Application Form

2011-2012 Texas Water Resources Institute Mills Scholarship Program

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4. **Research Proposal: Identifying Groundwater Dependent Ecosystems in Texas**

Groundwater dependent ecosystems (GDEs) rely on either the surface expression or subsurface presence of groundwater. They are typically found in the riparian zones of gaining streams and groundwater-fed wetlands; in upland areas, certain types of ecosystems, known as phreatophytes, can use deep roots to access groundwater. GDEs are vital because of their ecological, social, and economic values, but they are vulnerable to environmental changes. Increasing groundwater use of domestic, industrial, and agricultural sectors can alter groundwater regimes and result in the degradation of GDEs. Rapid urbanization can destroy the habitat of GDEs. Governmental agencies, such as the United States Geological Survey, the Australian National Water Commission, and the EU Water Framework Directive, have begun to address the importance of GDEs for groundwater resources management. However, GDEs are still poorly understood and the studies of GDEs are at the very early stage. To study GDEs and their role in sustainable groundwater management, the first question that needs to be answered: Where are these ecosystems located?

This proposed project addresses this question and aims to identify the spatial distribution of GDEs in Texas. Groundwater provides approximately 60 percent of the water used in Texas and plays an integral role in the GDEs—it maintains a necessary amount of the baseflow in the streams, sustains water needed for wetlands, provides for spring flows, and supports the water use of phreatophytes. Increasing population and groundwater extraction threatens the GDEs in Texas. Understanding of the spatial distribution of GDEs within the state is necessary for sustainable groundwater management. Unfortunately, relatively little information of GDEs distribution is available at the state scale. To address this knowledge gap, the proposed project will identify and map the likely locations of GDEs in Texas.

The objective of this project is to develop a large scale, cost effective method to identify GDEs and generate a state scale map of potential GDEs in Texas. Three major tasks will be conducted to achieve the project objective. First, a geo-referenced database will be constructed. It will contain a variety of geospatial information on Texas topography, hydrology, and ecology,

including previously generated maps of major streams, wetlands, springs, land use/land cover, vegetation type, and elevation. Relevant GIS data, aerial photography, satellite imagery and information from documentaries will also be incorporated in this database. Data that has not been geo-referenced will be digitized and incorporated into the database. Second, the locations of gaining streams and groundwater-fed wetlands will be determined using this database. Gaining streams will be identified by analyzing the streamflow data of each gauging station and return flow rates and withdraws within the subreaches. An algorithm to remotely identify the potential groundwater-fed wetland will be created; it will consider the indicators of vegetation, hydrogeology, and topography to find out whether or not the wetlands are groundwater-fed. Third, the extent of GDEs along the gaining streams, within the groundwater-fed wetlands, and around the springs will be delineated. Ecosystems using groundwater have different characteristics than other nearby vegetation, such as leaf area index. According to this criterion, satellite imagery like the Normalized Difference Vegetation Index (NDVI) and greenness, along with aerial photography, will be used to delineate the spatial extents of GDEs.

The final product of this project will be a state level database of potential GDEs, depicted graphically by a map of potential groundwater dependent ecosystems in Texas. This map will provide a foundation for future GDEs studies and groundwater resources management in Texas. This map can help researchers conduct field measurements of GDEs and reduce the cost of field verification. The information can also be used to estimate the impacts of groundwater extraction and urbanization on GDEs and identify the potential stressed and degraded GDEs in Texas. These efforts can support the sustainable groundwater development of Texas to balance both human and ecosystem needs for groundwater.

5. Academic Qualifications:

- PhD Candidate, Civil Engineering, Texas A&M University, US (GPR), 2010-Present
- M.S., Hydrology and Water Resources Engineering, China Institute of Water Resources and Hydropower Research, China (GPR) (GRE), 2007-2010
- B.S., Civil Engineering, China Agricultural University, China (GPR), 2003-2007
- Related Courses: Civil Engineering Application of GIS; Groundwater Engineering; Vadose Zone Hydrology; Stochastic Hydrology; Dynamics Modeling of Environment Systems.

6. Proposed Use of Funds:

I intend to use the funds to purchase relevant remote sensing products and computer software, and to pay for travel expenses to attend academic conference.

7. Intended Career Path:

After I finish my PhD, I intend to initially pursue an academic career, focusing on teaching and research in the field of Ecohydrology. I plan to later shift to working with non-government organizations to address issues involving water resources management and ecosystem protection.