← The US-Mexico border follows the vagaries of the Rio Grande from the Gulf of Mexico to El Paso, Texas, and Ciudad Juárez, Chihuahua.

Maintaining Shifting Boundaries & Managing Shared Resources

Between Mexico and the United States

By Emily Meyertholen, Esri Writer

From the Gulf of Mexico to El Paso, Texas, and Ciudad Juárez, Chihuahua, Mexico, nearly two-thirds of the border between the United States and Mexico lies along the Rio Grande. In accordance with the 1970 Boundary Treaty, when the river shifts, the two countries can either correct the change by restoring the channel or accept the change and perform a land exchange or credit to the country that gained or lost land.

Along this border, the International Boundary and Water Commission of the United States and Mexico (IBWC, or Comisión Internacional de Límites y Aguas) administers the many boundary and water-rights treaties and agreements that have been established between the two nations. It serves as the liaison in any disputes that might arise and advises both countries on issues involving natural resources along the border, where flood control and water quality are major concerns.

"We try to address each issue individually, and GIS has helped us a lot," said Gilbert Anaya, supervisory environmental engineer for the United States Section of the IBWC (USIBWC). With the help of imagery accessed via ArcGIS for Server, his team built a dataset that defined the river boundary, making it easier to track changes and make informed decisions when boundary refinements are necessary.

"As a federal agency, we look at environmental concerns for all of our project areas, so our environmental management section is heavily invested in GIS to support analysis. We have compiled datasets over the years on factors such as cultural resources, locations of impacted areas, and areas where there's an environmental concern, and we incorporate data from other agencies such as EPA to look at the whole gamut of environmental issues. When we collect imagery, we get permission from Mexico to also collect it there to ensure that we have good coverage for both of the project areas."

Starting in 2003, USIBWC began consolidating its GIS from several individual users into one central system in ArcGIS for Server so it could better collaborate among its own offices and with other agencies. Some datasets are currently available to the public via the USIBWC website, and plans are in the works to offer a web mapping interface so stakeholders have immediate access to GIS information, which is crucial during emergencies such as floods. The US and Mexican Sections are also working together to create a reference network for sharing datasets in an effort to complete a seamless dataset for the full border. Though the IBWC has created a digital line for the entire US-Mexico boundary, it is currently working with agencies in both countries to reach an agreement on the use of this line as the official boundary in all future datasets.

"There's still quite a bit of work to do," said Anaya. "We've started to assist the larger agencies, like the USGS and Mexico's mapping agency Instituto Nacional de Estadística y Geografía *[INEGI]* with national datasets such as watersheds, rivers, and elevation data, which are important to many stakeholders and are used quite a lot. We helped jump-start that effort when we started developing the river networks using something similar to the Arc Hydro model, where all of the tributaries and main rivers are now connected via the network for better analysis."

Many missions within the IBWC are concerned with controlling floods, and GIS proved valuable in creating inundation maps during record flooding of the Rio Grande in the summer of 2010. The USIBWC collected imagery and created templates in ArcGIS to automate map sheets that depicted river boundaries across the entire 1,254-mile stretch of the river that lies along the border.

"When we review our flood control procedures, look at hydraulic modeling scenarios, or study how our project areas have developed as the population grows, we go back up to a hundred years. It's good to be able to have historic information to compare with current conditions. We are an over 120-year-old agency and we have a lot of valuable and interesting information that we'd like to put into GIS, but it's going to take time," Anaya added.

The western half of the US-Mexico boundary crosses vast tracts of the Sonoran and Chihuahuan Deserts, the Colorado River, and urban areas near San Diego and Tijuana. While the landscape doesn't require clearing a demarcation line through forests and thick vegetation as it does along the US-Canada border, the United States and Mexico maintain 276 boundary monuments from El Paso, Texas, to the Pacific coast. Both countries share responsibility for maintaining each monument every five years to ensure that it is unobstructed and undamaged.

IBWC data is used by a wide variety of organizations and individuals, from fishermen who use bathymetric information to develop guide maps to federal agencies that leverage the data to better meet their missions, including Federal Emergency Management Agency (FEMA), the US Environmental Protection Agency (EPA), the Department of Homeland Security, the Army Corps of Engineers, and the Bureau of Reclamation. Collaboration with other federal organizations often involves hydraulic modeling or environmental analysis and always results in a GIS product.

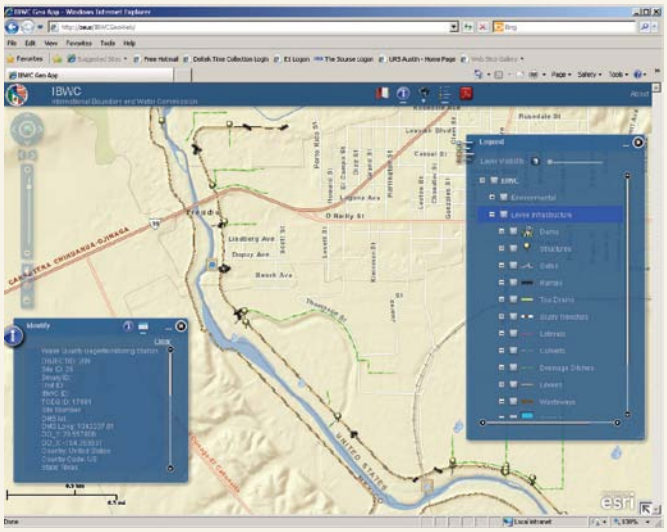
"The easiest way for people to visualize what we're doing is to show it to them on a map," said Anaya. "It's always more effective than data or a table."

Like the International Joint Commission (IJC) on the US-Canada border, the IBWC lead work groups focused on specific regions or environmental concerns. They have also formed technical work groups consisting of GIS professionals from both countries.

"Through open dialog, the work groups, and the use of GIS, there's more transparency, and we are able to freely exchange information between countries," said Anaya. "That is a big benefit we've seen within the last five years. We have a very good network of GIS users within federal and state agencies, and we're working toward harmonizing that data and making sure it's used as it was intended—to provide people with information."

Boundary organizations from other countries have expressed interest in the way the United States and Mexico manage their border, and they often share similar concerns. Groups from China and the Middle East have inquired about the IBWC as a model for handling international boundary issues, especially transboundary rivers. Both the Rio Grande and the Jordan River, for example, serve residents of different countries, making it difficult to manage water use while ensuring a healthy ecosystem.

"That's a common theme that we come across and that we struggle with as well," said Anaya. "As resources become less available, there has to be a commitment to conserve and find a balance, especially in times of drought. When you couple that with another country that's experiencing a similar need, it's twice as difficult. One of our jobs is to get people to notice the benefits of jointly managing resources and get the right people to the table. One of those components is providing the data to support proposed actions. Ultimately, that leads to visualizing what we're trying to do, and that always leads back to GIS. You have to provide the science behind what you're trying to do in order to get the support."



↑ The IBWC GIS web application was developed to review license/lease information on federal properties managed by the commission.

To learn more about these organizations and their GIS work, visit the International Boundary and Water Commission of the United States and Mexico website at www.ibwc.gov, the International Joint Commission website at www.ijc.org, or contact

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↑ This monument was erected as part of resurvey of monuments by commissioners J. W. Barlow (US) and Jacobo Blanco (Mexico) that was completed in 1896. *(Photo courtesy of the IBWC—US and Mexico)*