

Section 2

Sustainable Yield Approach

2.1 Sustainable Yield Criteria

There have been many definitions over the years of “sustainable, safe, or perennial yield” of an aquifer system. A reasonable and well accepted definition of sustainability that seems to encompass most ideas was proposed in 1998 by a Task Force of the American Society of Civil Engineers (ASCE, 1998). Their definition of sustainability is as follows:

“Sustainable water resource systems are those designed and managed to fully contribute to the objectives of society, now and in the future, while maintaining their ecological, environmental, and hydrological integrity.”

For this phase of water resources planning, the focus on unwanted results and metrics of unwanted results was on broader scale potential impacts resulting from the withdrawal of groundwater. Impacts were primarily assessed on an annual basis, with consideration for drought years. Only the limits of aquifer yield were explored, with no comparison to projected water needs. An initial set of metrics to constrain withdrawals to ranges of sustainable yields were developed based on broad scientific principles and practical guidelines. These criteria included those that have been applied in comparable circumstances elsewhere and were tested for their applicability in Georgia. It is expected that these criteria will serve as guidelines to be addressed in greater detail and possibly adjusted as the regional plans are developed and stakeholder input is solicited.

The overarching concept to be evaluated is whether an increase in recharge, removal of water stored in the system through larger groundwater withdrawals, or a decrease in discharge causes unwanted results. The following metrics are applied, with variations developed appropriate to each of the aquifers being studied and to the level of detail provided by the models used to assess sustainable yield:

- Drawdowns of groundwater levels in the pumped aquifer do not exceed 30 feet between pumping wells;
- Recharge from surface water sources were constrained to 40 percent of baseflow in order to maintain opportunities for surface water use (modified to 10 percent of baseflow in the Paleozoic rock aquifer and 40 percent of streamflow in the crystalline rock aquifer);
- Reduction in aquifer storage does not go beyond a new base level;
- Groundwater levels are not lowered below the top of a confined aquifer; and

- The ability of the aquifer to recover to baseline groundwater levels between periods of higher pumping during droughts is not exceeded.

2.1.1 Loss of Confined Head/Pressure (Drop of Water Levels Between Pumping Wells)

A practical limit to avoid impacts to nearby wells is to restrict withdrawals such that groundwater level drawdown in the pumped aquifer does not exceed 30 feet below levels representative of current conditions between pumping wells. Limiting drawdown between pumping wells to 30 feet could minimize effects of increased withdrawals on other wells. It would also decrease the potential for creating sinkholes in carbonate aquifers at or near the ground surface. Application of this metric would require a definition of where 30 feet of drawdown is measured and locations of new wells would need to consider where 30 feet of drawdown could occur. Assumptions associated with the use of this metric are presented separately for each of the modeled aquifers.

2.1.2 Changing an Aquifer from Confined to Unconfined Conditions

Pumping was restricted in all areas to avoid drawing the water table down from overlying aquifers and/or confining units such that portions of the confined aquifer become unconfined (i.e., the potentiometric surface drops below the top surface of the aquifer). Changing an aquifer from confined to unconfined conditions would decrease the transmissivity of an aquifer and thereby decrease well yields from the aquifer.

2.1.3 Minimize Impacts to Streamflow

Lowering of the groundwater table usually results in a reduction in water flowing from springs and in-stream baseflow (streamflow that is totally dependent on groundwater discharge). Metrics were selected to constrain recharge from surface water sources in order to maintain opportunities for surface water use. It should be noted that baseflows used to constrain surface water recharge to groundwater were baseflows generated by the model and not baseflows determined from stream hydrographs.

At this level of water resources planning, there is a need for a sufficiently simple method that can make use of readily available streamflow statistics. One practical method is the Tennant Method (Tennant, 1976), which relies on percentages of mean annual flow in order to recommend seasonally adjusted in-stream flows. The method has become popular because it is an easy to apply standard that can be used with limited and readily available data and is therefore practical for the level planning being completed for the Water Plan. Because this is a groundwater assessment, the Tennant Method was modified to focus the assessment on the period of lowest annual baseflow as well as the lowest annual streamflow. A modified Tennant Method is applied for most of these groundwater assessments in order to provide initial guidance on limits to groundwater withdrawals. As applicable, modifications to the Tennant Method are presented separately for each of the modeled aquifers.

2.2 Sustainability Measures by Modeling Approach

During this phase of the water resources planning process, the modeling approach used to estimate the sustainable yield of an aquifer depended on the availability of data and the level of detail required to answer basic questions about the potential impacts of withdrawals on aquifers and groundwater use. Three modeling approaches were piloted, ranging from a simple water budget to the development of fully calibrated numerical models with transient simulation capabilities. Each approach provides a different level of information, and thus a different approach to providing initial estimates of the sustainable yield of the aquifer in question. The exact metrics used to make a preliminary assessment of sustainability varied according to the modeling approach and are presented in the following sections. In all cases, the models were run until one of the sustainable yield metrics was reached and then that level of withdrawals was determined to be part of the range of sustainable yield.