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Ingenuity & Innovation

Across the globe, cities are applying inventive strategies to re-integrate ecology into the infrastructure, culture, and spirit of urban communities. Here, we examine the ways in which three types of cities are combining engineering, science, and good old human ingenuity to boost their resilience in the face of just one regional challenge.

Restoring Vital Lifelines in the Arid Southwest

In arid southwestern U.S. cities, the demand for water is increasing right along with the population, which is growing faster than the national average (U.S. Census Bureau 2010. *State & County Quick Facts*). At the same time, climate models predict that the region will only become more arid, and face increasingly severe and prolonged droughts. To put it bluntly, the water situation in arid southwestern U.S. cities is dire. The rivers that run through these cities, have been drastically altered if not sucked dry in the name of flood protection, irrigation, and water resources control. These rivers, which once served as lifelines for people and riparian ecosystems, were dammed, diverted, channelized, and lined in concrete.

Thankfully, efforts to restore the hydrology and ecology of urban rivers are underway in cities throughout the southwest. A promising example is the restoration of the Santa Fe river in the both the city and county of Santa Fe, New Mexico.

The Santa Fe River has sustained the city of Santa Fe since it was settled by the Spanish in the early 1600s. For centuries prior to Spanish occupation, Native Americans lived along the river and used the springs it recharged. The Spanish carved a network of "acequias" (gravity fed irrigation ditches) off the Santa Fe River to support agriculture and provide for domestic and livestock needs. Though the acequias diverted water from the river, the unlined ditches actually helped recharge groundwater, possibly to a greater extent than would have occurred naturally without the ditches (spiegel and baldwin, 1963). They also supported the local ecology. In fact, in 1774, a local resident, Señor don Pedro Alonso O'Crouley, described the Santa Fe River as "a crystal clear river full of small but choice trout."


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But the arrival of large numbers of American settlers in the mid-1800s brought the beginning of changes that ultimately resulted in the river's dewatering in Santa Fe. As development expanded, so did the demand for piped water, and the water company engineers built several reservoirs upstream of Santa Fe. The acequias soon dried up and farming in the floodplain virtually ceased.

The combined change in land use and hydrologic regime soon resulted in a drying floodplain and a river that became increasingly flashy, incised, and susceptible to severe flooding. 1968 saw a major flood that floated parked cars on downtown streets. Flood control became an urgent priority for the city.


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A decision was made to increase channel capacity by encouraging incision in the river channel. To do this, the City deliberately removed grade control structures that had previously been placed in the river to protect infrastructure. The result? Flood capacity increased, but a host of other problems got worse. In one mile-long reach of the urban channel, the river channel dropped a foot per year over 15 years, decimating its riparian habitat and threatening human infrastructure. The city responded with a classic engineering approach, freezing that degraded reach into a concrete and gabion lined trapezoidal channel that became known as "the big ugly." Then, in the early 1980s, the U.S. Army Corps of Engineers proposed lining the downtown reach with concrete colored adobe brown to make it look "historic."

The public reaction against these channelization projects was so vocal that the mayor appointed a citizen's River Task Force to look into restoration alternatives. In 1995, the group developed the river corridor master plan, a multi-year program to restore grade controls, multi-use corridors, and greenways to the river.

The city quickly funded the first phase of implementation, which softened the trapezoidal channel by use of stone drop structures, bank facing and vegetation, but also included a pedestrian/cycling path. This brought people to the river and began to create a constituency for further, more ambitious restoration work.


Feb. 2012 ©City of Santa Fe

More restoration projects continued, both upstream and downstream, in the city and county. The Santa Fe Watershed Association led outreach efforts in the downstream, traditional community of Agua Fria to persuade the local folks that vegetative/geomorphic treatments could restore the river their elders remembered. The county acquired a mile of river channel in Agua Fria, displacing an active gravel mine from the reach, and restoration work began in 1998 on the San Isidro River Park. Now, where there used to be vertically eroded banks as high as 40 feet, there is a sinuous, meandering channel flowing ephemerally and lined with native vegetation.


September 2013 ©City of Santa Fe

When Santa Fe's progressive mayor, David Coss took office in 2006, he defined a "living Santa Fe River" as a top priority for his administration.

Biohabitats' Neil Williams has been involved with the restoration of the Santa Fe River for more than 30 years–as City engineer, River Task Force member, and restoration consultant. "In the 1980s, I felt like an outsider opposing the Army Corps' plans to line the river in concrete," he said. "Today, the Santa Fe community is virtually united around the restoration of this river."

2011 saw the completion of a geomorphically-based restoration of 1.5 miles of the river through the city's densest neighborhood. The project integrated riparian restoration, the creation of a linear urban greenway park running along the river, and a wide hiking/biking trail that has since become a major thoroughfare for commuters.


Volunteers help with restoration ©City of Santa Fe

By 2012, after three years of experimentation with reservoir management, the city codified its commitment to the river by adopting the Santa Fe River Target Flow Ordinance. The ordinance commits up to 1000-acre-feet per year of the city's water supply back to the river. According to Brian Drypolcher, River and Watershed Coordinator for the City of Santa Fe, this signified a monumental shift in the way the community viewed water. "Until this point, reservoir management was all about getting water into a pipe for municipal water uses," he said. "To say that we are now going to include in our reservoir management practices a commitment to put some water back into the river…that's huge."

Current efforts are underway to restore eight miles of the river in Santa Fe County, extending not only the ecological benefits of a living river, but the hiking/biking trail and its recreation and transportation benefits. Together, these stacked benefits translate to good news, when it comes to a city's bottom line.


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"You might think of river restoration as some warm and fuzzy ecological issue that's just going to cost municipalities money, but it's just the opposite," said Drypolcher. "All communities are concerned about economic development and the vitality of the people who choose to live and stay there. Quality of life and aesthetics are big."

Drypolcher has high hopes for the future of the Santa Fe River. "I want the river to be an ecological success story, with habitat for plants and wildlife but also thriving habitat for the social life of the city," he said. "This kind of public open space contributes to our sense of community. This restoration is as much about stewardship of our social infrastructure as it is about stewardship of our water resources."