customers reached through ~120 Arc Hydro and H&H classes delivered on 4 continents.
- Aquaveo does Arc Hydro groundwater training.



Brief History

… and why it is important

- Arc Hydro is not a “solution”.
- Building blocks to develop your specific solution.
- Designed to be extensible and flexible.



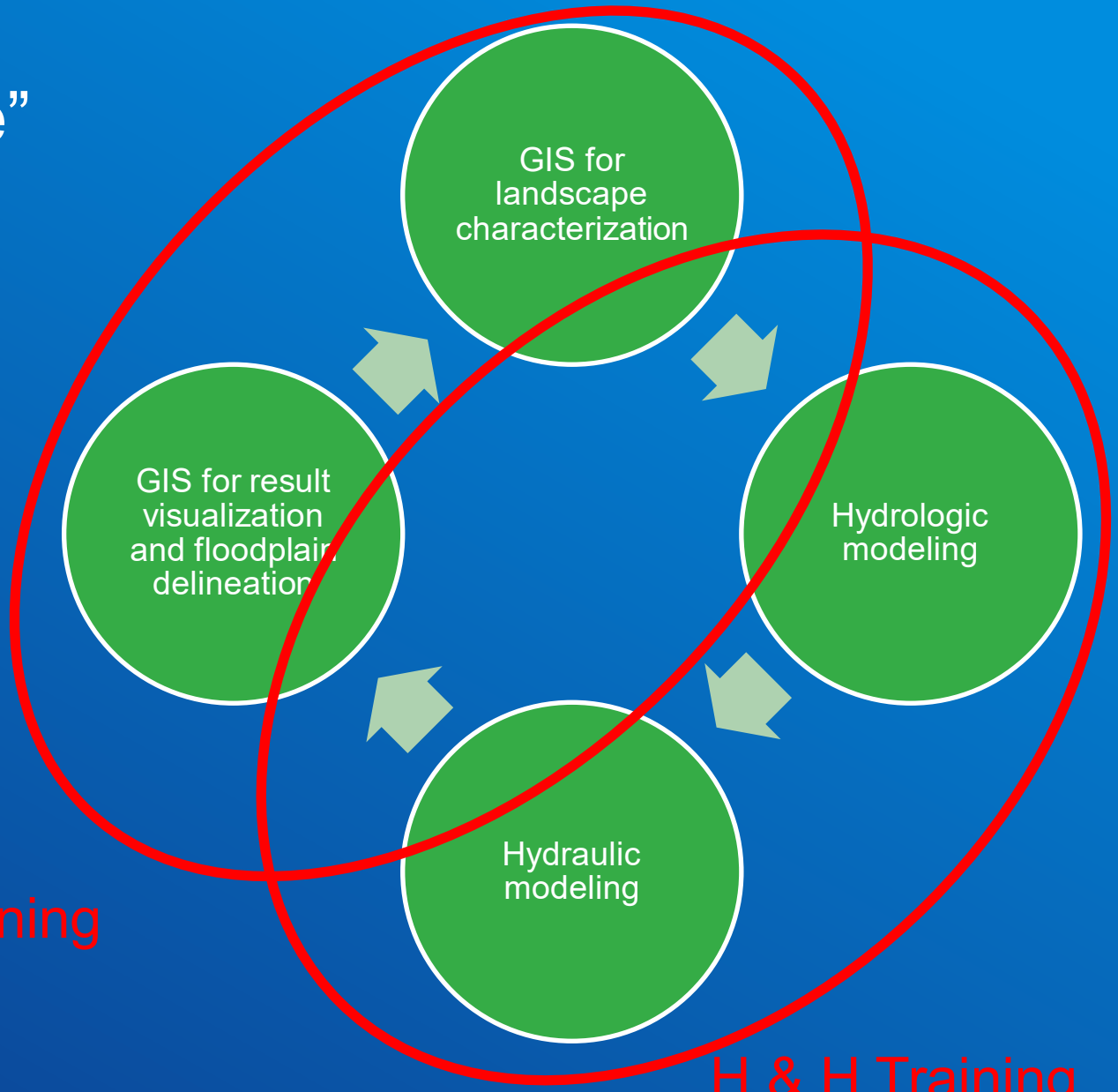
Brief History

… and why it is important

- Three “pillars” of Arc Hydro:
  - Geodatabase model and use of core capabilities
  - Workflows (data processing):
    - General ArcGIS
    - Specific “Arc Hydro”
  - Analysis:
    - GIS:
      - Vector
      - Raster
    - “Hydro:
      - Within GIS
      - H&H modeling

GIS for Hydro Modeling "Cycle"

- GIS is used for landscape characterization and model parametrization.
- Hydrology and Hydraulics (H&H) is used for determination of flows, depths and velocities.
- GIS is used for result postprocessing and visualization.
- GIS and H&H modeling are closely connected as one impacts the other



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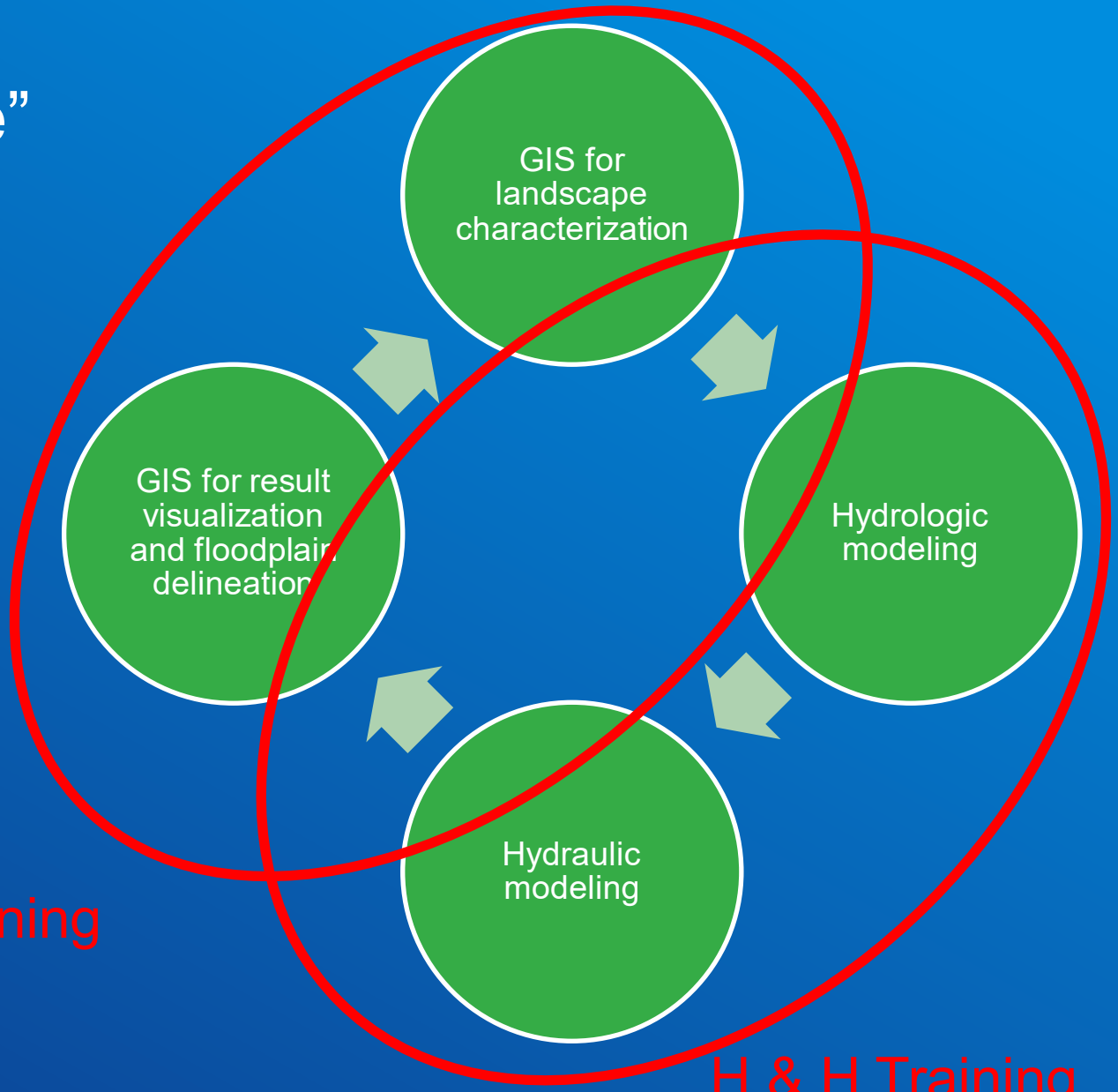
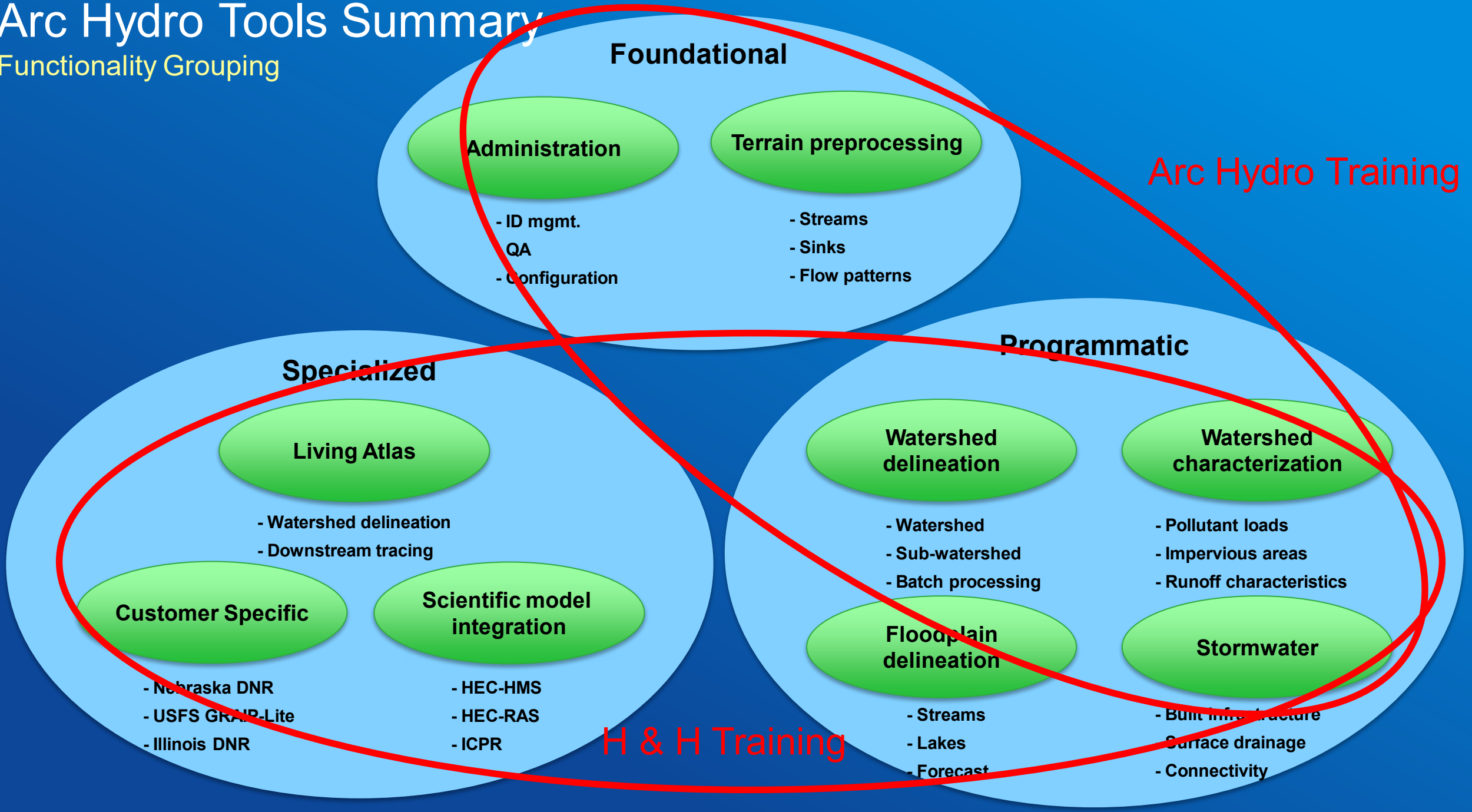
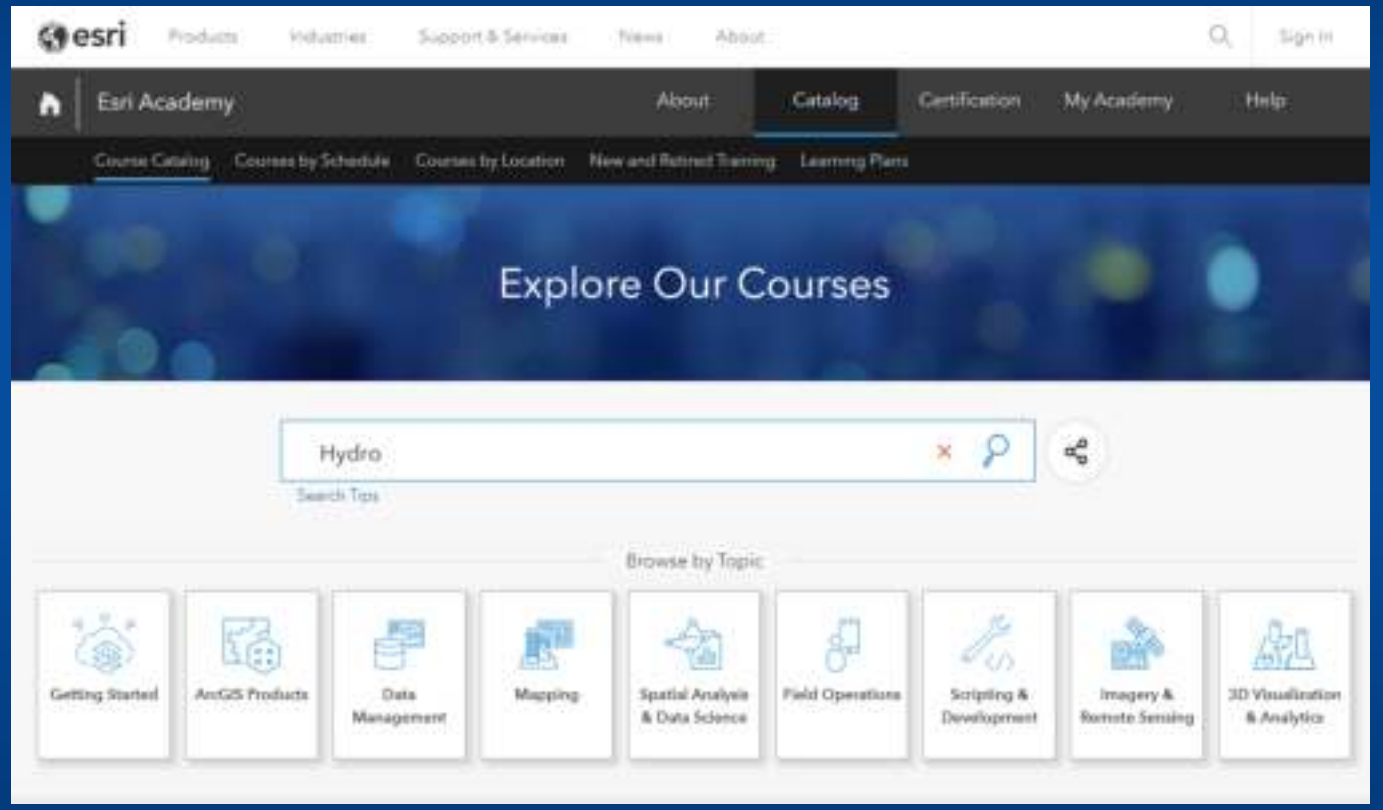


Arc Hydro Tools Summary

Functionality Grouping

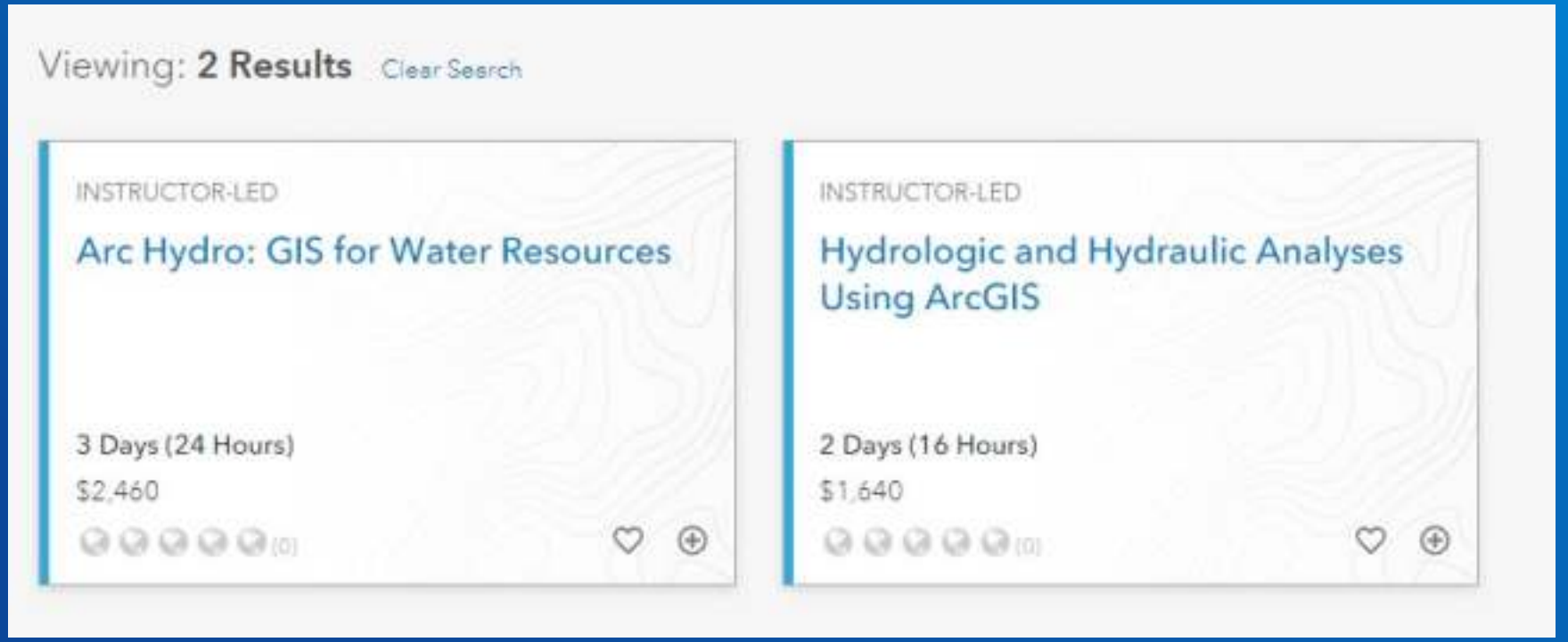




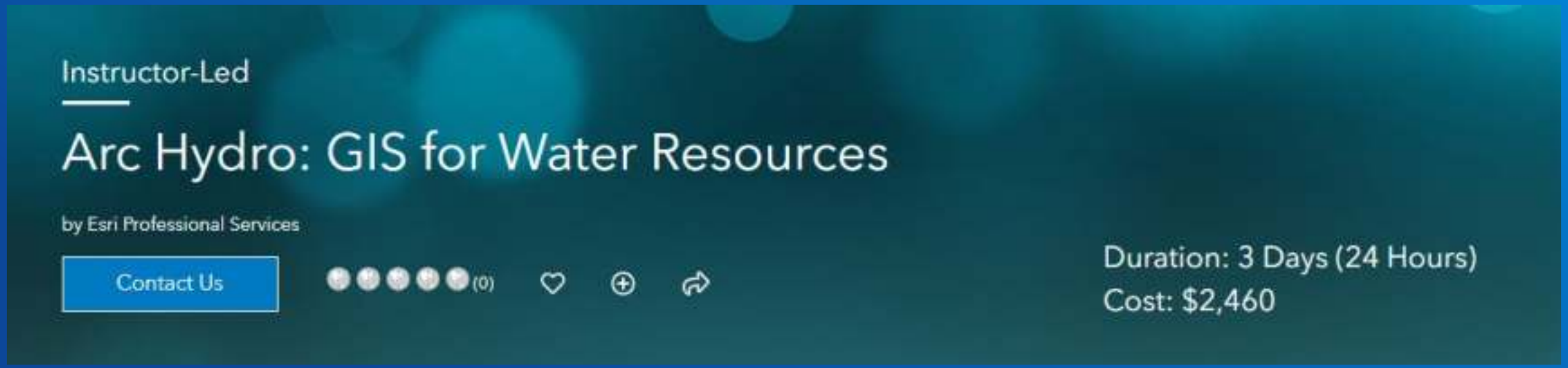
Instructor-Led Training

esri.com/training

Instructor Led: Two “Hydro” Options



Arc Hydro: GIS for Water Resources



https://www.esri.com/training/catalog/57630436851d31e02a43f0c4/arc-hydro%3A-gis-for-water-resources/

Arc Hydro: GIS for Water Resources – Data Model

- Arc Hydro data model
  - Core feature classes, properties, and relationships
  - HydroID as the unique identifier and primary key in all relationships
  - Managing HydroID
- Extending Arc Hydro data model
  - Adding properties to existing Arc Hydro feature classes
  - Adding additional feature classes to Arc Hydro projects and data model
  - Managing HydroID for new feature classes
  - Using existing relationships with new data model elements
  - Adding GRIDs and TINs to the Arc Hydro model and project

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Arc Hydro: GIS for Water Resources - Tools

- Core Arc Hydro tools
  - Tools managing Arc Hydro core properties
  - HydroID editor extension and management tools
  - Creating Arc Hydro feature classes through tools
  - Terrain processing and basic network tracing
  - Combining raster, vector, and network datasets into an integrated data environment
- Advanced Arc Hydro functionality
  - Local and global watershed delineation
  - Watershed characteristics extraction
  - Time series management tools
  - Advanced network/attribute tracing
  - Controlling tools' operations through XML
  - Controlling data structures through XML

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Arc Hydro: GIS for Water Resources - Implementations

- Arc Hydro in action
  - Loading time series data via WEB into Arc Hydro
  - Manipulating NEXRAD data
  - Mass-balance analyses
  - Watershed delineation and characterization
- Extending Arc Hydro tools
  - Developing custom functionality within Arc Hydro tools
  - Developing custom functionality on top of Arc Hydro tools
  - Arc Hydro tools programming framework
  - Control XML

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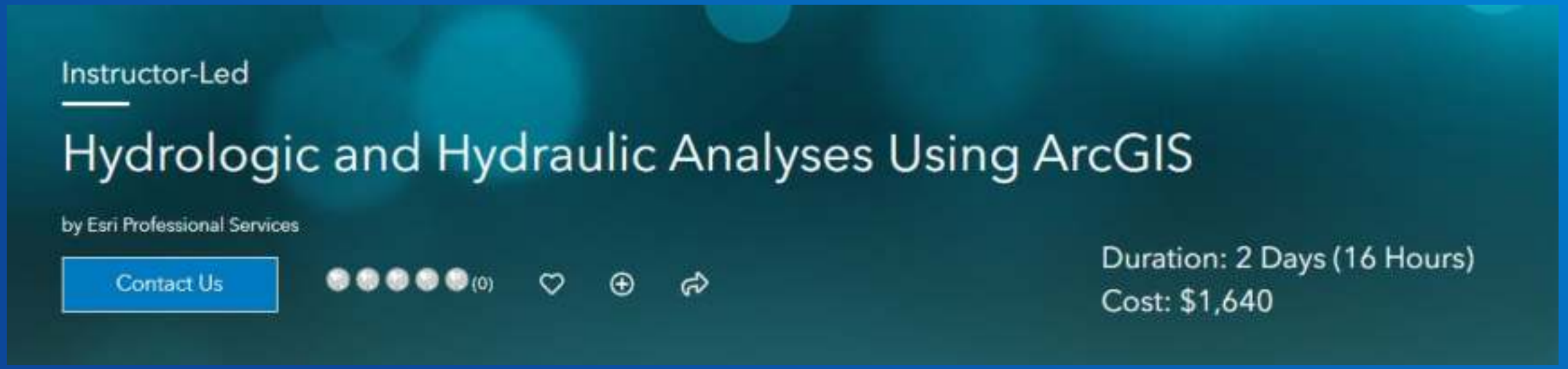
Arc Hydro: GIS for Water Resources – Model Integration

- Integration of external models into Arc Hydro
  - Principles of generic data exchange
  - XML as a vehicle for data exchange and exchange control
  - Building custom exporter
  - Building custom importer

https://www.esri.com/training/catalog/57630436851d31e02a43f0c4/arc-hydro%3A-gis-for-water-resources/

Hydrologic and Hydraulic Analyses Using ArcGIS



https://www.esri.com/training/catalog/57630437851d31e02a43f239/hydrologic-and-hydraulic-analyses-using-arcgis/

Hydrologic and Hydraulic Analyses Using ArcGIS

- What is ArcGIS?
  - Basic principles of GIS
  - Using GIS for water resources analyses
  - Data structures, tools, and techniques
- Data sources for H&H analyses
  - Terrain data, water features, precipitation, land use, soils, flows, curve numbers, and roughness (NED and NHDPlus HR, lidar, WBD, NHD, Nexrad, STATSGO, SURRGO)
  - What to expect and what not to expect
  - International data

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Hydrologic and Hydraulic Analyses Using ArcGIS

- Terrain representation for H&H analyses
  - Esri vector (TIN) and grid structures
  - Precision vs. generality
  - Size considerations
  - Managing large TIN and Esri Grid datasets
- USGS StreamStats
  - National regression equations for high and low flow estimation
  - Developing a StreamStats database
  - Watershed delineation and characterization
  - Running NSS
  - Desktop implementation of NSS

https://www.esri.com/training/catalog/57630437851d31e02a43f239/hydrologic-and-hydraulic-analyses-using-arcgis/

Hydrologic and Hydraulic Analyses Using ArcGIS

- HEC-GeoHMS
  - ArcGIS preprocessor for HEC-HMS
  - DEM preprocessing
  - Building a GeoHMS project
  - Extracting basin characteristics
  - HMS parameter computations
  - HMS schema generation
  - Exporting data to HMS
- HEC-GeoRAS
  - ArcGIS pre- and post-processor for HEC-RAS
  - Terrain preparation—developing consistent terrain representation from multiple data sources
  - Building a GeoRAS project—required and optional data
  - Developing RAS-required information
  - Exporting data to RAS

https://www.esri.com/training/catalog/57630437851d31e02a43f239/hydrologic-and-hydraulic-analyses-using-arcgis/

Hydrologic and Hydraulic Analyses Using ArcGIS

- Running HEC-HMS and HEC-RAS
  - Considerations when building an integrated HMS-RAS model
  - Supplementing HMS and RAS with additional required data
  - Running HMS and RAS
  - Post-processing HMS results (time series)
  - Post-processing RAS results—floodplain delineation
- Putting it all together
  - GIS support for floodplain mapping, real-time operations, and emergency management
  - Using ModelBuilder™ to automate processes

https://www.esri.com/training/catalog/57630437851d31e02a43f239/hydrologic-and-hydraulic-analyses-using-arcgis/

Custom IL Classes (Both AH and H&H)

- Usually developed for a specific organization.
- Two general types:
  - None or slight “tweaks” to class structure:
    - Focus on specific topics (or omission of others).
    - Using local data.
    - Adding an additional day for class summary and future directions
  - Full customization. This then transitions from a “class” to a “workshop” format.
    - Built around specific client requirements.
    - Not a “class” but a tech transfer engagement (different contract mechanism).

Current State of the IL Classes

- Open enrollment classes have not been held in the last two years.
  - COVID.
  - Class structure is not agreeable for distance learning mode (focus on discussions and examples developed in the class).
  - Transition from ArcMap to ArcGIS Pro.
- Custom/client classes continue to be held.
  - Easier to deliver around predefined focal areas.
  - Less discussion (that is part of class planning) and more hands-on
  - Specific technology.
- Aquaveo class on Arc Hydro Groundwater:
  - “GIS-Based Modeling & Data Management using AHGW”
  - April 5-8, 2022

Current State of the IL Classes

- Transition from ArcMap to Pro exercises.
  - Arc Hydro – reached “baseline critical functionality” match with ArcMap version with Arc Hydro release for Pro 2.8 (September 2021).
    - Big item: Trace Network vs. Geometric Network
  - H&H – deprecation of HEC-GeoHMS and HEC-GeoRAS (no ArcGIS Pro version).
    - Transition of selected H&H tools into Arc Hydro.
  - Inclusion of additional exercises based on new tools (WIM, rational method, floodplain delineation using HAND, …).
- Change in class structure to be more agreeable with distance learning mode (focus on using the tools and less on discussion).
- Q3 target for open enrollment (remote option)

Self Training

ArcGIS Foundation

- Back to the three “pillars” of Arc Hydro:
- MANY free (and at cost) resources through Esri and other entities (e.g.):
  - Pro:
    - Getting started with ArcGIS Pro (5.5 hours)
    - Going Pro: ArcGIS Pro Essentials for ArcMap Users (1 hour)
  - Gdb:
    - Getting started with the Geodatabase (3.5 hours)
    - Getting started with data management (1.5 hours)
  - Projections:
    - Basics of Map Projections (3 hours)
    - Introduction to coordinate systems (2.5 hours)

ArcGIS Foundation

- MANY free (and at cost) resources through Esri and other entities (e.g.):
  - Analysis:
    - Getting started with geoprocessing (1.5 hours)
    - ArcGIS Pro: Analysis and Geoprocessing Essentials (1 hour)
    - Deriving raster for terrain analysis using ArcGIS (2.75 hours)
    - Terrain analysis using ArcGIS Pro (2.75 hours)
    - Introduction to surface modeling using ArcGIS (3.5 hours)
- Work with your training consultant to develop a “learning plan” matching your skills and needs.

Arc Hydro: Getting Started

- Learning about Arc Hydro: Resources and Documentation
  - https://go.esri.com/AH_Resources

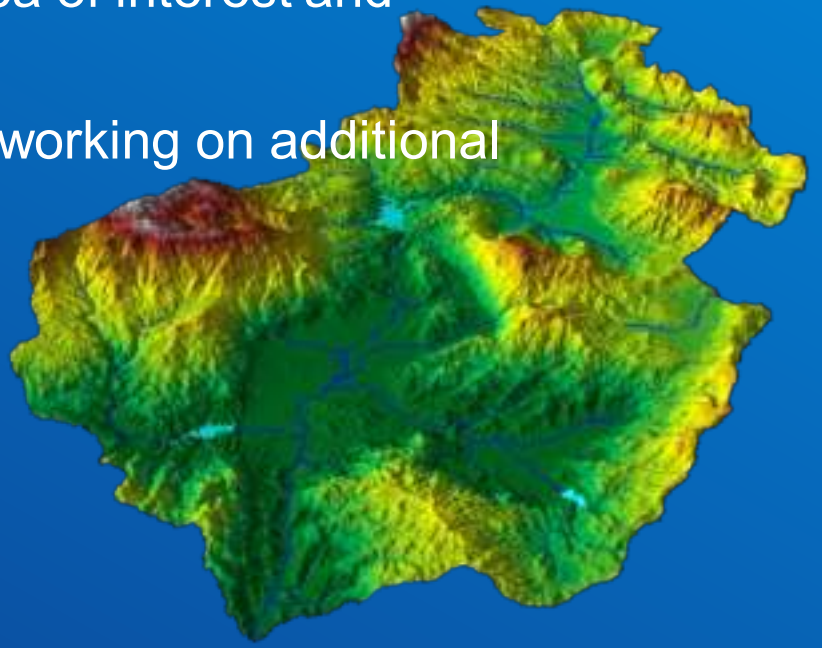
- Getting Started with Arc Hydro
  - https://go.esri.com/AH_Getting_Started

Arc Hydro: Your First “Project”

- Download and install the (correct) Arc Hydro tools. Follow instructions in “Downloading and Installing Arc Hydro Tools” document.
- Read “Arc Hydro: Project Development Best Practices” document – this is required reading. Follow the recommendations closely, specially as you are getting into Arc Hydro.
  - Once you learn its ropes, feel free to diverge from the recommendations (but be ready for “surprises”).
- Define the initial Arc Hydro implementation domain that you want to use first. Start simple and with something that is already well documented (review the “Arc Hydro Resources” document for a list of existing documents).

Arc Hydro: Your First “Project”

- Define spatial area of interest and collect data to use in Arc Hydro processing and analysis. Start with something small in extent and with low data requirements.
- Review any existing documentation pertinent to your domain of interest.
- Start using Arc Hydro tools in the context of your selected area of interest and implementation domain.
- Complete your first Arc Hydro (simple) project and then start working on additional capabilities by building on your first project.
  - Incremental addition.



Arc Hydro: New Materials

- Documentation:
  - Hillslope analysis (Q1).
  - HAND processing (Q2).
- Learn lessons:
  - Wetland Identification Model (Q2).
  - Floodplain delineation (Q3).
  - Watershed delineation and characterization (Q3).
  - Terrain processing (hydro-conditioning) (Q3/Q4).