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| **Discipline:** Environmental Engineering; Sustainable Cities | **Type:** Assignment; In-Class Exercise & Discussion | **Time Commitment:** 1-1.5 hours | **Category:** Case Studies on Sustainable Communities |
| **Big Ideas:** **:** [Environmental Justice & Citizen Science](http://serve-learn-sustain.gatech.edu/big-idea/environmental-justice-citizen-science); [Participatory Processes & Collaborative Governance](http://serve-learn-sustain.gatech.edu/big-idea/participatory-processes-and-collaborative-governance); [Collaborative Community Innovations](http://sls.gatech.edu/big-idea/collaborative-community-innovations); [Collaborative Problem-Solving](https://serve-learn-sustain.gatech.edu/big-idea/collaborative-problem-solving); [Sustainable Urban Development](https://serve-learn-sustain.gatech.edu/big-idea/sustainable-urban-development); [Infrastructure: Physical, Technological, Social](https://serve-learn-sustain.gatech.edu/big-idea/infrastructure-physical-technological-social) |
| **OVERVIEW:**The Edwards Aquifer is an artesian aquifer that supplies nearly all of the water in San Antonio, Texas. In this case study, read about the persistent conflict over limited water resources from the Edwards Aquifer. Learn about the process by which this entrenched water conflict was sustainably resolved, for both human users and the ecosystem as a whole.This tool was contributed by Kate Pride Brown. |
| **INSTRUCTIONS:** 1. Before or during class, ask students to read this case study.
2. Either as homework or as an in-class activity, ask students to answer the Discussion Questions in writing, and bring/save a copy of their answers.
3. Ask students to share their answers to the questions during class, either in pairs, small groups, or as a full class.
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| **SLS STUDENT LEARNING OUTCOMES & ASSESSMENT:**The Serve-Learn-Sustain toolkit teaching tools are designed to help students achieve not only SLS student learning outcomes (SLOs), but the unique learning outcomes for your own courses. Reflection, concept maps, rubrics, and other assessment methods are shown to improve student learning. For resources on how to assess your students’ work, please review our [Assessment Tools](http://serve-learn-sustain.gatech.edu/tool-category/assessment). **This tool achieves SLOs 1 and 3. See the end of this tool for further details.**  |

**Want Help?**

Kate Pride Brown is the contact for this tool. You can reach her at k.p.brown@gatech.edu.

SLS Case Study: The Edwards Aquifer in San Antonio

**Background**

The City of San Antonio was founded at the site of a freshwater spring called the Edwards Aquifer that erupted from the ground and flowed out to become the San Antonio River. It was one of hundreds of little springs that seeped up in a region that would otherwise have been arid and dry. But the Edwards Aquifer was plentiful and its pure water had been filtered by the porous karst rock above it. As San Antonio grew through the eighteenth and nineteenth centuries, so did the demands on its water supply, and smaller artesian springs dried up as the Edwards Aquifer receded further underground.

 But the larger springs continued to flow, and two of the largest (San Marcos and Comal Springs) feed into the Guadalupe River, which runs to the Gulf of Mexico. Human settlements along this river, most notably San Marcos, New Braunfels, and Victoria, also continued to grow and develop alongside San Antonio. Meanwhile, farming and ranching communities surrounding San Antonio also drew groundwater from the Edwards Aquifer to feed their crops and livestock. The pressure on the water system was unsustainable, but the draw was only increasing. By the 1950s, the various parties began fighting in “water wars” over this limited, life-giving resource.

Figure , Image of the Seco Sinkhole flowing into the Edwards Aquifer, mysanantonio.com

**Texas Water Law**

As hydrologists know, groundwater and surface water are connected as different parts of one large water system. There is a direct relationship between groundwater and surface water, such that it is hydrologically nonsensical to treat them as separate

systems. However, the legal code around water acquisition and use is not based on science, but rather on legal precedent. In Texas, this means that groundwater and surface water are governed by different legal requirements.

In 1904, the Texas Supreme Court established the “rule of capture” to govern groundwater. The principle behind the rule of capture is that, if you put a well on your

property, you are entitled to draw as much water as you physically can, even if it causes your neighbors’ wells to run dry. The Guadalupe River, on the other hand, is governed

by riparian law and prior appropriation. Users have a legal claim upon the river, as long as there was a river, but the right of San Antonio to capture the groundwater before it

ever reached the surface remained. Cities that relied upon the Guadalupe River for water could see their source run dry with no legal standing to challenge their loss. San Antonio had the legal right to pump as much as it could from the Edwards Aquifer, and it showed no signs of slowing down.



Figure , Edwards Aquifer system map, wikipedia.org

By the 1950s, users of the Edwards Aquifer, including the city of San Antonio and the farmers around it who pumped water for irrigation, were involved in increasingly bitter disputes with each other and with the residents of San Marcos, New Braunfels, Victoria and other downstream users. These constituents appealed to the state legislature to intervene, but the interests involved were so acrimonious that every attempt to legislate a solution failed.

**The Endangered Species Act**

In 1989, the downstream users, represented by the Guadalupe-Blanco River Authority (GBRA), seized upon the idea of using federal law to protect their water source. GBRA issued a notice of intent to sue the U.S. Fish and Wildlife Service under the Endangered Species Act (ESA) to protect eight species that were endemic to the region. The principal species in question was the fountain darter, a fish that lives only in the San Marcos and Comal springs. Should the springs run low or dry up, the fountain darter would become extinct, which would be considered a “taking” by the federal government.

Essentially, the thinking was that as long as there was enough water flowing out of the springs for the species that lived in that ecosystem, then there would certainly be enough to preserve the flow of the Guadalupe River for the downstream human communities as well. The Guadalupe-Blanco River Authority sought to use the threat of an ESA lawsuit to push forward negotiations in the legislature, still hoping for a legislative solution. But the notice to sue expired and the negotiations failed.

The strategy was taken up again in 1990, this time brought forward by environmentalists, represented by the Sierra Club. The environmental activists were not simply using the threat of a lawsuit to push for legislation – they wanted to actually protect the endangered species, and they took the case all the way to a federal court. The judge who heard the case, Lucius Bunton, ruled in favor of the Sierra Club. Without

proper management, the fountain darter and the other species would become extinct. Judge Bunton told the state legislature that they had to create a plan to manage the

Edwards Aquifer or suffer “the blunt axe” of federal regulation. The threat of federal regulation finally motivated the parties to craft a local solution to their water conflict.

**The Habitat Conservation Plan**

In response to the court order, the state legislature created the Edwards Aquifer Authority. This new regulatory body capped the number of acre-feet that could be legally drawn from the aquifer each year, and it issued permits to rights-holders for their allotted amount. During drought years, there would be an automatic reduction in permitted withdraws that would be

Figure , Edwards Aquifer Region, edwardsaquifer.net

triggered by specific aquifer levels. With the creation of the Edwards Aquifer Authority, San Antonio became the sole exception to the “rule of capture” for governing groundwater in the state of Texas.

However, even with permitted pumping, the state had still not successfully avoided the threat of federal regulation. To do that, the state would need to present an approved Habitat Conservation Plan (HCP) to guarantee proper management of water. The plan

had to assure the U.S. Fish and Wildlife Service that enough water would flow through the springs to preserve the species residing there. The legislature mandated that stakeholders in the Edwards Aquifer convene a Recovery Implementation Process (RIP) that would craft the required HCP before a court-ordered deadline, after which the federal government would seize and regulate the aquifer should the local stakeholders fail to produce an approved HCP.

**The Recovery Implementation Process**

Representatives of the key stakeholders – agriculture, the utility (San Antonio Water System, or SAWS), the spring communities, and the various downstream communities – met monthly over a period of four and a half years to discuss and agree upon the requirements for protecting the endangered species and the means to enact those requirements. To everyone’s surprise, the process was successful. Many attribute the RIP’s success to its moderator, Robert Gulley. An environmental attorney, Gulley built a consensus-based process for building the HCP that had several notable attributes.

***Key Takeaway:***

1. ***Start small.***
2. ***Science stands firm.***
3. ***Consensus means no objection.***
4. ***Cost comes in last.***
5. *Start small.* Given the long history of contentious issues, Gulley did not want the group to immediately fall into hostility and gridlock. He first had them discuss the

most basic questions and build consensus on those simpler, more fundamental concerns. Having developed rapport and trust through the easy questions, the group could more successfully tackle the harder ones as they arose. Also, the harder questions would now stand on a foundation of consensus around the basic terms of debate.

1. *Science stands firm*. To build a plan that would adequately protect the endangered species meant that the stakeholders had to feel reliably certain of the ecosystemic requirements of those species. The group commissioned a group of scientists to form a consensus-based scientific committee to provide solid, peer-reviewed knowledge about San Marcos and Comal springs and their resident species. The stakeholder group, which included multiple and competing parties, had to agree by consensus which scientists to include in the scientific committee (which meant that any scientist who might potentially show bias in

favor of industry or environmentalists was excluded). The most critical question was: what is the minimum flow necessary to maintain the endangered species, and what is the minimum aquifer level that would guarantee that level of flow? Peer-reviewed, empirically-based science, as agreed by a consensus of a diverse panel of scientists, became the shared baseline for the stakeholders in

moving forward on a management plan. Once the committee weighed in on a subject, the science of the issue was no longer held to be in question. Scientific consensus was the shared standard within which the stakeholders crafted their solution

Figure , Image of Comal Springs and Landa Park, edwardsaquifer.net

1. *Consensus means no objection*.The process allowed for parties to say that they did not object to a feature of the plan without requiring them to support it. Gulley recognized that there is more difficulty in asking someone to affirm something that they don’t like than asking them not to object to it. Moreover, no one was required to accept any feature of the plan until the very end. A party could say, “I am okay with this for now, so we can move on,” and still reserve their final vote until the end. The goal is lowered from agreement to avoiding impasse. As long as the parties are talking and making progress, a solution to conflict is still possible. Many stakeholders praised Gulley for his intuition at knowing when to take a break if things were growing fractious or to guide the conversation toward points of agreement.
2. *Costs come in last*. No one in the RIP was allowed to bring up costs or how some element of the plan would be paid for until the very end of the process. By the time it came to cost and payment, the group had already agreed to everything that was necessary and required. The stakeholders had found a mutually satisfying solution to prevent the depletion of the aquifer. At that point, cost would

not derail the progress that had been made. All parties understood that the solution they had crafted was, in fact, the best one for all parties given the terms that had already been settled: scientifically and legally. At that point, the cost was simply what it was, and how to pay for it was merely another technical question.

Under Gulley’s careful guidance, and in accordance with the process described above, the Edwards Aquifer Stakeholders Committee developed a HCP that was approved by the U.S. Fish and Wildlife Agency.

**Conclusion**

***Key Takeaway: The Edwards Aquifer solution was created by a mixture of active community participation, environmental benchmarks, and legal requirements.***

Stewardship of the Edwards Aquifer remains in local hands, and all the communities are mutually satisfied with the results. San Antonio Water System has one of the most robust water conservation programs in the country. Downstream users can rest assured of adequate flow from their springs. Farmers and ranchers are aware of their permitted allotments, and everyone is clear of their shared responsibilities in the face of drought. The Edwards Aquifer is regularly measured, and the level of the aquifer is broadcast on the nightly news. Ecosystemic sustainability is the minimum threshold upon which all human use is predicated. Regular environmental monitoring is a requirement for the HCP. At any point, should the ecosystem show evidence of failing, the threat of a federal takeover would return.

The stakeholders are proud of what they have achieved. And after decades of fighting between the various human users of the Edwards Aquifer, in the end, they preserved their ecosystem, not because they wanted to do it out of self-interest, but because they were legally required to in the interest of a little-known fish called the fountain darter.

Figure , Fountain Darter, txstate.fishesoftexas.org

**Discussion Questions**

1. What role did the Endangered Species Act (ESA) play in the resolution to San Antonio’s “water wars?” Some people are hostile to the ESA, believing that the law is harmful to economic growth. How do you think the members of the RIP Stakeholder Committee would respond to this critique?

2. How was science brought into the process of managing the aquifer? What did the scientific process provide to the stakeholder negotiations?

3. The moderator forbid any discussion of cost or payment until the very end of the process. Why do you suppose he structured the conversation in such a way? What other conflicts over sustainability might benefit from such an approach?

4. What lessons can be drawn from the water wars over the Edwards Aquifer and the means by which this conflict was resolved? What general recommendations or principles might be drawn from this case study to inform policy?

5. What from this class or your discipline could you draw on to apply to the case of the Edwards Aquifer? How might you be able to apply these lessons in your own work?

**Resources for Further Reading**

Brown, Kate Pride. 2018. “Multilevel Governance and Minimum Flow: The Varying Conservation Outcomes of Water Conflict Resolution.” *Research in Political Sociology* 25: 25-44.

Brown, Kate Pride. 2017. “Water, Water Everywhere (or, Seeing Is Believing): The Visibility of Water Supply and the Public Will for Conservation.” *Nature + Culture* 12(3): 219–245.

Eckhardt, Greg. 2015. Laws and regulations applicable to the Edwards Aquifer. <http://www.edwardsaquifer.net/rules.html>.

Ronald Griffin (ed.). 2011. *Water Policy in Texas: Responding to the Rise of Scarcity*. Washington, D.C.: Resources for the Future Press.

Gulley, Robert. 2015. *Heads above Water: The Inside Story of the Edwards Aquifer Recovery Implementation Program.* College Station, TX: Texas A&M University Press.

Votteler, T. H. 2004. Raiders of the lost aquifer? Or, the beginning of the end to fifty years of conflict over the Texas Edwards Aquifer. *Tulane Environmental Law Journal*, 15, 257-335

Votteler, T. H. 2008. The Edwards Aquifer: ESA-Driven Management. *Guadalupe- Blanco River Authority*.

SLS Student Learning Outcomes

1. Identify relationships among ecological, social, and economic systems.
2. Demonstrate skills needed to work effectively in different types of communities.
3. Evaluate how decisions impact the sustainability of communities.
4. Describe how to use their discipline to make communities more sustainable.\*

\* *Note:* SLO 4 is intended to be used by upper division, project-based courses such as Capstone.