June 19th, 2024

RE: Request to Develop a Socioeconomic Study Proposal for the Lost Pines Groundwater Conservation District

Dear Lost Pines GCD Board of Directors,

In late 2022, LRE Water was asked to develop a scope of work to perform a socioeconomic study on behalf of the Lost Pines Groundwater Conservation District (LPGCD). Since this time, we have had numerous conversations with the LPGCD to better understand the specific goals of this study. Presented within this document is our draft socioeconomic study proposal. This proposal is presented in draft format so that we may continue to workshop this scope of work with direction from the LPGCD Board.

For this project, LRE has conducted numerous internal meetings to ensure that we are fully capable of carrying out the various tasks, many of which we have already performed in different capacities. We have also engaged a key partner, Charles Wight, PhD to aid in specific facets of the project where LRE does not have direct demonstrated experience.

We appreciate the opportunity to provide this scope of work and look forward to assisting the LPGCD with this important project.

Sincerely,

Vince Clause, PG

LRE WATER

Introduction

Sustaining groundwater resources relies heavily on the decisions and actions of diverse stakeholders [1,2]. Groundwater management is complex due to several interrelated factors: the unpredictability of human behavior, a diverse array of water users and stakeholders, intricate feedback loops linking social dynamics to groundwater conditions, and the nuanced regulations and multiple institutions responsible for their enforcement [3].

In Texas, administration through groundwater districts is this state's preferred approach for groundwater management, to protect property rights, and to balance the conservation and development of groundwater to meet the needs of this state (2 TAC §36.0015(b)). Groundwater districts are required to develop a management plan (§36.1071(a)) and adopt the rules necessary to implement their management strategies (§36.1071(f)). Additionally, groundwater districts are required to participate in joint planning within their respective groundwater management area(s) (§36.1071). For Lost Pines Groundwater Conservation District (LPGCD), this is participation within Groundwater Management Area 12. Through this joint planning process districts are required to adopt desired future conditions (DFCs) for the relevant aquifers within their management area. DFCs must balance the highest practicable level of groundwater production with the conservation, preservation, protection, recharging, and prevention of waste of groundwater (§36.108(d-2)). To achieve this mandate in the establishment of DFCs, the management area is required to consider nine factors, one of which includes the socioeconomic impacts reasonably expected from declining water levels.
LPGCD understands firsthand the impacts of large-scale groundwater use within the region and the vulnerability of their management strategies to groundwater production. With a mission focused on developing rules to protect existing wells, prevent waste, promote conservation, and ensure sustainable groundwater availability and accessibility, LPGCD plays a vital role in managing groundwater resources in Bastrop and Lee Counties. However, achieving success in this mission requires obtaining information on the impacts of groundwater pumping to inform effective decision-making and conservation efforts. At times, such local efforts can be at odds with efforts undertaken by joint and regional planning groups.

Our proposal aims to address the challenges faced by the LPGCD by leveraging advances in hydrogeological modeling, socioeconomic impact assessments, and agile stakeholder engagement techniques through a collaborative project. By doing so, we seek to provide LPGCD with a comprehensive suite of assessments and tools to better understand the impacts of water level declines on different water users, encompassing both monetary and non-monetary values through a socioeconomic lens.

Currently, there is a lack of uniformity in how groundwater districts assess socioeconomic impacts, and an absence of quantitative tools for evaluating the ramifications of water level declines. This project aims to develop a transferable method and solution set using a conceptual model framework tailored to the LPGCD management area. Furthermore, this work may guide future investments and policy decisions, ensuring alignment with LPGCD's mission of protecting existing wells, preventing waste, promoting conservation, and ensuring sustainable groundwater availability and accessibility in Bastrop and Lee Counties.

Project Approach

The primary objective of this work is to provide LPGCD with a series of analyses which quantify different social and economic impacts based on historical (2011 – present) and future (2024 – 2070) groundwater pumping scenarios.

This work assumes the following:

- There are different values (social and economic) of water associated with their uses.
- Stakeholders (e.g. agricultural, industrial, domestic, public utility, ecosystem) may assign different values to different uses.
- Quantifying impacts (social and economic) of water level decline is feasible.
- Groundwater provides ecosystem services.

Data for this work will be obtained from the following primary sources:

1. Data from the literature on quantifying different social and economic impacts of water use.
2. Data from hydrological and hydrogeological models in Texas.
3. Local U.S. Census Bureau demographic and economic data.
4. Stakeholder engagement.

Although geographically bounded by the LPGCD management area of Lee and Bastrop counties, this work aims to provide a scalable solution that can be adopted across differing geographies, such as an entire groundwater management area.

To successfully complete this work, we propose a three-phase approach. Phase 1: Project Scoping and Data Collection, Phase 2: Model Development and Data Analysis, Phase 3: Results and Recommendations. This work will cumulate in two primary deliverables: 1) A concise written report including maps, diagrams, charts, and recommendations co-created with stakeholders, and 2) A web-based mapping tool where users can explore relationships between socioeconomic impacts and changes in groundwater levels.

Phase 1: Project Scoping and Data Collection

Task 1: Develop a Conceptual Framework

Objective: *Develop, socialize, and iterate a conceptual framework that aligns with LPGCD and guides the subsequent analysis.* This effort will ensure a solid project foundation that will (a) establish a clear, research-backed approach to analyzing socioeconomic factors related to groundwater use, and (b) provide a structured basis for subsequent phases of the project, ensuring that all future work is aligned with established expectations and realities.

Task 1.1: Review the literature on socioeconomic analysis in the context of groundwater use to develop a framework that aligns with realities and expectations in the LPGCD.
Task 1.2: We will work with the LPGCD Board to establish a stakeholder group that includes various water users (e.g. agricultural, industrial, domestic, public utility, ecosystem).
Task 1.3: Engage with the stakeholder group to check assumptions.
Task 1.4: Engage with LPGCD Board of Directors and Staff to solicit feedback on conceptual framework.
Task 1.5: Receive conceptual framework approval from the LPGCD.

Task 1 Deliverables: Technical memorandum and associated presentation describing the conceptual framework approved by the LPGCD Board of Directors.

Task 2: Develop a Technical Framework

Objective: *Develop and Validate the Technical Framework.* This task aims to create a robust technical framework that integrates stakeholder input with hydro-economic (i.e. economic impacts of changing water level) and agent-based modeling (i.e. decision-making of various groundwater users). The framework will be validated through stakeholder engagement to ensure it aligns with the realities and expectations within the LPGCD. This technical framework will serve as the foundation for subsequent analytical and implementation phases of the project by providing a structured approach to analyzing and managing groundwater use from both technical and socioeconomic perspectives.

Task 2.1: Synthesize the literature on stakeholder mapping, hydro-economic, and agent-based modeling to develop a framework that aligns with realities and expectations in the LPGCD.
Task 2.2: Engage with the stakeholder group to check assumptions, solicit feedback, and iterate approach. This also includes participation with a working group currently being established by Environmental Defense Fund (Vanessa Puig-Williams) and The Meadow's Center (Robert Mace) for Water and the Environment. The intention of this group is to propose a variety of ways that GCDs can evaluate socioeconomics and present those findings to the legislature. Our project would ideally run along a parallel track to this effort and be used as a case study in their discussion.
Task 2.3: Develop an infographic that outlines how social impacts are to be evaluated based on findings from the literature and stakeholder engagement. This infographic will also serve as the outline for the agent-based modeling.
Task 2.4: Develop the well impact economic cost calculation worksheet and regional economic analysis formulas. Through this task we will develop the formulas that will later be implemented in Task 4.
Task 2.5: Receive technical framework approval from the LPGCD.

Task 2 Deliverables: Technical memorandum and associated presentation describing the technical framework approved by the LPGCD Board of Directors.

Task 3: Perform Data Collection

Objective: *Collect all available data to carry out the technical framework*. Understanding socioeconomic impacts requires carefully collected and meticulously organized data that adheres to the technical framework to ensure consistency and reliability. This data will be collected and organized geospatially within the context of the LPGCD management area.

Task 3.1: Collect and develop U.S. Census Bureau demographic and economic data following the agreed technical frameworks.
Task 3.2: Collect and develop hydro-economic data (e.g. local energy costs, well drilling quotes, pump rating curves) following the agreed upon technical framework.
Task 3.3: Revise and communicate any changes in scope based on available data.

Task 3 Deliverables: (1) A geospatial database which organizes socioeconomic variables (2) Data documentation for collected datasets.

Phase 2: Model Development and Data Analysis

Task 4: Execute Model Development

Objective: *Develop the first iteration of the socioeconomic model.* The previous phases of work set the groundwork for the model by ensuring (a) the conceptual and technical framework matched the objectives of stakeholders in the LPGCD and (b) the obtaining of necessary data to develop a model in an intelligible format. Task 4 uses this information and data to develop a socioeconomic model.

Task 4.1: Develop water well impact economic cost calculator. This will be developed as a standalone excel spreadsheet that calculates economic costs associated with declining water levels at a single well location.
Task 4.2: Develop an analytical tool (Theis/Cooper-Jacobs) that evaluates local economic impacts based on pumping at a single well location. This tool will use a set of assumptions and will model economic impacts resulting from pumping at a single well location on surrounding wells.
Task 4.3: Develop GIS based regional economic impact tool. This tool will use a set of assumptions and user inputs to quantify the economic impacts for a given area (e.g. census block) based on water level declines
Task 4.4: Integrate social framework/agent-based modeling with economic forecasting tools to develop the integrated socioeconomic model. This will result in a web-based mapping tool where users can explore the relationship between changes in groundwater levels and socioeconomic impacts.
Task 4.5: Create a development environment for beta testing. This is to ensure that the tool can be tested by various stakeholders in a secure environment.
Task 4.6: Create a draft Socioeconomic Model.

Task 4 Deliverables: Demo the draft Socioeconomic Model to the LPGCD.

Task 5: Model calibration and refinement

Objective: *Collect feedback on the model and improve it.* Perhaps more important than being able to build a model that approximates reality is to solicit feedback on the proposed model from local stakeholders. The purpose of subjecting the model to feedback at this stage is to be able to make adjustments and calibrate assumptions and inputs to improve the accuracy and precision of results.

Task 5.1: Engage with stakeholder group to (a) preview results and (b) solicit feedback,
Task 5.2: Calibrate model based on feedback.

Phase 5 Deliverables: Final Calibrated Socioeconomic Model.

Phase 3: Results and Recommendations

Task 6: Data Analysis and Results

Objective: *Synthesize the data collected and analyzed throughout the previous phases.* This is important for effectively communicating the findings to different audiences. We will accomplish this through visual representations and a written report.

Task 6.1: Consolidate and synthesize findings into static graphs and maps.
Task 6.2: Develop a report for the LPGCD Board of Directors.

Task 6 Key Deliverables: Draft Report

Task 7: Socialize Results

Objective: *Effectively communicate the project results to a diverse set of water users around the LPGCD.* This is an imperative step to set the stage for gathering feedback, and collaboratively design initiatives for the final Task.

Task 7.1: Develop a communications strategy to perform a workshop with LPGCD stakeholders.
Task 7.2: Hold an in-person workshop to discuss the results from this analysis, solicit feedback and co-design policy recommendations.

Phase 7 Deliverables: A completed in person workshop.

Task 8: Develop Recommendations

Objective: *Develop recommendations to improve socioeconomic conditions in LPGCD and across the state.* At this point in the project, it's important to draw on collaborations, insights, and communications tools to provide recommendations that have real-world impact.

Task 8: Develop recommendations for different scales of water managers (e.g. irrigation districts, GCDs, and state).

Phase 8 Key Deliverables: A concise executive summary describing evidenced based recommendations for how LPGCD can ensure they fulfill their mission in the short- and long-term.

Timeline and Budget:

The above proposal focuses on a one-year effort, leveraging existing expertise, networks, and programming skills. Each phase will take approximately 4 months to complete. This timeline can be adjusted based on the priorities of LPGCD, including ensuring that key deliverables are provided at important strategic junctures (e.g. legislative sessions).

Phase	Task	Total
1	Task 1 Develop a Conceptual Framework	15,000
	Task 2 Develop a Technical Framework	20,000
	Task 3 Perform Data Collection	15,000
2	Task 4 Execute Model Development	50,000
	Task 5 Model Calibration and Refinement	10,000
3	Task 6 Data Analysis and Results	30,000
	Task 7 Socialize Results	10,000
	Task 8 Develop Recommendations	10,000
		$160,000

Subcontractor:

For this work LRE will subcontract work from each phase of this project to Charles Wight, PhD. Charles is an independent consultant who specializes in sustainable water management strategies and recently co-authored the Texas Water System Prioritization Tool (https://www.policyinnovation.org/txwaterdatatool) and will draw on many of these findings while assisting in the development of the LPGCD Socioeconomic Model. More can be learned about Charles here www.CharlesWight.com.

References:

1. An, L. Modeling human decisions in coupled human and natural systems: Review of agent-based models. *Ecological Modelling* **229**, 25–36 (2012).

2. Vörösmarty, C. J., Pahl-Wostl, C., Bunn, S. E. & Lawford, R. Global water, the anthropocene and the transformation of a science. *Current Opinion in Environmental Sustainability* **5**, 539–550 (2013).

3. Canales, M., Castilla-Rho, J., Rojas, R., Vicuña, S. & Ball, J. Agent-based models of groundwater systems: A review of an emerging approach to simulate the interactions between groundwater and society. *Environmental Modelling & Software* **175**, 105980 (2024).