

TO: Board Members

THROUGH: Kevin Patteson, Executive Administrator
Robert E. Mace, Ph.D., P.G., Deputy Executive Administrator, Water Science & Conservation
Les Trobman, General Counsel

FROM: Larry French, P.G., Director, Groundwater Resources

DATE: January 7, 2016

SUBJECT: Study of hydrology and geology of the confined and unconfined aquifers of Texas as required by House Bill 1232.

ACTION REQUESTED

Consider determining the minimum flow rates for inclusion in the study of the hydrology and geology of the confined and unconfined aquifers of Texas as required by House Bill 1232 from the 84th Legislative Session.

BACKGROUND

House Bill (HB) 1232, authored by Representative Eddie Lucio III, requires the Texas Water Development Board (TWDB) to conduct a study of the unconfined and confined aquifers of the state. HB 1232 directs the TWDB to determine: (1) the quality and quantity of groundwater in those aquifers; (2) whether those aquifers are tributary or non-tributary; (3) the contribution of those aquifers to any surface flow of any water in this state; and (4) the contribution of those aquifers to any other aquifer in this state. The TWDB is required to produce a map that identifies the area and water quality of the confined and unconfined aquifers, a map that identifies which aquifers are tributary and which are non-tributary, and a report on the contribution of those aquifers to any other aquifer.

KEY ISSUES

HB 1232 requires that, before conducting the study, the TWDB “shall determine the minimum rate at which an aquifer must contribute to another aquifer in this state or to the surface flow of any water in this state in order to be included in the study.”

As a means of explanation and context, Representative Lucio III provided a letter to the Executive Administrator’s staff. While his statements alone do not establish the full legislative intent of HB 1232, they do help clarify the background of the issues involved. The letter explains that this study would help:

<p style="text-align: center;">Our Mission</p> <p>To provide leadership, information, education, and support for planning, financial assistance, and outreach for the conservation and responsible development of water for Texas</p>	<p>⋮</p> <p>⋮</p> <p>⋮</p> <p>⋮</p> <p>⋮</p> <p>⋮</p>	<p style="text-align: center;">Board Members</p> <p>Bech Bruun, Chairman Kathleen Jackson, Member Peter Lake, Member</p> <p>Kevin Patteson, Executive Administrator</p>
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“...get sound, State-backed science on the make-up of our aquifers and the amount they contribute or do not contribute to other bodies of water, streams, or rivers in Texas. Additionally the study should identify deep aquifers in the state and the interplay, if any, that exists between deep aquifers and those that are closer to the surface. The study should address the make-up of our aquifers, the amount they contribute to other aquifers or state owned waters, and potential issues with drawing from those aquifers. For the purposes of this study, the term “tributary” needs to be defined in terms of an appreciable amount of flow into another body of water, stream, or river. This was considered a very important aspect of this study. While an aquifer may contribute to another body of water, stream, or river, that amount must be enough to directly and significantly affect that body of water, stream, or river. We would also like to be clear that this definition should not include waters of the United States or be as broad as the definition used by the EPA.”

On October 26, 2015, the Executive Administrator’s staff conducted a public meeting to receive and discuss technical input regarding the minimum rate at which an aquifer must contribute to another aquifer or to the surface flow of any water in the state. By October 31, written input via email or through an online survey had been received from over 50 stakeholders. The comments and suggestions covered a range of technical considerations, including both qualitative and quantitative metrics, to determine the flow requirements for the study.

Most commenters recognized the challenges associated with defining minimum flow criteria for aquifers to surface water. Usually the commenters cited the complexity of developing a study standard for a statewide resource for which data are not always available, where conditions vary widely across the state and through time, and where there is potential legal involvement related to groundwater management. Written comments covered a wide range: from recommending that a minimum flow not be defined quantitatively, to suggesting that a minimum flow rate (from an aquifer to a surface water body) be expressed as a percentage of baseflow, and also to expressing the minimum flow rate as a specific flow rate value. Commenters were split roughly evenly between providing definitions that are qualitative and definitions that are tied to specific data or modeled values.

To develop the proposed definitions, the Executive Administrator’s staff has used the stakeholder input and considered the following:

- The study will focus on the 30 major and minor aquifers that supply approximately 60 percent of water used by Texans.
- Employ groundwater availability models - wherever technically appropriate - to aid in the evaluation of regional inter-aquifer flows and groundwater–surface water interactions. Groundwater availability models are regional, numerical groundwater flow models that have been developed through legislative initiatives with rigorous technical standards defined by the TWDB, thoroughly reviewed via stakeholder input and public comment, and utilizing the best available science.
- Recognize long-term, seasonal aspects of surface water flow as well as groundwater flow in aquifers. At times groundwater may flow out of an aquifer to an adjacent aquifer or a surface water body. At other times, due to seasonal changes or pumping activities, flow directions may be reversed.

- HB 1232 requires a statewide aquifer evaluation, so there are some local features occurring at scales that may not be possible to document or map for purposes of the study. The study will therefore focus on the major rivers and reservoirs of Texas.
- Flow rates that may be significant in some areas may not be significant in other areas due to regional differences in climate, groundwater usage, and availability of surface water. The study will include groundwater resources that have significance to local, regional, and statewide interests.

RECOMMENDATION

Upon considering the statute, legislative intent, and input from stakeholders, the Executive Administrator proposes the following two definitions in compliance with the requirements of HB 1232:

1. Minimum rate at which an aquifer must contribute to another aquifer to be included in the study.

All major and minor aquifers in the state will be included in the study for evaluation of flow between aquifers. **The minimum flow rate is defined as the lowest annual net vertical flow from an aquifer to another aquifer as estimated by the applicable groundwater availability model. If no groundwater availability model exists or if the applicable groundwater availability model is insufficient, other appropriate methods may be used to estimate flow.**

This is a challenging parameter to assess as there are no available direct measurements or data; therefore, we do not recommend setting a “pre-defined” flow rate criterion. Some groundwater availability models may not have been appropriately designed to address this question. In addition, several minor aquifers do not yet have a groundwater availability model. In these cases, a flow rate will be estimated through water balance evaluations using available data and professional geologic judgment. This definition and method is intended to broadly encompass the major and minor aquifers as defined by the TWDB. In summary, this definition will allow for evaluations of inter-aquifer flow to be performed throughout the vast majority of the state for all major and minor aquifers.

2. Minimum rate at which an aquifer must contribute to the surface flow of any water to be included in the study.

For purposes of this study, the outcrop surface areas of all major and minor aquifers in the state will be included in the study for evaluation of groundwater contribution to surface flow. **The minimum flow rate criteria is defined as discharge from major and minor aquifers contributing 0.1 percent of the mean annual surface water flow over any specified geographic area of any major or minor aquifer.**

Understanding aquifer contributions to surface water (and vice versa) is a major research topic in the field of groundwater hydrology. As a practical matter, springflow and streamflow measurements are few (when viewed over the entire state) and vary widely over time. Furthermore, aquifer contributions to surface water may be discrete (springs) or diffused along the length of a stream. To address this issue, we will focus our efforts

on evaluating baseflow – the component of surface water streamflow that can be attributed to groundwater discharge to streams. The U.S. Geological Survey has conducted extensive, statewide studies involving hundreds of stream gauges that have been used to prepare baseflow indices¹. A baseflow index is the ratio of baseflow to streamflow expressed as a percentage of the streamflow. These baseflow indices are not aquifer-specific, so these datasets of baseflow index values will be compared to the surface outcrops of Texas aquifers. This comparison effort will yield maps illustrating – likely on a regional, and if appropriate, county-level basis – groundwater-surface water interactions in major watersheds related to outcrops of major and minor aquifers.

The Executive Administrator’s staff has performed an initial review of the U.S. Geological Survey’s baseflow index data for Texas. Based on that review, the proposed minimum rate of 0.1 percent of the mean annual surface water flow over any unit area of any specific aquifer maximizes the amount of gauge sites available for a state-wide evaluation. Regardless of the baseflow index, we will include, at a minimum, all major or minor aquifers that have available springflow data relevant to the study. The study will include springs classified as moderately to very large, as well as most medium springs documented by Brune² and in the U.S. Geological Survey database³. In summary, this definition will allow for groundwater-surface water evaluations to be performed throughout the vast majority of the state for all major and minor aquifers.

The Executive Administrator recommends approval of this item.

This recommendation has been reviewed by legal counsel and is in compliance with applicable statutes and Board rules.

¹ Wolock, D.M., 2003, Base-flow index grid for the conterminous United States, A GIS 1-kilometer raster digital dataset: U.S. Geological Survey Open-File Report 03-263.

² Brune, Gunnar, 1975, Major and Historical Springs of Texas: Texas Water Development Board Report No. 189.

³ Heitmuller, Franklin T. and Brian D. Reece, 2003, Database of Historically Documented Springs and Spring Flow Measurements in Texas: USGS Open-File Report 03-315.