ArcGIS in Support of Hydraulic Modeling Applications Including Municipal Dam Removals
GOMEZ & SULLIVAN ENGINEERS

• Engineering and Environmental Science Consulting Firm
• ESRI Business Partner
• Offices located in:
  ✔ Henniker, NH
  ✔ Utica, NY
  ✔ Williamsville, NY
  ✔ Albany, NY
Gomez & Sullivan Engineers

• Engineering Services:
  ✓ Dam Safety & Design
  ✓ Dambreak Analysis
  ✓ Dam Removal
  ✓ Hydrologic & Hydraulic Studies
  ✓ Hydropower plant design & rehabilitation
  ✓ Erosion & Sediment Control

• Environmental Science & Fisheries Services:
  ✓ Fish Passage Design
  ✓ Instream Flow Studies
  ✓ Habitat Assessments & Restoration
  ✓ Environmental Impact Statements
  ✓ Sediment management and geomorphology

• Other Services:
  ✓ FERC Licensing & Compliance
  ✓ Land-use Planning
  ✓ GIS & IT Solutions
ArcGIS & Hydraulic Modeling — A Case Study
More than 3,000 dams in MA

- 43 are flood control dams
- 44 licensed hydropower dams
- 164 water supply dams (not all in use)

From MA DER
Gomez and Sullivan partnered with the MA Division of Ecological Restoration (MassDER) to study the feasibility of removing the dam.

Originally built to support historic mill operations.

The dam condition has deteriorated since the mill ceased operations over 25-years ago.

In 2001, the MA Office of Dam Safety required the dam owner to permanently remove the gate and dewater the impoundment for public safety.

Over the last 15-years, the former impoundment has converted to Bordering Vegetated Wetlands and floodplain, and possible riverfront area.

Removing the dam will provide river herring access to upstream habitat not accessed in decades.
DAM CONDITION

65' Wide

10' Tall

GOMEZ AND SULLIVAN ENGINEERS
**Project Objectives**

- Remove the dam and eliminate a public safety threat
- Provide aquatic organism passage (AOP), particularly for river herring
- Restore natural stream processes
- Protect existing infrastructure
  
  ✓ Route 106 Bridge, former mill building
**POST DAM REMOVAL CONDITIONS**

**Key Considerations:**

- What will the river look like after dam removal under normal flow conditions?
- Any impacts on upstream flooding?
- Any impacts on downstream flooding?
- Changes in upstream wetlands?
How will these questions be addressed:

- Collect or compile various geospatial datasets including LiDAR, FEMA Flood Insurance data, DEM’s, topographic survey data, bathymetric survey data, and aerial imagery
- Develop terrains and various feature classes in ArcGIS using ArcMap and extensions (3D Analyst, Spatial Analyst, and HEC-GeoRAS)
- Input data developed in ArcGIS exported to a hydraulic model (HEC-RAS)
- Conduct various model runs (dam vs. no dam scenarios) over a range of hydrologic conditions to determine the impacts of removing the dam
- Import results of the hydraulic model back into ArcGIS to conduct inundation mapping via HEC-GeoRAS
- **TOOLS USED**: RTK GPS, Total Station, Acoustic Doppler Current Profiler (ADCP), ArcGIS (including 3D Analyst and Spatial Analyst), HEC-GeoRAS, and HEC-RAS
- **DATA SOURCES**: MassGIS, FEMA, ESRI, and field collected data
The Hydraulic Engineering Center - River Analysis System (HEC-RAS) is a hydraulic modeling platform developed by the US Army Corps of Engineers.

Several main components, including:

- Analysis of water surface profiles and flow simulations
- Inundation mapping
- Sediment transport

Geospatial data (land-use, elevation data, etc.) act as the foundation of the model; this is referred to as the model geometry.

Geometric data can be setup in HEC-RAS or the ArcGIS extension HEC-GeoRAS:

- HEC-GeoRAS is an ArcGIS extension developed by the Army Corps
- Free download, however, 3D Analyst and Spatial Analyst are required
HEC-GeoRAS Overview

- Set of procedures, tools, and utilities for processing geospatial data in ArcGIS
- Allows for import of geometric data into HEC-RAS and processes simulation results exported from HEC-RAS
- Geometric input features include:
  - Riverbanks, stream centerline, flowpaths, inline structures, and bridges
  - Cross-sections
  - Land-use
- Water surface profile data and velocity data exported from HEC-RAS simulations may be processed by HEC-GeoRAS for GIS analysis of:
  - Floodplain mapping
  - Flood damage computations
  - Ecosystem restoration
  - Flood warning response and preparedness
**HEC-GeoRAS Input Data**

- **Elevation Data:** terrain/TIN must include entire floodplain – in-channel and upland
  - LiDAR data for upland areas
  - Supplemental bathymetric survey data
  - Supplemental topographic survey data

- **Aerial Imagery:**
  - Stream centerline, flow paths, ineffective areas, riverbanks, bridges, inline structures
  - Land-use delineation

- **Cross-sections:**
  - Aerial imagery
  - Elevation Data
  - FEMA Flood Insurance study
IMPORT TO HEC-RAS
RESULTS

- The results of the HEC-RAS model were used to:
  - Conduct water surface elevation, flow, and flood inundation analyses for dam vs. no dam scenarios over a range of hydrologic conditions
  - Conduct a scour analysis at the Rt. 106 Bridge
  - Assess and evaluate the potential for fish passage
  - Inform the design of channel modifications and a constructed riffle
  - Conduct sediment transport analysis
RESULTS – INUNDATION MAPPING

Legend
- Points of Interest
- No Dam 100-yr Floodplain
- Gate Open 100-yr Floodplain
- Gate Closed 100-yr Floodplain

Map showing inundation mapping with various floodplains indicated.